GURU NANAK COLLEGE (AUTONOMOUS)

(Affiliated to University of Madras and Accredited at A++ Grade by NAAC)
Guru Nanak Salai, Velachery, Chennai - 600042

SCHOOL OF SCIENCES

B.Sc. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

Syllabus

(For the UG Batch of 2024-27 and thereafter)

LOCF - Learning Outcome based Curriculum Framework

1. Preamble – About the Programme

The overarching aim of the Plant Biology and Plant Biotechnology Programme in higher education is to cultivate students' readiness for societal engagement. At the undergraduate level, the current curriculum stands as a meticulously structured framework designed to deliver outcome-driven learning experiences tailored to address diverse student needs. Through organized teaching methodologies, the program endeavors to establish a robust academic foundation while nurturing essential skills for both academic and professional preparedness. Emphasizing qualities such as social justice, emotional resilience, critical thinking, and holistic wellbeing, the curriculum seeks to equip students with a versatile skill set crucial for lifelong learning and sustainable living. The updated curriculum introduces a comprehensive range of subjects including Plant Diversity, Biotechnology, Genetics, Ecology, and Microbiology, complemented by practical applications like Herbal Botany and Plant Disease Management. By providing flexibility through optional courses and interdisciplinary electives, students are empowered to enrich their expertise in Plant Science based on individual interests and career aspirations. The curriculum adopts a student-centric approach, prioritizing outcome-oriented and inquiry-based learning to foster creativity and deter rote memorization. Central to the curriculum is the pragmatic application of theoretical concepts, guiding students towards practical problem-solving and real-world application of knowledge.

2. Vision

To establish a viable and conducive environment for the conduct of learning and research in plant sciences and equip the graduate with updated skills to seek their professional pursuits.

3. Mission

Earnest endeavors towards imparting fundamental and essential subject knowledge and also to incorporate new emerging frontiers knowledge in the curriculum to keep up with the contemporary academic trends.

4. Program Educational Outcomes (PEOs)

PEO 1: Values of Life, Ethics & Social Concern

The graduates exhibit truth, loyalty, and love as integral moral principles, thereby contributing to a society characterized by enhanced well-being and fundamental goodness in behaviour.

PEO 2: Employability & Entrepreneurship

The graduates apply analytical, logical, and critical problem-solving skills in professional contexts, elevating employability and cultivating entrepreneurial capabilities through upskilling.

PEO 3: Regional/National/Global Relevance & Competency

The graduates foster advanced analytical skills and a heightened appreciation for current Regional/National/Global perspectives, enabling informed and sustainable decision-making in a dynamic environment.

PEO 4: Skill Enhancement, Self-Directed & Lifelong Learning

The graduates independently engage in skill-based learning, utilizing infrastructure and opportunities for continuous upskilling, enabling self-evaluation and lifelong excellence attainment.

PEO 5: Research Skills & Innovation

The graduates proficiently apply scientific reasoning, fostering creativity, strategic thinking, and effective problem-solving skills. They demonstrate a core competency in generating innovative ideas for advancements and inventions.

5. Program Outcomes (POs)

PO 1: Instill scientific and analytical reasoning to empower students towards critical thinking thereby enriching inter/multi-disciplinary knowledge.

PO 2: Encourage self-regulated learning leading to problem-solving skills and adaptability.

PO 3: Incorporate experiential learning opportunities and engage in tangible situations to develop essential life skills.

PO 4: Enhance application skills by interconnecting academia and professional realm to achieve employability.

PO 5: Foster research abilities to address everyday challenges, make impactful contributions, and participate in shaping a better future for the society.

6. Program Specific Outcomes (PSOs)

PSO 1: Demonstrate a deep understanding of molecules, cells, systems, organisms, and ecosystems, using comparative approaches to explain evolution and genetic diversity in flora and fauna.

PSO 2: Acquire subject knowledge to excel in diverse fields, including plant exploration, conservation, ecology, horticulture, genetics, molecular biology, and environmental consulting.

PSO 3: Develop proficiency in research methodologies, data analysis, and utilization of advanced technologies for impactful contributions to botanical science.

PSO 4: Foster an awareness of environmental stewardship and sustainable practices, with the ability to address challenges and contribute to conservation efforts.

PSO 5: Enhance effective communication skills, both written and oral, and promote collaboration with interdisciplinary teams and diverse stakeholders to tackle botanical and environmental issues.

7. PEO – PO mapping

	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PO 1	5	5	5	5	5
PO 2	5	5	5	5	4
PO 3	5	5	4	5	5
PO 4	5	5	5	5	4
PO 5	5	5	5	4	5

8. PO – PSO mapping

	PO 1	PO2	PO3	PO4	PO5
PSO 1	3	2	3	3	3
PSO 2	3	3	3	3	3
PSO 3	3	3	3	3	3
PSO 4	3	3	3	2	3
PSO 5	3	3	3	3	3

9. Choice Based Credit System (CBCS)

The College follows the CBCS with Grades under the Semester pattern. Each course is provided with a credit point based on the quantum of subject matter, complexity of the content and the hours of teaching allotted. This is done after a thorough analysis of the content of each subject paper by the members of the Board of Studies and with the approval of the Academic Council. Students are also offered a variety of Job oriented Elective, Multidisciplinary skill-based courses as part of the curriculum. Students can earn extra credits by opting for Massive Open Online Courses (MOOCs) and Certificate Courses.

The evaluation method under CBCS involves a more acceptable grading system that reflects the personality of the student. This is represented as Cumulative Grade Point Average (CGPA) and Grade Point Average (GPA) which are indicators of the Academic Performance of the student. It provides students with a scope for horizontal mobility and empowers them with the flexibility of learning at their convenience.

Eligibility for Admission

Candidates admitted to the first year of the UG programme should have passed the higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras. Students applying for the PG programme should have taken the UG degree in the relevant subject from a recognized university as per the norms of the University of Madras.

Duration of the Course

The UG programme is of three years duration with six semesters and the PG programme is of two years duration with four semesters. The period from June to November is termed as the odd semester and the period from December to April is referred to as the even semester. Each semester must compulsorily have 90 working days before the students appear for the final End Semester Exam.

Course of Study

The main course of study for the Bachelor's Degree shall consist of the following:

Foundation Courses

PART - I: Tamil/ Hindi /Sanskrit/French

PART - II: English

Core Courses

PART - III: Consisting of (a) Main subject (b) Allied Subjects (c) Elective subjects related to the main subject of study and project work.

PART – IV: Those who have not studied Tamil up to XII standard and have taken a non- Tamil language under Part – I, shall opt for Basic Tamil in the first two semesters.

Those who have studied Tamil up to XII standard, and taken a non -Tamil language under Part – I, shall opt for Advanced Tamil in the first two semesters.

Others, who do not come under either of the clauses mentioned above, can choose a Non-Major Elective (NME) in the first two semesters.

Soft Skills (I, II, III & IV Semesters)

Self-Study (Compulsory) Course (III Semester)

Environmental Studies (IV Semester)

Value Education (V Semester)

Summer Internship (After IV Semester)

PART - V: Compulsory Extension Services

A Student shall be awarded one credit for compulsory extension service. A student must enroll in NSS / NCC /Sports & Games/ Citizen Consumer Club / Enviro Club or any other service organization in the College and should put in compulsory minimum attendance of 40 hours, which shall be duly certified by the Principal of the College. If a student lacks 40 hours compulsory minimum attendance in the extension services in any Semester, s/he shall have to compensate the same, during the subsequent Semesters.

Course Structure

The UG programme consists of 15-19 Core courses with 3-4 credits for each paper, 3 Elective courses and 4 Allied courses with 4-5 credits for each paper in addition to 4 Soft Skill courses with two credits each. Internship as a compulsory component carries 2 credits.

Internship training is a compulsory component for all the UG & PG programmes.

10. Consolidated Credit Structure for all the 3 years

	No. of Paper	Credits
Languages	8	24
Core (Including Practical)	24	80
Elective	5	18
Soft Skills	5	10
Internship	-	2
Project	1	3
EVS / Value Education	2	4
Extension activity	-	1
	Total	142

11. Credit Distribution for Each Semester

Semester I		**Subject**	**Hrs/Week**	**Credit**	**Marks**		**Total**
Course Component					**Internals**	**Externals**	
Part I	Language	Language–I	6	3	50	50	100
Part II	English	English–I	4	3	50	50	100
Part III	Core-I	Plant Diversity - I: Microbiology and Phycology	6	4	50	50	100
	Core Practical - II Extended to Semester - II	Practical - I (Plant Diversity - I & II: Microbiology and Phycology, Mycology, Plant Pathology and Lichenology)	2	*	*	*	*
	Allied-I	Allied Zoology – I	6	3	50	50	100
	Allied	Allied Zoology Practical – I	2	*	50	50	100
Part IV	Non-Major Elective-I	Basic Tamil-I/ Advanced Tamil-I/ Gardening and Landscaping	2	2	50	50	100
	Soft Skills-I	Communication and Presentation Skills	2	2	50	50	100
	Total		**30**	**17**			

Semester II Course Component		Subject	Hrs/Week	Credit	Marks		Total
					Internals	Externals	
Part I	Language	Language–II	6	3	50	50	100
Part II	English	English– II	4	3	50	50	100
Part III	Core- III	Plant Diversity - II: Mycology, Plant Pathology and Lichenology	6	4	50	50	100
	Core Practical – II Extended from Semester I	Practical – I (Plant Diversity - I & II: Microbiology and Phycology, Mycology, Plant Pathology and Lichenology)	2	4	50	50	100
	Allied - II	Allied Zoology – II	6	3	50	50	100
	Allied Practical	Allied Zoology Practical – I	2	4	50	50	100
Part IV	Non-Major Elective-II	Basic Tamil-II/ Advanced Tamil-II/ Mushroom Cultivation	2	2	50	50	100
	Soft Skills-II	Interview Skills and Resume Writing	2	2	50	50	100
	Total		**30**	**25**			

Semester III Course Component		Subject	Hrs/Week	Credit	Marks		Total
					Internals	Externals	
Part I	Language	Language–III	6	3	50	50	100
Part II	English	English–III	4	3	50	50	100
Part III	Core- IV	Plant Diversity - III: Bryophytes and Pteridophytes	6	4	50	50	100
	Core V	Practical - II (Plant Diversity - III & IV: Bryophytes and Pteridophytes, Gymnospermae, Paleobotany and Evolution)	2	*	*	*	*
		Mini Project	2	3	50	50	100
	Allied-III	Allied Chemistry - I	5	3	50	50	100

	Allied	Allied Chemistry Practical – I	3	*	*	*	*
Part IV	Soft Skills-III	Digital Proficiency and Multimedia Skills	2	2	50	50	100
	Self-Study (Compulsory Course) Can choose any one	Indian Heritage and Knowledge System/ Contemporary World and Sustainable Development	-	2	50	50	100
	Total		**30**	**20**			

Semester IV **Course Component**		**Subject**	**Hrs/Week**	**Credit**	**Marks**		**Total**
					Internals	**Externals**	
Part I	Language	Language–IV	6	3	50	50	100
Part II	English	English–IV	4	3	50	50	100
Part III	Core- VI	Plant Diversity - IV: Gymnosperms, Paleobotany and Evolution	6	4	50	50	100
	Core -V	Practical - II (Plant Diversity - III & IV: Bryophytes and Pteridophytes, Gymnosperms, Paleobotany and Evolution)	2	4	50	50	100
	Allied-IV	Allied: Chemistry - II	5	3	50	50	100
	Allied	Allied Chemistry Practical – I	3	4	50	50	100
Part IV	Soft Skills-IV	Foundations of Quantitative Aptitude	2	2	50	50	100
	EVS	Environmental Studies	2	2	50	50	100
	Total		**30**	**25**			

Semester V **Course Component**		**Subject**	**Hrs/Week**	**Credit**	**Marks**		**Total**
					Internals	**Externals**	
	Core–VII	Plant Morphology, Taxonomy and Economic Botany	4	4	50	50	100
	Core–VIII	Plant Anatomy and Reproductive Biology	4	4	50	50	100

Part III	Core- IX	Cell Biology and Bio-instrumentation	4	4	50	50	100
	Core- X	Plant Biotechnology and Molecular Biology	4	4	50	50	100
	Core XI	Plant Morphology, Taxonomy and Economic Botany, Plant Anatomy and Reproductive Biology, Cell Biology and Bio instrumentation, Plant Biotechnology and Molecular Biology	8	*	50	50	100
	Elective – I	IDE – Horticulture and Mushroom cultivation	5	4	50	50	100
Part IV	Value Education	Value Education	1	2	50	50	100
	Internship	Internship	-	2	-	-	-
	Total		**30**	**24**			

Semester VI **Course Component**		**Subject**	**Hrs/Week**	**Credit**	**Marks**		**Total**
					Internals	**Externals**	
Part III	Core- XII	Plant Ecology, Phytogeography and Remote sensing	4	4	50	50	100
	Core-XIII	Plant Physiology and Plant Biochemistry	5	4	50	50	100
	Core-XIV	Genetics, Plant Breeding and Biostatistics	5	4	50	50	100
	Elective - II	Herbal Technology	5	5	50	50	100
	Elective - III	Plant Microtechniques	5	5	50	50	100
	Core XV	Plant Ecology, Phytogeography and Remote sensing, Plant Physiology and Plant Biochemistry, Genetics, Plant Breeding and Biostatistics	6	8	50	50	100
Part V	Extension Activity	Participation in NSS/NCC/ Enviro Club, etc.	-	1	-	-	-
	Total		**30**	**31**			
Grand Total				**142**			

Examination

Continuous Internal Assessment (CIA) will be for 50 percent and
End Semester Examination (ESE) will be for 50 percent.

Continuous Internal Assessment (CIA)

Every semester will have a mid-semester examination which will be conducted on completion of 45 working days in each semester. A Model exam for three hours duration will be conducted on completion of 80 working days in each semester. For the courses coming under Part IV, ESE will be conducted in MCQ pattern. Internship credits will be given in semester V after verification of documents by the respective Heads.

The schedule for these tests is as follows:

CIA	Schedule	Syllabus Coverage
Mid Semester Examination	After **45** working days of the Semester	60%
Model Examination	After **80** working days of the Semester	95%

The components for the CIA (Theory & Practicals) are as follows:

Internal Components			
Assessment Type	**Nature**	**Maximum Marks**	**% of Weightage**
CIA	Mid Semester Examination	50	10
Model	Model Examination	100	10
	Assignment		10
	Class activities		15
	Attendance		5
		Total	50

The class activity relates to a programme of accepted innovative techniques such as Seminar, Quiz, Portfolio creation, PowerPoint presentation, Objective tests, Role play, Group discussion, Case Study etc. The mode of evaluation of the class activity will be fixed before the commencement of the semester and an approval will be obtained from the Head of the programme/wing. The students will be informed of the various methods of evaluation once the semester begins.

A record of all such assessment procedures will be maintained by the department and is open for clarification. Students will have the right to appeal to the Principal in case of glaring disparities in marking. CIA marks for practical subjects will be awarded by the respective faculty based on the performance of the student in the model practical examination, observation notebook, submission of record books, regularity and attendance for the practical classes. The attendance particulars for practical classes will be maintained by the concerned faculty. The marks for attendance will be awarded as per the following:

% of General Attendance	Marks Awarded
90-100	5
75-89	4
60-74	3
<60	0

End Semester Examinations (ESE)

After the completion of a minimum of 90 working days each semester, the End Semester Examinations will be conducted. Examinations for all UG and PG programmes will be held for all courses in November/December and April/May. Practical examinations will be conducted only during the end of the odd / even semester before, during or after the commencement of the theory exam. The schedule for ESE Practicals will be notified by the Controller of Examinations in consultation with the Dean (Academics)

12. Mode of Evaluation

MODE OF EVALUATION		
Internal Evaluation	Mid Sem Exam (10)	50 Marks
	Model Exam (10)	
	Assignment (10)	
	Class activity (15)	
	Attendance (5)	
External Evaluation	End Semester Examination	50 Marks
Total		100 Marks

13. Method of Assessment

Remembering (K1)	• The lowest level of questions requires students to recall information from the course content • Knowledge questions usually require students to identify information in the textbook. **Suggested Keywords:** **Choose, Define, Find, How, Label, List, Match, Name, Omit, Recall, Relate, Select, Show, Spell, Tell, What, When, Where, Which, Who, Why**

Understanding (K2)	• Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. • The questions go beyond simple recall and require students to combined at altogether **Suggested Keywords:** **Classify, Compare, Contrast, Demonstrate, Explain, Extend, Illustrate, Infer, Interpret, Outline, Relate, Rephrase, Show, Summarize, Translate**
Applying (K3)	• Students have to solve problems by using / applying a concept learned in the classroom. • Students must use their knowledge to determine a exact response. **Suggested Keywords:** **Apply, Build, Choose, Construct, Develop, Experiment with, Identify, Interview, Make use of, Model, Organize, Plan, Select, Solve, Utilize**
Analyze (K4)	• Analysing the question is one that asks the students to breakdown something into its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations. **Suggested Keywords:** **Analyze, Assume, Categorize, Classify, Compare, Conclusion, Contrast, Discover, Dissect, Distinguish, Divide, Examine, Function, Inference, Inspect, List, Motive, Relationships, Simplify, Survey, Take part in, Test for, Theme**
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged in decision-making and problem–solving. • Evaluation questions do not have single right answers. **Suggested Keywords:** **Agree, Appraise, Assess, Award, Choose, compare, Conclude, Criteria, Criticize, Decide, Deduct, Defend, Determine, Disprove, Estimate, Evaluate, Explain, Importance, Influence, Interpret, Judge, Justify, Mark, Measure, Opinion, Perceive, Prioritize, Prove, Rate, Recommend, Rule on, Select, Support, Value**
Create (K6)	• The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem-solving skills **Suggested Keywords:** **Adapt, Build, Change, Choose, Combine, Compile, Compose, Construct, Create, Delete, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Happen, Imagine, Improve, Invent, Make up, Maximize, Minimize, Modify, Original, Originate, Plan, Predict, Propose, Solution, Solve, Suppose, Test, Theory**

SEMESTER I

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH: 2024-27**
PART: III	**COURSE COMPONENT: CORE - I**
COURSE NAME: MICROBIOLOGY AND PHYCOLOGY	**COURSE CODE:**
SEMESTER: I	**MARKS:100**
CREDITS: 4	**TOTAL HOURS: 90**
THEORY	

COURSE OBJECTIVE:

To understand the evolution, features, and ecological roles of plant groups and microorganisms, alongside mastering lab techniques

COURSE OUTCOMES:

1. Recognize and categorize major plant groups and microorganisms based on their evolutionary relationships and distinctive features.
2. Demonstrate knowledge of fundamental microbiological concepts, including the structure and functions of microorganisms.
3. Evaluate the ecological significance of algae and microorganisms in various environments.
4. Assess the contributions of plants and microorganisms in agriculture, industry, and medicine.
5. Develop proficiency in basic microbiological laboratory techniques, including isolating, cultivating, and characterizing microorganisms.

Microbiology

Unit-I **15 Hrs**

Virus: Viruses Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).

Unit – II **20 Hrs**

Bacteria: Sterilization technique. Bacteria – general character, Types-Archaea, Eubacteria, wall-less forms (mycoplasma and spheroplasts); cell structure, Cell wall – chemical structure and differences between Gram +ve & Gram– ve bacteria, Bacterial DNA & extra-chromosomal genetic elements; nutritional types; classification of Bacteria (Bergey's,1994 – outline only); reproduction – vegetative, asexual and recombination (conjugation, transformation, transduction). Economic importance of bacteria.

Unit- III **20 Hours**

General characters, structure and reproduction of *E.coli.* Food Microbiology – principles and methods of food preservation; Industrial microbiology – Production of enzymes (Amylase), Alcohol (Ethanol) amino acids (Glutamic acid), vitamins (Riboflavin), antibiotics (Tetracycline).

Phycology

Unit – IV: **15 Hours**

Algae: General characters, range of thallus structure, cell structure and components; cell wall, pigment system, methods of reproduction; life cycle patterns; Classification of algae - Fritsch (1945). Economic importance of Algae, biofuel, phycoremediation, CO_2 sequestration.

Unit – V **20 Hours**

Morphology, Reproduction-vegetative, asexual, sexual reproduction and life histories of following genera- Cyanophyta - *Oscillatoria*, Chlorophyta - O*edogonium,* Charophyta - *Chara,* Phaeophyta – *Sargassum* and Rhodophyta – *Gracilaria*.

PRESCRIBED BOOKS:

1. Adams, M.R. and Moss. M.O. (1995). Food Microbiology. New International (P) Ltd. Publishers.
2. Campbell, N.A., Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V. Jackson, R.B. (2008). *Biology*, 8th edition. San Francisco, California: Pearson Benjamin Cummings.
3. Dehradun. Edward lee, R.2018. Phycology,5thEd.,Cambridge University Press, London.
4. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London.
5. Kumar, H.D. (1999). *Introductory Phycology*, 2nd edition. New Delhi, Delhi: Affiliated East-West Press.
6. Kumar, H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi
7. Lee, R.E. (2008). *Phycology*, 4th edition. Cambridge, Cambridge: Cambridge University Press,
8. Pelczar, M.J. (2001). *Microbiology*, 5thedition.New Delhi, Delhi: Tata McGraw-Hill Co.
9. Raven, F.H., Evert, R.F., Eichhorn, S.E. (1992). *Biology of Plants*. New York, NY:W.H.Free man and Company.

REFERENCE BOOKS:

1. Alexander. (1997). Introduction to soil Microbiology. John Wiley and Sons. N.Y.
2. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1.
3. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.
4. Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera.
5. David, B.D., Delbecco, R., Eisen, H.N. and Ginsburg, H.S. (1990). Microbiology. 5thEdition. Harper & Row, New York.
6. Denyer, S.P., Hodges, N.A., Gorman, S.P. and Gilmore, B.F. (2011). Hugo & Russell's Pharmaceutical Microbiology.8th edition. Blackwell scientific publications / Oxford.
7. Dubey, R.C. and Maheswari, D.K. (2005). A Text book of microbiology. S. Chand &Company Ltd. New Delhi.
8. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press.
9. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York
10. Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi.
11. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
12. Pelczar Jr. M.J. Chan. E.C.S and Kreig. N.R (2006). Microbiology – 5th Edition Mc GrawHill Inc. New York.
13. Prescott, L.M., HarleyJ.P., KleinD.A.(2005). *Microbiology*, 6th edition. New Delhi, Delhi: McGraw Hill.

14. Round, FE. 1984. The Ecology of Algae. Cambridge University Press.
15. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
16. Stainer, R.Y., Ingraham, J.L., Wheelis, M.L and Painter, P.R. (1986). GeneralMicrobiology. MacMilan Education Ltd. London.
17. Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi.
18. Wiley JM, Sherwood LM and Woolverton CJ. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.

E-LEARNING RESOURCES:

1. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of Algae/Pereira/p/book/9781498755382
2. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382
3. https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327
4. https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678
5. https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh
6. https://www.wileyindia.com/a-textbook-of-algae.html
7. https://www.kobo.com/in/en/ebook/algae-biotechnology
8. https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Units	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	1
III	3	2	1
IV	2	1	1
V	2	1	2
TOTAL	12	**7**	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	2
CO 2	2	3	3	3	2
CO 3	3	3	2	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	2.8	3	2.8	3	2.6

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Recognize and categorize major plant groups and microorganisms based on their evolutionary relationships and distinctive features.	PSO 1, PSO 2, PSO 3, PSO 4	K1, K2, K5
CO2	Demonstrate knowledge of fundamental microbiological concepts, including the structure and functions of microorganisms.	PSO 2, PSO 3, PSO 4	K1, K2, K3, K4
CO3	Evaluate the ecological significance of algae and microorganisms in various environments.	PSO 1, PSO 2, PSO 3	K1, K3, K4, K6
CO4	Assess the contributions of plants and microorganisms in agriculture, industry, and medicine.	PSO 1, PSO 3, PSO 4	K2, K4, K5, K6
CO5	Develop proficiency in basic microbiological laboratory techniques, including isolating, cultivating, and characterizing microorganisms.	PSO 3, PSO 4, PSO 5	K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT: CORE- II**
COURSE NAME: MICROBIOLOGY AND PHYCOLOGY	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To develop practical skills in microbiological laboratory techniques and microscopic observation of plant structures

COURSE OUTCOMES:

1. Understand the structure and replication of plant viruses
2. Master aseptic techniques for laboratory practices in microbiology, including sterilization methods and bacterial culture handling.
3. Identify bacteria morphologically through microscopic examination and utilize Gram's staining for differentiation.
4. Gain proficiency in preparing bacteriological media and isolating pure cultures using dilution streak methods.
5. Explore Phycology by observing vegetative and reproductive structures of selected algae species and mastering the preparation of herbarium sheets.

Practical

Microbiology **05 Hrs**

Electron micrographs/Models of plant viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.

Aseptic method **15 Hrs**

Sterilization technique by Autoclaving, Hot air oven, Surface sterilization and filter sterilization.
Types of Bacteria to be observed from temporary/permanent slides/photographs.
Examination of bacteria from bacterial culture by Gram's staining method.
Preparation of standard bacteriological medium (Nutrient agar/ Nutrient broth/ Muller Hinton Agar).
Preparation of slant and plates.
Pure culture technique: dilution streak method.
Preservation of microbial cultures

Phycology **10 Hrs**

Microscopic observation of vegetative and reproductive structures observed under permanent slides. Identifying the micro slides relevant to the syllabus.
Study of vegetative and reproductive structures of *Oscillatoria*, O*edogonium*, *Chara*, *Sargassum and Gracilaria*.

Five (05) Herbarium sheets, field notebook and bonafide record to be submitted.

PRESCRIBED BOOKS:

1. 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.
2. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
3. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
4. Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
5. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
6. Wiley JM, Sherwood LM and Woolverton CJ. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.

PROGRAMME: ALL UG STUDENTS	**BATCH:** 2024-27
PART: IV	**COURSE COMPONENT: NON-MAJOR ELECTIVE - I**
COURSE NAME: GARDENING AND LANDSCAPING	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

COURSE OBJECTIVE:

To impart knowledge and skills in landscaping, and garden design, emphasizing propagation techniques.

COURSE OUTCOMES:

1. Understand why gardening matters, focusing on floriculture and landscape gardening.
2. Cultivate flowers, trees, and succulents, and grasp simple pot cultivation and bonsai techniques.
3. Develop basic skills in soil care, watering, pest management, and get introduced to easy garden design.
4. Understand simple design principles for different garden styles, including features like walls, lawns, and flower beds.
5. Get an overview of landscaping in public spaces, and learn the basics of flower production and packaging in commercial floriculture.

Unit – I **05 Hrs**

History of gardening; Importance and scope of floriculture and landscape gardening. Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading;Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

Unit – II **10 Hrs**

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms andCycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

Unit – III **05 Hrs**

Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

Unit – IV **05 Hrs**

Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.

Unit – V **05 Hrs**

Landscaping Places of Public Importance: Landscaping highways and Educational institutions. Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose,Lilium, Orchids).

PRESCRIBED BOOKS:

1. Agrawal, P.K. (1993). *Hand Book of Seed Technology.* New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd.
2. Bose T.K., Mukherjee, D. (1972). *Gardening in India.* New Delhi, Delhi: Oxford & IBH Publishing Co.
3. Jules, J. (1979). *Horticultural Science,* 3rd edition. San Francisco, California: W.H. Freeman and Co.
4. Kumar, N. (1997). *Introduction to Horticulture.* Nagercoil, Tamil Nadu: Rajalakshmi Publications.
5. Randhawa, G.S., Mukhopadhyay, A. (1986). *Floriculture in India.* New York, NY: Allied Publishers.

PROGRAMME: ADVANCED ZOOLOGY AND BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT: ALLIED - I**
COURSE NAME: ALLIED BOTANY-I	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

To provide comprehensive knowledge of virus, bacteria, fungi, algae, bryophytes, pteridophytes, gymnosperms, cell biology, and plant anatomy.

COURSE OUTCOMES:

1. Learn about viruses, bacteria, and fungi, including their structures and replication mechanisms.
2. Explore algae diversity and economic importance, focusing on their structures, reproduction, and life cycles.
3. Examine the life cycles of bryophytes, pteridophytes, and gymnosperms, highlighting key genera.
4. Understand plant cellular biology, covering cell ultrastructure, organelles, genome organization, chromosomes, and cell division.
5. Develop a foundational understanding of plant anatomy, including meristems, tissues, and internal structures of leaves, stems, and roots in dicot and monocot plants.

Virus, Bacteria and Fungi

Unit I **20 Hrs**

Virus - general characters, structure and replication. Structure of plant virus (TMV) and bacteriophage. Replication and transmission of plant diseases caused by viruses. Bacteria - general characters, structure, nutrition and reproduction of Escherichia coli. General characters of fungi, structure, reproduction and life cycle of Penicillium and Agaricus. Economic importance of Bacteria and Fungi.

Unit II: Algae **15 Hrs**

General characters of algae – structure, reproduction and life cycle of the following genera - Nostoc, Chlorella, Sargassum, Gracillaria. Economic importance of algae.

Unit III: Bryophytes, Pteridophytes and Gymnosperms **15 Hrs**

General characters of Bryophytes, Structure and life cycle of Funaria. General characters of Pteridophytes, Structure and life cycle of Lycopodium. General characters of Gymnosperms, Structure and life cycle of Cycas.

Unit IV: Cell Biology **20 Hrs**

Plant cell: Ultra structure of cell, cell wall and cell membranes. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Genome Organization of Prokaryotes and Eukaryotes. Chromosomes and Cell Division: Chromosomes: Morphology,

Organization of DNA in a chromosome, Euchromatin and Heterochromatin, Karyotype. Cell division: Cell cycle and its regulation, Mitosis and Meiosis.

Unit V: Anatomy **20 Hrs**

Meristems: Types, histological organization of shoot and root apices. Tissues: Simple, Complex and special tissues. Leaf – Diversity of internal structure, stomata and epidermal out growths. Primary structure of Dicot stem, dicot root and dicot leaf. Structure of monocot root, stem & leaf.

PRESCRIBED BOOKS:

1. Alexopolous, J.and W.M Charles. 1988 introduction to Mycology. Wiley Eastern, New Delhi. Ananthanarayan & Panikers; Microbiology 9th edition.
2. Cutter. E.G (1989) – Plant Anatomy– Part I–Addison– Wesley Publishing Co.
3. Eames, A.J. (1936). Morphology of Vascular Plants (Lower Groups). McGraw Hill, New York.
4. Esau. K. (1985) – Anatomy of Seed Plants–John Willey
5. Fahn, A. (1982). Plant Anatomy (3^{rd} edition). Pergamon Press, Oxford.
6. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
7. Pandey, B.P 2001. College Botany Vol. I: Algae, Fungai, Lichens, Bacteria, Viruses, Plant pathology, Industrial Microbiology and Bryophyta. S. Chand & company Ltd, New Delhi.
8. Pandey, B.P 2007. Botany for Degree students: Diversity of microbes, Cryptograms, Cell biology and Genetics. S. Chand & company Ltd, New Delhi.
9. Parihar, N. S. (1999). An Introduction to Embryophyta. Vol. II. Pteridophyta. Central Book Depot, Allahabad.
10. Sambamurthy, A.V.S.S 2006. A textbook of Algae. I.K. International Pvt. Ltd., New Delhi.
11. Sambamurthy, A.V.S.S 2006. A textbook of Plant Pathology. I.K. International Pvt. Ltd., New Delhi
12. Sharma, O.P 2006. A text book of Thallophyta, McGraw Hill Publishing. Co. NewDelhi.
13. Smith, G.M. (1955). Cryptogamic Botany. Vol.II (2nd ed.). (Bryophytes and Pteridophytes). Tata McGraw Hill Publishing Co. Ltd., New Delhi.
14. Thakur, A.K. and S.K. Bassi. 2008. A text book of Botany: Diversity of Microbes and Cryptogams. S. Chand & company Ltd, New Delhi.
15. Vashishta, B.R.1990. Botany for Degree Students: Fungi. S. Chand & company Ltd, New Delhi.
16. Vashishta, B.R., A.K. Sinhaand V.P. Singh. 2008. Botany for Degree Students: Algae. S. Chand & company Ltd, New Delhi.
17. Vashista. P.C. (1988) –A Text Book of Plant Anatomy. S. Nagin & Co.

RECOMMENDED TEXT BOOKS

1. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
2. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
3. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.
4. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
5. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
6. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.

REFERENCE BOOKS

1. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
2. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
3. David, B. D., Delbecco, R., Eisen, H.N. and Ginsburg, H.S. (1990). Microbiology. 5th Edition.H arper & Row, New York.
4. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press
5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &II, S. Chand and Co. New Delhi.
6. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
7. Parihar, N.S. 2013. An introduction to Embryophyta - Bryophytes -, Surjeet Publications, Delhi.
8. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
9. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.

E- LEARNING RESOURCES

1. https://www.kobo.com/us/en/ebook/the-algae-world
2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
6. https://www.us.elsevierhealth.com/medicine/cell-biology
7. https://www.us.elsevierhealth.com/medicine/genetics
8. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

Unit	SECTION - A	SECTION - B	SECTION - C
I	2	1	1
II	2	2	1
III	3	2	1
IV	2	1	2
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	2	3	3	3	2
CO 5	2	3	3	3	3
Ave.	2.6	3	3	3	2.8

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Learn about viruses, bacteria, and fungi, including their structures and replication mechanisms.	PSO 1, PSO2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4
CO2	Explore algae diversity and economic importance, focusing on their structures, reproduction, and life cycles.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K2, K3, K4, K5
CO3	Examine the life cycles of bryophytes, pteridophytes, and gymnosperms, highlighting key genera.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K2, K3, K4, K5, K6
CO4	Understand plant cellular biology, covering cell ultrastructure, organelles, genome organization, chromosomes, and cell division.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K3, K4, K5, K6
CO5	Develop a foundational understanding of plant anatomy, including meristems, tissues, and internal structures of leaves, stems, and roots in dicot and monocot plants.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: ADVANCED ZOOLOGY AND BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT: ALLIED PRACTICAL - I**
COURSE NAME: ALLIED BOTANY-I	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To develop practical skills in the identification and micro-preparation of microorganisms, algae, fungi, bryophytes, pteridophytes, and gymnosperms.

COURSE OUTCOMES:

1. Identify microorganisms, algae, and fungi based on morphology and microstructure.
2. Understand how to identify Bryophytes, Pteridophytes, and Gymnosperms using morphology, anatomy, and reproduction.
3. Learn to prepare and examine microorganisms, algae, fungi, Bryophytes, Pteridophytes, and Gymnosperms.
4. Describe plants from specified families using technical terms.
5. Explore cell biology concepts through microphotographs.
6. Study internal structures of dicot and monocot stems, roots, and leaves.

PRACTICALS

1. Enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of microorganisms, algae, and fungi.

2. Comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.

3. Describe and to make suitable micro – preparations: Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms prescribed in the theory.

4. To describe in technical terms plants belonging to the families prescribed.

5. Microphotographs of cell biology.

6. Study of internal structure of dicot & monocot stem, root and leaf.

SEMESTER II

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT: CORE - III**
COURSE NAME: MYCOLOGY, PLANT PATHOLOGY AND LICHENOLOGY	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

To understand and practical skills in mycology, plant pathology, and lichenology, emphasizing the classification, structure, reproduction, economic importance.

COURSE OUTCOMES:

1. Understand the characteristics, classification, and importance of fungi in various ecosystems.
2. Learn about the cultivation of mushrooms, mycorrhizal fungi, and their agricultural applications.
3. Explore the economic significance of fungi in producing biofertilizers, mycotoxins, and industrially important products.
4. Study plant pathology, including disease distribution, symptomology, control methods, and defense mechanisms.
5. Gain insights into lichenology, covering the occurrence, classification, reproduction, and ecological importance of lichens.

Mycology

Unit I: 15 Hrs

General characters of fungi, thallus organization, mode of nutrition. Classification of fungi - (Alexopoulos and Mims, 1979), Structure, reproduction and life-history of following classes: Zygomycotina (*Mucor*), Ascomycotina (*Peziza*), Basidiomycotina (*Agaricus*, *Puccinia*) and Deuteromycotina (*Cercospora*). Importance of mycorrhizal association.

Unit II 20 Hrs

Cultivation of mushroom – *Pleurotus*, Mycorrhizal Fungi and its importance. Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12). Biological control of fungi. Economic importance of fungi.

Plant Pathology

Unit III 15 Hrs

Geographical distribution of plant diseases in India; etiology, symptomology; Host – Pathogen relationships; disease control methods (physical, chemical and biological methods); Defence mechanism – Phytoalexin (Allicin and capsidiol).

Unit IV **20 Hrs**

Symptoms, causal organism, etiology and management of the following plant diseases Mycoplasmal disease (Little leaf of Brinjal), Bacterial disease (Citrus canker), Viral disease (Bunchy top of Banana), Fungal disease (Red rot of Sugarcane). Plant quarantine – role and functions, regulations in India.

LICHENOLOGY

Unit V **20 Hrs**

Lichens – occurrence, general characteristics, growth forms and thallus organization, -types- Crustose, Foliose and fruticose. Classification (Hale, 1969). Reproduction; Nature of associations of algal and fungal partners; occurrence, structure and reproduction of (*Usnea*). Economic and ecological importance of Lichens.

PRESCRIBED BOOKS

1. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi.
3. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
4. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology.
5. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
6. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
7. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.

REFERENCE BOOKS

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
2. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.
3. Burnett, J.H. 1971.The fundamentals of Mycology. ELBS Publication, London.
4. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.
5. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.
6. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company.
7. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
8. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology, Tata MaGraw Hill Publishing House, New Delhi.
9. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi.
10. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.

E-LEARNING RESOURCES

1. https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE
2. http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html
3. http://www.freebookcentre.net/Biology/Mycology-Books.html
4. https://www.kobo.com/us/en/ebook/introduction-to-fungi
5. http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html
6. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	QUESTION NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL				**100**

BREAK UP OF QUESTIONS

Unit	SECTION - A	SECTION - B	SECTION - C
I	2	2	1
II	2	2	1
III	3	1	1
IV	2	1	1
V	3	1	2
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	2	3	3	3	3
CO 2	3	3	3	3	2
CO 3	3	3	3	2	3
CO 4	3	2	3	3	3
CO 5	3	3	3	3	3
Ave.	2.8	2.8	3	2.8	2.8

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand the characteristics, classification, and importance of fungi in various ecosystems.	PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5
CO2	Learn about the cultivation of mushrooms, mycorrhizal fungi, and their agricultural applications.	PSO 1, PSO 2, PSO 3, PSO 4,	K1, K2, K3, K4
CO3	Explore the economic significance of fungi in producing biofertilizers, mycotoxins, and industrially important products.	PSO 1, PSO 2, PSO 3, PSO 5	K2, K3, K4, K5, K6
CO4	Study plant pathology, including disease distribution, symptomology, control methods, and defense mechanisms.	PSO 1, PSO 3, PSO 4, PSO 5	K2, K3, K4, K5, K6
CO5	Gain insights into lichenology, covering the occurrence, classification, reproduction, and ecological importance of lichens.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT: CORE- II**
COURSE NAME: MYCOLOGY, PLANT PATHOLOGY AND LICHENOLOGY	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To develop practical skills in the identification, cultivation, and demonstration of fungi, as well as the diagnosis and management of plant diseases.

COURSE OUTCOMES:

1. Understand the structure and reproduction of specific fungal genera.
2. Learn to identify macroscopic and microscopic forms of fungi.
3. Create herbarium specimens for bacterial diseases.
4. Demonstrate mushroom cultivation techniques.
5. Practice inoculation techniques for fungal cultures.

Practicals

Fungi **18 Hrs**

1. Study of structure and reproduction of following genera:
   Mucor, *Peziza*, *Agaricus*, *Puccinia* and *Cercospora*
2. Identification of all the macroscopic and microscopic forms included in the theory.
3. Herbarium/ photograph specimens for bacterial diseases.
4. Demonstration for mushroom cultivation.
5. Inoculation techniques for fungal culture (Demonstration only).

Plant Pathology **10 Hrs**

1. Little leaf of Brinjal
2. Citrus canker
3. Bunchy top of banana
4. Red rot of sugarcane

Lichenology

02 Hrs

1. Different types of thalli and their external morphology

Note: Temporary Preparations / Permanent Slides – Available Materials only

PROGRAMME: ALL UG STUDENTS	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT: NON-MAJOR ELECTIVE - II**
COURSE NAME: MUSHROOM CULTIVATION	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
ELECTIVE	

COURSE OBJECTIVE:

To equip students with comprehensive knowledge and practical skills in mushroom cultivation, including substrate preparation.

COURSE OUTCOMES:

1. Understand the nutritional and medicinal value of edible mushrooms, including types available in India.
2. Learn cultivation techniques and factors affecting mushroom bed preparation.
3. Explore storage methods and nutrition content of mushrooms.
4. Identify diseases and pests affecting mushroom production, and post-harvest technologies.
5. Explore value-added products, research centers, and marketing strategies for mushrooms.

Unit I **20 Hrs**

Introduction, history, Nutritional and medicinal value of edible mushrooms, Poisonous mushrooms, Types of edible mushrooms available in India: *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus.* Entrepreneurship opportunities in mushroom cultivation.

Unit II **20 Hrs**

Cultivation technology, Substrate preparation, Components of Mushroom shed, Media Preparation, Compost preparation, Factors affecting the mushroom bed preparation - low cost technology, composting technology in mushroom production.

Unit III **20 Hrs**

Storage and nutrition, short term storage (Refrigeration upto 24 hours) long term storage (canning, pickles and papads) drying, storage in salt solutions. Nutrition- proteins, amino acids, mineral elements nutrition- carbohydrates, crude fibre content- vitamins.

Unit IV **15 Hrs**

Diseases and post-harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.

Unit V **15 Hrs**

Types of food prepared from mushroom, Value added products from mushrooms. Research centers- National level and Regional level, Cost benefit ratio, Marketing in India and abroad, Export value.

PRESCRIBED BOOKS:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan, R. (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Nita Bahi (1984-1988) Hand book of Mushrooms, II Edition, vol. I& II.
3. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. LTD, No. 88, Mysore Road, Bangalore - 560018.
4. Tewari, Pankaj Kappor, S.C. (1998) Mushroom cultivation, Mittal Publications, Delhi.
5. Handbook of Mushroom Cultivation. 1999. TNAU publication.
6. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
7. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.
8. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
9. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.

REFERENCE BOOKS:

1. Handbook of Mushroom Cultivation. 1999. TNAU publication.
2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.
4. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
5. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

E- LEARNING RESOURCES:

1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X
2. http://nrcmushroom.org/book-cultivation-merged.pdf
3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf
4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/
5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

PROGRAMME: ADVANCED ZOOLOGY AND BIOTECHNOLOGY	**BATCH:** 2024-27
PART: IV	**COURSE COMPONENT: ALLIED - II**
COURSE NAME: ALLIED BOTANY-II	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

Understand the morphology, physiology, ecology, embryology, genetics, and biotechnology of plants.

COURSE OUTCOMES:

1. Understand the morphology and economic importance of specific plant families.
2. Learn about water absorption, transpiration, photosynthesis, and respiration processes in plants.
3. Explore ecosystem components, energy flow, food chains, and productivity.
4. Study the structure of anthers, ovules, embryo sacs, and seeds in embryology.
5. Gain insights into Mendel's laws, plant tissue culture, and gene transfer methods in plant biotechnology.

Unit I: Morphology of Flowering Plants **20 Hrs**

Taxonomy: Systematic study and economic importance of following families: Fabaceae, Cucurbitaceae, Asteraceae, Euphorbiaceae and Poaceae.

Unit II: Plant Physiology **20 Hrs**

Absorption of water, Transpiration – definition and its types. Photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.

Unit III: Ecology **15 Hrs**

Ecosystems: Concept and components, energy flow, Food chain, Food web, Ecological pyramids. Energy flow in ecosystem – Trophic level, Food chain, Food web. Productivity of ecosystems- Primary, Secondary and Net productivity. Biogeochemical cycles – Nitrogen.

Unit IV: Embryology **15 Hrs**

Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination - double fertilization and Triple fusion. Structure of dicotyledonous and monocotyledonous seeds.

Unit V: Genetics and Plant Biotechnology **20 Hrs**

Mendelism: Laws of Mendel's. Mono, dihybrid, test and back cross. Plant tissue culture - *In vitro* culture methods. Totipotency – differentiation, de-differentiation and re-differentiation; Plant tissue culture and its application in biotechnology. Brief concept of gene transfer methods. *Agrobacterium* mediated gene transfer.

PRESCRIBED BOOKS:

1. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
2. Jeffery C, 1968 .An Introduction to Plant Taxonomy .J and A Churchill, London.
3. Lawrence G H M, 1951. Taxonomy of Vascular Plants. Macmillan, New York.
4. Maheshwari P andUmaroSingh, 1965. Dictionary of Economic Plants in India. ICAR, NewDelhi.
5. NaikVN, 1984. Taxonomy of angiosperms. TataMcGraw–HillPublishing Company, NewDelhi.
6. PandeyS N, MisraS P, 2008. Taxonomyof Angiosperms. AneBooksIndia, New Delhi.
7. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.
8. RendleAB, 1979. Classification of flowering plants, Vols.I&II. Vikas Publishing House,U.P.
9. SambamurthyA, 2005. Taxonomy of Angiosperms.I.K. International Pvt.Ltd, New Delhi.
10. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
11. SharmaOP, 1996. PlantTaxonomy. Tata Mc Graw Hill, NewDelhi.
12. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
13. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.

REFERENCE BOOKS:

1. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
2. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
3. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &II, S.Chand and Co. New Delhi.
4. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
5. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.
6. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
7. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.

E- LEARNING RESOURCES:

1. https://www.kobo.com/us/en/ebook/the-algae-world
2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
6. https://www.us.elsevierhealth.com/medicine/cell-biology
7. https://www.us.elsevierhealth.com/medicine/genetics
8. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	3	2	1
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	2
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	2	3
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2
Ave.	3	2.8	2.8	2.8	2.8

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand the morphology and economic importance of specific plant families.	PSO 1, PSO 3, PSO 4, PSO 5	K1, K2, K3
CO2	Learn about water absorption, transpiration, photosynthesis, and respiration processes in plants.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4
CO3	Explore ecosystem components, energy flow, food chains, and productivity.	PSO 1, PSO 2, PSO 3, PSO 5	K1, K2, K3, K4, K5
CO4	Study the structure of anthers, ovules, embryo sacs, and seeds in embryology.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5
CO5	Gain insights into Mendel's laws, plant tissue culture, and gene transfer methods in plant biotechnology.	PSO 1, PSO 2, PSO 4	K1, K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: ADVANCED ZOOLOGY AND BIOTECHNOLOGY	**BATCH:** 2024-27
PART: IV	**COURSE COMPONENT: ALLIED PRACTICAL - I**
COURSE NAME: ALLIED BOTANY-II	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To provide hands-on experience and understanding of plant systematics, genetics, physiology, ecology, and tissue culture techniques.

COURSE OUTCOMES:

1. Familiarize with plant systematics and genetics principles.
2. Understand inheritance laws and genetic loci.
3. Learn about plant metabolism physiology.
4. Describe ecology concepts and components.
5. Understand plant physiology experiments and tissue culture techniques.

PRACTICALS

1. To be familiar with the basic concepts and principles of plant systematics.
2. Understanding of laws of inheritance, genetic basis of loci and alleles.
3. To learn about the physiological processes that underlie plant metabolism.
4. Concept and Components of Ecology as per syllabus.
5. To describe experimental setup in plant physiology
6. Structure of Mature anther and Ovule types (Permanent slides only).
7. Plant Tissue Culture (Demonstration/ Instrument Photographs)

PRESCRIBED BOOKS:

1. Dutta A.C., College Botany, Vol. I & II.
2. Ganguly A.K. 1971, General Botany, Vol.I. The New Book Stall, Calcutta.
3. Gupta P.K., Elements of Biotechnology Rastogi and Company
4. Rao. K.N. Krishnamurthy K.V. and Rao. G., 1979, Ancillary Botany, Viswanathan Private Ltd.

RECOMMENDED TEXTS:

1. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
2. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
3. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
4. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
5. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & WileyPublications.
2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
3. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher.
4. Steward, F.C. 2012. Plant Physiology Academic Press, US
5. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.

E-LEARNING RESOURCES:

1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=g y mnosperms&printsec=frontcover
3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4. https://medlineplus.gov/genetocs/understanding/basics/cell/
5. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
6. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
7. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

SEMESTER III

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: IV	**COURSE COMPONENT:** CORE- IV
COURSE NAME: BRYOPHYTES AND PTERIDOPHYTES	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:
To understand bryophytes and pteridophytes: classification, structure, reproduction, ecology, economics, and key researchers.

COURS OUTCOMES:
1. Learn about Bryophytes and Pteridophytes, their importance, and examples.
2. Understand their ecological roles and economic uses.
3. Study their classification and basic reproductive processes.
4. Explore their morphology and anatomy.
5. Appreciate contributions of key individuals and their impact.

Bryophytes

Unit I **20 Hrs**

General characters of Bryophytes, classification (Watson, 1971) (up to family). Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (*Riccia);* Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*).

Unit II **20 Hrs**

Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture, industrial uses and absorbent bandages. Contributions of Johann Hedwig and Shiv Ram Kashyap.

Pteridophytes

Unit III **15 Hrs**

General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and apospory, homospory and heterospory. Origin and evolution of Pteridophyte. Telome concept, Heterospory, Stelar Evolution.

Unit IV **20 Hrs**

Morphology, anatomy and reproduction of reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium*), Sphenopsida (*Equisetum*), Pteropsida (*Adiantum/Marsilea*).

Unit V **15 Hrs**

Contributions made by S.S.Bir and V.S. Manikam towards Pteridophytes in India. Economic importance of Pteridophytes (Commercial, Industrial and Pharmaceutical).

PRESCRIBED BOOKS:

1. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.
2. Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101.
3. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.
4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
5. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.

REFERENCE BOOKS

1. Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai.
2. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
3. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes.Central Book Depot, Allahabad.
4. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteriodophyta, Central book depot, Allahabad.
5. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai
6. Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai.
7. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & Co, UK.

E- LEARNING RESOURCES:

1. http://www.bryoecol.mtu.edu/
2. https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NWFWQK
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
5. http://www.botany.ubc.ca/bryophyte/mossintro.html

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	3	2	1
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	2
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	1
CO 5	2	3	3	3	2
Ave.	2.8	3	3	3	2.4

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Learn about Bryophytes and Pteridophytes, their importance, and examples.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Understand their ecological roles and economic uses.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Study their classification and basic reproductive processes.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Explore their morphology and anatomy.	PSO 1, PSO 2, PSO 3,PSO 4	K3, K4, K5, K6
CO5	Appreciate contributions of key individuals and their impact.	PSO 2, PSO 3, PSO 4	K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE - V
COURSE NAME: BRYOPHYTES AND PTERIDOPHYTES	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To develop practical understanding of bryophytes and pteridophytes, their economic significance, and contributions of scientists.

COURSE OUTCOMES:

1. Study the structure of Bryophytes and Pteridophytes
2. Understand their vegetative and reproductive anatomy.
3. Explore their economic importance.

PRACTICALS

1. Bryophytes: Study of morphology, anatomy and structure of the vegetative and reproductive organs of Hepaticopsida (*Riccia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*).
2. Pteridophytes: Study of morphology, anatomy and structure of the vegetative and reproductive organs of Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium*), Sphenopsida (*Equisetum*), Pteropsida (*Adiantum*/*Marsilea*).
3. Photograph of evolution scientists and contributors in the field of Bryophytes, Pteridophyta and Gymnospermae.
4. Economic Importance of Bryophytes and Pteridophytes

PRESCRIBED BOOK:

1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.

SEMESTER IV

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE- VI
COURSE NAME: GYMNOSPERMAE, PALEOBOTANY AND EVOLUTION	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

To understand classification, morphology, anatomy, reproduction, economic importance of gymnosperms, paleobotany, and evolution.

COURSE OUTCOMES:

1. Understand Gymnosperms' classification, morphology, and economic significance.
2. Explore contributions of notable paleobotanists and fossil studies.
3. Study evolution theories and their implications.
4. Gain insights into the historical development of botany and its modern applications.
5. Appreciate the interdisciplinary nature of paleobotany and evolutionary studies.

Gymnospermae

Unit I **20 Hrs**

Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*). Gnetales (*Gnetum*).

Unit II **15 Hrs**

Contributions of R.C. Srivastava and K.R. Sporne. Economic importance of Gymnospermae (Timber, Dye, Resin, Food, Ornamental Value)

Paleobotany

Unit III **15 Hrs**

History and scope of Paleobotany; Fossils – types – methods of fossilization – Carbon Dating – Uses. Geological time scale. Contributions of Birbal Sahni.

Unit IV **20 Hrs**

Study of the following fossils: *Rhynia, Lepidodendron, Lepidocarpon, Calamites* and *Williamsonia sewardiana*.

Evolution
Unit V **20 Hrs**

Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De Vries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.

PRESCRIBED BOOKS;

1. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.
2. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.

REFERENCE BOOKS:

1. James. W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom.
2. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.

E- LEARNING RESOURCES:

1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover
2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721
3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ
4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	2
III	2	1	1
IV	2	2	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	2	3	3
CO 3	3	2	3	2	3
CO 4	3	3	3	3	3
CO 5	1	3	3	3	3
Ave.	2.6	2.8	2.8	2.8	3

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand Gymnosperms' classification, morphology, and economic significance.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Explore contributions of notable paleobotanists and fossil studies.	PSO 1, PSO 2, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Study evolution theories and their implications.	PSO 1, PSO 3, PSO5	K1, K2, K3, K4, K5, K6
CO4	Gain insights into the historical development of botany and its modern applications.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K3, K4, K5, K6
CO5	Appreciate the interdisciplinary nature of paleobotany and evolutionary studies.	PSO 2, PSO 3, PSO 4, PSO5	K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE - V
COURSE NAME: GYMNOSPERMAE, PALEOBOTANY AND EVOLUTION	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICALS	

COURSE OBJECTIVE:

To develop practical skills in gymnosperm identification, anatomy, and field observation, acknowledging contributions to evolution and taxonomy by key scientists.

COURSE OUTCOMES:

1. Study morphology, anatomy, and reproductive structures of Gymnospermae.
2. Identify relevant microslides pertaining to the syllabus.
3. Conduct field visits to study habitats or local fossil sites.
4. Examine fossils like Rhynia, Lepidodendron, Calamites, etc., through permanent slides.
5. Explore contributions of scientists in Evolution and their impact on Bryophytes, Pteridophyta, and Gymnosperms through photographs.

PRACTICAL

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of *Cycas, Pinus* and *Gnetum.*
2. Identifying the micro slides relevant to the syllabus.
3. Field visit to study the habitat (Hill station/ Local Fossil site).
4. Study the following fossil members: *Rhynia*, *Lepidodendron*, *Lepidocarpon*, *Calamites* and *Williamsonia sewardiana* through permanent slides.
5. Photographs of scientists in the field of Evolution and their contribution in Bryophytes, Pteridophyta and Gymnosperm.

PRESCRIBED BOOKS:

1. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.
3. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
4. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
5. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
6. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
7. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.

REFERENCE BOOKS:

1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
2. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom.
3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
4. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.

E-LEARNING RESOURCES:

1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4
2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html
4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual
5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

PROGRAMME: ALL UG	**BATCH: 2024 - 27**
PART: IV	**COURSE COMPONENT:** EVS
COURSE NAME: ENVIRONMENTAL STUDIES	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

UNIT I:
The Multidisciplinary nature of environmental studies Definition; Scope and importance, Need for public awareness.

UNIT II:
Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and Over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water dams benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. - Role of an individual in conservation of natural resources. - Equitable use of resources for sustainable lifestyles.

UNIT III: Ecosystems
Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem.
Ecological succession - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem: -
a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT IV: Biodiversity and its Conservation
- Introduction-Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

- Biodiversity at global, National and local levels.
- India as a mega-diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT V: Environmental Pollution:

Definition - Causes, effects and control measures of:

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

UNIT VI: Social Issues and the Environment

- From Unsustainable to Sustainable development.
- Urban problems related to energy. - Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

UNIT VII: Human Population and the Environment

- Population growth, variation among nations.
- Population Explosion-Family welfare Programme.
- Environment and human health.
- Human Rights.

- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of information Technology in Environment and human health.
- Case Studies. UNIT-8: Field Work (Practical).
- Visit to a local area to document environmental assets-river/forest/grassland/ hill/mountain.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

UNIT VIII: Field Work (Practical)

- Visit to a local area to document environmental assets-river/forest/grassland/ hill/mountain.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

SEMESTER V

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE -VII
COURSE NAME: PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

To understand angiosperm morphology, taxonomy, and economic botany for practical application in plant sciences.

COURSE OUTCOMES:

1. Learn angiosperm morphology: roots, shoots, leaves, inflorescences, and fruits.
2. Understand taxonomy systems: artificial, natural, and phylogenetic; herbarium techniques; and dichotomous keys.
3. Explore key families: Annonaceae, Capparidaceae, Rutaceae, etc., and their economic importance.
4. Study additional families: Asteraceae, Apocynaceae, Asclepiadaceae, etc., for their characteristics and economic value.
5. Investigate cultivation methods and distribution of economically important plants

Unit I: Morphology of Angiosperms **15 Hrs**

Morphology of Root and Shoot system – modifications – (Aerial, sub-aerial and underground). Leaf- Types-simple and compound- phyllotaxy, modifications (phyllode, pitcher), tendrils, stipules. Inflorescences – definition and types – racemose, cymose, mixed and special types. Fruits - classification.

Unit II: Systems of Classification **20 Hrs**

Taxonomy: Objectives, scope and importance - Introduction-types of classification-Artificial (Linnaeus), Natural – (Bentham and Hooker) and Phylogeny- Angiosperm Phylogeny Group (APG IV) system (outline only). Herbarium techniques, Botanical gardens, Construction of dichotomous keys – Indented and bracketed keys - computer aided interactive and identification keys (DELTA System)

Unit III: Type Studies (Families) **20 Hrs**

Detailed study of the key characteristics and economic importance of the following families: Annonaceae, Capparidaceae, Rutaceae, Caesalpiniaceae, Cucurbitaceae and Rubiaceae.

Unit IV: Type Studies (Families) **20 Hrs**

Detailed study of the key characteristics and economic importance of the following families: Asteraceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Orchidaceae and Poaceae.

Unit V: Economic Botany **15 Hrs**

A detailed study with reference to distribution, method of cultivation of following economically important products. Food (Paddy); Pulses (Black gram); Nuts (Groundnut); Sugar (Sugarcane); Fiber (Cotton); Spices (Cardamom); Root tubers – (Tapioca); Timber (Teak); Latex – (Rubber); Beverages- (Coffee).

PRESCRIBED BOOKS:

1. Gurcharan Singh. (1999). Plants Systematics – Theory and practice. Oxford and IBH Publishing Co. (P) Ltd. New Delhi.
2. Heywood, V.H. (1967). Plant Taxonomy, Edward Arnold, London.
3. Pandey, B.P. (2005). Economic Botany.S.Chand & Company Pvt. Ltd., New Delhi.
4. Sambamoorthy, A.V. and Subramanyam. N.S. (1989). A text book of Economic Botany. Wilay Easters, New Delhi.
5. Sharma, O.P. (1996). Plant Taxonomy. TATA McGraw Hill, New Delhi.
6. Singh, V. and Jain, K.K. (1989). Taxonomy of Angiosperms – Rastogi, Meerut.
7. Sivaraajan,V.V. (1989). Introduction to Principle of Plant Taxonomy, Oxford and IBH, New Delhi.

REFERENCE BOOKS:

1. Pandey B.P.2011.College Botany. Vol. III. S. Chand & Company Pvt. Ltd., New Delhi.
2. Sambamurthy A. S.S. 2005; Taxonomy of Angiosperms, I.K. International Pvt. Ltd, New Delhi.32
3. Simpson M.G. (2006). Plant systematics, Elsevier Academic Press, USA
4. Sivarajan V. Principles of plant taxonomy. Oxford and IBH, 1999.
5. Subramanium NS. Modern Plant taxonomy. Vikas publishing house, New Delhi,
6. Takhtajan, A.L. (1969). Flowering Plants – Origin and dispersal – Oliver & Boyed
7. Verma V. 2009. Text book of Economic botany. Ane Books Pvt. Ltd., New Delhi.

E- LEARNING RESOURCES:

1. https://www.biologydiscussion.com › essay › taxonomy
2. https://www.wileyindia.com/taxonomy-of-angiosperms.html
3. https://www.easybiologyclass.com/angiosperm-systematics-and-taxonomy-free-online-study-materials-and-lecture-notes/
4. https://www.semanticscholar.org/paper/Taxonomy-of-Angiosperms-Arun-Mohammed/2101895c12d66c885208875a2f0edf7c7260bbe4
5. https://pragatiprakashan.in/taxonomy-of-angiosperms-and-utilization-of-plants.html
6. https://www.nhbs.com/en/morphology-and-economic-botany-of-angiosperms-book

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	1
III	2	1	2
IV	2	2	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	2	3	3
CO 3	3	3	3	2	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	2.8	2.8	3

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Learn angiosperm morphology: roots, shoots, leaves, inflorescences, and fruits.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Understand taxonomy systems: artificial, natural, and phylogenetic; herbarium techniques; and dichotomous keys.	PSO 1, PSO 2, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Explore key families: Annonaceae, Capparidaceae, Rutaceae, etc., and their economic importance.	PSO 1, PSO 3, PSO5	K1, K2, K3, K4, K5, K6
CO4	Study additional families: Asteraceae, Apocynaceae, Asclepiadaceae, etc., for their characteristics and economic value.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K3, K4, K5, K6
CO5	Investigate cultivation methods and distribution of economically important plants	PSO 2, PSO 3, PSO 4, PSO5	K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE- XI
COURSE NAME: PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICALS	

COURSE OBJECTIVE:

To understand plant morphology, identification, dissection, and field observation for comprehensive botanical knowledge.

COURSE OUTCOMES:

1. Identify and understand root, stem, and leaf modifications.
2. Recognize local flora and deduce family identification.
3. Dissect and sketch floral parts, noting diagnostic features.
4. Compile Herbarium sheets and field notes.
5. Participate in guided field trips for plant observation and collection.

Practicals

1. Spotters; Morphology of root, stem and leaf modification, types of inflorescence.
2. Plants of local flora included under theory and family identification and derivation based on reasoning.
3. Dissection, identification, observation and sketching the floral parts of the plants belonging to the families included in the syllabus.
4. Students must describe the diagnostic features of floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.
5. Twenty (20) Herbarium sheets, field notebook and bonafide record to be submitted.
6. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
7. Field trips of 2 to 5 days duration to biodiversity rich places for observation, study and collection of plants prescribed in the syllabus under the guidance of faculties.

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE - VIII
COURSE NAME: PLANT ANATOMY AND REPRODUCTIVE BIOLOGY	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

To explore plant anatomy, meristem types, vascular bundles, reproductive biology, fostering comprehensive understanding in botanical sciences and applied fields.

COURSE OUTCOMES:

1. Understand plant anatomy, including tissue classification and adaptations.
2. Learn about meristem types, vascular bundles, and root, stem, and leaf structure.
3. Explore cambium function, secondary growth, and growth anomalies.
4. Study reproductive biology, including anther and pollen structure.
5. Learn about female gametophyte development, fertilization, and seed structure.

Anatomy of Angiosperms

Unit I **20 Hrs**

Introduction and scope of Plant Anatomy. Contributions of Nehemiah Grew, A. Fahn, P. Jayaraman, Classification of tissues; Simple and complex tissues (no phylogeny); Pits and plasmodesmata; Wall ingrowths and transfercells, adcrustation and incrustation, Ergastic substances. Epidermal tissue system, classification, Anatomical adaptations of xerophytes and hydrophytes, Secretory tissues-Hydathodes, cavities, lithocysts and laticifers.

Unit II **20 Hrs**

Meristems- classification and types, Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory, quiescent centre), Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory -cytohistological zonation). Types of vascular bundles, Structure of dicot and monocot root; origin of lateral root. Structure of dicot and monocot stem. Structure of dicot and monocot leaf, Kranz anatomy.

Unit III **20 Hrs**

Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Anomalous secondary growth in stem (*Nyctanthes, Boerhaavia, Begonia*). Development and composition of periderm, rhytidome and lenticels. Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late

wood, tyloses; Dendrochronology. Clues on applications in systematics, forensics and pharmacognosy.

Reproductive Biology

Unit IV **15 Hrs**

History (contributions of S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope of Reproductive Biology. Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Micro-gametogenesis; Pollen wall structure, MGU (male germ Unit) structure, NPC system (no details but table to be included); Palynology and scope (a brief account); Unique features: Pseudomonads, polyads, massulae, pollinia.

Unit V **15 Hrs**

Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of *Polygonum* type); Organization and ultrastructure of mature embryo sac; Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria, Suspensor: structure and functions; Polyembryony - types Embryo-endosperm relationship apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.

PRESCRIBED BOOKS:

1. Dickison,W.C.(2000).Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn,A. (1974). Plant Anatomy. Pergmon Press, USA.
3. Mauseth,J.D.(1988).PlantAnatomy.TheBenjammin/CummingsPublisher,USA.
4. Esau,K.(1977). Anatomy of Seed Plants. John Wiley & Sons,Inc., Delhi.

RECOMMENDED TEXTS:

1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
5. Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi.
6. Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi.
7. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi.
8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots: The Hidden Hall (2nd edition). Marcel Dekker, New York.

REFERENCE BOOKS:

1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.
2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co.
3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,
4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.
7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/Cummings Publisher, USA.
8. Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency.
9. Swamy, B.G.L and Krishnamurthy, K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	2
III	2	2	1
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	2	3
CO 4	3	3	2	3	2
CO 5	3	3	3	3	3
Ave.	3	3	2.8	2.8	2.8

PSO-CO-question paper mapping

CO	**COURSE OUTCOMES**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Understand plant anatomy, including tissue classification and adaptations.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Learn about meristem types, vascular bundles, and root, stem, and leaf structure.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Explore cambium function, secondary growth, and growth anomalies.	PSO 1, PSO 2, PSO 3, PSO5	K1, K2, K3, K4, K5, K6
CO4	Study reproductive biology, including anther and pollen structure.	PSO 1, PSO 2, PSO 4,	K3, K4, K5, K6
CO5	Learn about female gametophyte development, fertilization, and seed structure.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE-XI
COURSE NAME: PLANT ANATOMY AND REPRODUCTIVE BIOLOGY	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To enhance comprehension of plant anatomy, reproduction, and developmental stages through focused sessions on botanical structures and processes.

COURSE OUTCOMES:

1. Identify and describe various plant tissues and structures.
2. Differentiate between monocot and dicot stem, root, and leaf anatomy.
3. Understand adaptations in xerophytes and hydrophytes.
4. Explore reproductive anatomy in angiosperms.
5. Investigate pollination, seed dispersal, and reproductive processes in plants.

Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot and Dicot Based on availability (only Permanent slides).
4. Root: Monocot and Dicot Based on availability (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds. Structure of pollen grains using whole mounts (Based on availability).
13. Study of ovule types and developmental stages of embryo sac using permanent slides /Photographs.
14. Structure of endosperm (nuclear and cellular); Developmental stages of dicot and monocot Embryos using permanent slides / Photographs

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE - IX
COURSE NAME: CELL BIOLOGY AND BIOINSTRUMENTATION	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

Gain comprehensive understanding of cell organization, organelle function, nucleic acid/protein characterization, and advanced imaging techniques for practical biological applications.

COURSE OUTCOMES:

1. Understand the structure and functions of cells, including prokaryotic and eukaryotic cells.
2. Learn about cell organelles like endoplasmic reticulum, Golgi apparatus, lysosomes, and mitochondria.
3. Explore the nucleus, chromosomes, and cell division processes.
4. Discover imaging techniques like light microscopy and electron microscopy.
5. Gain knowledge of bioanalytical methods

Cell Biology

Unit I **20 Hrs**

Introduction- scope- cell organisation- Ultra structure of Prokaryotic cell and Eukaryotic cell. Origin of eukaryotic cell (Endosymbiotic theory). Ultra-structure of Plant cell. Cell wall (Middle lamella, primary wall, secondary wall), Structure and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane- occurrence, structure (fluid mosaic model) chemistry and function. Various hypothetical models of cell membrane. Properties of Cytoplasm Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Unit II **15 Hrs**

Cell Organelles: - Origin, Occurrence, structure and function of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria, Chloroplast and Micro bodies. Semi genetic autonomy of Mitochondria and Chloroplast.

Unit III **20 Hrs**

Ultrastructure and functions of Nucleus, nuclear envelope, nuclear pore complex, nucleolus, chromosomes structure molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lamp brush chromosomes, Centromere: types. cell inclusion. Cell cycle, Cell division, Mitosis and Meiosis- their significance.

Bioinstrumentation

Unit IV **20 Hrs**

Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS) (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit V **15 Hrs**

Characterization of proteins and nucleic acids. Electrophoresis: AGE, PAGE, SDS- Principle of spectrophotometry and its application in biological research. Mass spectrometry; X-ray diffraction; X-ray crystallography.

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Units	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	2
III	2	2	1
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	2	3
CO 4	3	3	3	3	3
CO 5	1	3	3	2	1
Ave.	2.6	3	3	2.8	2.6

PSO-CO-question paper mapping

CO	**COURSE OUTCOMES**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Understand the structure and functions of cells, including prokaryotic and eukaryotic cells.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5
CO2	Learn about cell organelles like endoplasmic reticulum, Golgi apparatus, lysosomes, and mitochondria.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K6
CO3	Explore the nucleus, chromosomes, and cell division processes.	PSO 1, PSO 2, PSO 3, PSO5	K1, K2, K3, K4, K5, K6
CO4	Discover imaging techniques like light microscopy and electron microscopy.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K3, K4, K5, K6
CO5	Gain knowledge of bioanalytical methods	PSO 2, PSO 3	K1. K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE- XI
COURSE NAME: CELL BIOLOGY AND BIOINSTRUMENTATION	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To develop practical skills in organelle study, cell division observation, microscopy techniques, and electrophoresis Unit operation for comprehensive cell biology understanding.

COURSE OTUCOMES:

1. Learn about organelles and cell inclusions.
2. Understand the process of mitosis and meiosis through practical demonstrations.
3. Explore the ultrastructure of plant cells and organelles using ultra-microphotographs.
4. Familiarize with different types of microscopes through photographs and instrument demonstrations.
5. Observe and understand the functionality of an electrophoresis Unit.

Practicals

1. Study of organelles/inclusion.
2. Mitosis (Squash), Meiosis (Smear)
3. Ultra-structure of Plant cell and cell organelles with the help of ultra-microphotograph.
4. Different types of microscope (Photograph), Instrument Demonstration (Available in the department).
5. Display of electrophoresis Unit.

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE -X
COURSE NAME: PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

Understand biotechnology's history, scope, applications, including transgenic crops, plant tissue culture principles, gene screening, transfer techniques, DNA replication mechanisms, and genetic code.

COURSE OUTCOMES:

1. Learn biotechnology history, scope, and applications, including transgenic crops.
2. Understand plant tissue culture principles and applications.
3. Explore gene screening, transfer techniques, and library construction.
4. Grasp DNA replication mechanisms and challenges.
5. Gain insights into genetic code, transcriptional regulation, and protein synthesis.

Unit I **20 Hrs**

Biotechnology – definition, history and scope. Applications of Biotechnology; Development of Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Human Growth Hormone; Humulin;Biosafety concerns.

Unit II **20 Hrs**

Plant Tissue Culture- Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and cybrids; Cryopreservation; Germplasm Conservation). Application of plant tissue culture in agriculture, horticulture and forestry.

Unit III **15 Hrs**

Construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, PCR; Methods of gene transfer- *Agrobacterium*-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit IV **15 Hrs**

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).

Unit V **20 Hrs**

Genetic code – characters – codons and anticodons, Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E.coli*. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones. Protein Synthesis; Various steps in protein synthesis, initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins; Gene silencing.

PRESCRIBED BOOKS:

1. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer – Verlag
2. Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice.
3. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd.
4. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi.
5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur.
6. Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers.

REFERENCE BOOKS:

1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.
2. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Application
4. 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.
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. Klug,W.S.,Cummings,M.R.,Spencer,C.A.(2009).Concepts of Genetics.Benjamin Cummings.U.S.A. 9th edition.
7. Klug,W.S.,Cummings,M.R.,Spencer,C.A.(2009).Concepts of Genetics .Benjamin Cummings. U.S.A. 9th edition.
8. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III, Coldspring Harbor Laboratory Press, New York.
9. Micklos DA., Freyer G.A. (2003) DNA Science: A FirstCourse (2nd Edition), Cold Spring HarborL aboratory; Greg A.,CSHL Press, USA
10. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabolism of plant cell cultures – Springer – Verlag, Berlin.
11. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York.

12. Russell, P. J. (2010). iGenetics- A Molecular Approach. Benjamin Cummings, U.S.A.3rdedition.
13. Russell,P.J. (2010). iGenetics-A Molecular Approach. Benjamin Cummings, U.S.A.3rd edition.
14. Snustad, D.P. and Simmons,M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5thedition.
15. Snustad, D.P. and Simmons,M.J.(2010).Principles of Genetics.John Wiley and Sons Inc., U.S.A.5th edition.
16. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHLPress, NewYork, U. S.A.6th edition.

E-LEARNING RESOURCES:

1. https://byjus.com/biology/bioremediation/
2. https://elearning.icar.gov.in/DisplayUG_ECoursesContent.aspx?CourseCode=chJ5LKUDTDyMkOb1pzEcwA==
3. https://mgcub.ac.in/pdf/material/20200417120524fa775c070f.pdf
4. https://unacademy.com/content/csir-ugc/study-material/life-sciences/enzymes-involved-in-dna-replication/
5. https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/regulation-of-gene-expression-and-cell-specialization/a/the-lac-operon

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	2
III	2	2	1
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	2	3
Ave.	3	3	3	2.8	3

PSO – CO mapping

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Learn biotechnology history, scope, and applications, including transgenic crops.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5
CO2	Understand plant tissue culture principles and applications.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Explore gene screening, transfer techniques, and library construction.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Grasp DNA replication mechanisms and challenges.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1. K3, K4, K5, K6
CO5	Gain insights into genetic code, transcriptional regulation, and protein synthesis.	PSO 1, PSO 2, PSO 3, PSO5	K1. K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE- XI
COURSE NAME: PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

Comprehend plant tissue culture, DNA structure, agricultural biotech, genetic engineering, and DNA repair mechanisms for applied biotechnological understanding.

COURSE OUTCOMES:

1. Learn plant tissue culture techniques through demonstrations.
2. Understand DNA structure and replication with visual aids.
3. Explore agricultural biotechnology applications, like algal biofertilizers.
4. Discover genetic engineering using vectors
5. Gain insights into DNA repair mechanisms and the genetic code.

PRACTICALS

Plant Biotechnology

1. Demonstration and photographs:
2. M. S. Medium preparation,
3. Sterilization techniques in plant tissue culture.
4. Explant sterilization.
5. Callus induction.
6. Plantlet.
7. Hardening.
8. Anther culture
9. Embryo culture.
10. VAM fungi, Bacteria – Azospirillum
11. Study of algal biofertilizers

Molecular Biology – Photographs

1. DNA Structure
2. tRNA
3. DNA – Replication
4. DNA – Repair
5. Genetic code
6. Vectors -PBR 322, BAC &YAC vectors, Lac and TRP operon

PROGRAMME: FOR ALL UG STUDENTS	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** IDE
COURSE NAME: HORTICULTURE & MUSHROOM CULTIVATION	**COURSE CODE:**
SEMESTER: V	**MARKS:**100
CREDITS: 5	**TOTAL HOURS:** 90
INTER DISCIPLINARY ELECTIVE -I	

COURSE OBJECTIVE:

Gain horticultural expertise covering history, nursery management, water and soil management, crop protection, propagation, post-harvesting, and marketing strategies.

COURSE OUTCOMES:

1. Understand the fundamentals of horticulture and its historical significance.
2. Learn essential techniques for nursery management and soil preparation.
3. Explore water management methods, including irrigation and mulching.
4. Gain knowledge of crop protection strategies and propagation techniques.
5. Study post-harvest processes and marketing strategies in horticultural crop production.

Horticulture

Unit – I **15 Hrs**

Brief history of horticulture, horticultural classification, horticultural crops, Economic importance; Essentials of Nursery Management; Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices.

Unit – II **20 Hrs**

Water management: Water quality, Irrigation, Mulching. Nursery structures**:** Protected cultivation (Greenhouses), environment controls. Hydroponic culture **–** types of container. Uses of manures and fertilizers in Horticultural crop production. Organic farming.

Unit – III **20 Hrs**

Horticultural crops protection; Environment factors influencing vegetable and fruit production, Physical control – pruning. Chemical control – pesticides, fungicides. Plant propagation – cutting, layering, grafting. Indoor gardening. Floriculture, ornamental gardening and landscaping.

Unit – IV **15 Hrs**

Post harvesting processes –packaging, transport and storage; Chemical treatment. Food processing – freezing, bottling, canning, drying and chemical preservation. Horticultural crops marketing.

Mushroom Cultivation
Unit – V **20 Hrs**

Prospects and scope of Mushroom cultivation – paddy straw – oyster mushroom. Life cycle of *Pleurotus* species. Nutritional value and control of pests and pathogens. Post harvesting techniques and storage methods of mushroom. Marketing.

REFERENCES

1. Bose, T.K. and Yadav, L.P. 1989. Commercial flowers. Naya Prakash, Calcutta.
2. Bose, T.K., Mitra, S.K. and Sadhu, M.K. 1991. Propagation of tropical and subtropical horticultural crops. Naya Prakash.
3. Chadha, K.L. 1986. Ornamental horticulture in India ICAR. Krishi Bhavan, New Delhi.
4. Hartmann, H.T., Kester, D. E., Davies, F.T., Robert L. and Geneve, R.L. 2011.Hartmann and Kester's Plant propagation: principles and practice. 8th ed. Pearson Education, Inc., Publishing as Prentice Hall, One Lake Street, Upper Saddle River, NJ.
5. Kumar, N. 1986. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil.
6. Larsen, R.A. 1981. Introduction to Floriculture. Academic Press, New York.
7. Manibushan Rao, K. 1990. Text book of Horticulture. Macmillan India Limited, NewDelhi.
8. Rangaswami, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India (4^{th}edition). Prentice Hall Pvt. Ltd., New Delhi.
9. Singh, R. and Singh, U.C. 2005. Modern Mushroom Cultivation. International Book Distributors, Dehradun.
10. Singh, S.P. 1989. Mist propagation. Metropolitan Book Co., New Delhi.
11. Suman, B.C. and Sharma, V. P. 2006. Mushroom: Cultivation, Processing and Uses.Agrobios, India.
12. Trivedi, P.P. 1983. Home gardening. ICAR, New Delhi.

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	1
III	2	2	2
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	2
CO 5	3	2	3	3	3
Ave.					

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand the fundamentals of horticulture and its historical significance.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Learn essential techniques for nursery management and soil preparation.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Explore water management methods, including irrigation and mulching.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Gain knowledge of crop protection strategies and propagation techniques.	PSO 1, PSO 2, PSO 3, PSO 4	K1. K3, K4, K5, K6
CO5	Study post-harvest processes and marketing strategies in horticultural crop production.	PSO 1, PSO 3, PSO 4, PSO5	K1. K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: ALL UG	**BATCH: 2024 - 27**
PART: IV	**COURSE COMPONENT:** VALUE EDUCATION
COURSE NAME: VALUE EDUCATION	**COURSE CODE:**
SEMESTER: IV	**MARKS:100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY	

UNIT I: EDUCATION AND VALUES

Definition, Concept, Classification, Theory, Criteria and Sources of values Aims and objectives of value education Role and Need for value education in the contemporary society, Role of education in transformation of values in society Role of parents, teachers, society, peer group and mass media in fostering values

UNIT II: VALUE EDUCATION AND PERSONAL DEVELOPMENT

Human Values: Truthfulness, Sacrifice, Sincerity, Self-Control, Altruism, Scientific Vision, relevancy of human values to good life. Character Formation towards Positive Personality
Modern challenges of adolescents: emotions and behavior Self-analysis and introspection: sensitization towards gender equality, differently abled, Respect for - age, experience, maturity, family members, neighbors, strangers, etc.

UNIT III: HUMAN RIGHTS AND MARGINALIZED PEOPLE

Concept of Human Rights – Principles of human rights – human rights and Indian constitution – Rights of Women and children – violence against women – Rights of marginalized People – like women, children, minorities, transgender, differently abled etc.

Social Issues and Communal Harmony Social issues – causes and magnitude - alcoholism, drug addiction, poverty, unemployment – communal harmony –concept –religion and its place in public domain –secular civil society

UNIT IV: VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT

Constitutional Values :(Sovereign, Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, Fraternity)
Social Values: (Pity and Probity, Self-Control, Universal Brotherhood).
Professional Values :(Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, Faith).
Religious and Moral Values: (Tolerance, Wisdom, character).
Aesthetic Values: (Love and Appreciation of literature, fine arts)
Environmental Ethical Values
National Integration and international understanding.
Need of Humanistic value for espousing peace in society. Conflict of cross-cultural influences, cross-border education

UNIT V:

Guru Nanak Devji's Teachings
Relevance of Guru Nanak Devji's teachings' relevance to Modern Society
The Guru Granth Sahib
The five Ks
Values and beliefs

Rights and freedom (Right of equality, Right to Education, Right to Justice, Rights of women, Freedom of religion, Freedom of culture, Freedom of assembly, Freedom of speech)
Empowerment of women
Concept of Langar
Eminent Sikh personalities

REFERENCE BOOKS:

1. Dr. Abdul Kalam. My Journey-Transforming Dreams into Actions. Rupa Publications, 2013.
2. Steven R Covey, 8th Habit of Effective People (From Effectiveness to Greatness), Free Press, New York, 2005.
3. Prem Singh, G.J. (2004). 'Towards Value Based Education', University News. Vol. 42 (45): P.11-12.
4. V.R. Krishna Iyer. Dialectics & Dynamics of Human Rights in India (Tagore Law Lectures) The Yesterday, Today and Tomorrow, Eastern Law House **(**1999, Reprint 2018)
5. http://www.ncert.nic.in/rightside/links/pdf/framework/english/nf2005.pdf

SEMESTER VI

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE -XII
COURSE NAME: PLANT ECOLOGY, PHYTOGEOGRAPHY AND REMOTE SENSING	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

To gain the knowledge on organism-environment interactions, energy flow, biodiversity, remote sensing applications, and India's vegetational regions for environmental comprehension.

COURSE OUTCOMES:

1. Understand the basic interactions between living organisms and their environment.
2. Explore the flow of energy, trophic organization, and diverse ecosystems.
3. Appreciate the importance of biodiversity at different levels and conservation approaches.
4. Comprehend the fundamental principles and applications of remote sensing.
5. Gain insights into plant distribution, India's vegetational regions, and biodiversity indicators.

Unit I **15 Hrs**

Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis. Biotic and abiotic factors and their influence on vegetation – a brief account of plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology-Population ecology.

Unit II **20 Hrs**

Principles and models of energy flow. Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus. Hydrological Cycle; Water in soil; Water table.

Unit III **20 Hrs**

Biodiversity: Ecosystem/commUnity, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation (*In situ* and *ex situ*). Methods of study of vegetation (Quadrat and transect). Plant succession –Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors. Levels of biodiversity-genetic, species and ecosystem. Biodiversity hotspots- conservation (In situ and ex situ methods). Seed banks - conservation of genetic resources and their importance.

Remote Sensing

Unit IV **20 Hrs**

Remote sensing: Definition and data acquisition techniques. Application of remote sensing in vegetation classification, understanding the key environmental issues and ecosystem management, Study of satellite maps, vegetation mapping. Role of remote sensing in Forest Management.

Unit V **15 Hrs**

Phytogeography Introduction, continuous and discontinuous distribution, Phytogeography of India, Vegetational regions of India, Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography.

PRESCRIBED BOOKS:

1. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd.,
2. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.
4. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India.8th edition.
5. Shukla, R.S and Chandel, PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd.,
6. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.

REFERENCE BOOKS:

1. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.
2. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi.
3. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK.
4. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland.
5. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,
6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA.
7. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
8. Smith,W.H. 1981. Air pollution and forest: Interactions between air contaminants and forest ecosystems.
9. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.
10. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.

E- LEARNING RESOURCES

1. https://www.kobo.com/us/en/ebook/plant-ecology-3.
2. https://www.worldcat.org/title/plant-ecology/oclc/613206385
3. https://books.google.co.in/books/about/Plant_Ecology.html?
4. https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP
5. http://www.freebookcentre.net/Biology/Ecology-Books.html

6. https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X
7. https://www.tandfonline.com/toc/tped20/current (Plant Ecology and Diversity)
8. https://link.springer.com/journal/11258 (Plant Ecology)

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	1
III	2	2	2
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	2
CO 5	3	2	3	3	1
Ave.	3	2.8	3	3	2.4

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand the basic interactions between living organisms and their environment.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Explore the flow of energy, trophic organization, and diverse ecosystems.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Appreciate the importance of biodiversity at different levels and conservation approaches.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Comprehend the fundamental principles and applications of remote sensing.	PSO 1, PSO 2, PSO 3, PSO 4	K1. K3, K4, K5, K6
CO5	Gain insights into plant distribution, India's vegetational regions, and biodiversity indicators.	PSO 1, PSO 3, PSO 4	K1. K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE- XV
COURSE NAME: PLANT ECOLOGY, PHYTOGEOGRAPHY AND REMOTE SENSING	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To understand plant adaptations, species assessment, adaptive modifications, and utilize remote sensing for vegetation mapping and environmental analysis.

COURSE OUTCOMES:

1. Learn plant adaptations to various environments.
2. Practice plant species assessment methods.
3. Identify adaptive plant modifications.
4. Understand remote sensing for vegetation mapping.
5. Apply remote sensing in environmental studies.

Practicals

1 Study the morphological and anatomical adaptations of the hydrophytes, xerophytes, halophytes, epiphytes and parasites.

2. Find out the density, frequency & abundance of plant species by quadrat and Transect methods.
3. Plant adaptive modifications. Specimens/slides.
   Opuntia B) *Euphorbia* C) *Hydrilla* D) *Eichornia* E) *Typha* and F) *Rhizophora*
4. Demonstration - Remote Sensing - study of satellite maps, vegetation mapping.

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE-XIII
COURSE NAME: PLANT PHYSIOLOGY AND BIOCHEMISTRY	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

To understand plant-water relationships, photosynthesis, respiration, nitrogen metabolism, and basic biochemistry, including enzymes and biomolecules in plant physiology.

COURSE OUTCOMES:

1. Understand plant-water relationships and mechanisms of water uptake.
2. Learn the process and factors affecting photosynthesis and respiration.
3. Explore nitrogen metabolism and the role of plant growth regulators.
4. Study the basics of biochemistry, including biomolecules and enzymes.
5. Comprehend enzyme properties, mechanisms, and coenzymes.

Plant Physiology

Unit – I **15 Hrs**

Plant - Water relationship: structure and properties and significance of water - osmotic and non-osmotic uptake of water. Ascent of sap-cohesion theory: root pressure, transpiration, physiology of stomatal action, Translocation of solutes and assimilates. Mass flow, Membrane permeability mineral uptake: Passive and active. Role of major and minor elements, mineral deficiency symptoms.

Unit – II **20 Hrs**

Photosynthesis: Absorption spectrum, Action spectrum, Photosynthetic pigments, enhancement effect, photosystems I & II, Photophosphorylation, Carbon Assimilation: Calvin cycle, Hatch & Slack pathway, CAM pathway. Photorespiration.

Respiration: Aerobic and anaerobic. Glycolysis, Kreb's Cycle and oxidative phosphorylation, energetics of respiration.

Unit – III **20 Hrs**

Nitrogen Metabolism: Importance of nitrogen in plant life, Nitrogen fixation – biological and non-biological (symbiotic and non- symbiotic), nitrogen cycle and nitrogen metabolism. Plant Growth regulatory substances; auxins, gibberellins, cytokinin's, ethylene, abscisic acid, CLAVATA -3 their chemical nature, physiological effects and function. Role of hormones in flowering, senescence and abscission- Photoperiodism, vernalization and seed dormancy.

Biochemistry

Unit – IV **15 Hrs**

Biochemistry: definition and scope. Biomolecules and Biomacromolecules (Brief account). Carbohydrates – Classification – structure and properties of mono, di, tri saccharides. Starch and cellulose – structure and function. Lipids – Classification – Properties – saturated and unsaturated fatty acids.

Unit – V **20 Hrs**

Enzyme – properties – classification – nomenclature of enzymes – mode of enzyme action – Mechanism of Enzyme action – Michaelis- Menton constant- Factors affecting Enzyme activity. Coenzymes: Introduction, salient features of coenzymes, mechanism of coenzyme action and Classification of coenzymes (NAD, FAD, CoA, ATP and TPP).

PRESCRIBED BOOKS:

1. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry Niley Easdtern Ltd., New Delhi.
2. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
3. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bombay.
4. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi.
5. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi.
6. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi.
7. Verma,V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.
8. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant. Oxford University Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi.

REFERENCE BOOKS:

1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England.
3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, NewYork, USA.
7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.
8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee. 1999. Concepts in Photobiology: Photosynthesis and Photo morphogenesis. Narosa Publishing House, New Delhi.
10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.

11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.

E- LEARNING RESOURCES

1.https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of-plants
2.https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/dp/B004FV4RS6
3.https://www.kobo.com/us/en/ebook/plant-biochemistry
4.https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1
5.https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/dp/B01JP5L0YA
6.https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692
7.https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	1
III	2	2	2
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	2	3	3	2
CO 5	3	3	3	3	2
Ave.	3	2.8	3	3	2.6

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand plant-water relationships and mechanisms of water uptake.	PSO 1, PSO 2, PSO3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Learn the process and factors affecting photosynthesis and respiration.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Explore nitrogen metabolism and the role of plant growth regulators.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Study the basics of biochemistry, including biomolecules and enzymes.	PSO 1, PSO 3, PSO 4	K2, K3, K4, K5, K6
CO5	Comprehend enzyme properties, mechanisms, and coenzymes.	PSO 1, PSO 2, PSO 3, PSO 4	K1. K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE - XV
COURSE NAME: PLANT PHYSIOLOGY AND BIOCHEMISTRY	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To understand plant physiology principles through experiments on osmotic potential, photosynthesis, stomatal characteristics, rooting, and biochemical tests for carbohydrates, proteins, and lipids.

COURSE OUTCOMES:

1. Understand osmotic potential and diffusion pressure deficit in plant cells.
2. Learn methods to determine water potential and membrane permeability.
3. Explore the effects of light intensity and wavelength on photosynthesis.
4. Study stomatal characteristics and rooting from stem cuttings.
5. Perform biochemical tests for carbohydrates, proteins, and lipids in plants.

Plant Physiology

Individual Experiments **18 Hrs**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of Diffusion Pressure Deficit of given tissue (potato tuber) by weight method.
3. Determination of water potential of given tissue (potato tuber) by falling drop method.
4. Effect of temperature on membrane permeability using calorimetery.
5. Study of the effect of light on the rate of transpiration in excised twig/ leaf using Ganong's Potometer
6. Separation of plant pigments- chlorophyll by paper chromatography.
7. Study the rate of photosynthesis under different light intensities by using Willmott's bubble Counter.
8. Study of rate of photosynthesis under different wavelengths (red, blue, green yellow) of light. using Willmott's bubble counter.
9. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and a xerophyte.
10. Rooting from stem cuttings (application of auxins).

Demonstration Experiments **8 Hrs**

1. Comparison of rate of respiration of different respiratory substrates.
2. Measurement of pH of different soils using pH meter.
3. To study the phenomenon of seed viability using tetrazolium chloride
4. To study the induction of amylase activity in germinating barley grains.
5. Bolting experiment.

Biochemistry **4 Hrs**

1. Biochemical test for carbohydrates, proteins and lipids

REFERENCE BOOKS:

1. Bajracharya, D. (1999). Experiments in Plant Physiology: A Laboratory Manual. New Delhi, Delhi: Narosa Publishing House.
2. Bhatla, S.C., Lal, M.A. (2018). Plant Physiology, Development and Metabolism. Singapore: Springer Nature, Singapore Pvt. Ltd.
3. Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd.
4. Kochhar, S.L., Gujral, S.K. (2017). Plant Physiology: Theory and Applications. New Delhi, Delhi: Foundation Books, Cambridge University Press India Pvt, Ltd. Additional Resources:
5. Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2018). Plant Physiology and Development, 6th edition. New York, NY: Oxford University Press, Sinauer Associates.
6. Bajracharya, D. (1999). *Experiments in Plant Physiology: A Laboratory Manual.* New Delhi, Delhi: Narosa Publishing House.
7. Bhatla, S.C., Lal, M.A. (2018).*Plant Physiology, Development and Metabolism.* Singapore: Springer Nature, Singapore Pvt. Ltd.
8. Hopkins, W. G., Huner, N. P. A. (2009). *Introduction to Plant Physiology*, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd.
9. Kochhar, S.L., Gujral, S.K. (2017). *Plant Physiology: Theory and Applications.* New Delhi, Delhi: Foundation Books, Cambridge University Press India Pvt, Ltd.

ADDITIONAL RESOURCES:

1. Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2018). *Plant Physiology and Development*, 6th edition. New York, NY: Oxford University Press, Sinauer Associates.

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE-XIV
COURSE NAME: GENETICS, PLANT BREEDING & BIOSTATISTICS	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

To understand Mendelian genetics, gene interactions, polyploidy, plant breeding methods, and statistical techniques applied in genetics research and analysis.

COURSE OUTCOMES:

1. Understand Mendelian genetics principles and their application in inheritance patterns.
2. Explore gene interactions and chromosome theory, including sex-linked inheritance.
3. Learn about polyploidy, mutations, and chromosomal aberrations in genetics.
4. Grasp the principles of plant breeding methods and their application for crop improvement.
5. Familiarize with statistical methods and data presentation techniques used in genetics research

Genetics

Unit I **15 Hrs**

Genetics: branches and application, Mendelian genetics– monohybrid, dihybrid crosses. Mendel's laws, Test cross, Back cross and Reciprocal cross. Incomplete dominance - *Mirabilis jalaba*, and co – dominance. Multiple alleles, ABO Blood grouping in Human.

Unit II **20 Hrs**

Gene interactions – complementary gene, supplementary gene, inhibitory genes, epistasis (dominant and recessive), duplicate genes. Polygenic gene interaction, sex linked inheritance: haemophilia and colour blindness in man. Sex determination in plants. Chromosome theory of linkage, cytoplasmic inheritance, linkage and crossing over, recombination and chromosome mapping.

Unit III **15 Hrs**

Origin and types of Polyploidy and significance. Mutation-types and significance. Chromosomal aberration – addition, deletion, inversion, duplication and translocation. Extra nuclear inheritance and its significance - Male sterility in corn, Maternal inheritance – Plastid Inheritance in *Mirabilis jalaba*. Genetics of *Neurospora*. Population genetics – Hardy – Weinberg principle.

Plant Breeding
Unit IV **20 Hrs**

Principles involved in plant breeding: Importance of plant breeding and domestication. Methods of crop improvement: selection (mass, pure line, and clonal).
Hybridization techniques. Heterosis – interspecific and Intergeneric, causes and effects. Mutation in plant breeding, polyploidy in plant breeding and its applications. Breeding for crop improvement for paddy and sugarcane. Transgenics – scope and limitations; Bt-Cotton.

Biostatistics
Unit V **20 Hrs**

Statistical methods - basic principles: Measures of central tendency – Mean, median and mode. Measures of dispersion – range, standard deviation and standard error. Simple (hypothesis) - Small sample testing: t – Test, and Chi – square test. Data – types. Presentation of data– Graphical methods: Histogram, Bar and Pie diagrams.

PRESCRIBED BOOKS:

1. Adrin, M.S.R.B., Owen, R.D. and Edger,R.S.(1979).General Genetics. In: Mendelism. Eurasia Publishing House (P) Ltd., New Delhi.
2. Agarwal,V.K. (2000).Simplified course in Genetics(B.Sc., Zoology).S.Chand & Company Ltd., New Delhi.
3. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore
4. Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of plant Breeding. Narosa Publishing House. New Delhi.
5. Chandrasekaran,S.N. and Parathasarathy,S.V.(1965).Cytogenetics and Plant Breeding.P. Varadhachari & Co., Madras.
6. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co.
7. Daniel Sundararaj, D and Thulsidas,G.(1972).Introduction to Cytogenetics&PlantBreeding(3rd Ed.). Popular Book Depot, Madras.
8. Gupta, P.K. 2007. Genetics -Classical to modern. Rastogi Publications, Meerut, India.
9. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA.
10. Singh, R.J. 2017. Practical Mannual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.
11. Sinha,U.and Sinha,S.(1989). Cytogenetics, Plant Breeding &Evolution. Vikas Publishing House, New Delhi.
12. Sinnott, EW., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi.
13. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55.

REFERENCE BOOKS:

1. Adrin,M.S.R.B., Owen,R.D.andEdger,R.S.(1979). General Genetics. In: Mendelism. Eurasia Publishing House(P)Ltd., New Delhi.
2. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.

3. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
4. Gardner,E.J. and Snusted,D.P.(1984).Principles of Genetics (7th edition).John Wiley &Sons, New York.
5. Hackett, P.B., Fuchs, J.A and Messing, J.W. 1988. An Introduction to Recombinant. DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California.
6. Herskowitz,I.H. (1977). Principles of Genetics (2ndEd.). Mac Millan Publishing Co.Inc., New York.
7. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA.
8. Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
9. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.
10. Pandey,B.P.(2012).Cytology,GeneticsandMolecularGenetics.TataMcGraw Hill Education Priv ate Ltd.,New Delhi.
11. Biostatistic, Danniel, W.W., 1987.New York, John Wiley Sons.
12. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223.
13. Lewin,B.(1990).GenesIV.OxfordUniversityPress,Oxford.
14. Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.
15. Shukla, R.S. and Chandel P.S. Cytogenetics, Evolution and Plant Breeding , 2004. Singh, B.D. 2005. Plant Breeding, principles and methods (7th Revised and enlarged edition). Kalyani publishers, New Delhi.
16. Biostatistic, Danniel, W.W., 1987.New York, John Wiley Sons.
17. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press. 4. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin.
18. Statistics for Biologists, Campbell, R.C., 1998.Cambridge

E- LEARNING RESOURCES:

1. https://www.visiblebody.com/learn/biology/dna-chromosomes/dna-structure
2. https://www.iit.edu/sites/default/files/2021-02/mendelian_genetics.pdf
3. http://www.freebookcentre.net/Biology/Cell-Biology-Books.html
4. https://www.us.elsevierhealth.com/medicine/cell-biology
5. https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A
6. http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html
7. https://www.us.elsevierhealth.com/medicine/genetics
8. https://libguides.uthsc.edu/genetics/ebooks
9. https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding
10. http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	1
III	2	2	2
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	2
CO 5	3	3	3	3	2
Ave.	3	3	3	3	2.8

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Understand Mendelian genetics principles and their application in inheritance patterns.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Explore gene interactions and chromosome theory, including sex-linked inheritance.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Learn about polyploidy, mutations, and chromosomal aberrations in genetics.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Grasp the principles of plant breeding methods and their application for crop improvement.	PSO 1, PSO 2, PSO 3, PSO 4	K2, K3, K4, K5, K6
CO5	Familiarize with statistical methods and data presentation techniques used in genetics research	PSO 1, PSO 2, PSO 3, PSO 4	K1. K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** CORE- XV
COURSE NAME: GENETICS, PLANT BREEDING & BIOSTATISTICS	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
PRACTICAL	

COURSE OBJECTIVE:

To understand Mendelian genetics practically, analyze human karyotypes, conduct chromosome mapping, and demonstrate emasculation and bagging in plant breeding.

COURSE OUTCOMES:

1. Solve Mendelian genetic problems practically.
2. Identify modified Mendelian ratios.
3. Analyze human karyotypes for syndromes.
4. Conduct chromosome mapping experiments.
5. Demonstrate emasculation and bagging in plant breeding.

Practicals

Genetics **20 Hrs**

1. Students are expected to work out and record the problems in:
2. Monohybrid, dihybrid cross and back crosses.
3. All types of modified Mendelian ratios mentioned in the syllabus.
4. Study of human karyotype and study of characteristic karyotypes and symptoms of the syndromes mentioned in the syllabus and record it.
5. Chromosome mapping.
6. Blood Typing: ABO groups.

Plant breeding **2 Hrs**

1. Emasculation and bagging (Demonstration / Photographs)

Biostatistics **08 Hrs**

1. To study the standard deviation with reference to leaf length in plants (mean, median and mode).
2. Construct a histogram, pie chat and line diagram of plants within the plants.

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** ELECTIVE II
COURSE NAME: HERBAL TECHNOLOGY	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 5	**TOTAL HOURS:** 90
ELECTIVE	

COURSE OBJECTIVE:

To understand cultivation, processing of herbs, identify major herbs, conduct phytochemical screening, ensure herbal quality control, explore plant gene banks.

COURSE OUTCOMES:

1. Learn about the cultivation and processing of herbs in herbal technology.
2. Identify major herbs used in various herbal products.
3. Understand the botanical details and active principles of specific herbs.
4. Learn methods for evaluating drug adulteration and conducting phytochemical screening.
5. Gain insight into plant gene banks and quality control measures in herbal formulations.

Unit I **15 Hrs**

Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.

Unit II **15 Hrs**

Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmeticals and biopesticides, their Botanical names, plant parts used, major chemical constituents.

Unit III **20 Hrs**

Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, *Catharanthus roseus*, *Withania somnifera*, *Centella asiatica*, *Achyranthes aspera*, Kalmegh, Giloe (Tinospora), Saravar. Herbal foods, future of pharmacognosy.

Unit IV **20 Hrs**

Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).

Unit IV **20 Hrs**

Plant gene banks, Cultivation of Plants and their value-added processing / storage / quality control for use in herbal formulations. Brief introduction to Network Pharmacology (NP), Pharmacokinetic Parameters, Acquisition and analysis of compounds related Targeted genes, Acquisition and analysis of diseases related Targeted genes, Compound targeted and Disease targeted genes, Protein-Protein Interaction (PPI), Molecular docking analysis, ADMET profile estimation.

PRESCRIBED BOOKS:

1. AYUSH (www.indianmedicine.nic.in). About the systems— An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
2. Evans, W.C. 2009: Trease and Evans Pharmacognosy. 16th Edition, Saunders / Elsevier.
3. Sivarajan, V.V. and India, B. 1994. Ayurvedic Drugs and Their Plant Sources. Oxford & IBH Publishing Company, 1994 - Herbs - 570 pages.
4. Miller, L. and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. Motilal Banarsidass,; Fourth edition .
5. Kokate, C.K. 2003. Practical Pharmacognosy. Vallabh Prakashan, Pune.

REFERENCE BOOKS:

1. Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. 2013. Current scenario of Herbal Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105-17.
2. Arbe r, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.
3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. 2016. Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5 : 88.
4. Aburjai, T. and Natsheh, F.M. 2003. Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000.
5. Patri, F. and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.

E- LEARNING RESOURCES

1. https://www.kopykitab.com/Herbal-Science
2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE
3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu.
4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404.
5. https://www.dattanibookagency.com/books-herbs-science.html.
6. https://www.springer.com/gp/book/9783540791157.

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	1
III	2	2	2
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	1	3	1
Ave.	3	3	2.6	3	2.6

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Learn about the cultivation and processing of herbs in herbal technology.	PSO 1,PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Identify major herbs used in various herbal products.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Understand the botanical details and active principles of specific herbs.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO4	Learn methods for evaluating drug adulteration and conducting phytochemical screening.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Gain insight into plant gene banks and quality control measures in herbal formulations.	PSO 1, PSO 2, PSO 4	K1. K2, K3, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: PLANT BIOLOGY AND PLANT BIOTECHNOLOGY	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** ELECTIVE III
COURSE NAME: PLANT MICROTECHNIQUES	**COURSE CODE:**
SEMESTER: VI	**MARKS:**100
CREDITS: 5	**TOTAL HOURS:** 90
THEORY	

COURSE OBJECTIVE:

Master plant microtechniques: fixation, staining, sectioning; prepare specimens for electron microscopy; develop skills in whole mount preparation and sectioning.

COURSE OUTCOMES:

1. Learn plant microtechniques for fixing and staining.
2. Understand dehydration, embedding, and sectioning methods.
3. Practice staining techniques for plant specimens.
4. Gain skills in specimen preparation for electron microscopy.
5. Master whole mount preparation and sectioning of various plant groups.

Unit – I **15 Hrs**

Plant Microtechniques - Killing and Fixing
Principles and techniques of killing and fixing; properties of reagents, fixation images; properties and composition of important fixatives - Carnoy's Fluid, FAA, FPA, Chrome acetic acid fluids, Zirkle Erliki fluid.

Unit – II **20 Hrs**

Dehydration, clearing, embedding and sectioning
Sectioning: Free hand sections – Prospects and problems; Sectioning in rotary microtome - sledge microtome and cryotome. Types of Microtomy- Rotary, sledge, Freezing, Cryostat and Ultratomes. Dehydration: Principles of dehydration, properties and uses of important dehydrating and clearing agent. Dehydration Methods. Embedding: Paraffin embedding, Camera Lucida.

Unit – III **20 Hrs**

Staining
Principles of staining; classification of stains, protocol for preparation of staining. Types of staining-single, double and triple stains. Histochemical localization of starch, protein, lipid and lignin.

Unit – IV **20 Hrs**
Specimen preparation for transmission electron microscopy
Material collection, fixing, dehydration, embedding, sectioning (glass knife preparation, grid preparation, ultra-microtome) and staining.

Unit – V **15 Hrs**

Preparing whole mount of Algae and Fungi, Sectioning of Bryophytes, Pteridophytes and Gymnosperms. Maceration and sectioning of Angiosperm material.

REFERENCE BOOKS:

1. Prasad M. K. & Prasad M. K. 2000. Emkay Publications
3. Kierman, J.A.1999. Histological and Histochemical Methods. Butterworth Publ. London.
4. Ruzin, Z. E. 1999. Plant Microtechnique and Microscopy. Oxford Press, New York.
5. Harris, J. R. 1991. Electron Microscopy in Biology. Oxford University Press, New York.
6. Gahan, P.B. 1984. Plant Histochemistry and Cytochemistry. Academic Press, London.
7. Johanson, W. A.1984. Plant Microtechnique. McGraw Hill, New York.
8. Johanson, W. A. 1982. Botanical Histochemistry-Principles and Practice. Freeman Co.
9. John E. Sass. 1964. Botanical Microtechnique. Oxford & IBH Publishing Co. Calcutta.
10. Gary, P. 1964. Hand book of Basic Microtechnique. John Wiley & Sons, New York.
11. Yeung E.C.T., Stasolla C., Sumner M. J. & Huang B. Q. 2015. Plant Microtechniques and Protocols. Springer Nature.

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS FOR THEORY

Unit	SECTION A	SECTION B	SECTION C
I	2	1	1
II	3	2	1
III	2	2	2
IV	2	1	1
V	3	1	1
TOTAL	12	7	6

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	1
Ave.	3	3	3	3	2.6

PSO-CO-question paper mapping

CO	COURSE OUTCOMES	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Learn plant microtechniques for fixing and staining.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Understand dehydration, embedding, and sectioning methods.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO3	Practice staining techniques for plant specimens.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1, K2, K3, K4, K5, K6
CO4	Gain skills in specimen preparation for electron microscopy.	PSO 1, PSO 2, PSO 3, PSO 4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Master whole mount preparation and sectioning of various plant groups.	PSO 1, PSO 2, PSO 3, PSO 4	K1. K2, K3, K4, K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

SOFT SKILL COURSES

SOFT SKILLS	**BATCH: 2024-27**
COURSE NAME: COMMUNICATION AND PRESENTATION SKILLS	**COURSE CODE:**
SEMESTER: I	**MARKS: 100**
CREDITS: 2	**TOTAL HOURS: 30**

COURSE OBJECTIVE:

To build communication skills for personal and professional development.

COURSE OUTCOMES:

1. Students will demonstrate the ability to listen to others actively, understand diverse perspectives, and paraphrase key points accurately, enhancing their comprehension skills in various personal and professional contexts.
2. Students will be able to articulate thoughts, ideas, and information clearly and concisely, using appropriate language and structure to convey messages effectively in both written and verbal communication.
3. Students will develop confidence in expressing opinions, asserting boundaries, and advocating for themselves and others, enhancing self-assurance and effectiveness in interpersonal and group communication.
4. Students will learn to adapt their communication style and approach based on the audience, context, and purpose of communication, fostering flexibility and versatility in interacting with diverse individuals and groups.
5. Students will acquire techniques for resolving conflicts, managing disagreements, and negotiating mutually beneficial outcomes through effective communication strategies, promoting constructive problem-solving and collaboration in personal and professional settings.

UNIT I Essentials of Effective Communication 6 Hrs

Communication Skills-LSRW- Characteristic features of LSRW-Consequences of Ineffective Communication-Impact of technology on Communication

UNIT II Types of Communication 6 Hrs

Verbal Communication – Non-verbal Communication- Visual Communication - Written Communication-Group Communication-Digital Communication-Formal and Informal Communication-Vertical-Horizontal-Diagonal Grapevine

UNIT III Barriers in Communication 6 Hrs

Physical Barriers - Language Barriers - Social and Cultural Barriers - Psychological Barriers - Semantic Barriers - Interpersonal Barriers - Technological Barriers- Means to overcome the various barriers to Communication

UNIT IV Etiquettes and Ethical Practices in Communication 6 Hrs

Active Listening - Clarity and Conciseness - Professional Tone - Timeliness - Constructive

Feedback-Transparency-Professionalism-Accountability-Confidentiality-Cultural Sensitivity-Emotional Intelligence-Empathy-Social Intelligence-Social Etiquettes- Appreciation and Gratitude

UNIT V Presentation Skills **6 Hrs**

Types of Presentation- Preparing a presentation-Do's and Don'ts while giving a presentation-Managing tools for presentation-Using prompts-Making effective uses of Audio/Visual aids during presentation-Dealing with Questions, Interruptions and Pauses- Practical: Participating in Mock presentations

PRESCRIBED BOOKS:

1. Monippally, Matthukutty, M. Business Communication Strategies. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 2001.
2. Peter, Francis. (2012) Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill.
3. Raman, Meenakshi & Prakash Singh (2012) Business Communication Oxford University Press

REFERENCE BOOKS:

1.Gallo, Maria. D (2018) Stop Lecturing Start Communicating: The Public Speaking Survival Guide for Business Kindle Edition
2. Hasson, Gill. (2012)Brilliant Communication Skills. Great Britain: Pearson Education.
3. Patil, Shailesh (2020) Handbook on Public Speaking, Presentation & Communication Skills: Principles & Practices to create high impact presentations & meaningful conversations, Chennai, Notion Press Media Pvt Ltd.

E-LEARNING RESOURCES:

1. https://uwaterloo.ca/centre-for-teaching-excellence/catalogs/tip-sheets/effective-communication-barriers-and-strategies
2. https://www.coursera.org/articles/presentation-skills
3. https://positivepsychology.com/how-to-improve-communication-skills/

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
A	Answer any 5 out of 7 questions (answer in 50 words)	1-7	2	**10**
B	Answer any 4 out of 6 questions (answer in 300 words)	8-13	5	**20**
C	Answer any two (Internal (Choice)	14-15	10	**20**
	Internal & Viva Voce		50	**50**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	----
II	2	1	1
III	1	1	1
IV	1	1	1
V	1	1	1
TOTAL	12	**6**	4

SOFT SKILLS	**BATCH: 2024-27**
COURSE NAME: INTERVIEW SKILLS AND RESUME WRITING	**COURSE CODE:**
SEMESTER: II	**MARKS:100**
CREDITS: 2	**TOTAL HOURS: 30**

COURSE OBJECTIVE:

To equip the students to acquire the relevant skills for better employability.

COURSE OUTCOMES:

1. Students will gain an overall understanding of the concept, the purpose, and the objectives of an interview
2. Students will become aware of the various types of interviews and the nuances of each one of them
3. Students will understand and equip themselves with the techniques and strategies required to ace an interview
4. Students will be able to draft a biodata /CV/Resume in the proper format
5. Students will embark on acquiring the relevant skills and will learn to leverage them effectively for better employability

UNIT I Introduction to Interview Skills 6 Hrs

Definition- meaning- concept of interview –Purpose- Objectives of interview-Characteristic features of job interviews

UNIT II Types of Interview 6 Hrs

Traditional one on one job interview- Panel interview- Behavioral interview-Group interview-Phone Interview- Preliminary Interview-Patterned Interview Depth Interview, Stress Interview, Exit Interview- Interview through tele and video conferencing

UNIT III Interviews: Techniques and Strategies 6 Hrs

Preparing for the Interview Process- Before the interview-During the interview-After the interview -Tips to ace an interview -Commonly asked questions in interview -Do's and Don'ts of interview -Reasons for rejections

UNIT IV Preparing Biodata/CV/Resume 6 Hrs

Essential characteristics of a job Application-Difference between Biodata- CV-Resume-covering letter-Tips to draft an application

UNIT V Leveraging Employability Skills 6 Hrs

Personality Development-Organizational skills-Time Management–Stress Management-Effective Communication Skills -Reasoning Ability-Verbal Ability- Group Discussion-Technical skills -Presentation skills

PRESCRIBED BOOKS:

1. Monipally, Matthukutty M. (2017) Business Communication: From Principles to Practice
2. Peter, Francis. (2012) Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill.

REFERENCE BOOKS:

1. Higgins, Jessica JD (2018)10 Skills for Effective Business Communication: Practical Strategies from the World's Greatest Leaders
2. Nicholas, Sonji (2023) Interviewing: Preparation, Types, Techniques, and Questions, Pressbooks
3. Storey, James (2016) The Art of The Interview: The Perfect Answers to Every Interview Question

E-LEARNING RESOURCES

1. https://careermobilityoffice.cs.ny.gov/cmo/documents/Resume%20&%20Interviewing%20Handout.pdf
2. https://edu.gcfglobal.org/en/interviewingskills/interview-etiquette/1/
3. https://findjobhub.com/en/types-of-interviews
4. https://egyankosh.ac.in/bitstream/123456789/23411/1/Unit-2.pdf
5. https://bharatskills.gov.in/pdf/E_Books/CTS/ES/English/ES_Part_1_62%20hour_English.pdf
6. https://bharatskills.gov.in/pdf/E_Books/CTS/ES/English/ES_Part2_58hour_English.pdf

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
A	Answer any 5 out of 7 questions (answer in 50 words)	1-7	2	**10**
B	Answer any 4 out of 6 questions (answer in 300 words)	8-13	5	**20**
C	Answer any two(Internal (Choice)	14-15	10	**20**
	Internal & Viva Voce		50	**50**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	----
II	2	1	1
III	1	1	1
IV	1	1	1
V	1	1	1
TOTAL	12	6	4

PROGRAMME: For All Non-IT students	**BATCH: 2024-27**
PART: IV	**COURSE COMPONENT: SOFT SKILL III**
COURSE NAME: DIGITAL PROFICIENCY AND MULTIMEDIA SKILLS	**COURSE CODE:**
SEMESTER: III	**MARKS:100**
CREDITS: 2	**TOTAL HOURS: 30**
PRACTICAL	

COURSE OBJECTIVE:

To equip students with essential computing skills.

COURSE OUTCOMES:

1. Design document using salient features of MS-Word.
2. Utilize MS-Excel to manipulate data and prepare dynamic presentation using MS-Power Point.
3. Develop a static web page using HTML.
4. Exhibit proficiency in multimedia creation using GIMP.
5. Demonstrate expertise in data visualization with Raw Graphs.

Unit I: **6 Hrs**

MS-Word: Creating, Editing, Formatting and Printing of Documents - Headers and Footers -Spell check- Insert/Draw Tables, Table Auto format – Page Borders and Shading - Mail Merge.

MS-Excel: Creating a new worksheet – Entering, editing and formatting the text, numbers – Formatting cells.

Unit II: **6 Hrs**

Inserting Rows/Columns - Changing column widths and row heights – Freezing Titles, splitting screen - Formulae for calculation - Changing font sizes and colours, Sort.

MS-PowerPoint: Creating a Presentation - Inserting and Deleting Slides in a Presentation – Adding Text/Clip Art/Pictures - Slide Transition – Custom Animation.

Unit III: **6 Hrs**

Web designing using HTML: Basic tags – heading tags – paragraph, bold, italic, underline tags – font tags – ordered and unordered list – inserting images – hyperlinks.

Unit IV: **6 Hrs**

Multimedia applications using GIMP: Interface and Drawing Tools in GIMP- Applying Filters Creating and handling multiple layers - Using Stamping and Smudging tools - Importing pictures.

Unit V: **6 Hrs**

Data visualization using Raw Graphs: Importing and exploring data - Basic chart types -mapping - customizing visualizations - Exporting visualizations.

E-LEARNING RESOURCES:

1. https://www.javatpoint.com/ms-word-tutorial
2. https://www.w3schools.com/excel/
3. https://www.tutorialspoint.com/html/
4. https://www.gimp.org/tutorials/
5. https://www.rawgraphs.io/learning

PROGRAMME: ALL UG	**BATCH: 2024 - 27**
PART: IV	**COURSE COMPONENT:** SOFT SKILL-4
COURSE NAME: FOUNDATIONS OF QUANTITATIVE APTITUDE	**COURSE CODE:**
SEMESTER: IV	**MARKS:100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To develop learners' problem-solving skills and critical thinking abilities in the context of recruitment aptitude tests.

COURSE OUTCOMES:

1. The learner will be able to recognize, describe and represent patterns and relationships, as well as to solve problems using algebraic language and skills.
2. To learn about factors and multiples that numbers have in common with each other.
3. The student will analyse monthly profit and loss statements for a school store and calculate profit margin percentages.
4. Students learn what different types of interest are, where it occurs in real life and understand the concept of simple and compound interests.
5. The learner will draw, interpret and compare pie charts, bar charts and frequency diagrams.

Unit I: Number system and Number series **6 Hrs**

Numbers: Numbers and their classification, test for divisibility of numbers, General properties of divisibility, division and remainder, remainder rules.

Number Series: Number series, three steps to solve a problem on series, two-line number series, sum rules on natural numbers.

Unit II: HCF and LCM of Numbers **6 Hrs**

Factors, Multiples, Principal of Prime factorization, Highest Common Factor (HCF) and Least Common Multiple (LCM), Product of two numbers, Difference between HCF and LCM.

Unit III: Percentage, Profit and Loss **6 Hrs**

Percentage: Introduction, fraction to rate percent, rate percent to fraction, rate percent of a number, express a given quantity as a percentage of another given quantity, convert a percentage into decimals and convert a decimal into percentage.

Profit and Loss: Gain/Loss and % gain and % loss, relation among Cost price, Sale price, Gain/Loss and % gain and % loss.

Unit IV: Simple Interest and Compound Interest **6 Hrs**

Simple Interest: Definition, effect of change of *P, R and T* on Simple Interest, amount.

Compound Interest: Introduction, conversion period, basic formula, to find the Principal/Rate/Time, Difference between Simple Interest and Compound Interest.

Unit V: Data interpretation **6 Hrs**

Tabulation, Bar Graphs, Pie Charts, Line Graphs, average.

PRESCRIBED BOOK:

Quantitative Aptitude by R.S. Agarwal

REFERENCE BOOKS:

1. Quantitative Aptitude by Abhijit Guha, Fourth Edition.
2. Quantitative Aptitude by Ramandeep Singh.

E - LEARNING RESOURCES:

1.https://byjus.com/maths/numeralsystem/#:~:text=crore%20is%207.,International%20Numeral%20System,8%20%E2%80%93%20Ones

2.https://byjus.com/maths/hcf-and-lcm/

3.https://byjus.com/maths/profit-loss-percentage/

4.https://www.vedantu.com/jee-main/maths-difference-between-simple-interest-and-compound-interest

5.https://sites.utexas.edu/sos/guided/descriptive/descriptivec/frequency/

SELF STUDY COURSES

INDIAN HERITAGE AND KNOWLEDGE SYSTEM

PROGRAMME: For all UG Programmes	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** Self Study Course
COURSE NAME: INDIAN HERITAGE AND KNOWLEDGE SYSTEM	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 2	
QUESTION PATTERN: MCQ	
THEORY	

COURSE OBJECTIVE:

To delve into Indian Heritage, this course focuses on South Indian cultures and ancient knowledge like Yoga, Ayurveda, and Siddha, shaping the Nation's identity.

COURSE OUTCOMES:

1. To develop a comprehensive understanding among students of Indian heritage, its richness and diversity, and its role in shaping the nation's cultural identity.
2. Students will gain an enhanced insight into the artistic, architectural, and literary achievements of South India and other regions, fostering a sense of pride in Indian cultural heritage.
3. To enhance students' cultural literacy by gaining insights into traditional practices preserved through folklore across India.
4. To acquire knowledge among students of ancient Indian sciences for holistic well-being, promoting physical, mental, and spiritual health.
5. Students will develop a deeper understanding of the interconnectedness of spiritual, medicinal, and artistic dimensions within Indian Heritage systems.

UNIT I: Introduction to Indian Heritage

- **Concept of Heritage:** Definition, the importance of studying heritage, and its diverse forms.
- **Cultural Landscape of India:** Overview of major cultural zones in India, with a focus on South India.

  Key Concepts: Cultural heritage, diversity, tangible heritage (e.g., monuments), intangible heritage (e.g., traditions, practices).

UNIT II: Cultural Tapestry of South India

- **Literature:** The classical Tamil literature of *Sangam poetry*, the epic Kannada works like the *"Kuvempu Ramayana,"* the Telugu compositions of *Annamacharya*, and the poetic Malayalam works of Kerala's rich literary tradition.

- **Painting:** The intricate gold leaf work of *Tanjore* painting, the intricate patterns of *Mysore* painting, hand-painting or block-printing of Kalamkari.
- **Theatre:** The ancient art form of *Koothu* and the elaborate dance-dramas of *Bhagavata Mela* in Tamil Nadu, and the colourful folk theatre of *Yakshagana* in Karnataka.
- **UNESCO Indian Heritage Sites:** *Great Living Chola Temples* artistry, *Hampi*-Virupaksha Temple and the Vijaya Vittala Temple, *Mahabalipuram*- a treasure trove of Pallava art, *Mysore Palace*-Indo-Saracenic architecture, *Periyar National Park*- Western Ghats, *Kanchipuram*-City of Thousand Temples

UNIT III: Tamil Nadu Folklores

- **Origins and Significance:** Historical background of Tamil Nadu folklore and its cultural significance.
- **Folk Dances:** Exploration of traditional Tamil folk dances like *Karakattam, Kolattam,* and *Kummi.*
- **Folk Music:** Overview of folk music traditions in Tamil Nadu, including *Parai Attam and Villu Paatu.*
- **Rituals and Festivals:** Understanding the role of folklore in Tamil Nadu's rituals and festivals-*Pongal and Jallikattu.*

Key Concepts: Karakattam, Kolattam, Parai Attam, Villu Paatu, Tamil folk tales, cultural rituals.

UNIT IV: Unveiling the Knowledge Systems

- **Cultural Landscape of India:** Overview of major cultural zones in India, with a focus on South India.
- **Yoga:** Exploring the various aspects of Yoga - its philosophy, Eight Limbs, practices (e.g., Asanas, Pranayama), and benefits for physical and mental well-being.
- **Ayurveda:** Understanding the core principles of Ayurveda - its focus on holistic health, diagnosis, and treatment methods.

Key Concepts: Yoga philosophy, Asanas, Pranayama, Tridosha theory (Ayurveda), Doshas (Vata, Pitta, Kapha), Panchakarma, herbal medicine, Ayurvedic lifestyle.

UNIT V: Siddha Tradition and Other Knowledge Systems

- **Siddha Tradition:** Origins, philosophy, medicinal practices, and spiritual aspects.
- **Other Important Knowledge Systems:** Jyotish Shastra (Indian astrology), Natya Shastra (Treatise on performing arts).

Key Concepts: Siddha literature, alchemy, and spirituality in Siddha tradition. Pancha Boothas (Siddha), herbal remedies, Planetary influences, elements of classical Indian dance and music, and aesthetics in Natya Shastra.

CONTEMPORARY WORLD AND SUSTAINABLE DEVELOPMENT

PROGRAMME: For all UG Programmes	**BATCH:** 2024-27
PART: III	**COURSE COMPONENT:** Self Study Course
COURSE NAME: CONTEMPORARY WORLD AND SUSTAINABLE DEVELOPMENT	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 2	
QUESTION PATTERN: MCQ	
THEORY	

COURSE OBJECTIVE:

To delve into global dynamics, this course highlights Asia and India's pivotal role in achieving global sustainability objectives.

COURSE OUTCOMES:

1. Students will gain a comprehensive understanding of the key actors, institutions, and dynamics shaping the contemporary world order.
2. Students will acquire the ability to analyze the political, economic, and security challenges within major Asian regions, fostering informed perspectives on these critical issues.
3. Through the study of recent wars, students will develop critical thinking skills to assess the root causes, human costs, and potential solutions to contemporary conflicts.
4. Students will gain a deeper understanding of the principles and challenges of sustainable development, empowering them to advocate for responsible solutions at local, national, and international levels.
5. Students will be equipped to critically evaluate India's contributions to the SDGs, particularly through specific programs implemented in Tamil Nadu, and assess their effectiveness in achieving sustainable development goals.

UNIT I: Global Governance and Institutions

- **State & Non-State Actors:** Definition, types (nation-states, failed states), functions.
  Key Actors: International states, Intergovernmental organizations (IGOs), nongovernmental organizations (NGOs), multinational corporations (MNCs).
- **United Nations (UN):** Structure, key organs (General Assembly, Security Council), functions, WB, & others.
  Key Concepts: United Nations General Assembly, United Nations Security Council.
- **Regional Organizations:** European Union (EU), African Union (AU), North Atlantic Treaty Organization (NATO)
  Key Concepts: European Union Commission, African Union Commission, North Atlantic Treaty Organization.
- **International Law and Treaties:** Significance, role in addressing global challenges.
  Key Concepts: International Court of Justice, International Criminal Court, Geneva Conventions.

UNIT II: Contemporary Asia

Major Geographical Regions

- **Middle East:** Characterized by rich oil reserves, Complex political dynamics, and ongoing conflicts.
  Key countries: Iran, Iraq, Israel, Saudi Arabia, Syria, Turkey
- **Southeast Asia:** Rapid economic growth, Challenges- maritime security and environmental degradation.
  Key countries: Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam
- **Far East:** Major economic powerhouses and Potential flashpoints.
  Key countries: China, Japan, North Korea, South Korea
- **Rise of China:** Political-South China Sea, Territorial disputes and Competition for Resources. Economic- China's Belt and Road Initiative (BRI)
- **Major Economic Centers: Singapore-** Global financial hub, **Hong Kong-** Special Administrative Region of China, **United Arab Emirates (UAE)-** Diversified economy driven by oil and gas, tourism, and trade.

Regional Organizations:

- Association of Southeast Asian Nations (ASEAN)
- South Asian Association for Regional Cooperation (SAARC)
- Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)
- Asia-Pacific Economic Cooperation (APEC)
- Shanghai Cooperation Organization (SCO)

UNIT III: Recent Wars of the World

- **Syrian Civil War (2011-present):** Bashar al-Assad regime, Syrian opposition groups, ISIS.
  Key Concepts: Origins of the conflict, humanitarian crisis, foreign intervention, refugee crisis.
- **Yemeni Civil War (2015-present):** Houthi rebels, Yemeni government, Saudi-led coalition.
  Key Concepts: Proxy war dynamics, humanitarian crisis, role of Iran and Saudi Arabia, UN peace efforts.
- **Ukraine Conflict (2014-present)**: Ukrainian government, Russian-backed separatists, Russia.
  Key Concepts: Annexation of Crimea, Donbas region conflict, Minsk agreements, NATO-Russia tensions.
- **Ethiopia Civil War (2020-present):** Ethiopian government, Tigray People's Liberation Front (TPLF), Eritrean forces.
  Key Concepts: Tigray conflict, humanitarian crisis, regional implications, efforts for ceasefire and peace talks.
- **Nagorno-Karabakh War (2020):** Armenia, Azerbaijan, Russia.
  Key Concepts: Conflict over Nagorno-Karabakh region, ceasefire agreement, role of Turkey, peace negotiations.
- **Myanmar Civil War (2021-present):** Myanmar military (Tatmadaw), ethnic armed groups, and Civilian resistance.
  Key Concepts: Coup aftermath, Rohingya crisis, ethnic conflicts, ASEAN mediation efforts.

UNIT IV: Sustainable Development Goals

- **Definition of Sustainable Development:** Balancing economic, social, and environmental needs.
  Key Concepts: United Nations Development Programme (UNDP), World Wildlife Fund (WWF), Sustainable Development Solutions Network (SDSN).
- **UN Sustainable Development Goals (SDGs):** Overview, targets.
  Key Concepts: United Nations, national governments, NGOs, private sector.
- **Challenges and Opportunities:** Achieving sustainability, global cooperation.

Key Concepts: United Nations, national governments, civil society organizations, multinational corporations.

UNIT V: India's Role in Achieving Sustainable Development Goals (SDGs) with Tamil Nadu Initiatives

Addressing Basic Needs:

- **Goal 1: No Poverty**
  - National Rural Employment Guarantee Act (NREGA)
  - Kalaignar Kanchi Thalaiyalar Scheme
  - Ungal Thozhil Udhayanam (UTOY)
- **Goal 2: Zero Hunger**
  - National Food Security Act (NFSA)
  - Nutritious Noon Meal Programme
  - Annadhanam Scheme
  - Amma Unavagam
- **Goal 3: Good Health and Well-being**
  - National Health Mission (NHM)
  - Health Insurance of Tamil Nadu
  - Chief Minister's Comprehensive Health Insurance Scheme
  - Maruthuva Mitri
  - Amma Mini Clinics

Ensuring Essential Services:

- **Goal 4: Quality Education**
  - Sarva Shiksha Abhiyan (SSA)
  - Rashtriya Madhyamik Shiksha Abhiyan (RMSA)
  - Namakkal District Library Scheme
  - Pudhumai Penn Scheme under Higher Education Assurance Scheme (HEAS)
  - Free Coaching for Competitive Exams
- **Goal 6: Clean Water and Sanitation**
  - Swachh Bharat Mission (Clean India Mission)
  - National Rural Drinking Water Programme (NRDWP)
  - Jal Jeevan Mission Tamil Nadu
  - Namakku Naathey Scheme
  - Kudimaramathu Scheme
- **Goal 7: Affordable and Clean Energy**
  - National Solar Mission
  - Tamil Nadu Solar Energy Policy
  - Green House Scheme

Building Sustainable Communities:

- **Goal 11: Sustainable Cities and Communities**
  - Smart Cities Mission
  - Atal Mission for Rejuvenation and Urban Transformation (AMRUT)
  - Adi Dravidar Housing Scheme
- **Goal 13: Climate Action**
  - National Action Plan on Climate Change (NAPCC)
  - International Solar Alliance
  - Tamil Nadu Wind Energy Policy 2019
- **Goal 17: Partnerships for the Goals**
  - Development Assistance Programmes (DAPs)
  - International Development Cooperation (IDC)