SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS)

Reaccredited with 'B++' Grade by NAAC

(Affiliated to Periyar University)

Salem - 16

B.Sc., Botany

OUTCOME BASED SYLLABUS

DEPARTMENT OF BOTANY

(DBT STAR COLLEGE SCHEME Sponsored)

TANSCHE SYLLABUS

(For the students admitted from 2025 – 26 onwards)

Programme: B.Sc., Botany	
Programme Code:UBO	
Duration: 3 years	
Programme Outcomes (PO)	
The B.Sc. Botany program is designed to achieve the following objectives	
PO1	Apply the knowledge of science and technology fundamentals for findings solution for complex problems.
PO2	To provide up to date theoretical knowledge on various forms of plants, their interactions with biotic and abiotic entities in the ecosystem and relevant practical skills.
PO3	To comprehend and interpret various facets of Botany including the importance and judicious utilization of plant sources.
PO4	Exploration of diverse plant life-forms and to nature the conservation of biodiversity.
PO5	To understand the principles and applications of various traditional and modern techniques used in Botany.
PO6	To disseminate knowledge on the design and execution of experiments in Botany with emphasis on the operation of relevant sophisticated instruments.
PO7	To impart knowledge on the economic importance of plant/microbial resources and their products and to promote entrepreneurship skill.
PO8	To promote proficiency in designing the research problems, review of literature, laboratory experiments, data analyses and preparation of reports with professional ethics.
PO9	To motivate the students to take up innovative and cutting-edge research in frontier areas of Botany and related biology subjects.
PO10	To enable the students to take up various qualifying examinations concerning Botany and to face the challenges in career opportunities.
Program Specific Outcomes (PSO)	
On successful completion of the B.Sc. Botany program, the students are expected to	
PSO1	Implement the concept of science and technology to foster the traditional and modern techniques for solving the complex problems in Plant Biology.
PSO2	Ensure the use of contemporary tools and techniques in understanding the scope and significance of Botany.
PSO3	Develop the scientific problem solving skills during experimentation, research projects, analysis and interpretation of data.
PSO4	Design scientific experiments independently and to generate useful information to address various issues in Botany.
PSO5	Enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings.
PSO6	Design and standardize protocols for public health and safety, and cultural, societal,and environmental considerations.
PSO7	Apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.
PSO8	Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.
PSO9	Follow the concept of professional ethics and bioethics norms for practicing the value of plant kingdom.
PSO10	Communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively.

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM-16

DEPARTMENT OF BOTANY
(DBT Star College Scheme Sponsored)

B.Sc., BOTANY

PROGRAMME STRUCTURE UNDER CBCS

(For the students admitted in 2025 – 26 Onwards)

Total Credits: 140+1 + Extra Credit (Maximum 28)

SEMESTER I					
Part	**Course**	**Course Title**	**Code**	**Hrs./ week Lecture/ Tutorial**	**Credits**
I	Language	Tamil-I/ Hindi-I/ Sanskrit – I	25ULTC1/ 25ULHC1/ 25ULSC1	6	3
II	English	General English – I	25ULEC1	6	3
III	Core – I	Plant Diversity I – Algae	25UBOCC1	5	5
	Core Practical	Core Practical : Plant Diversity I - Algae	25UBOCCQ1	4	-
	Generic Elective - I (GE)	Zoology – I	25UBOZGEC1	3	3
		Zoology Practical	25UBOZGECQ	2	-
IV	Skill Enhancement Course - I (NME)	Nursery and Landscaping	25UBOSEC1	2	2
	Skill Enhancement Foundation Course	Basics of Botany	25UBOSEFC	2	2
		TOTAL		**30**	**18**
Extra Skills		• **Articulation and Idea Fixation skills** • **Physical Fitness Practice – 35 Hrs. per semester (Out of College Hrs. – 1 Extra Credit)** • **Society Connect Activity – 1 Extra Credit**			

- **Advanced Diploma in Gardening and Landscaping**
  Level 1: Certificate course in Gardening - 100 Hrs. per year – 3 Extra Credits
- **Extra credits are given for extra skills and courses qualified in MOOC / NPTEL – 2 Extra Credits**

SEMESTER II					
Part	**Course**	**Course Title**	**Code**	**Hrs./ week Lecture/ Tutorial**	**Credits**
I	Language	Tamil/ Hindi/ Sanskrit – II	25ULTC2/ 25ULHC2/ 25ULSC2	6	3
II	English	General English – II	25ULEC2	6	3
III	Core – II	Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens	25UBOCC2	5	5
	Core – III	Core Practical : Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens - Practical – I(Core I and Core II)	25UBOCCQ1	4	4 (2+2)
	Generic Elective – II (GE)	Zoology – II	25UBOZGEC2	3	3
		Zoology Practical	25UBOZGECQ	2	4 (2+2)
	Skill Enhancement Course –II (NME)	Mushroom Cultivation	25UBOSEC2	2	2
IV	Skill Enhancement Course -III (IKS)	Traditional System of Plant Therapy	25UBOSEC3	2	2
			TOTAL	**30**	**26**
Extra Skills	• **Articulation and Idea Fixation skills** • **Physical Fitness Practice – 35 hrs. per semester (Out of College Hrs. – 1 Extra Credit)** • **Society Connect Activity – 1 Extra Credit**				

- **Advanced Diploma in Gardening and Landscaping**
  Level 1: Certificate course in Gardening - 100 Hrs. per year – 3 Extra Credits
- **Extra credits are given for extra skills and courses qualified in MOOC / NPTEL – 2 Extra Credits**

SEMESTER III					
Part	**Course**	**Course Title**	**Code**	**Hrs/ week**	**Credits**
I	Language	Tamil III Hindi III Sanskrit III	25ULTC3 25ULHC3 25ULSC3	6	3
II	English	English III	25ULEC3	6	3
III	Core – IV	Plant Diversity III – Bryophytes and Pteridophytes	25UBOCC3	5	5
	Core Practical	Core Practical : Plant Diversity III – Bryophytes and Pteridophytes	25UBOCCQ2	4	-
	Generic Elective – III (GE)	Chemistry – I	25UBOCGEC1	3	3
		Chemistry Practical – I	25UBOCGECQ1	2	2
IV	Skill Enhancement Course - IV	Herbal Technology	25UBOSEC4	2	2
	Skill Enhancement Course -V	Entrepreneurial opportunities in Botany (Entrepreneurial Skill)	25UBOSEC5	1	1
	EVS	Environmental Studies	25UEVSC	1	-
			TOTAL	**30**	19
	Health and Wellness (Out of College Hrs.)			**1**	**1**
Extra Skills	• **Articulation and Idea Fixation skills** • **Life Skills Promotion – 2 Hrs. per semester (Out of College Hrs. – 1 Extra Credit)** • **Physical Fitness Practice – 35 Hrs. per semester (Out of College Hrs. – 1 Extra Credit)** • **Society Connect Activity - 1 Extra Credit**				

- **Advanced Diploma in Gardening and Landscaping**
  Level 2: Diploma Course in Landscaping - 100 Hrs. per year – 3 Extra Credits
- **Extra credits are given for extra skills and courses qualified in MOOC / NPTEL – 2 Extra Credits**

SEMESTER IV					
Part	**Course**	**Course Title**	**Code**	**Hrs/ week**	**Credits**
I	Language	Tamil IV Hindi IV Sanskrit IV	25ULTC4 25ULHC4 25ULSC4	6	3
II	English	English IV	25ULEC4	6	3
III	Core – V	Plant Diversity IV – Gymnosperms, Paleobotany and Evolution	25UBOCC4	6	5
	Core - VI	Core Practical II : Gymnosperms, Paleobotany and Evolution Practical – II (Core IV and Core V)	25UBOCCQ2	2	3
	Generic Elective – IV (GE)	Chemistry – II	25UBOCGEC2	3	3
		Chemistry Practical - II	25UBOCGECQ2	2	2
IV	Skill Enhancement Course -VI	Fermentation Technology	25UBOSEC6	2	2
	Skill Enhancement Course -VII	Environmental Impact Analysis	25UBOSEC7	2	2
	EVS	Environmental Studies	25UEVSC	1	2
			TOTAL	**30**	**25**
Extra Skills		• **Articulation and Idea Fixation skills** • **Life Skills Promotion – 2 Hrs. per semester (Out of College Hrs. – 1 Extra Credit)** • **Physical Fitness Practice – 35 Hrs. per semester (Out of College Hrs. – 1 Extra Credit)** • **Society Connect Activity - 1 Extra Credit** • **Second Year Vacation – Internship – 40 hours (2 Credits)**			

- **Advanced Diploma in Gardening and Landscaping**
  Level 2: Diploma Course in Landscaping - 100 Hrs. per year – 3 Extra Credits
- **Extra credits are given for extra skills and courses qualified in MOOC / NPTEL – 2 Extra Credits**

SEMESTER V					
Part	**Course**	**Course Title**	**Code**	**Hrs/ week**	**Credits**
III	Core - VII	Plant Morphology, Taxonomy and Economic Botany	25UBOCC5	5	5
	Core -VIII	Plant Anatomy and Embryology	25UBOCC6	4	4
	Core - IX	Cell Biology, Genetics and Plant Breeding	25UBOCC7	5	4
	Core - X	Core Practical III : Covering – Core – VII, VIII & IX	25UBOCCQ3	6	-
	Discipline Specific Elective Course I	EC I: Bio Analytical Techniques / Aquatic Botany / Entrepreneurial Botany	25UBODSEC1A/ 25UBODSEC1B/ 25UBODSEC1C	3	2
	Project and Viva -Voce	Project and Viva -Voce	25UBOPVV	5	4
IV		Value Education	25UVEN	2	2
		Summer Internship	25UBOI	-	2
TOTAL				30	23
Extra Skills		• **Life Skills Promotion – 2 Hrs. per semester (Out of College Hrs. – 1 Extra Credit)** • **Physical Fitness Practice – 35 Hrs. per semester (Out of College Hrs. – 1 Extra Credits)** • **Society Connect Activity - 1 Extra Credit**			

- **Advanced Diploma in Gardening and Landscaping**
  Level 3: Advanced Diploma in Turfing and Turf Management - 100 Hrs. per year – 3 Extra Credits
- **Extra credits are given for extra skills and courses qualified in MOOC / NPTEL – 2 Extra Credits**

CORE - I PLANT DIVERSITY I - ALGAE

Title of the Course		**PLANT DIVERSITY I – ALGAE**					
Paper Number		CORE I					
Category	Core	**Year**	I	**Credits**	5	**Course Code**	
		Semester	I			25UBOCC1	
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		5	-		-	5	
Pre-requisite		Students should be familiar with the basics of different classes of algae.					

Learning Objectives

C1	To provide a comprehensive knowledge on the biology of algae.
C2	To provide a basis for better understanding of the evolution higher of plants.
C3	To understand reproductive biology, ecology of plants by studying the simpler systems in algae.
C4	To understand the role of algae in ecosystems as primary producers of nutrition.
C5	To understand importance of algae to animals and humans.

Course Outcomes : On completion of this course, students will be able to: CO	**Programme Outcomes**
1. Relate to the structural organization, reproduction and significance of algae.	K1
2. Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth	K2
3. Explain the benefits of various algal technologies on the ecosystem.	K3
4. Compare and contrast the thallus organization and modes of reproduction in algae.	K4
5. Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.	K5

UNIT	**CONTENTS**
I	Definition of algae. Characteristic features of Algae w.s.r.t. cell wall, flagella eye spot, pigmentation and reserve food materials in algae. algal distribution. Habit and Habitat (Hydrophytes: Benthophytes, Epactiphytes, Thermophytes, planktophytes, Halophytes, Epizoophytes; Edaphophytes: saprophytes, cryptophytes; Aerophytes; Cryptophytes; symbionts; Endozoophytes; Parasites; Fluviatile). Thallus organization: (unicellular-colonial-filamentous- siphonous-parenchymatous). Reproduction and lifehistory: (haplontic-diplontic- diplohaplontic-and diplobiontic) Classification (Fritsch-1935-1945), criteria for classification.
II	A general study of Thallus organization; Reproduction-Vegetative, asexual, sexual reproduction and life histories of the following genera: Anabaena, *Chlorella, Volvox, Oedogonium*, *Chara*.

III	A general study of Thallus organization; Reproduction-Vegetative, asexual, sexual reproduction and life histories of the following genera: *Caulerpa*, *Ulva*, Diatoms, *Sargassum, Gracilaria*.
IV	Inorganic nutritional requirements of algae and algal culture media. Algal cultivation methods indoor cultivation methods and large-scale cultivation of algae, Algal production systems; harvesting of algae and value added products.
V	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phyco remediation. Role of algae in CO_2 sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.
Extend Professional component (is a [part of internal component only, Not to be included in the External Examination on question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London. 2. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi 3. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut. 4. Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi. 5. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London.
References Books	1. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1. 2. Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi 3. Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera. 4. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press. 5. Round, FE. 1984.The Ecology of Algae. Cambridge University Press. 6. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York. 7. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.
Web 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/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	1	3	2	1	2	2	2	1
CO 2	3	3	2	2	3	3	2	`1	3	3
CO 3	2	2	1	1	2	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	3	2	3	3	3	2	3

S - Strong (3) M - Medium (2) L – Low (1)

CORE PRACTICAL I : PLANT DIVERSITY I - ALGAE

Title of the Course	**PLANT DIVERSITY I – ALGAE – PRACTICAL – I (Assessed in II Semester)**					
Paper Number	CORE PRACTICAL – 1					
Category	Core	**Year**	I	**Credits**	Assessed in II Semester	**Course Code**
		Semester	I			25UBOCCQ1
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**
		-		-	4	4
Pre-requisite	Students should be familiar with the basics of algae.					

Learning Objectives	
C1	To develop skills to identify algae based on habitat, thallus structure and the internal organization.
C2	To identify microalgae in a mixture.
C3	To develop skills to prepare the microslides of algae.
C4	To study the economic importance of few species.
C5	To understand importance of algae to animals and humans

Course Outcomes: On completion of this course, the students will be able to : CO	**Programme Outcomes**
1. Recall and identify algae using key identification characters.	K1
2. Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.	K2
3. Describe the internal structure of algae prescribed in the syllabus	K3
4. Decipher the algal diversity in fresh/marine water and their economic significance.	K4
5. Evaluate the various techniques used to culture algae for commercial purposes	K5

EXPERIMENTS

1. Micro-preparation of the types prescribed in the syllabus.
2. Identifying the micro slides relevant to the syllabus.
3. Identifying types of algal mixture.
4. Economic importance of Algae as: (i) Food (ii) Feed (iii) Biofertilizers (iv) Seaweed liquid fertilizer (v) Hydrogen production by algae (vi) SCP (vii) Agar Agar (viii) Alginate (ix) Diatomaceous earth.
5. Field visit to study fresh water/marine water algal habitats.
6. Visit to nearby industry actively engaged in algal technology.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitiveexaminations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)

Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable skill
Recommended Texts	1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany-1 (10^{th} ed).Rastogi Publications, Meerut. 3. Round, FE. 1984. The Ecology of Algae. Cambridge University Press. 4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1. 5. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
Reference Books	1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying 2. Manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London. 4. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York. 5. Dehradun. Edwardlee, R. 2018. Phycology, 5^{th} Ed., Cambridge University Press, London.
Web Resources	1. https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492 2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id= 8d5DAAAACAAJ&redir_esc= 3. https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae- (PDF-21P).html 4. https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/ 5. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	3	2	1
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	1	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	2	2	3	3	3	2	3

S - Strong (3) M - Medium (2) L – Low (1)

GENERIC ELECTIVE I : ZOOLOGY – I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
25UBOZGEC1	ZOOLOGY – I	Core	Y	-	-	-	3	3	30	70	100

Learning Objectives	
CO1	To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida
CO2	To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata
CO3	To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia
CO4	To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia
CO5	To acquire detailed knowledge of select invertebrate and chordate forms

UNIT	Details	No. of Hours	Course Objectives
I	Invertebrata - Principles of taxonomy. Criteria for classification – Symmetry and Coelom – Binomial nomenclature .General characters and Structure of Protozoa - Paramecium, Porifera - Leucosolenia,Coelenterata-Aurelia	9	CO1
II	General characters and Structure of Helminthes - Fasciolahepatica and Annelid - Leech,Arthropoda –Cockroach,Mollusca-Freshwater musseland Echinodermata-Starfish.	9	CO2
III	Classification and External characters of Prochordata – Cephalochordata - Amphioxus, Pisces- Shark and Amphibia - Frog.	9	CO3
IV	Classification and External characters of Reptilia-Calotes,Aves-PigeonandMammalia - Rabbit.	9	CO4
V	Animal organization-Structure and organization Of Earthworm, Fish & Rat	9	CO5
	Total	**45**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Recall the characteristic features invertebrates and chordates.	PO1
CO2	Classify invertebrates up to class level and chordates upto order level	PO1, PO2
CO3	Explain and discuss the structural and functional organisation of some invertebrates and chordates	PO4, PO6
CO4	Relate the adaptations and habits of animals to their habitat	PO4, PO5, PO6
CO5	Analyse the taxonomic position of animals.	PO3, PO8
Text Books (Latest Editions)		
1.	Ekambaranatha Iyer,-Outlines of Zoology, Viswanathan Publications	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Ekambaranatha Iyar and T.N. Ananthakrishnian - A Manual of Zoology -Invertebrata– Vol I: Viswanathan Publishers.	
2.	EkambaranathaIyar and T. N. Ananthakrishnan,-A Manual of Zoology-Invertebrata–Vol II: ViswanathanPublishors.	
3.	Ekambaranatha Iyar and T.N.Ananthakrishnan,- A Manual of Zoology: Chordata, ViswanathanPublishers.	
4.	Jordan E.L. and P.S. Verma- Invertebrate Zoology, S.Chand & Co.	
Web Resources		
1.	www.sanctuaryasia.com	
2.	www.iaszoology.com	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	30 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	

Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S	L	L	L	L	L	L	L
CO 2	M	S	L	L	L	L	L	L
CO 3	L	L	L	S	L	S	L	L
CO 4	L	L	L	S	S	M	L	L
CO 5	L	L	S	L	L	L	L	S

S - Strong (3) **M - Medium (2)** **L – Low (1)**

NON - MAJOR ELECTIVE - I

NURSERY AND LANDSCAPING

Title of the Course	**NURSERY AND LANDSCAPING**					
Paper Number	Non-Major Elective-I					
Category	Elective	**Year**	I	**Credits**	2	**Course Code**
		Semester	I			25UBOSECI
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		2	-		-	2
Pre-requisite	Students should know about the fundamental concepts of nursery and landscaping.					

Learning Objectives	
C1	To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.
C2	To be able to design gardens and become entrepreneur in Horticulture.
C3	To study the methods of propagation.
C4	To know about nursery structure.
C5	To learn about gardening.

Course Outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the basic principles and components of gardening.	K1
2. Explain about bio- aesthetic planning and conceptualize flower arrangement.	K2
3. Apply techniques for design various types of gardens according to the culture and art of bonsai.	K3 & K6
4. Compare and contrast different garden styles and landscaping patterns.	K4
5. Establish and maintain special types of gardens for outdoor and indoor landscaping.	K5 & K6

UNIT	**CONTENTS**
I	Introduction, prospects and scope of nursery and landscaping.
II	Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.
III	Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.
IV	Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai Culture.
V	Planning residential and non-residential landscape: Site analysis, Assessment of the area, Designing. Examples – House, College.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi. 2. Butts, E and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd.
Reference Books	1. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi. 2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. 3. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co.,San Francisco, USA. 4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers. 5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep and Deep Publ. Pvt. Ltd.
Web Resources	1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And- Landscaping-by-V-Amarnath 2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788 3. https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031 4. https://in.pinterest.com/pin/496733033900458021/?lp=true 5. https://www.gardenvisit.com/ebooks

Mapping with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	1	3
CO 2	3	3	2	2	3	3	2	2	2	2
CO 3	2	2	3	1	1	1	1	3	3	1
CO 4	3	2	2	1	3	2	1	3	2	1
CO 5	3	3	2	3	2	1	2	3	2	3

S - Strong (3) M - Medium (2) L – Low (1)

FOUNDATION COURSE FOR BOTANY – BASICS OF BOTANY

Title of the Course	**BASICS OF BOTANY**					
Paper Number	Foundation Course					
Category	Skill Enhancement	**Year**	I	**Credits**	2	**Course Code**
		Semester	I			25UBOSEFC
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		2	-		-	2
Pre-requisite	To recall the students about the basic aspects of botany.					

Learning Objectives	
C1	To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.
C2	To understand the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.
C3	To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.
C4	Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.
C5	Understanding of laws of inheritance, genetic basis of loci and alleles.

Course Outcomes : On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
2. Develop an understanding of microbes and fungi and appreciate their adaptive strategies	K2
3. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
4. Compare the structure and function of cells and explain the development of cells.	K4
5. Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5

UNIT	**CONTENTS**
I	**BIODIVERSITY** Systematics : Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.
II	**CELL BIOLOGY** Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) - Light Microscope and Electron Microscope Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane Plastids, Ribosomes.

III	**PLANT MORPHOLOGY** Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.
IV	**GENETICS** Concept of Heredity and Variation - Mendel's Laws of Inheritance.
V	**PLANT PHYSIOLOGY** Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi. 5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi. 6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany, S. Viswanathan Pvt. Ltd., Madras.
Reference books	1. Parihar, N.S. 2012. An introduction to Embryophyta – Pteridophytes - Surjeet Publications, Delhi. 2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd. 3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi. 4. Coulter, M. Jhon,2014. Morphology of Gymnosperms. Surjeet Publications, Delhi. 5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi. 6. Parihar, N.S. 2013. An introduction to Embryophyta – Bryophytes -, Surjeet Publications, Delhi.

Web 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

Mapping with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	1	3
CO 4	3	3	2	3	3	3	3	2	3	3
CO 5	3	2	2	2	2	2	2	1	2	2

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CORE – II: PLANT DIVERSITY II - FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS

Title of the Course	**PLANT DIVERSITY II - FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS**					
Paper Number	CORE II					
Category	Core	**Year**	I	**Credits**	**5**	**Course Code**
		Semester	II			25UBOCC2
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**	**Total**
	5		--		--	5
Pre-requisite	Students should be familiar with the basics of fungi, bacteria, viruses and lichens.					
Learning Objectives						
C1	To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.					
C2	To understand the biology of fungi and to discuss the importance of fungi in various ecological roles.					
C3	To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.					
C4	To identify the main groups of plant pathogens, their symptoms.					
C5	To understand the various types of plant diseases.					

Course Outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the general characteristics, thallus organization, structure, reproduction and life history of fungi.	K1
2. Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.	K4
3. Understanding of microbes, appreciate their adaptive strategies based on structural organization and their economic importance.	K2
4. Identify the common plant diseases, according to geographical locations and device control measures.	K3
5. Determine the structure, reproduction and economic importance of lichens and as pollution indicators.	K5

UNIT	CONTENTS
I	**FUNGI** Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, each with one suitable example: Zygomycotina (~~*Pilobolus, Mucor*~~, *Rhizopus*), Ascomycotina (~~*Aspergillus,*~~ *Saccharomyces*, *Peziza*), Basidiomycotina (*Agaricus*, ~~*Pleurotus,*~~ *Puccinia*) and Deuteromycotina (*Cercospora*, ~~*Alternaria*~~).
II	**ECONOMIC IMPORTANCE OF FUNGI:** Cultivation of mushroom – *Pleurotus* (food). Fungi in agriculture application (biofertilizers including VAM): 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), Applications of fungi in pharmaceutical products (Penicillin). Harmful effects of Fungi: Mycotoxins.
III	**BACTERIA, VIRUS:** General characters of Bacteria. Morphology and ultra structure of bacteria. Mode of Nutrition in Bacteria: Heterotrophic-parasitic, saprophytic, symbiotic; autotrophic-chemosynthetic, Photosynthetic. Reproduction in bacteria. Classification (Bergey's, 1994). Economic importance of bacteria: Agriculture, Industry-butter, cheese, vinegar, alcohol, tobacco and tea curing, tanning, retting; sewage, medicines etc. Mycoplasma: History, general characters and cell structure of Mycoplasma Virology -Viruses general characters, structure and reproduction of plant viruses. Structure of reproduction of Bacteriophage.
IV	**PLANT PATHOLOGY:** General symptoms of plant diseases; Geographical distribution of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; Prevention and control of the following plant diseases. **Bacterial diseases** – Citrus canker and Bacterial blight of paddy **Viral diseases** – Tobacco Mosaic and Vein clearing of Papaya **Fungal diseases** – Blast disease in rice and Tikka disease of groundnut
V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to *Usnea*. **Economic importance of Lichens**: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology. 2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi. 3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer. 4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International. 5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata. 6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India. 7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
Reference Books	1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore. 2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge. 3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi. 4. Burnett, J.H. 1971.The fundamentals of Mycology. ELBS Publication, London. 5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi. 6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi. 7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi. 8. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi. 9. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH. 10. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company.

Web 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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	2
CO 2	3	3	3	3	3	2	3	3	3	3
CO 3	3	3	2	2	3	3	2	1	2	1
CO 4	2	2	3	3	1	2	1	3	1	3
CO 5	3	3	2	3	2	3	3	3	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

CORE PRACTICAL I: PLANT DIVERSITY II - FUNGI, BACTERIA, VIRUSES, PATHOLOGY AND LICHENS

Title of the Course	**Plant diversity II - Fungi, Bacteria, Viruses, Plant Pathology and Lichens**					
Paper Number	CORE III – Core Practical – I (Including Core I + II)					
Category	Core	**Year**	I	**Credits**	4	**Course Code**
		Semester	II			25UBOCCQ1

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	-	-	4	4

Pre-requisite	Students should be familiar with the basics of fungi and lichens.

Learning Objectives

C1	To enable students to identify microscopic and macroscopic fungi.
C2	To prepare microslides of fungi and lichens.
C3	To know the presence of pathogen inside the plant tissues through microscopic sections.
C4	To identify the fungi and lichens based on the morphology, and microslides.
C5	To know the economic importance of the microbes studied.

Course Outcomes : On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Identify microbes, fungi and lichens using key identifying characters	K1
2. Develop practical skills for culturing and cultivation of fungi.	K2
3. Identify and select suitable control measures for the common plant diseases.	K3
4. Analyze the characteristics of microbes, fungi and plant pathogens	K4
5. Access the useful role of fungi in agriculture and pharmaceutical industry.	K5

EXPERIMENTS

1. Microscopic observation of vegetative and reproductive structures of types prescribed in the syllabus through temporary preparations and permanent slides.
2. Identifying the micro slides relevant to the syllabus.
3. Herbarium specimens of bacterial diseases/photograph.
3. Protocol for mushroom cultivation.
4. Inoculation techniques for fungal culture (Demonstration only).
5. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*), edible mushroom/Yeast and vitamins.
6. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs)
7. Visit to fungal biotechnology laboratories.
8. Ultra sturcture of bacteria.
9. Simple and Gram staining of Bacteria
10. Structure of bacteriophage.
11. Micro-preparation of *Usnea* to study vegetative and reproductive structures.
12. Identifying the micro slides relevant to the syllabus.
13. Study of thallus and reproductive structures (apothecium) through permanent slides.
14. Economic importance of Lichens - Dye and perfume.

Recommended Texts:

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.
2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.
3. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge University Press, Cambridge.
4. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata

Reference Books:

1. Alexopoulos, J and Mims, W. 1985. Introductory Mycology, Wiley Eastern Limited New Delhi.
2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10th ed). Rastogi Publications, Meerut.
3. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
4. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
5. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.

Web resources:

1. https://www.amazon.in/Practical-Manual-Fungi-Fungicides/dp/B0025AEFP4
2. https://books.google.co.in/books/about/Practical_Mycology.ht ml? id=5ycJ AQAAMAAJ &redir_esc=y
3. https://www.flipkart.com/colour-handbook-practical-plant-pathology/p/itmefsn6dyhfhs9b
4. https://books.google.co.in/books/about/Practical_Botany.html? id=T5narQEACAAJ&redir_esc=y
5. https://www.kobo.com/us/en/ebook/introduction-to-fungi

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO 2	2	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	1	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) M-Medium (2) L-Low (1)

GENERIC ELECTIVE II: ZOOLOGY- II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
25UBOZGEC2	ZOOLOGY- II	Core	Y	-	-	-	3	3	30	70	100

Learning Objectives

CO1	To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology.
CO2	To enable students to comprehend the processes involved during development
CO3	To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination Schedule
CO4	To enable students to comprehend the basic concepts of human genetics and patterns of inheritance
CO5	To enable students to learn about aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning

UNIT	Details	No. of Hours	Course Objectives
I	Respiratory pigments and transport of gases. Mechanism of blood clotting. Structure of neuron – Conduction of nerve impulse, Mechanism of vision and Hearing. Types of excretory products–Ornithine cycle.	9	CO1
II	Fertilization-Cleavage, Blastulation, Gastrulation and Organogenesis of Frog; Placentain mammals (Sheep and Pig).	9	CO2
III	Immunity - Innate and Acquired Immunity - Active and Passive Immunity; Antigens and Antibodies; Immunological organs–responses in humans; Vaccination schedule.	9	CO3
IV	Human Genetics - Human Chromosomes – Sex Determination; Patterns of Inheritance: Autosomal Dominant and Recessive, X-linked Inheritance, Y-linked Inheritance, Mitochondrial Inheritance, Multiple Allelic and Polygenic Inheritance ,Genetic Counseling.	9	CO4
V	Animal Behaviors - Habitat Selection (Shelter and Nest Construction), Food Selection, Anti-predator defense, Parental Care, Migration.	9	CO5
	Total	**45**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behavior	PO1
CO2	Analyse the different developmental stages	PO1, PO2
CO3	Analyse the working of body and immune systems	PO4, PO6
CO4	Analyse the different patterns of inheritance	PO4, PO5, PO6
CO5	Relate the behaviour of animals to physiology. Analyse the different types of behavior	PO3, PO8
Text Books (Latest Editions)		
1.	Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Owen, J. A., Punt, J. & Stranford, S. A. - Kuby Immunology. New York: W.H. Freeman & Company	
2.	Klug, W. S., Cummings, M. R. & Spencer, C - Concepts of Genetics. (12th ed.). New Jersey: Pearson Education	
3.	Mathur, R.- Animal Behaviour. Meerut: Rastogi.	
4.	VermaP.S.&Agarwal- Developmental Biology, Chordataembryology S.Chand & Co.	
Web Resources		
1.	Continuous Internal Assessment Test	
2.	Assignments	
3.	Seminars	
4.	Attendance and Class Participation	
5.	End Semester Examination	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	30 Marks
	Simple definitions, MCQ, Recall steps, Concept definitions	
	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
External Evaluation	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	70 Marks
	Longer essay/ Evaluation essay, Critique or justify with pros and cons	100 Marks

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S	M	M	L	M	L	M	M
CO 2	M	S	M	L	M	L	M	L
CO 3	S	M	M	S	M	S	M	L
CO 4	S	M	S	S	S	M	M	L
CO 5	M	M	S	L	S	L	M	S

L – Low; M – Medium; S – Strong

GENERIC ELECTIVE: ZOOLOGY PRACTICAL (25UBOZGECQ)

Course Code	Course Name	Category	L	T	P	S	Credits	Inst.Hours	Marks		
									CIA	External	Total
25UBOZGECQ1	**LAB COURSE - ZOOLOGY**	Core	Y	-	-	-	2	2	40	60	100

Learning Objectives	
CO1	1. Learn and be familiar with the Laboratory techniques. **2.** To understand the taxonomic position ,body organization and evolutionary relationship of animals. **3.** To inculcate the significance of various non chordates and chordates.

Expected Course Outcomes- On the success ful completion of the course,student will be able to:			
1	Familiar with practical skills in the use of tools ,technologies and methods common To microbiology and physiology.		
2	Apply knowledge and come to know how to handle different organisms.		
3	Analyze and to observe various specimens by using Microscope.		
UNIT	**Details**	**No.of Hours**	**Course Objectives**
MAJOR (20 Marks)	1. Cockroach/Fish–Digestive System. 2. Qualitative detection of excretory products(Ammonia, Urea, Uric acid).	12 12	CO1
MINOR (10 Marks)	1. Mouth parts of Honey Bee, Mosquito. 3. Fish–Earthworm Body Setae. 4.ABO blood group	12 12	CO2
SPOTTERS (20 Marks)	Invertebrata: Amoeba, Paramecium, Trypanosoma ,Euglena, Plasmodium, Leucosolenia, Sycon sponge, Aurelia, Obelia, Liver fluke, Tapeworm, Earthworm, Nereis, Leech,Cockroach, Prawn, Scorpion, Grasshopper, Fresh water mussel, Pila, Starfish. Protochordata and Vertebrata: Amphioxus, Shark, Fish, Frog, Salamander, Calotes, Chamaeleon, Turtle, Cobra, Viper, Pigeon, Rat, Bat, Rabbit. Larval forms: Zoealarva ,Mysislarva ,Bipinneria larva, Tadpole larva.	12	CO3
		60	

TextBook(s)

1	Arumugam N.(2013).*Developmental Zoology*,SarasPublication,Nagercoil, Tamilnadu,India.
2	DasS.(2020). *Microbiology Practical Manual,* CBSPublication,Delhi.

3	Jayasurya, ArumugamN,DulsyFatima.(2013).*PracticalZoologyVol3*,SarasPublication,Nagercoil, Tamilnadu, India.
4	SinghHRand Neerajkumar.(2014). *Animal Physiology and Biochemistry*, Vishal Publishing Co.Jalandhar,Delhi.

MappingwithProgrammeOutcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	L	M	S	L	M	S	L
CO2	L	S	L	M	M	L	L	L
CO3	S	S	L	L	L	L	L	L

S-Strong; M-Medium ;L-Low

Skill Enhancement Course II (NME II): MushroomCultivation

Programme Title : **B.A./ B. Sc./ B.Com.**

Course Title **Skill Enhancement Course II (NME II): MushroomCultivation**

Course Code : **25UBOSEC2** **Hours/Week : 2**

Semester : **II** **Credits: 2**

Course Objectives: The course aims

- To know about the food and energy value of mushrooms.
- To study the cultivation of different kinds of mushrooms.
- To know about the medicinal value of mushrooms.
- To make aware of diseases and storage of mushrooms.

SYLLABUS

Unit I

Mushroom – Morphology, types and advantages of mushroom cultivation. Medicinal, nutritional and nutritional value of mushroom. Edible and poisonous mushroom

Unit – II

Mushroom cultivation: Spawn and spawning - different types of spawn - virgin, flake, brick and grain spawn. Methods of spawning - double layer, top, through, shake-up, active mycelium, spot and super spawning, storage of spawn. Casing - sterilization, Time of casing.

Unit – III

Techniques in mushroom cultivation - mushroom farm location, layout. Cultivation of Paddy straw mushroom - Standard bed, Hollow bed, Cage method - Substrates,spawn making methods and field cultivation.

Unit – IV

Oyster and White button Mushroom cultivation - substrates, spawn makingmethods and field cultivation. Factors affecting Mushroom cultivation.

Unit – V

Storage of mushrooms-blanching, steeping, sun-drying, canning, pickling and freeze drying. Do's and Dont's of mushroom growing. Diseases of mushrooms - Bacterial, Fungal, Viral diseases and other diseases caused by insects, mites and nematodes. Recipes of mushroom (omlette, tikka, chilly, soup and pickle).

Books for Study:

1. Pandey, R.K. and S.K. Ghosh. 1999. A Hand Book on Mushroom Cultivation.Emkay Publications, Delhi

Books for Reference:

1. Bahl, N. 1988. Hand book on Mushrooms. Oxford and IBH publishing Co.Pvt. Ltd.,Delhi. (2nd Edition).
2. Suman, B.C. and V.P. Sharma. 2011. Mushroom Cultivation and Uses.Agrobios Publication, Jodhpur.
3. V.P. Sharma and B.C. Suman, 2011. Diseases and pests of Mushroom. Agrobiospublication, Jodhpur.

Course Outcomes (CO): On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	List out the significance of food and energy value of mushrooms.	K1
CO2	Illustrate cultivation methods of various kinds of mushrooms.	K2
CO3	Applythe medicinal values of mushrooms in terms of human welfare.	K3
CO4	Compile different kinds of diseases and mushroom preservation methods.	K6
CO5	Create different food recipes using mushrooms.	K6

Mapping of COs with POs

POs/ COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	M

L – Low; M – Medium; S – Strong

SKILL ENHANCEMENT COURSE – III: IKS

2 Hrs/ Week **Semester – II** **Credits – 2**

Total Hrs:30

SKILL ENHANCEMENT COURSE – III: IKS - TRADITIONAL SYSTEM OF PLANT THERAPY (25UBOSEC2)

(To come into effect from 2025-2026 onwards for the students admitted from 2025-2026)

Course Objectives : The course aims

- To understand about Indian system of medicine like Ayurveda and Siddha.
- To acquire knowledge about some herbal remedies for some common ailments.
- To know about herbal remedy for skin and hair problems.
- To gain knowledge about Aroma therapy and its uses.

Syllabus

Unit – I

Introduction, Basic principles of Ayurveda, Naturopathy and Siddha medicine- Panchabhutas - Tridhosha concept – Vatta, Pitta and Kappa dhosha.

Unit – II

Preparation of Ayurvedic and Siddha medicine. Herbal remedies for some common infection diseases: Asthma, Chickenpox, Cold, Diarrhoea, Dental care, fever Worms.

Unit – III

Herbal remedies for some common disorders - Menstrual disorder, Hypertension, Jaundice, Diabetics and Ulcer (symptoms, causes and home remedies).

Unit – IV

Symptoms, causes and herbal remedies for Acne, Black heads, Corns, Warts, Boils, Stings and Bites (symptoms, causes and home remedies).

Unit – V

Dandruff, Premature greying and loss of Hair (symptoms, causes and home remedies). Aroma Therapy - Essential oils and its uses and Nutraceuticals.

Books for Study:

1. Jaibala,S. and G. Balakrishnan. 1975. *A Hand Book of Common Remedies Based on Siddha Medicine*. Ed. St. Louis Institute Press, Madras.

Books for Reference:

1. Vaidya Bhagwar Dash, 1978. *Fundamentals of Ayurvedic Medicine,* Konark, Publishers Pvt. Ltd. Delhi.
2. Saha, N.N.1981. *Herbal Remedies.* Universal Publication - New Delhi.
3. Bakhru, H.K. 1992. *Herbs that Heals*. Vision Books Ltd., New Delhi.
4. Prajapati, N.D., S.S. Purohit & U. Kumar.2003. *A Hand Book of Medicinal Plant*. Agrobios Publication, India.
5. Frank, H. & M. Martin. 2006. *Herbal Medicine and Botanical Medicinal fads*. Viva Books Pvt., Ltd., New Delhi.
6. Despandey, D.J.2008. *A Handbook of Herbal Remedies*. Agrobios, Jodhpur, India.

Web Resources:

htpps://www.ayusante.com > articles

Course Outcomes (CO): On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Apply the practice of using herbs and their remedies to maintain health and cure diseases.	K3
CO2	Categorize Indian system of medicine such as Ayurveda, Siddha, Unani and Naturopathy.	K4
CO3	Improve skills in better usage of herbal medicines.	K6
CO4	Choose different herbal remedies for skin.	K5
CO5	Prioritize about Aromatherapy and its applications.	K5

Mapping of COs with POs

POs / Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S

CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

L – Low: M – Medium: S – Strong

CORE-IV: PLANT DIVERSITY III - BRYOPHYTES AND PTERIDOPHYTES

Title of the Course	**PLANT DIVERSITY III - BRYOPHYTES AND PTERIDOPHYTES**						
Paper Number	CORE IV						
Category	Core	**Year**	II	**Credits**	5	**Course Code**	
		Semester	III			25UBOCC3	

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	5	-	-	5

Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes.
Learning Objectives	
C1	To enable the students to have an overview of Non-vascular and Vascular cryptogams.
C2	To understand the morphological diversity of Bryophytes and Pteridophytes.
C3	To know the evolution of Bryophytes and Pteridophytes.
C4	To understand the economic importance of the Bryophytes and Pteridophytes.
C5	To understand anatomy and reproduction of Bryophytes and Pteridophytes.

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Recognize morphological variations of Bryophytes and Pteridophytes.	K1
2. Explain the anatomy and reproduction of Bryophytes and Pteridophytes.	K2
3. Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes.	K3
4. Decipher the stages of plant evolution and their transition to land habitat.	K4
5. Access the useful role of Bryophytes and Pteridophytes.	K5

UNIT	**CONTENTS**
I	**BRYOPHYTES** General characters of Bryophytes, classification (Watson, 1971) (up to family). criteria for classification. Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (*Marchantia, ~~Porella~~*)
II	Structure, reproduction and life histories of the following classes each with a suitable example: Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*). Evolution of Bryophytes. Progressive evolution theory and Regressive evolution theory. Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture and industrial uses.
III	**PTERIDOPHYTES** General Characters of Pteridophytes - Classification (Reimer, 1954). Criteria for classification. Apogamy and apospory. Morphology, anatomy and reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*), Lycopsida (*Selaginella*).

IV	Morphology, anatomy and reproduction of the taxa belonging to each of the following classes: Sphenopsida (*Equisetum*), Pteropsida (*Marsilea*). Homospory and heterospory. Heterospory and seed habit.
V	Origin and evolution of Pteridophytes: origin of vascular cryptogams: Anthocerotean theory, Protocorm theory, Phyton theory. Origin of sporophyte: Telome theory, Enation theory. Stelar Evolution. Economic importance of Pteridophytes- as food, as fibre, as horticulture plant, as weed, as biofertilizer, as medicine etc.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this	Knowledge, Problem Solving, Analytical ability, Professional
course	Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 2. Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101. 3. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press. 4. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India. 5. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
Reference Books	1. Eames, A.1963. Morphology of lower vascular plant, McGraw Hill, Chennai. 2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteriodophyta, Central book depot, Allahabad. 3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai. 4. Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai. 5. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & Co, UK. 6. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad. 7. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
Web 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.html6.aeTIUC&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2	1	2	2	1	2
CO 2	3	3	3	2	3	2	2	3	2	2
CO 3	2	2	3	3	1	2	2	1	2	2
CO 4	3	3	3	3	3	2	3	3	2	3
CO 5	3	3	2	2	2	1	3	3	1	3

S-Strong (3) **M-Medium (2)** **L-Low(1)**

CORE PRACTI CAL: PLANT DIVERSITY III - BRYOPHYTES AND PTERIDOPHYTES

Title of the Course	**PLANT DIVERSITY III - BRYOPHYTES AND PTERIDOPHYTES - PRACTICAL-II (Assessed in IV semester)**					
Paper Number	CORE VI					
Category	Core	**Year**	II	**Credits**	Assessed in IV semester	**Course Code**
		Semester	III			25UBOCCQ2

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	-	-	4	4

Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes.

Learning Objectives	
C1	To enable students gain expertise in hand sectioning technique.
C2	To study diversity of Bryophytes and Pteridophytes.
C3	To understand the anatomical structure of the Bryophytes and Pteridophytes.
C4	Develop comprehensive skills in sectioning and micro preparation.
C5	Describe the structure of fossil forms prescribed in the syllabus.

Course outcomes: On successful completion of this course the student will be able to: CO	**Programme Outcomes**
1. Recognize the major groups of Non-vascular and Vascular cryptogams	K1
2. Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.	K2
3. Identify and illustrate the morphological and anatomical features of Bryophytes and Pteridophytes.	K3
4. Develop comprehensive skills in sectioning and micropreparation.	K4
5. Interpret the significance of reproductive structures in Bryophytes and Pteridophytes.	K5

EXPERIMENTS

Bryophytes

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus.
2. Hepaticopsida (*Marchantia*, ~~*Porella*~~); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*) (need not study developmental aspects).

Pteridophytes

3. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes genera and fossils included in the theory syllabus.
   Psilotopsida (*Psilotum*), Lycopsida (*Selaginella*), Sphenopsida (*Equisetum*), Pteropsida (*Marsilea*). Identifying the micro slides relevant to the syllabus.
4. Botanical excursion.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi. 2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 3. 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. 4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India. 5. 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. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 3. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi. 4. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai. 5. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi.
Web 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/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	2
CO 2	3	3	2	2	3	3	2	3	3	2
CO 3	2	2	3	3	1	2	1	3	2	1
CO 4	3	3	3	3	3	2	3	2	2	3
CO 5	3	3	2	3	2	3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY - I</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective –III (GE)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">25UBOCGEC1</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>-</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Higher secondary chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">This course aims at providing knowledge on
• basics of atomic orbitals, chemical bonds, hybridization and fundamentals of organic chemistry
• concepts of nuclear chemistry and industrial chemistry
• importance of specialty drugs and artificial sweeteners
• separation and purification techniques.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I 9 Hours
Chemical Bonding and Nuclear Chemistry
Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. MO diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.
Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions- group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion – differences – Stellar energy. Applications of radioisotopes – carbon dating, rock dating and medicinal applications.
UNIT II 9 Hours
Industrial Chemistry
Fuels: Fuel gases: natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required).
Silicones: Synthesis, properties and uses of silicones.
Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate.
UNIT III 9 Hours
Fundamental Concepts in Organic Chemistry
Hybridization: Orbital overlap hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6.Polar effects: Inductive effect and consequences on ka and kb of organic acids and bases, electrometric, mesometric, hyper conjugation and steric-examples and explanation. Reaction mechanisms: Types of reactions- aromaticity-aromatic electrophilic substitution; nitration, halogenation,Friedel-Craft’s alkylation and acylation.
Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.</td></tr>
</table>

	UNIT IV **9 Hours** **Drugs and Speciality Chemicals** Definition, structure and uses : Antibiotics viz., Penicillin, Chloramphenicol and Streptomycin; Anaesthetics viz., Chloroform and ether; Antipyretics viz., aspirin, paracetamol and ibuprofen; Artificial Sweeteners viz., saccharin, aspartame and cyclamate; Organic halogen compounds viz., Freon, Teflon. **UNIT V** **9 Hours** **Analytical Chemistry** Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques: extraction, distillation and crystallization. Chromatography: principle and applications of column, paper and thin layer chromatography.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Veeraiyan, V, *Textbook of Ancillary Chemistry*; High mount publishing house, Chennai, 1st Ed., 2009. 2. Vaithyanathan, S, *Text book of Ancillary Chemistry;* Priya Publications, Karur, 2006. 3. Arun Bahl, Bahl, B. S, *Advanced Organic Chemistry;* S. Chand and Company, New Delhi, 23rd Ed., 2012. 4. Soni, P. L, Chawla, H. M, *Text Book of Inorganic Chemistry*; Sultan Chand & sons, New Delhi, 29th Ed., 2007.
Reference Books	1. Soni, P.L,& Mohan Katyal, *Text book of Inorganic chemistry*; Sultan Chand and Company, New Delhi, 29th Ed., 2007. 2. Sharma, B. K, *Industrial Chemistry*; GOEL publishinghouse, Meerut, 16th Ed., 2014. 3. Jayashree Gosh, *Fundamental Concepts of Applied Chemistry*, Sultan & Chand, 1st Ed., 2006.

Course Learning Outcomes

On completion of the course the students should be able to

CO1: describe the theories of chemical bonding, nuclear reactions and its applications.

CO2: evaluate the efficiencies and uses of various fuels and fertilizers.

CO3: explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.

CO4: demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.

<table>
<tr><td>Title of the Course</td><td colspan="8">CHEMISTRY PRACTICAL- I</td></tr>
<tr><td>Course No.</td><td colspan="8">Elective -III (GE)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>II</td><td rowspan="2">Credit</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">25UBOCGECQ1</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td></td><td>-</td><td colspan="2">-</td><td colspan="2">2</td><td colspan="3">2</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Higher Secondary Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">This course aims to provide knowledge on the
● basics of preparation of solutions.
● principles and practical experience of volumetric analysis.</td></tr>
<tr><td>Course Outline</td><td colspan="8">Volumetric analysis

1. Estimation of sodium hydroxide using standard sodium carbonate.
2. Estimation of hydrochloric acid using standard oxalic acid.
3. Estimation of ferrous sulphate using standard Mohr's salt.
4. Estimation of oxalic acid using standard ferrous sulphate.
5. Estimation of potassium permanganate using standard sodium hydroxide.
6. Estimation of magnesium using EDTA.
7. Estimation of ferrous ion using diphenyl amine as indicator.</td></tr>
<tr><td>Reference Book</td><td colspan="8">Venkateswaran, V, Veerasamy, R, Kulandaivelu, A.R, Basic Principles of Practical Chemistry; Sultan Chand & sons, 2nd Ed., 199.</td></tr>
<tr><td colspan="9">Course Outcomes

On completion of the course the students should be able to

On successful completion of the course the students should be able to

CO1: gain an understanding of the use of standard flask and volumetric pipettes, burette.

CO2: design, carry out, record and interpret the results of volumetric titration.

CO3: apply their skill in the analysis of water /hardness.

CO4: analyze the chemical constituents in allied chemical products.</td></tr>
</table>

SKILL ENHANCEMENT COURSE - IV

HERBAL TECHNOLOGY

Title of the Course		**HERBAL TECHNOLOGY**				
Paper Number		Skill Enhancement Course – IV				
Category	SEC	**Year**	II	**Credits**	2	**Course Code**
		Semester	III			25UBOSEC4
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**
		2		-	-	2
Pre-requisite		To understand the importance of herbal technology.				
Learning Objectives						
C1		To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.				
C2		To gain an insight into the commercially important secondary products and significance of bioprospecting.				
C3		To understand various plants based drugs used in ayurveda, unani, homeopathy, siddha etc.				
C4		To apply the knowledge to cultivate medical plants.				
C5		To know the pharmacological importance of medicinal plants.				

Course Outcomes: On completion of this course, the students will be able to : CO	**Programme Outcomes**
1. Define and describe the principle of cultivation of herbal products.	K1
2. List the major herbs, their botanical name and chemical constituents.	K2
3. Apply techniques for monitoring drug adulteration through the biological testing.	K3
4. Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
5. Develop the skills for cultivation of plants and their value added processing / storage.	K5 & K6

UNIT	**CONTENTS**
I	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.
II	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.
III	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.
IV	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).

V	Plant gene banks, Cultivation of Plants and their value added processing for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of some medicinal plants (*Withania somnifera*, neem and tulsi).
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Recommended Texts	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.
Web 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-medicinenatural- 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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	3	2
CO 2	3	3	3	3	3	3	3	1	3	1
CO 3	3	3	3	3	3	3	3	2	3	2
CO 4	3	3	3	3	3	3	3	1	3	1
CO 5	3	3	3	3	3	3	3	1	3	1

L – Low; M – Medium; S – Strong

SKILL ENHANCEMENT COURSE - V

***ENTREPRENEURIAL SKILL**

ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Title of the Course		**ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**					
Paper Number		Skill Enhancement – V					
Category	SEC	**Year**	II	**Credits**	1	**Course Code**	
		Semester	III			25UBOSEC5	
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**
		1	-		-		1
Pre-requisite		To understand the concept of Entrepreneurial Opportunities in Botany.					
C1		To enable students to understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.					
C2		To create a mindset among students to start their own companies for income generation.					
C3		The students may understand about various fields of botany.					
C4		To develop the concept of Entrepreneurial Opportunities in Botany.					
C5		Describe the new strategies to describe marketing and business management strategy.					

Course Outcomes: On completion of this course, the students will be able to : CO	**Programme Outcomes**
1. Relate to how various fields of botany could be understood with an entrepreneurial approach.	K1
2. Explain the concept of Entrepreneurial Opportunities in Botany.	K2
3. Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations	K3
4. Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.	K4
5. Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.	K5 & K6

UNIT	**CONTENTS**
I	**INTRODUCTION TO ENTREPRENEURSHIP** Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.
II	**TOOLS AND TECHNIQUES** Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, beverages, antibiotics.
III	**NEW VENTURE CREATION** Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.

IV	**PRODUCT DEVELOPMENT AND COMMERCIALIZATION** Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Areca Leaf Plates, cups & bags, Jute Products.
V	**BIO-BUSINESS PLANS, IPR AND BIOETHICS** Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution, Pearson Prentice Hall, New Delhi, India. 2. Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications. Chennai, India. 3. Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA. 4. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture. 5. Sathe,T.V. 2004. Vermiculture and Organic farming, Daya Publishers.
Reference books	1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK. 2. Peter F.Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed Cambridge University Press, Cambridge
Web sources	1. https://www.brainkart.com/article/Entrepreneurial-Botany_38321/ 2. https://www.youtube.com/watch?v=hnBla1FfcLo 3. https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation 4. http://www.brainkart.com/article/Economically-Useful-Plants-and Entrepreneurial - Botany_38301 5. https://www.ebooks.com/en-us/subjects/gardening/ 6. https://www.amazon.in/Preservation-Techniques-Publishing-Technology Nutrition-ebook/dp/B00RXCXB3Q

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	2	1	2	2	1	2
CO 2	3	3	2	2	3	1	2	3	1	2
CO 3	2	2	3	1	2	2	1	3	2	1
CO 4	3	3	1	2	3	2	3	3	2	3
CO 5	3	3	2	3	1	3	3	3	3	3

L – Low; M – Medium; S – Strong

CORE-V: PLANT DIVERSITY IV - GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Title of the Course	**PLANT DIVERSITY IV - GYMNOSPERMS, PALEOBOTANY AND EVOLUTION**					
Paper Number	CORE V					
Category	Core	**Year**	II	**Credits**	5	**Course Code**
		Semester	IV			25UBOCC4

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	6	-	-	6

Pre-requisite	Students should know about the fundaments of Gymnosperms, fossil records and evolution.
Learning Objectives	
C1	To enable the students to understand thallus organization,
C2	To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.
C3	To acquaint students with evidences of the past history of plant groups and significance of the fossilization.
C4	To know the scope of paleobotany, types of fossils and geological time scale.
C5	Understand the various fossil genera representing different fossil groups.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the general characteristics of Gymnosperms and fossil forms	K1
2. Explain about the morphology and anatomy Gymnosperms.	K2
3. Compare and contrast the reproductive structures of Gymnosperms & fossil forms.	K3
4. Analyze the anatomy and reproduction Gymnosperms along with their ecological and economical importance.	K4
5. Determine the various fossilization methods and their significance in paleobotany.	K5

UNIT	**CONTENTS**
I	**GYMNOSPERMS** General characteristics of Gymnosperms. Classification of Gymnosperms (Sporne, 1954) (up to family). Criteria for classification. Economic importance of Gymnosperms with special reference to oil, resin, timber, etc. Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*),

II	**GYMNOSPERMS** Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Coniferales (*Pinus*). Gnetales (*Gnetum*).
III	**PALEOBOTANY** Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni
IV	P**ALEOBOTANY** Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.
V	**EVOLUTION** Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Gupta, M.N. 1972. The Gymnosperms (2nd Edition) Shiva Lal Agarwala & Co., Agra. 2. Vashista, P.C. 1976. Gymnosperms, S.Chand & Co. New Delhi. 3. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India. 4. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi. 5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.
Reference Books	1. Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications, New Delhi. 2. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi. 3. Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press. 4. Raup,D.M and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971. 5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.

Web Resources	1. https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false 2. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y 3. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC 4. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond -pine-cones-an-introduction-to-gymnosperms.pdf 5. https://www.palaeontologyonline.com/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	1	1	2	2	2	2
CO 2	3	3	2	2	3	3	2	3	2	3
CO 3	3	3	2	2	1	2	1	3	1	3
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	2	1	3	1	3

S-Strong (3) **M-Medium (2)** **L-Low(1)**

CORE PRACTICAL II : PLANT DIVERSITY IV- GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Title of the Course		**PLANT DIVERSITY IV - GYMNOSPERMS, PALEOBOTANY AND EVOLUTION**					
Paper Number		CORE VI - Core Practical - II (Including Core IV+V)					
Category	Core	**Year**	II	**Credits**	3	**Course Code**	
		Semester	IV			25UBOCCQ2	
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**
		-		-		2	2
Pre-requisite		Students should be familiar with the fundamentals of Gymnosperms, Paleo botany.					

Learning Objectives	
C1	To enable students observe and record the morphological features of selected species of Gymnosperms.
C2	To enable students observe and record the anatomical features of selected species of Gymnosperms.
C3	To develop the skill of preparation of microslides of the gymnosperm samples.
C4	To enable students to gain insights into the basics of paleobotany and methods of fossilization.
C5	To understand the anatomy of the fossil plants through microscopy.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Analyze and observe and record the morphological features of selected species of Gymnosperms.	K1
2. Describe the structure of fossil forms prescribed in the syllabus.	K2
3. Identify and Illustrate the morphological and anatomical features of Gymnosperms.	K3
4. Develop comprehensive skills in sectioning and micro preparation.	K4
5. Interpret the significance of reproductive structures in Gymnosperms.	K5

EXPERIMENTS

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).
4. Study the following fossil members: *Rhynia*, *Lepidodendron*, *Lepidocarpon*, *Calamites* and *Williamsonia sewardiana* through permanent slides.
5. Photograph of evolution scientists: Darwin, Lamark and De veries.
6. Photograph related to evolution theory: Darwinism, Lamarkism and De veries, modern synthetic theory.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan. 2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand. 3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 3. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
Reference Books	1. Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi. 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. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 5. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.
Web 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 5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2	1	2	2	2	3
CO 2	3	3	2	2	3	3	2	3	2	2
CO 3	2	2	3	3	1	2	1	3	3	3
CO 4	3	3	3	3	3	2	2	3	3	3
CO 5	3	3	2	2	3	3	2	3	2	2

S-Strong (3) **M-Medium (2)** **L-Low(1)**

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY-II</td></tr>
<tr><td>Course No.</td><td colspan="7">Elective- IV (GE)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">25UBOCGEC2</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>-</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Chemistry I for Biological Sciences</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">This course aims to provide knowledge on
● Nomenclature of coordination compounds and carbohydrates.
● Amino Acids and Essential elements of biosystem
● Understand the concepts of kinetics and catalysis
● Basics and types of polymers
● Provide fundamentals of photochemistry</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT I 9 Hours
Co-ordination Chemistry and Water Technology
Co-ordination Chemistry: Definition of terms - IUPAC Nomenclature - Werner’s theory - EAN rule - Pauling’s theory – Postulates - Applications to $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$,$[Co(CN)_6]^{3-}$ Chelation - Biological role of Hemoglobin and Chlorophyll (elementary idea) - Applications in qualitative and quantitative analysis.
Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques –BOD and COD.</td></tr>
<tr><td colspan="7">UNIT II 9 Hours
Carbohydrates
Classification, preparation and properties of glucose and fructose.Discussion of open chain ring structures of glucose and fructose.
Glucose-fructose interconversion. Preparation and propertiesof sucrose, starch and cellulose.</td></tr>
<tr><td colspan="7">UNIT III 9 Hours
Amino Acids and Essential elements of biosystem
Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method - Proteins- classification –structure - Colour reactions – Biological functions – nucleosides - nucleotides – RNA and DNA – structure. Essentials of trace metalsin biological system-Na, Cu, K, Zn, Fe, Mg.</td></tr>
<tr><td colspan="7">UNIT IV 9 Hours
Polymer chemistry
Polymers - monomers, classification of polymers, types of polymerizations- addition and condensation polymerization. Natural polymers: polysaccharides - (eg., starch and cellulose). Polyhydrocarbon (eg., natural rubber) and polyamide (eg., protein). Synthetic polymers: preparation and applications of polyethylene, polypropylene, polyester, polyvinylchloride, polyvinylcarbonate, polyamide, polytetra fluoroethylene, synthetic rubber, vulcanization of rubber.</td></tr>
</table>

	UNIT V **9 Hours** **Photochemistry** Grothus - Drapper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Veeraiyan V, *Textbook of Ancillary Chemistry*; High mountpublishing house, Chennai, 1st Ed., 2009. 2. Vaithyanathan S, *Text book of Ancillary Chemistry*; PriyaPublications, Karur, 2006. 3. Arun Bahl, Bahl B.S, *Advanced Organic Chemistry*; S.Chandand Company, New Delhi, 23rd Ed., 2012. 4. Soni P.L, Chawla H M, *Text Book of Organic Chemistry*; SultanChand & sons, New Delhi, 29th Ed., 2007. 5. Gowariker V R, Viswanathan N V, Jayadev Sreedhar, *PolymerScience*, Wiley Eastern Ltd, 1986.
Reference Books	1. Arun Bahl, Bahl B.S, *Advanced Organic Chemistry*; S.Chandand Company, New Delhi, 23rd Ed., 2012. 2. Soni P L, Chawla H M, *Text Book of Organic Chemistry*;Sultan Chand & sons, New Delhi, 29th Ed., 2007. 3. Soni P L, Mohan Katyal, *Text book of Inorganic chemistry*;Sultan Chand and Company, New Delhi, 20th Ed., 2007. 4. Puri B R, Sharma L R, Pathania M S, *Text book PhysicalChemistry*; Vishal Publishing Co., New Delhi, 47th Ed., 2018. 5. Sharma B K, *Industrial Chemistry*; GOEL publishing house,Meerut, sixteenth edition, 2014.

Course Outcomes

On completion of the course the students should be able to

CO 1: write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology.

CO 2: explain the preparation and property of carbohydrate.

CO 3: enlighten the biological role of transition metals, amino acids and nucleic acids.

CO 4 :acquire knowledge about the polymer and its types.

CO 5: outline the various type of photochemical process.

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY PRACTICAL-II</td></tr>
<tr><td>Course No.</td><td colspan="7">Elective-IV (GE)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">25UBOCGECQ2</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">2</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7"></td></tr>
<tr><td>Objectives of thecourse</td><td colspan="7">This course aims to provide knowledge on
● identification of organic functional groups
● different types of organic compounds with respect to their properties.
● determination of elements in organic compounds.</td></tr>
<tr><td></td><td colspan="7">SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS
The analysis must be carried out as follows:
(a) Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose].
(b) Detection of elements (N, S, Halogens).
(c) To distinguish between aliphatic andaromatic compounds.
(d) To distinguish – Saturated and unsaturatedcompounds.</td></tr>
<tr><td>Reference Books</td><td colspan="7">Venkateswaran V, Veerasamy R, Kulandaivelu A R, Basic Principles of Practical Chemistry; Sultan Chand & sons, 2nd Ed., 1997.</td></tr>
<tr><td colspan="8">Course Outcomes
On completion of the course the students should be able to
CO1: observe the physical state, odour, colour and solubility of the given organic compound.
CO2: identify the presence of special elements and functional group in an unknown organic compound performing a systematic analysis.
CO3: analyze the given organic compound and explain the reactions behind it.</td></tr>
</table>

SKILL ENHANCEMENT COURSE SEC – VI

FERMENTATION TECHNOLOGY

Title of the Course		FERMENTATION TECHNOLOGY				
Paper Number		Skill Enhancement Course – VI				
Category	SEC	**Year**	II	**Credits**	2	**Course Code**
		Semester	IV			25UBOSEC6
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**
		2		-	-	2
Pre-requisite		To students to know about the various fermentation technology.				
Learning Objectives						
C1		To appreciate the significance of microbes synthesizing fermented products.				
C2		To gain insights on safety and quality control in large scale production of fermentative products.				
C3		To design and operation of industrial practices in mass production of fermented products.				
C4		To know about the various fermentation technology.				
C5		To learn about the bioproduct recovery.				

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Enumerate the significance of industrially useful microbes.	K1
2. Explain the process of maintenance and preservation of microorganisms.	K3
3. Analyze the various aspects of the fermentation technology and apply for fermentative production.	K4
4. Explain the design and operation of industrial practices in mass production of fermented products.	K2
5. Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover.	K5 & K6

UNIT	**CONTENTS**
I	Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms (any two – Penicillium and Saccharomyces cerevisiae).
II	Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.
III	Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.
IV	Fermentative production of vinegar, alcohol (ethanol), acids (citric acid), amino acids (glutamic acid) and antibiotics (penicillin).
V	Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.

Extended Professional Compone nt (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Waites M.J. 2008. Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK. 2. Prescott S.C., Dunn C.G., Reed G. 1982. Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA. 3. Reed G. 2004. Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA. 4. JR Casida L.E. 2015. Industrial Microbiology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, India. 5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK. 6. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
Reference Books	1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK. 2. Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press. 3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA. 4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany. 5. John E. Smith. Biotechnology. 2009. Cambridge University Press.UK. 6. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY. 7. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. Springer publications, Germany.

Web resources	1. https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html 2. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ 3. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W 4. https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html 5. https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	1	2
CO2	2	2	3	1	1	1	2	3	1	2
CO3	3	3	2	1	3	2	1	3	2	1
CO4	3	3	2	2	1	2	3	2	2	3
CO5	3	3	2	1	2	2	3	3	2	3

S-Strong (3) M-Medium (2) L-Low(1)

ENVIRONMENTAL IMPACT ANALYSIS

Title of the Course		**ENVIRONMENTAL IMPACT ANALYSIS**				
Paper Number		Skill Enhancement Course - VII				
Category	SEC	**Year**	II	**Credits**	1	**Course Code**
		Semester	IV			25UBOSEC7
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**
		1		-	-	1
Pre-requisite		To students to know about the environmental impact assessment.				

Learning Objectives	
C1	To understand about the theory and practice of environmental impact assessment.
C2	To develop skills in identifying and solving problems of environmental concerns.
C3	Define and classify Environmental Impacts and the terminology.
C4	Understands the environmental Impact assessment procedure.
C5	List and describe environmental audit and different environmental resources.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Enumerate the fundamental concepts and significance of environmental impact assessment.	K1
2. Explain the important steps of EIA process.	K2
3. Develop their own perspectives on impact assessment and be able to solve problems related to environment.	K5 & K6
4. Decipher how to prepare the various documents required by state and federal regulations.	K4
5. Interpret the environmental appraisal and procedures in India.	K3

UNIT	**CONTENTS**
I	Origin and Development Purpose and aim, core values and principles, History of EIA development, Environmental Management Plan, Environmental Impact Statement, Scope of EIA in Project planning and Implementation.
II	EIA Process Components of EIA, EIA Methodology- Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation.
III	Techniques of Assessment-Cost-benefit Analysis, Impact on Environmental component: air, noise, water, land, biological, social and environmental factors.
IV	Main participants in EIA Process Role of Project proponent, environmental consultant, PCBs, PCCs, public and IAA. Public participation.
V	Environmental Appraisal and Procedures in India and EIA Methodology, indicators and mitigation, Environmental Audit of different environmental resources, Risk Analysis.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1 Morris, P. and Therivel, R. 1995. Methods of Environmental Impact Assessment, UCL Press, London. 2. Petts, J. 1999. Handbook of Environmental Impact Assessment, volume 1 and 2, Blackwell Science, Oxford. 3. Therivel, R. and Partidario, M.R. 1996. The Practice of Strategic Environmental Assessment, Earthscan, London. 4. Vanclay, F. and Bronstein, D.A. 1995. Environmental and Social Impact Assessment, Wiley & Sons, Chichester. 5. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996
Reference Books	1. Kulkarni, V. and Ramachandra, T.V. 2006. Environmental Management, Capital Pub. Co. New Delhi. 2. Petts, J. 2005. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell Publishers, UK. 3. Glasson, J. Therivel, R. and Chadwick. 2006. A. Introduction to Environmental Impact Assessment. Routledge, London. 4. Canter, W.L. 1995. Environmental Impact Assessment, McGraw-Hill Science/ Engineering/ Math, New York. 5. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
Web resources	1. https://www.amazon.in/Environmental-Impact-Assessment-Gajbhiye-Khandeshwar-ebook/dp/B06XTNQ5PW 2. https://www.ikbooks.com/books/book/earth-environmental-sciences/environmental-impact-assessment/9789382332930/ 3. https://www.elsevier.com/books/environmental-impact-assessment/mareddy/978-0-12-811139-0 4. https://link.springer.com/book/10.1007/978-3-030-80942-3 5. https://onlinelibrary.wiley.com/doi/book/10.1002/0471722022

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	2	2	3	1	3	3	3	3	3
CO4	3	3	3	3	2	2	3	3	3	3
CO5	2	2	1	3	1	1	2	3	2	3

S-Strong (3) **M-Medium (2)** **L-Low(1)**

CORE – VII: PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**					
Paper Number	CORE VII					
Category	Core	**Year**	III	**Credits**	5	**Course Code**
		Semester	V			**25UBOCC5**

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	5		-	5

Pre-requisite	Prior knowledge on morphological, anatomical characteristics and uses of plants.

Learning Objectives	
C1	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.
C2	Students will know about the basic concepts of classification of plants.
C3	Understand major evolutionary trends in Angiospermic plants.
C4	To know the characteristic features of the selected families.
C5	To know the economic importance of plants.

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.	K1
2. Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium.	K2
3. Describe the core concepts of economic Botany and relate its applications in human life.	K3
4. Analyze the characters of the families according to the Bentham and Hooker's system of classification.	K4
5. Assess terms and concepts related to Phylogenetic Systematics.	K5

UNIT	**CONTENTS**
I	Morphology – root system – modifications. 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.
II	History of Angiosperm classification – Artificial (Linneaus), Natural (Bentham and Hooker) and Phylogenetic (Thakthjan) system of classification (Including merits and demerits). An outline of Bentham and Hooker system of classification, an overview of APG Classification. Herbarium technique–collection, pressing, drying, mounting and preservation of plant specimens, digital herbarium. Botanical Survey of India. Botanical nomenclature–rules, typification and author citation.
III	Study of the following families based on the Natural system and their economic importance: Annonaceae, Nymphaeaceae, Capparidaceae, Rutaceae, Leguminosae (Fabaceae / Fabaoideae, Caesalpinaceae/ Caesalpinioideae, Mimosaceae / Mimosoideae), Cucurbitaceae, Asteraceae, Apocynaceae and Asclepiadaceae.
IV	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Verbenaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

V	Source, cultivation method (brief) and the processing of the economically important products of the following – Cereal (Rice), Pulses (Black gram), Sugar (Sugarcane), Beverage (Coffee), Oil seed (Groundnut), spices (Cardamom), essential oil (Rose), natural rubber (Hevea brasiliensis) and timber plants (Teak) and Fibre (Cotton).
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad. 2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi 3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London. 4. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Weslley Publicating Co. Ind USA. 5. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York. 6. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey. 7. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
Reference Books	1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London. 2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta 3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh. 4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York. 5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London. 6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA. 7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-HilI Book Co., New York.
Web Resources	1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=_px_WAhttps://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&redir_esc=y_esc=y 2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y 3. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9hC&redir_esc=ygC&redir_esc=y 4. https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y 5. https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&redir_esc=y=XmZFJO_JHv8C&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	2
CO 2	3	3	2	2	3	3	2	3	3	2
CO 3	2	2	3	3	1	2	1	3	2	1
CO 4	3	3	3	3	3	2	3	2	2	3
CO 5	3	3	2	3	2	3	3	3	3	3

S-Strong (3) **M-Medium (2)** **L-Low(1)**

CORE - VIII: PLANT ANATOMY AND EMBRYOLOGY

Title of the Course	**PLANT ANATOMY AND EMBRYOLOGY**					
Paper Number	CORE VIII					
Category	Core	**Year**	III	**Credits**	4	**Course Code**
		Semester	V			**25UBOCC6**

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	-	-	4

Pre-requisite	To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.

Learning Objectives	
C1	To know fundamental concepts of plant anatomy and embryology.
C2	To understand the internal tissue organization of various plant organs.
C3	To differentiate normal and abnormal secondary growth.
C4	To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.
C5	To know embryology of plants.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the fundamental concepts of plant anatomy and embryology.	K1
2. Describe the internal tissue organization of various plant organs.	K2
3. Elucidate the stages of normal and abnormal secondary growth.	K3
4. Compare the structural organization of flower in relation to the process of pollination and fertilization.	K4
5. Access the various anatomical adaptations in plants.	K5

UNIT	**CONTENTS**
I	Cell wall - structure, and function. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory.
II	Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in root and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types.
III	Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- *Boerhaavia*, *Nyctanthes* and *Dracaena*. Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.

IV	Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule**,** types of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type); Organization and ultrastructure of mature embryo sac.
V	Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
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. 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

Web Resources	1. https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2 2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG 5. https://www.worldcat.org/title/embryology-of- angiosperms/oclc/ 74234 2811 6. https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&redir_esc=y.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	1	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) **M-Medium (2)** **L-Low(1)**

CORE – IX: CELL BIOLOGY, GENETICS AND PLANT BREEDING

Title of the Course	**CELL BIOLOGY, GENETICS AND PLANT BREEDING**					
Paper Number	CORE IX					
Category	Core	**Year**	III	**Credits**	4	**Course Code**
		Semester	V			**25UBOCC7**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		5	-		-	5
Pre-requisite	To acquire knowledge on cell and expose the students a fundamental of the various techniques used in plant breeding.					

Learning Objectives	
C1	To enable students to gain insights into cell wall organization and its functions.
C2	To familiarize with various cell organelles and their functions.
C3	To gain knowledge in classical genetics.
C4	To know about sex linked inheritance.
C5	To have knowledge about plant breeding techniques for crop improvement.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Enumerate the structure and functions of cells, cellular structures and organelles.	K1
2. Explain about cell cycle, cell division and laws of inheritance with suitable examples.	K2
3. Elucidate concepts of sex determination and sex linked inheritance	K3
4. Analyze the importance of genes interactions at population and evolutionary levels.	K4
5. Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool.	K5

UNIT	**CONTENTS**
I	Introduction- scope- cell organisation- Ultra structure of Prokaryotic cell and Eukaryotic cell. Plant cell structure and function. Cell boundaries- cell wall- gross layer i.e. middle lamella, primary wall, secondary wall- Structure, chemistry and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane- occurrence, structure (fluid mosaic model) chemistry, function and origin. Properties of Cytoplasm Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.
II	Occurrence, structure, function and origin of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria, Chloroplast and Micro bodies. Semi genetic autonomy of Mitochondria and Chloroplast. Ultrastructure and functions of Nucleus, nuclear envelope, nuclear pore complex, nucleolus, chromosomes structure molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lampbrush chromosomes-, Centromere: types. cell inclusion. Cell cycle, Cell division, Mitosis and Meiosis- their significance.

III	Mendelian genetics – monohybrid, dihybrid crosses. Laws of Mendel, Reciprocal cross - Back cross and Test cross. Incomplete dominance - *Mirabilis jalaba.* Interaction of factors – Complementary genes, Supplementary genes, inhibitory genes, epistasis (dominant and recessive), duplicate genes and multiple alleles. Multiple alleles. ABO Blood grouping in Human. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes. Sex determination in plants.
IV	Sex linked inheritance – Haemophilia and colour blindness. Polyploidy origin, types 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.
V	Principles involved in plant breeding. Plant introduction and acclimatization. Methods of crop improvement: selection (mass, pure line and clonal), hybridization techniques. Heterosis – Interspecific and intergeneric, causes and effects. Brief account of Mutation in plant breeding, polyploidy in plant breeding and its applications. Breeding for crop improvement for paddy and sugarcane. A brief outline of biotechnological approaches in crop improvement eg. Transgenics – Bt- Cotton (only scope and its limitations).

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55. 2. Sinnott, EW., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi. 3. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co. 4. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA. 5. Singh, R.J. 2017. Practical Mannual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.
Reference Books	1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA. 2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York. 3. 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. 4. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA. 5. 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.

	6. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A. 7. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223. 8. Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.
Web Resources	1. http://www.freebookcentre.net/Biology/Cell-Biology- Books.html 2. https://www.us.elsevierhealth.com/medicine/cell-biology 3. https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A 4. http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html. 5. https://www.us.elsevierhealth.com/ medicine/genetics 6. https://libguides.uthsc.edu/genetics/ebookshttps://libguides.uthsc.edu/genetics/ebooks 7. https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and- breeding 8. http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	1
CO 2	3	3	2	2	3	3	2	3	3	2
CO 3	3	3	2	3	1	2	1	3	3	2
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	2

S-Strong (3) M-Medium (2) L-Low(1)

CORE PRACTICAL III: Covering Core – VII, VIII & IX

Title of the Course	**CORE PRACTICAL – III (ASSESSED IN VI SEMESTER)**					
Paper Number	CORE – X – Core Practical III (Covering Core – VII,VIII & IX)					
Category	Core	**Year**	III	**Credits** -	Assessed in VI Semester	**Course Code**
		Semester	V			25UBOCCQ3

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	-	-	3	3

Pre-requisite	Theoretical understanding of plant taxonomy as well as basic laboratory skills for the relevant core course.
Learning Objectives	
C1	To study morphological characters of the families.
C2	Able to describe the plant technically using the floral characteristics.
C3	To preserve the plants and prepare herbarium sheets.
C4	To be able to identify the local flora.
C5	To understand the economic importance of the plants.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the distinguishing plant morphological characters.	K1
2. Identify locally available plants to their respective families.	K2
3. Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation.	K3
4. Construct floral diagram and write floral formula for a given flower.	K4
5. Validate the plant specimen by analyzing and dissecting the vegetative and floral characters.	K5

EXPERIMENTS

1. Morphology of root, stem and leaf modification, types of inflorescence and fruits.
2. Plants of local flora included under theory syllabus and family identification and derivation based on reasoning (Bentham and Hooker Classification).
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 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 to places for observation, study and collection of plants prescribed in the syllabus for 2 to 5 days under the guidance of faculties.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Recommended	1. https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-

Web resources	Sinha/dp/9380578210 2. https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html 3. https://www.flipkart.com/practical-taxonomy-angiosperms/ p/itm194794e7a76e8 4. https://book s.google.co.in/books/about/Plant_Taxonomy.html?id =uWg76rCqA 68C 5. https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592 6. https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma- eBook.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	3
CO 2	3	3	2	2	3	3	2	3	2	2
CO 3	2	2	3	3	1	2	1	2	3	3
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) M-Medium (2) L-Low(1)

Title of the Course	**CORE PRACTICAL – III (ASSESSED IN VI SEMESTER)**					
Paper Number	CORE – X – Core Practical III (Covering Core – VII,VIII & IX)					
Category	Core	**Year**	III	**Credits** -	To be assessed in VI semester	**Course Code**
		Semester	V			
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		-	-		3	3
Pre-requisite		Theoretical understanding of anatomy, embryology, cell biology, genetics and plant breeding as well as basic laboratory skills for the relevant core course.				

Learning Objectives	
C1	To study the anatomy of the plant organs using various techniques.
C2	To study the embryology of the plant.
C3	To identify the structure of various cell organelles.
C4	To understand genetics through problem solving.
C5	To study various plant breeding techniques.

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Identify the structure of cell organelles and stages of cell division.	K1
2. Classify the types of stomata and ovules.	K2
3. Compare the functions of various ergastic substances present in plant tissues.	K3
4. Perform free hand sectioning of plant materials and decipher the internal tissue organization.	K4
5. Interpret the given genetic data to develop genetic map based on the principles of Mendelian inheritance and gene interaction.	K5

EXPERIMENTS

Anatomy

1. Study of simple and complex (Primary and Secondary) tissues by maceration.
2. Study the internal structure of primary (young) and secondary (old) stems dicot and monocot stem and root.
3. Anomalous secondary growth in the stems of *Boerhaavia*, ***Bignonia,*** *Nycthanthes* and *Dracaena*.
4. T.S of dicot and monocot leaves.
5. Study of stomatal types by leaf peeling.

Embryology

1. T.S of (young and mature) anther (section from *Datura* or *Cassia* flower).
2. Observation of pollinia –Calotropis.
3. Types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent slides).
4. Types of Endosperm - Nuclear, cellular and helobial (Permanent slides).
5. Dissection and display of any two stages of embryo in *Tridax*

Cell biology

1. Study of the photomicrographs of cell organelles.
2. Ergastic substances - starch grains, aleurone grains, crystals – cystolith and raphide (Permanent slides).
3. Study the polytene and lamp brush chromosome structure through photograph. Identification of different stages of mitosis by using squash and smear techniques – Onion root tip.

Genetics

1. Genetic problems – test cross, back cross and allelic interaction.
2. Construction of chromosome map – three point test cross
3. Multiple alleles problems.

Plant Breeding

1. Emasculation technique.
2. To test the viability of seeds using Tetrazolium chloride.
3. Genetic models of heterosis.
4. Phenotype of heterosis (Maize).

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts

1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
2. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.
3. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.
4. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
5. Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.
6. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.

Reference Books

1. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
2. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.
3. Allen, Sarah et al., 2016. Plant Anatomy Lab Manual, Fall.
4. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
5. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
6. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.

Web resources

1. https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973- Foster/dp/1341784509
2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id%20%20%20%20%20%20=Cq1KPwAACAAJ&redir_esc=y
3. https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219
4. https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X
5. https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9327272498

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	3
CO 2	3	3	2	2	3	3	2	3	2	2
CO 3	2	2	3	3	1	2	1	3	3	3
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) M-Medium (2) L-Low(1)

DISCIPLINE SPECIFIC ELECTIVE - I
1. BIO ANALYTICAL TECHNIQUES

<table>
<tr><td>Title of the Course</td><td colspan="6">BIO ANALYTICAL TECHNIQUES</td></tr>
<tr><td>Paper Number</td><td colspan="6">Discipline Specific Elective-I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Discipline Specific Elective</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td>Course Code</td></tr>
<tr><td>Semester</td><td>V</td><td>25UBODSEC1A</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">-</td><td>-</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="5">To impart expertise about analysis and research.</td></tr>
<tr><td colspan="7">Learning Objectives</td></tr>
<tr><td>C1</td><td colspan="6">To understand the principle, operation and maintenance of various tools/equipment in the laboratory.</td></tr>
<tr><td>C2</td><td colspan="6">Perform experiments using the laboratory instruments, formulate experiments for project work and evaluate critically the acquisition of data.</td></tr>
<tr><td>C3</td><td colspan="6">To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.</td></tr>
<tr><td>C4</td><td colspan="6">To give an exposure to various forms of field research and data analysis techniques.</td></tr>
<tr><td>C5</td><td colspan="6">To provide an overview on modern equipments that they would help students gain confidences to instantly commence research careers and / or start entrepreneurial ventures.</td></tr>
<tr><td colspan="6">Course outcomes:
On completion of this course, the students will be able to: CO</td><td>Programme Outcomes</td></tr>
<tr><td colspan="6">1. Relate to the various biological techniques and its importance.</td><td>K1</td></tr>
<tr><td colspan="6">2. Explain the principles of Light microscopy, compound microscopy, Fluorescence microscope and electron microscopy</td><td>K2</td></tr>
<tr><td colspan="6">3. Apply suitable strategies in data collections and disseminating research findings.</td><td>K3</td></tr>
<tr><td colspan="6">4. Compare and contrast the significance of different types of chromatography techniques.</td><td>K4</td></tr>
<tr><td colspan="6">5. Develop methodologies for extraction and analysis of biochemical compounds.</td><td>K5 & K6</td></tr>
<tr><td>UNIT</td><td colspan="6">CONTENTS</td></tr>
<tr><td>I</td><td colspan="6">MICROSCOPY:
Principles of microscopy; Light microscopy; compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Fluorescence microscopy; Transmission and Scanning electron microscopy. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida.</td></tr>
<tr><td>II</td><td colspan="6">CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:
Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).</td></tr>
</table>

III	**ELECTROPHORESIS AND PH METER:** Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
IV	**SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUE:** Principle and law of absorption, construction, operation and uses of colorimeter and UV–Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuge and applications.
V	**BIOSTATISTICS:** Data collection methods, population, samples, parameters; Representation of Data: Tabular, Graphical– Histogram – frequency curve – Bar diagram–measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and goodness of fit –t–test.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts

1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata McGraw Hill, New Delhi.
2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochemistry, Narosa Publishing House.
3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publications.
4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Chand & Company, New Delhi.
5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications.
6. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques, 20th century publications, Palkalai nagar, Madurai.

Reference Books

1. Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publications
2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication. U.S.A.
3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics and research methods, PHI learning Private Ltd., New Delhi.
4. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book Co., Ins., New Delhi.
5. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw hill publication, New York.
6. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley & sons, Londo
7. Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia Pvt. L
8. Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Edn. T McGraw Hill Publishing Company Ltd. New Delhi.
9. Zar, J.H. 1984. Biostatistics Analysis, Prentice Hall International, England C New Jersy.

Web Resources

1. https://www.kobo.com/in/en/ebook/bioinstrumentation-1
2. https://www.worldcat.org/title/bioinstrumentation/oclc/74848857
3. https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pandeyebook/dp/B01JP3M9TW
4. https://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	2	1	2	2	3	2
CO2	3	3	2	2	1	3	2	3	3	3
CO3	2	2	3	2	1	2	1	3	2	2
CO4	3	2	1	1	3	2	1	3	3	2
CO5	3	2	1	3	2	2	3	3	3	2

S - Strong (3) **M - Medium (2)** **L - Low(1)**

DISCIPLINE SPECIFIC ELECTIVE - I

2. AQUATIC BOTANY

<table>
<tr><td>Title of the Course</td><td colspan="6">AQUATIC BOTANY</td></tr>
<tr><td>Paper Number</td><td colspan="6">Discipline Specific Elective-I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Discipline Specific Elective</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td>Course Code</td></tr>
<tr><td>Semester</td><td>V</td><td>25UBODSEC1B</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">-</td><td>-</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="5">To understand ecological functions and economic uses of aquatic plants.</td></tr>
<tr><td colspan="7">Learning Objectives</td></tr>
<tr><td>C1</td><td colspan="6">To give an overview of the distribution of lower plants forms and its ecological significance.</td></tr>
<tr><td>C2</td><td colspan="6">To enable students to understand the ecological functions and economic uses of aquatic plants.</td></tr>
<tr><td>C3</td><td colspan="6">To equip students to collect, analyze and identify the planktons.</td></tr>
<tr><td>C4</td><td colspan="6">To give an exposure to various forms seaweeds.</td></tr>
<tr><td>C5</td><td colspan="6">To know about the values and uses of aquatic plants..</td></tr>
<tr><td colspan="5">Course outcomes:
On completion of this course, the students will be able to: CO</td><td>Programme Outcomes</td></tr>
<tr><td colspan="5">1. Recognize aquatic plants and their ecological importance.</td><td>K1</td></tr>
<tr><td colspan="5">2. Explain about commonly occurring marine and limnetic algae of the Indian coasts.</td><td>K2</td></tr>
<tr><td colspan="5">3. Apply techniques for conservation of aquatic plants for value addition.</td><td>K3</td></tr>
<tr><td colspan="5">4. Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.</td><td>K4</td></tr>
<tr><td colspan="5">5. Develop new strategies to conserve mangroves and device innovative methods for cultivation of aquatic plants.</td><td>K5 & K6</td></tr>
<tr><td>UNIT</td><td colspan="6">CONTENTS</td></tr>
<tr><td>I</td><td colspan="6">MARINE AND LIMNETIC MACRO ALGAE:
Common seaweeds of Indian subcontinent: Ulva, Caulerpa, Sargassum, Gracilaria, etc. Common terrestrial algae, including cyanobacteria and lichen photobionts of Indian subcontinent and its life cycle, ecology and taxonomy: Anabaena, Chlorella, Scenedesmus.</td></tr>
<tr><td>II</td><td colspan="6">MANGROVES:
Mangrove forests of India, including Sundarbans, Pichavaram, Kerala mangroves, Rathnagiri mangroves. Common species of mangroves and mangrove associated plants, including Avicennia, Rhizophora, Acanthus and Aegiceras. Ecological significance of mangroves.</td></tr>
<tr><td>III</td><td colspan="6">PHYTOPLANKTONS,CYANOBACTERIA, DINOFLAGELLATES AND DIATOMS:
Common marine microalgae of India, including phytoplanktons and picoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial cyanobacteria of India.</td></tr>
<tr><td>IV</td><td colspan="6">AQUATIC ANGIOSPERMS:
Common aquatic angiosperms of India, including Lotus, Water Lilly,</td></tr>
</table>

	Water hyacinth. Ecology, life cycle, taxonomy and economic importance of aquatic angiosperms.
V	**VALUES AND USES OF AQUATIC PLANTS:** Economic importance of aquatic plants, Ecosystem services of aquatic plants, including biogeochemical cycles, oxygen production and carbon sequestration and so on, edible seaweed and algal resources of India, aesthetic, cultural, spiritual importance of aquatic plants.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC–CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University Press, Cambridge. 2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Prescott's Microbiology. 9th Edition. Mc Graw Hill International. 3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press. 5. Daubenmire, R.F.1973. Plant and Environment. John Willey. 6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi. 7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 *ISSN*: 0971-8044.
Reference Books	1. Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited. 2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands. 3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (R.S.K. Barnes & K.H. Mann,eds.), Blackwell Sci. Publ., London, 229 pp. 4. Bennet, G.W. 1971 Management of Lakes and Ponds. von Nostrand Reinhold Co.,NY.375 pp. 5. Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw Hill Internat.Book.Co.Tokyo,464 pp. 6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.
Web Resources	1. http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-science.pdf 2. http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-science.pdf 3. https://www.springer.com/gp/book/9788132221777 4. http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-science.pdf 5. https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B07NS9V7LN

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	2	1	1	2	3	2	3	2	3
CO3	2	2	3	1	1	2	1	3	1	2
CO4	3	3	3	3	3	2	1	2	3	2
CO5	3	2	1	1	2	3	3	3	2	3

S-Strong (3) **M-Medium (2)** **L-Low(1)**

DISCIPLINE SPECIFIC ELECTIVE - I

3. ENTREPRENEURIAL BOTANY

Title of the Course	**ENTREPRENEURIAL BOTANY**					
Paper Number	Discipline Specific Elective - I					
Category	Discipline Specific Elective	**Year**	III	**Credits**	2	**Course Code** 25UBODSEC1C
		Semester	V			
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
	3	-	-	3		
Pre-requisite	To develop innovative ideas to exploit the economically useful plant products for commercial purposes.					

Learning Objectives	
C1	To enable students to develop innovative ideas to exploit the economically useful plant products for commercial purposes.
C2	To inculcate entrepreneurial values to start a new business. To enlighten peopl about bioventure.
C3	To comprehend the molecular processes.
C4	To expose the students a fundamental of the various value added products.
C5	To introduce the entrepreneurial opportunities.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**

1. Recognize the significance of government agencies for entrepreneurs hip development.	K1
2. Explain about entrepreneurial values, risk assessment and solutions	K2
3. Make use of entrepreneurial opportunities.	K3
4. Analyze and decipher the significance of bioventure and value added products.	K4
5. Devise innovative methods for making value added products.	K5& K6

UNIT	CONTENTS
I	**INTRODUCTION:** Need - definition and concept - Types and characterization - entrepreneurial values- motivation and barriers-entrepreneurship as innovation, risk assessment and solutions.
II	**BIOVENTURE:** Industry - overview of *Spirulina*, *Pleurotus*, Natural dyes, Banana fibers, Wine, Hydroponics, Drumstick and coconut - Straight Vegetable Oil (SVO) and Pure Plant Oil (PPO) -methods and marketing - fresh and dry flowers for aesthetics.
III	**VALUE ADDED PRODUCTS:** Canning of fruits - process and equipment, fruit and vegetable based products (squash) - ready to serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jam and jellies), Palmyrah Palm products, Perfumes from Rose/Jasmine - Bamboo and cane based products-virgin coconut oil, jasmine oil production, nutraceuticals, standards and quality management.
IV	**ORGANIZATIONS AND AGENCIES:** TIIC, DIC, NABARD, MICROSTAT, DBT - case study - sarvodaya – SIDCO – Micro Small and Medium Enterprises – support structure for promoting entrepreneurship – various government schemes.
V	**ENTREPRENEURIAL OPPORTUNITIES:** Understanding a market and assessment, selection of an enterprise, business planning, mobilization of resources, Break Even Analysis, project proposal (guidelines, collection of information and preparation of project report), steps in filing patents, trademarks and copyright, Intellectual Property Rights, export and import license

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE /TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Taneja,S.and Gupta,S.L.2015. Entrepreneurship development, New venture creation, Galgeha publication company, New Delhi.ISSN: 2321-8916. 2. Desai,V.,2015. Entrepreneurship development, First edition.Himalaya publication house, Mumbai. ISBN:9789350973837. 3. Khanna,S.S. 2016. Entrepreneurial development.S.Chand company limited, New Delhi.ISBN:9788121918015. 4. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10_{th} ed). Rastogi Publications, Meerut. 5. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
Reference Books	1.Manohar,D.1989. Entrepreneurship of small scale industries,vol.III.Deepanddeep publication, New Delhi. ISSN: 09735925. 2. Lal,G.,Siddhapa,G.S.andTandon,G.L.,1988.Preservation of fruits and vegetables. Indian Council of Agricultural Research (ICAR). ISSN:01012061. 3. Ranganna,S.,2001.Handbook of analysis and quality control of fruits and Vegetable products, Second edition, Tata Mc Graw hill, New Delhi.ISBN: 780074518519. 4. Gupta. P.K.,1998. Elements of Biotechnology. Rastogi publications, Meerut. 5. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co.New Delhi.
Web Resources	1.https://store.pothi.com/book/ebook-priya-lokare botanicalentrepreneurship/ 2. https://www.taylorfrancis.com/chapters/mono/10.1201/b14920-15/valueadded-products-microalgae-faizal-bux 3.https://www.amazon.in/Microalgae-Biotechnology-Health-Value-Products-ebook/dp/B0845QXPY3 4.https://www.elsevier.com/books/value-addition-in-food-products-andprocessing-through-enzyme-technology/kuddus/978-0-323-89929-1 5.https://www.oreilly.com/library/view/selling-today partnering/9780134477404/xhtml/fileP70010119400000000000000000001D EB.xhtm

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	1	2
CO 2	3	1	3	2	1	3	1	3	3	1
CO 3	2	2	3	3	1	1	2	3	1	2
CO 4	3	3	2	2	3	2	3	3	2	3
CO 5	3	3	2	3	1	2	3	3	2	3

S - Strong (3) M - Medium (2) L - Low (1)