

RAJEEV GANDHI GOVT. POST GRADUATE COLLEGE
AMBIKAPUR, SURGUJA (C.G.) INDIA



Learning Outcome based Curriculum
For
UNDERGRADUATE PROGRAMME
In
BOTANY (HONS.)
Semester System (CBCS)

Vision:

To be distinguished as a renowned academic institution recognized for its innovation, excellence and inventions; producing the best human resource in the field of Plant Sciences and help them to realize their full potential in ways that benefits the society.

Mission:

To develop human resource with competence in frontier areas of Plant Sciences by fostering a culture of scientific and intellectual inquiry supported by critical thinking, reasoning skills and discourse.

To educate students with the fundamental knowledge and the application of scientific methods, skills and attitudes with the help of conventional and modern tools to understand everything related to plants.

To impart a student-centered, profession-oriented, multidisciplinary higher education in a genuine research environment and to establish collaboration with eminent institutes for the benefit of the students.

To advance the fundamental knowledge of Plant Sciences through innovative research, thereby creating a positive impact on society and the country.

Programme Outcomes

The students will be able to demonstrate ability –

1. To understand concept and theory of their respective subject.
2. To express thoughts and ideas effectively in writing and orally.
3. To identify relationship within and across disciplines in the sciences.
4. Cognitive and technical skills in their field and in multidisciplinary context.
5. To select and use relevant methods and tools for problem solving.
6. To make judgment and take decisions, based on analysis of data and evidences.
7. To critically evaluate principles and theory of sciences.
8. In digital literacy and data analysis.
9. To find a job in their field, exercise responsibilities to job assigned and start- up a business.
10. To develop a sense of respect and duty towards constitutional, human and moral and professional values.
11. to mitigating the effects of environmental degradations, climate change and pollution.

Graduate Attributes

The graduates should be able to demonstrate the capability to:

Disciplinary Knowledge:

- Comprehensive knowledge and understanding of their subject area, the ability to engage with different traditions of thought, and the ability to apply their knowledge in practice including in multi-disciplinary or multi-professional contexts.

Problem solving

- Solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.

Critical thinking:

- apply analytic thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well as evidence, arguments, claims, beliefs, and their liability and relevance of evidence,
- identify relevant assumptions or implications ;and formulate coherent arguments.

Creativity

- Create, perform ,or think in different and diverse ways about the same objects or scenarios,
- Deal with problems and situations that do not have simple solutions,
- Innovate and perform tasks in a better manner,
- View a problem or a situation from multiple perspectives,
- Think‘out of the box’and generate solutions to complex problems in unfamiliar contexts, adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence.

Communication Skills:

- Listen carefully, read texts and research papers analytically, and present complex information in a clear and concise manner to different groups/audiences,
- Express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media,
- Confidently share views and express herself/himself,
- Construct logical arguments using correct technical language related to a field of learning, work/vocation, or an area of professional practice, convey ideas, thoughts ,and arguments using language that is respectful and sensitive to gender and other minority groups.

Analytical reasoning/thinking

- Evaluate the liability and relevance of evidence;
- Identify logical flaws in the argument soothers;

- Analyze and synthesize data from a variety of sources;
- Draw valid conclusions and support them with evidence and examples, and addressing opposing view points

Research-related skills:

- A keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions
- The ability to problem arise, synthesize and articulate issues and design research proposals,
- The ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships.
- The capacity to develop appropriate methodology and tools of data collection.
- The appropriate use of statistical and other analytical tools and techniques.
- The ability to plan, execute and report the result so fan experiment or investigation.
- The ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/in personal research work, regardless of the funding authority or field of study.

Coordinating/collaborating with others:

- Work effectively and respectfully with diverse teams,
- Facilitate cooperative or coordinate effort on the part of a group,
- Act together as a group or at remain the interest so far common cause and work efficiently as a member of a team

Learning how to learn' skills:

- Acquire new knowledge and skills, including 'learning how to learn' skills, that are necessary for pursuing learning activities throughout life, through self-paced and self-

directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing trades and demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/skill development/re skilling,

- Work independently, identify appropriate resources required for further learning,
- Acquire or generational skills and time management to set self-defined goals and targets with timelines.
- Inculcate a healthy attitude to be a lifelong learner

Digital and technological skills

- Use ICT in a variety of learning and work situations,
- Access, evaluate, and use a variety of relevant information sources,
- Use appropriate software for analysis of data

Multicultural competence and inclusive spirit

- The acquisition of knowledge of the values and belief so multiple cultures and a global perspective to honor diversity,
- Capability to effectively engage in a multicultural group/society and interact respectfully with diverse groups,
- Capability to lead diverse team to accomplish common group tasks and goals.
- Gender sensitivity and adopt gender-neutral approach, as also empathy to the less advantaged and the differently-able including those with learning disabilities.

Value inculcation

- Embrace and practice constitutional, humanistic ,ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, non-violence, scientific temper, citizenship values,
- Practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to

become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies,

- Identify ethical issues related to work, and follow ethical practices, including avoiding unethical behavior such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights,
- Recognize environmental and sustainability issues, and participate in actions to promote sustainable development.
- Adopt objective, unbiased, and truthful actions in all aspects of work.
- Instill integrity and identify ethical issues related to work, and follow ethical practices.

Programme Specific Outcome

PSO1. Critically evaluation of ideas and arguments by collection relevant information about the plants, so as recognize the position of plant in the broad classification and phylogenetic level.

PSO2. Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and a depth and breadth of knowledge/expertise in the field of Plant Identification.

PSO3. Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of plant in the taxonomy.

PSO4. Students will be able to apply the scientific method to questions in botany by formulating testable hypotheses, collecting data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses.

PSO5. Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists.

PSO6. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works.

PSO7. Students will be able to apply fundamental mathematical tools (statistics, calculus) and physical principles (physics, chemistry) to the analysis of relevant biological situations.

PSO8. Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of plants, algae, and fungi that differentiate them from each other and from other forms of life.

PSO9. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.

PSO10. Students will be able to explain how Plants function at the level of the gene, genome, cell, tissue, Flower development. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and mode of life cycle followed by different forms of plants.

PSO11. Students will be able to explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems.

PSO12. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

DSC:- Disciplinary Specific Course

DSEC:- Disciplinary Specific Elective Course

GE:- General Elective Course

Semester	Code Type	Code No	Paper Title	Theory Credit	Practicum Credit	Total Credit
First	DSC	DSCBOT-01	Microbial Diversity and Thallophyta	3	1	4
	GE	GECBOT-01	Flowering Plants	3	1	4
Second	DSC	DSCBOT-02	Embryophyta	3	1	4
	GE	GECBOT-02	Economic Botany	3	1	4
Third	DSC	DSCBOT-03	Plant taxonomy and Embryology	3	1	4
	DSEC	DSEBOT-01	Fundamentals of plant pathology	3	1	4
Fourth	DSC	DSCBOT-04	Plant Physiology	3	1	4
	DSEC	DSEBOT-02	Plant anatomy and Biochemistry	3	1	4
Fifth	DSC	DSCBOT-05	Cell and Molecular Biology	3	1	4
	DSEC	DSEBOT-03	Biotechnology and Plant tissue culture	3	1	4
	GE	GECBOT-03	Forestry	3	1	4
Sixth	DSC	DSCBOT-06	Ecology	3	1	4
	DSEC	DSEBOT-04	Aquatic and marine botany	3	1	4
	GE	GECBOT-04	Nursery and Gardening	3	1	4
Seventh	DSC	DSCBOT-07	Research Methodology	3	1	4
	DSEC	DSEBOT-05	Evolution Biology	3	1	4
		DSEBOT-06	Remote sensing Digital Technology	3	1	4
		DSEBOT-07	Biofertilizer Technology and IPR	3	1	4
	GE	GECBOT-05	Non Vascular Plants/Soil Biology	3	1	4
		GECBOT-06	Vascular Cryptogames/Seed science and technology	3	1	4
		GECBOT-07	Phanerogames/ Agricultural Botany	3	1	4
Eight	DSC	DSCBOT-08	Biophysical techniques and Instrumentation	3	1	4
	DSEC	DSEBOT-08	Biostatistics and Bioinformatics	3	1	4
		DSEBOT-09	Microbial Biotechnology	3	1	4
		DSEBOT-10	Plant Bioelectronics	3	1	4
	GEC	GECBOT-08	Air pollution and Climate change	3	1	4
		GECBOT-09	Natural Resource Management	3	1	4
		GECBOT-10	Our Environment	3	1	4

SEMESTER I

Microbial diversity and Thallophta

(Disciplinary Specific Course)

Course Learning Outcome:

At the end of this course, the students will be able to:

CO1. Understand the Concept of microbe and Lichen.

CO2. Learn economic importance of microbes which will be beneficial for agriculture industry.

CO3. Understand the General characteristics and affinities of Algae with microbes.

CO4. Understand the life cycle of different genera of Mycology and algology

CO5. Learn economic importance of fungi which will be beneficial for baking industry.

CO6. Understand the techniques and good lab practices for working in a laboratory.

CO7. Develop Skill in Slide Preparation.

CO8. Learn to identify fungal disease on the basis of symptoms.

PO-CO Mapping:

PO	CO-01	CO-02	CO-03	CO-04	CO-05	CO-06	CO-07	CO-08	CO-09
PO-01	√			√				√	
PO-02			√						
PO-03	√		√						
PO-04						√	√		
PO-05		√			√				
PO-06									
PO-07									
PO-08									
PO-09					√				
PO-10						√			
PO-11		√							

B.Sc. (BOTANY)		I ST SEMESTER	
COURSE CODE: DSCBOT-01		COURSE TYPE: DSC	
COURSE TITLE: MICROBIAL DIVERSITY AND THALLOPHYTA			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u>			
i. Objective type questions			
ii. Short answer type questions: Word limit 70-100 words			
iii. Middle answer type questions: Word limit 200-250 words			
iv. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Microbiology: General classification, characteristics, Structure and types of Virus and Bacteria. Cell structure of prokaryotic cells; Viroid, Prions, Virions, Actinomycetes, Mycoplasma.	09
2	Mycology: General characteristic, features and Classification of Fungi. Habit and Habitat, structure, nutrition and reproduction in <i>Albugo</i> , <i>Rhizopus</i> ; <i>Saccharomyces</i> , <i>Ustilago</i> , <i>Puccinia</i> , <i>Agaricus</i> ; <i>Alternaria</i> . Heterothallism & Parasexuality; Economic importance of Fungi and their significance.	15
3	Phycology: General characteristic, features, classification and range of thallus organization in algae. Classification, structure, Reproduction and life cycle in – <i>Nostoc</i> , <i>Volvox</i> , <i>Chlamydomonas</i> , <i>Ulothrix</i> , <i>Vaucheria</i> . <i>Ectocarpus</i> and <i>Polysiphonia</i> ; Economic importance of Algae	15
4	Lichenology: General account, Types, structure, Reproduction in Lichen; Economic Importance of Lichen.	06

Practical List:

- Slide Preparation: Identification and study of external and internal structure of fungi. *Phytophthora*, *Mucor*, *Rhizopus*, *Saccharomyces*, *Aspergillus*, *Peziza*, *Puccinia*; *Alternaria*, *Cercospora*, *Agaricus*
- Study / Slide preparation and Staining of material – *Nostoc*, *Chara*, *Oedogonium*, *Volvox*, *Vaucheria*, *Ectocarpus*, *Sargassum*, *Polysiphonia*.
- Isolation and identification of pathogen from fungal diseased leaf.
- Staining techniques: Gram's, staining.

Text Book:

- Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press.
- Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, New Delhi.
- Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
- Aggarwal, S. K. 2009. Foundation Course in Biology, A one books Pvt. Ltd., New Delhi.
- Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Cent Book Dt.
- Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut, India.

Flowering Plants

(General Elective Course)

Course Learning Outcome: At the end of this course, the students will be able to:

CO1. Understand the concept evolution in flowering plants.

CO2. Understand the General characteristics of flowering plants and their life cycle.

CO3. Understand the difference between Hydrophytes, Xerophytes, Halophytes.

CO4. Learn Mechanism of Photosynthesis and Respiration.

CO5. Know about Saprophytic and Insectivores plants.

CO6. Understand the techniques and good lab practices for working in a laboratory.

CO7. Develop Skill in Herbarium Preparation.

CO8. Develop skills for identifying Hydrophytes, Xerophytes plants.

CO9. Learn the technicality of flower dissection.

PO-CO Mapping:

[illegible]

B.Sc. (BOTANY)			I ST SEMESTER	
COURSE CODE: GECBOT-01			COURSE TYPE: GE	
COURSE TITLE: FLOWERING PLANTS				
CREDIT:			HOURS:	
THEORY: 3		PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS				
THEORY: 80+20			PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u> v. Objective type questions vi. Short answer type questions: Word limit 70-100 words vii. Middle answer type questions: Word limit 200-250 words viii. Long answer type questions: Word limit 500-600 words.				
Unit	Content of the Course			No of Periods
1	Morphology: Habit and habitat of plants, Plant parts (Root, stem and leaf) and its modification.			11
2	Emryology: Flower and its parts, Role of flower, Androecium, Gynoecium, Fertilization, Seed setting, factors causing pollination			11
3	Physiology: Introduction and Mechanism of Photosynthesis and Respiration; Saprophytic and Insectivores Plants.			11
4	Different types of flowering Plant(Hydrophytes, Xerophytes, Halophytes) and modification in their morphology and anatomy.			12

Practical List:

- Dissection of flower present in the garden to study morphological and reproductive characters.
- Preparation of Herbarium.
- Prepare a tour record on Hydrophytes and Xerophytes plants after a visit to nearest Land/Lake/River.

Text Book:

- Bhatnagar SP (1996) Gymnosperms, New Age International Publisher.
- Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
- Pandey, B.P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics.
- Plant Systematics. Arun K. Pandey & Shruti Kansana. 2020. Jaya Publishing House.
- Pandey BP .Plant Anatomy, S. Chand Publishers, New Delhi.
- Srivastava HN (2006). Plant Anatomy, Pradeep Publications, Jalandhar.
- Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.

SEMESTER II

Embryophyta

(Disciplinary Specific Course)

Course Learning Outcome: At the end of this course, the students will be able to:

CO1. Understand characteristics & affinities of Bryophytes, Pteridophytes & Gymnosperms.

CO2. Learn morphology, and anatomy of Embryophytes.

CO3. Learn life cycles of selected genera of different groups.

CO4. Understand Phylogenetic relationships with the help of Palaeobotanical studies.

CO5. Understand the Economic Importance of Plants from different group of Embryophyta.

CO6. Understand the techniques and good lab practices for working in a laboratory.

CO7. Develop skills for preparation of slides.

CO8. Can initiate his laboratory of slide preparation and can sell the slide to the market.

CO9. Can prepare herbaria of bryophytes and pteridophytes for business purpose.

CO10. Can prepare a Gymnosperm Garden in own house.

PO-CO Mapping:

PO	CO-01	CO-02	CO-03	CO-04	CO-05	CO-06	CO-07	CO-08	CO-09	CO-10
PO-01	√	√			√					
PO-02		√								
PO-03	√									
PO-04			√	√		√	√			
PO-05										
PO-06										
PO-07										
PO-08						√				
PO-09								√	√	
PO-10						√	√	√		√
PO-11				√					√	√

B.Sc. (BOTANY)		II ND SEMESTER	
COURSE CODE: DSCBOT-02		COURSE TYPE: DSC	
COURSE TITLE: EMBRYOPHYTA			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u>			
ix. Objective type questions			
x. Short answer type questions: Word limit 70-100 words			
xi. Middle answer type questions: Word limit 200-250 words			
xii.Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Bryology: Classification, structure, Reproduction and life cycle in <i>Riccia</i> , <i>Marchantia</i> , <i>Anthoceros</i> and <i>Funaria</i> . Economic Importance of Bryophytes. Affinities of bryophytes with pteridophytes;	11
2	Pteridology I: General characteristic, features and classification of Pteridophytes; Morphology, anatomy, reproduction and life cycle in <i>Lycopodium</i> , <i>Selaginella</i> , <i>Equisetum</i> , and <i>Dryopteris</i> .	11
3	Pteridology II: Economic importance of Pteridophytes. Fossilization & types of fossils; life cycle of Fossil plants i.e. <i>Rhynia</i> , <i>Medullosa</i> ; Geological time scale; Heterospory and seed habit; Stelar evolution theory. Telome theory. Apogamy and Apospory.	12
4	Gymnosperm: Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales.; Morphology, anatomy and life cycle of <i>Cycas</i> , and <i>Pinus</i> ; Economic importance of Gymnosperm.	11

Practical List:

- Study / Slide preparation and Staining of material–
Riccia, Marchantia , Anthoceros and Funaria.
- Study / Slide preparation and Staining of material –
Lycopodium, Selaginella, Equisetum, Marselia, and Dryopteris.
- Study / Slide preparation and Staining of material –*Cycas, and Pinus.*
- Study of certain Paleobotanic material provided by institution

Text Book:

- Pandey BP (2010) College Botany Vol II S. Chand and Company, New Delhi.
- Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta.
- Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut, India.
- Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press.
- Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd.
- Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd.
- Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi.
- Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students
- Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd

Economic Botany

(General Elective Course)

Course Learning Outcome: At the end of this course, the students will be able to

CO1. Understand the concept of Ethnobotany and its role in the society.

CO2. Differentiate in the concept of Ethnobotany and medicinal botany.

CO3. Evaluate the management strategies of different natural resources.

CO4. Reflect upon the different national tribal groups and their role in ethnobotany.

CO5. Learn economic importance of different plants of the concerned families.

CO6. Understand the traditional knowledge about the plants and possible use of this knowledge

CO7. Recognise different medicinal plants and can use that plants in needs.

CO8. Understand different mode of studies for ethnobotanical study.

CO9. Learn different Medicinal plants and their role.

PO-CO Mapping:

PO	CO-01	CO-02	CO-03	CO-04	CO-05	CO-06	CO-07	CO-08	CO-09
PO-01	√			√					√
PO-02									
PO-03		√		√				√	
PO-04									
PO-05	√		√				√		√
PO-06									
PO-07		√				√			
PO-08									
PO-09					√		√		
PO-10									
PO-11			√		√				

B.Sc. (BOTANY)		II ND SEMESTER	
COURSE CODE: GECBOT-02		COURSE TYPE: GE	
COURSE TITLE: ECONOMIC BOTANY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u>			
xiii.			
bjective type questions			
xiv. Short answer type questions: Word limit 70-100 words			
xv. Middle answer type questions: Word limit 200-250 words			
xvi. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Domestication of crop plants; Botanical name, family, part used and uses of Cereales, Pulses, and oil yielding plants.	11
2	Botanical name, family, part used and uses of Timber, Rubber, Dyes and fibre yielding plants,	11
3	Ethnobotany: Concept of Ethnobotany, Documentation, Conservation and application of Traditional Knowledge; Role of important medicinal plants: a) <i>Aegle marmelos</i> b) <i>Asparagus racemosus</i> c) <i>Andrographis paniculata</i> d) <i>Ocimum sanctum</i> e) <i>Aloe vera</i> f) <i>Tinospora cordifolia</i> , etc.	12
4	Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) <i>Azadiractha indica</i> b) <i>Ocimum sanctum</i> c) <i>Vitex negundo</i> . d) <i>Gloriosa superba</i> e) <i>Tribulus terrestris</i> f) <i>Pongamia pinnata</i> g) <i>Cassia auriculata</i> h) <i>Indigofera tinctoria</i> .	11

Practical List:

- Collection of different medicinal plants and preparation of herbaria.
- Preparation of records on ethnic and medicinal plants.
- Visit to your surrounding area and prepare a list of different tribes and different plant produce used by them.

Text Book:

- S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
- Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –Chichester
- Rama Rao, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh
- Dutta A.C. 2016. Botany for Degree Students.
- Singh, B., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation.
- Sharma, OP. 1996. Hill's Economic Botany (Late Dr. AF Hill, by OP Sharma).

SEMESTER III

Plant taxonomy and Embryology

(Disciplinary Specific Course)

Course Learning Outcome: At the end of this course, the students will be able to

CO1. Understand the concept evolution in flowering plants and Plant Taxonomy.

CO2. Understand the General characteristics of flowering plants and their life cycle.

CO3. Understand the traditional knowledge about the plants and possible application of this knowledge.

CO4. Understand the life cycle of angiospermic plants with details of microsporogenesis, megasporogenesis, fertilization and other developmental details up to embryogenesis

C05. Learn the technicality of flower dissection.

CO6. Understand the techniques and good lab practices for working in a laboratory.

CO7. Develop Skill in Herbarium and slide Preparation.

PO-CO Mapping:

[illegible]

B.Sc. (BOTANY)		III RD SEMESTER	
COURSE CODE: DSCBOT-03		COURSE TYPE: DSC	
COURSE TITLE: PLANT TAXONOMY AND EMBRYOLOGY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL: 50	
<u>Scheme of Paper in Semester Exam:</u>			
xvii.			
bjective type questions			
xviii. Short answer type questions: Word limit 70-100 words			
xix. Middle answer type questions: Word limit 200-250 words			
xx.Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No. of Periods
1	Taxonomic Resources & Nomenclature: Components of taxonomy (identification, nomenclature, classification); Herbaria and Botanical gardens; Principles and rules of Botanical Nomenclature according to ICBN	10
2	Classification type: Artificial, natural and phylogenetic. Bentham and Hooker Classification, Engler and prantl system of classification (upto series), Hutchinson system of classification (upto series)	10
3	A study of the following families with economic imp.: Brassicaceae, Malvaceae, Fabaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Asclepiadaceae, Solanaceae, Euphorbiaceae, Apiaceae, Lamiaceae, and Poaceae.	15
4	Plant Embryology: Flower structure; Microsporangium and Microsporogenesis, Ovule: Structure and types, Megasporogenesis, Development of gametophyte, Pollination and its mode, Fertilization, Endosperm and its types, Embryogenesis, Apomixis and Polyembryony.	10

Practical List:

- Dissection of flower present in the garden to study morphological and reproductive characters according to family.
- Preparation of Herbarium of local wild plant.
- Study of different type of ovule placentation.
- Comments on the different type of fruits provided.

Text Book:

- Pandey, B.P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics.
- Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
- Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
- Dutta A.C. 2016. Botany for Degree Students.
- Pandey BP (2010) College Botany Vol II, S. Chand and Company, New Delhi.
- Maheshwari P (1971). An Introduction to Embryology of Angiosperms, McGraw Hill Book Co., London.
- Bhojwani SS and Bhatnagar SP (2000). The Embryology of Angiosperms (4th Ed.).

Fundamentals of Plant Pathology **(Disciplinary Specific Elective Course)**

Course Learning Outcome:

At the end of this course, the students will be able to

CO1. Understand the difference among Viruses, Bacteria and other microbes.

CO2. Learn to identify important microbial disease on the basis of symptoms. also will be able to treat them at primary level.

CO 3. Learn economic importance of microbes which will be harmful for living being.

CO 4. Apply their knowledge in the societal field to eradicate or avoid the diseases.

CO5.Understand the instruments, techniques and good lab practices for working in a microbiology laboratory.

CO6. Work in Pathological laboratory and medical stores

CO7. Develop skills for identifying microbes and Skill in Slide Preparation.

PO-CO Mapping:

[illegible]

B.Sc. (BOTANY)		III RD SEMESTER	
COURSE CODE: DSEBOT-01		COURSE TYPE: DSEC	
COURSE TITLE: FUNDAMENTALS OF PLANT PATHOLOGY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u>			
xxi.			
bjective type questions			
xxii. Short answer type questions: Word limit 70-100 words			
xxiii. Middle answer type questions: Word limit 200-250 words			
xxiv. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis.	10
2	Cause and classification of plant diseases; Important plant pathogenic organisms of different groups: fungi, bacteria, Phytoplasmas, viruses, viroids, protozoa, with examples of diseases caused by them	10
3	Methods of control: Host plant resistance, mechanical, physical, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the disease management. Survey surveillance and forecasting of plant diseases	10
4	Symptoms and management of diseases of follow. crops: Field Crops: Rice: blast, brown spot; Wheat: Smut; Sorghum: smuts; Bajra: downy mildew; Groundnut: leaf spot. Horticultural Crops: Guava: wilt; Banana: bunchy top; Papaya: leaf curl; Tomato: damping off; Potato: late blight; Okra: Yellow Vein Mosaic;	15

	Crucifer: White rust; Coffee: rust disease.	
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Practical List:

- Acquaintance with various laboratory equipment and microscopy
- Staining and identification of plant pathogenic bacteria
- Preparation of media
- Isolation and purification of fungi and bacteria
- Identification and histo-pathological studies of selected diseases of field and horticultural crops covered in theory.
- Collection and preservation of disease specimen in an herbarium selected diseases of field and horticultural crops covered in theory.

(Note: Students should submit 10 pressed and well-mounted specimens)

Text Book:

- Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur
- Agrios, GN. 2010. Plant Pathology. Acad. Press.
- Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur
- Singh RS. 2008. Plant Diseases. 8 th Ed. Oxford & IBH. Pub. Co.
- Singh RS. 2013. Introduction to Principles of Plant Pathology. Oxford and IBH Pub. Co.
- Alexopoulos, Mims and Blackwel. Introductory Mycology
- Mehrotra RS & Aggarwal A. 2007. Plant Pathology. 7 th Ed. Tata McGraw Hill Publ. Co. Ltd.
- Gibbs A & Harrison B. 1976. Plant Virology - The Principles. Edward Arnold, London.

SEMESTER IV

Plant Physiology
(Disciplinary Specific Course)

Course Learning Outcome:

At the end of this course, the students will be able to:

CO1. Understand the role of Physiological and metabolic processes for plant growth and development.

CO2. Learn the symptoms of Mineral Deficiency in crops and their management.

CO3. Assimilate Knowledge about Biochemical constitution of plant diversity.

CO4. Understand role of Enzyme in metabolic process of plants.

CO5. Understand the techniques and lab practices for working in field of Physiology.

CO6. Know the physiological processes undergoing in plants along with their metabolism.

C07. Identify Mineral deficiencies based on visual symptoms in their crop fields.

PO-CO Mapping:

[illegible]

B.Sc. (BOTANY)		IV TH SEMESTER	
COURSE CODE: DSCBOT-04		COURSE TYPE: DSC	
COURSE TITLE: PLANT PHYSIOLOGY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u>			
xxv.			
bjective type questions			
xxvi. Short answer type questions: Word limit 70-100 words			
xxvii. Middle answer type questions: Word limit 200-250 words			
xxviii. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Plant water relation: Imbibition, Osmosis, Diffusion, DPD, and water potential; Mineral Nutrition deficiency and disease, Mechanism of water absorption, Ascent of sap and Phloem transport; Transpiration, its significance and guttation.	15
2	Photosynthesis: Photosynthetic apparatus; Light Reaction: Photosystems, Z-Scheme and Photophosphorylation; Dark Reaction- the Calvin cycle, Photorespiration, C4 and CAM cycle.	10
3	Respiration-Structure of mitochondria, aerobic and anaerobic respiration and fermentation, Glycolysis, Krebs cycle, and electron transport system, RQ, Factors affecting respiration.	10
4	Plant Development: developmental roles of phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene); Photoperiodism (SDP, LDP, Day neutral plants); Vernalization; Dormancy & Senescence, Plant Movement.	10

Practical List:

- Demonstration of exosmosis and endosmosis with the help of raisin
- Study of the imbibition phenomenon by using different gram seed
- Experiment to demonstrate plasmolysis and deplasmolysis by using *tradescatia* leaf
- Experiment to demonstrate the transpiration phenomenon with the bell jar method.
- Structure of stomata (dicot & monocot).
- Study the rate of transpiration by using four leaf model
- Experiment to measure the rate of transpiration by using Ganong's/ Farmer's photometer.
- Study the evolution of oxygen gas during photosynthesis process with the help of Hydrilla twig
- Study the effect of light color on rate of photosynthesis

Text Book:

- Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
- A Handbook On Mineral Nutrition and Diagnostic Techniques for Nutritional Disorders of Crops (pb)ISBN
- Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
- Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 1992, Wadsoworth Publishing Company.
- Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
- Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.

Plant Anatomy and Biochemistry
(Disciplinary Specific Elective Course)

Course Learning Outcome:

At the end of this course, the students will be able to

CO1. Understand the internal structure of root, stem and leaves.

CO2. Learn about the anomalous secondary growth of some plants.

CO3. Understand role of Enzyme in metabolic process of plants

CO4. Understand the basic differences in monocot and dicot.

CO5.Understand the techniques and lab practices for working in field of Anatomy.

CO6. Develop skills for preparation of Slides.

CO7. Can initiate his laboratory of slide preparation and can sell the slide to the institution.

CO8. Understand the concept of biomolecule and their role and structure

PO-CO Mapping:

[illegible]

B.Sc. (BOTANY)		IV TH SEMESTER	
COURSE CODE: DSEBOT -02		COURSE TYPE: DSEC	
COURSE TITLE: PLANT ANATOMY AND BIOCHEMISTRY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u> xxix. bjective type questions xxx. Short answer type questions: Word limit 70-100 words xxxi. Middle answer type questions: Word limit 200-250 words xxxii. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Period
1	Plant tissue and Plant tissue system, Meristem cell and differentiation, Types of cells on the basis of function; Theories of apical organization (Apical Cell Theory, Histogen Theory and Tunica Carpus Theory). Structure and types of Conducting tissue (Xylem, phloem). Types of vascular bundle.	15
2	Anatomy and Secondary growth: Anatomy of Root, Stem and Leaves of both Dicots and Monocots. Secondary growth in Dicots root and stem.	10
3	Anomalous secondary growth in <i>Bignonia</i> , <i>Boerhaavia</i> , <i>Bougainvillea</i> , <i>Dracaena</i> and <i>Nyctanthus</i> . Modification in anatomy of hydrophytes, Xerophytes (Modification of Stem Root and leaf on the basis of function).	10
4	Structure, types and Function of Protein Carbohydrate and Lipid; Nitrogen metabolism; Enzymes: Structure and types of enzyme, mechanism of action; enzyme inhibition and factors affecting enzyme activity, Allosteric enzymes.	10

Practical List:

- Slide Preparation: Identification and comments on material (monocot/dicot stem and roots) provided.
- Slide Preparation: Identification and comments on material mentioned: *Bignonia*, *Boerhaavia*, *Bougainvillea*, *Dracaena* and *Nycthanthes*,
- Slide preparation for anatomical study of hydrophytes, Xerophytes plants with comments.
- Biochemical test: Protein, Starch, Lipid

Text Book:

- Evert RF (2006). Esau's Plant Anatomy: Meristems, Cells and Tissues of the Plant body: Their Structure, Function and Development, John Willey and Sons, Inc.
- Pandey BP. Plant Anatomy, S. Chand Publishers, New Delhi.
- Srivastava HN (2006). Plant Anatomy, Pradeep Publications, Jalandhar.
- Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
- Mathews, C.K., Van Holder, K.E. & Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.

SEMESTER V

Cell and molecular Biology
(Disciplinary Specific Course)

Course Learning Outcome: At the end of this course, the students will be able to:

CO1. Acquire knowledge on ultra-structure of cell.

CO2. Understand the structure and composition of chromatin and concept of cell division.

CO3. Interpret the Mendel's principles, acquire knowledge on cytoplasmic inheritance and sex linked inheritance characters.

CO4. Understand the concept of ‘one gene one enzyme hypothesis’ along with molecular mechanism of mutation.

CO5. To perform all experiments related to Cytogenetics.

CO6. Can be employed in environment in the genetical laboratory & start his own venture.

CO7. Develop understanding of gene interaction and pedigree analysis.

PO-CO Mapping:

[illegible]

B.Sc. (BOTANY)		V TH SEMESTER	
COURSE CODE: DSCBOT -05		COURSE TYPE: DSC	
COURSE TITLE: CELL AND MOLECULAR BIOLOGY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u> xxxiii. Objective type questions xxxiv. Short answer type questions: Word limit 70-100 words xxxv. Middle answer type questions: Word limit 200-250 words xxxvi. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Cytology: Structure and function of cell wall and plasma membrane; Cell organelles their structure and function. Organization and types of chromosomes; Lampbrush chromosomes and polytene chromosomes.	10
2	Cell cycle: G0, G1, S and G2 phases; Cell division and its types: Mitosis, amitosis, meiosis; Significance of cell division. Variation in Chromosome number: Numerical aberrations and Structural aberrations.	10
3	Mendal's Law, Chromosome theory of inheritance; Concept of Dominance (Incomplete dominance and co-dominance); Interaction of Genes; Multiple alleles, Lethal alleles; Concept and types of epistatis; Pleiotropy and Polygenic inheritance. Linkage and crossing over; Concept of sexdetermination.	10
4	Structure and organization of DNA and RNA, Function of Nucleic acid, Steps and Mechanism involved in Replication, Transcription and translation, Genetic code and mutation.	15

Practical List:

- Study of plant cell structure with the help of epidermal peal mount of *Oim/Rhoeo*.
- Measurement of cell size by the technique of micrometry.
- Determination of frequency of different mitotic stages in pre-fixed root tips of *Allium cepa*.
- Monohybrid cross (Dominance and incomplete dominance).
- Dihybrid cross (Dominance and incomplete dominance).
- Gene interactions (All types of gene interactions mentioned in the syllabus).
 - Recessive epistasis 9: 3: 1.
 - Dominant epistasis 12: 3: 1
 - Complementary genes 9: 7
- Solving problem on Pedigry analysis.

Text Book:

- G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
- Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
- Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8th edition. Pearson Education Inc. U.S.A.
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.

Biotechnology and Plant tissue culture
(Disciplinary Specific Elective Course)

Course Learning Outcome: At the end of this course, the students will be able to:

CO1. Understand the core concepts and fundamentals of biotech. and genetic engineering.

CO2. Develop their competency on different types of plant tissue culture technique.

CO3. Analyze the enzymes and vectors for genetic manipulations.

CO4. Examine gene cloning and evaluate different methods of gene transfer.

CO5. Critically analyze the major concerns and applications of transgenic technology.

CO6. Understand the instruments and techniques of biotechnology and PTC laboratory.

CO7. Enhance learning skill for the operation of tools and techniques of genetic engineering and understand the statistical tools.

CO8. Start own enterprises of improved Plant Varieties and can produce Transgenic Crop.

PO-CO Mapping:

[illegible]

B.Sc. (BOTANY)		V TH SEMESTER	
COURSE CODE: DSEBOT -03		COURSE TYPE: DSEC	
COURSE TITLE: BIOTECHNOLOGY AND PLANT TISSUE CULTURE			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u>			
xxxvii.			
bjective type questions			
xxxviii. Short answer type questions: Word limit 70-100 words			
xxxix. Middle answer type questions: Word limit 200-250 words			
xl. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Plant Tissue Culture:Steps and mechanism; Formulation of nutrient media; Sterilization, role of vitamins and hormones; Totipotency; Organogenesis; Embryogenesis; Embryo culture, and Callus culture. Protoplast isolation, culture and fusion; Plant Tissue culture applications; Germplasm conservation, and Cryo-preservation.	15
2	Enzymes and Vectors for Genetic Manipulations Cloning Vectors: History, basic sequences of any vector, types of bacterial vectors, Ti plasmid, BAC; Yeast vector.	10
3	Gene Cloning: Basic concept and advantages of Gene cloning; Natural (Bacterial Transformation methods) and Artificial method (PCR-mediated gene cloning) of gene cloning; Selection of recombinant clones	10
4	Methods of Gene Transfer: Biological (<i>Agrobacterium</i> mediated Transformation) and artificial/direct gene transformation (Electroporation, Microinjection, Microprojectile bombardment). Selection of transgenics, Genetically modified crops; Major Concerns and Applications of Transgenic	10

	Technology in India.	
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Practical List:

- Preparation of a liquid and solid MS medium.
- Study of Dry and Wet sterilization techniques.
- Demonstration of *in vitro* sterilization of seeds and germination in MS media.
- Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
- Study Isolation of protoplasts and protoplast culture using photographs.
- Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile, bombardment.

Text Book:

- Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
- Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
- A. Slater, N.W. Scott and M.R. Fowler (2008). Plant Biotechnology. Oxford.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons.
- Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
- Chrispeels, M.J. and Sadava, D.E. (1994). Plants, Genes and Agriculture. Jones & Bartlett Publishers.

Forestry

(General Elective Course)

Course Learning Outcome: At the end of this course, the students will be able to:

CO1. To provide knowledge about Forest ecosystem concept, stand dynamics, forest succession, productivity and vegetation forms and natural regeneration of tree species.

CO2. Develop understanding of tree measurements, forest inventory and yield concepts.

CO3. The course will equip the students regarding wood based industries.

CO4. The course will equip the students regarding different product of wood like wood extracts resins and gums, katha, tannis and various type of non-timber products

CO5. To develop understanding of students about forest policy and laws and international conventions

CO6. Clear the concept of IPR.

CO7. Start the small entrepreneurship on forest products and its marketing

PO-CO Mapping:

PO	CO-01	CO-02	CO-03	CO-04	CO-05	CO-06	CO-07	CO-08	CO-09
PO-01	√			√	√				
PO-02									
PO-03	√								
PO-04		√							
PO-05			√				√		
PO-06									
PO-07	√					√			
PO-08		√	√	√					
PO-09							√		
PO-10					√	√			
PO-11					√				

B.Sc. (BOTANY)		V TH SEMESTER	
COURSE CODE: GECBOT -03		COURSE TYPE: GE	
COURSE TITLE: FORESTRY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u> xli.Objective type questions xlii. Short answer type questions: Word limit 70-100 words xliii. Middle answer type questions: Word limit 200-250 words xliv. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Introduction and types of Forest, classification of world's forest vegetation; Ecosystem concept and succession; competition and tolerance, forest composition and structure. Eco-physiology of tree growth; effect of Radiation, water, mineral nutrients and temperature on eco-physiology and tree growth.	15
2	Description and location of different forest based industries in your state- paper, furniture, bamboo, sports goods, pencil making, match box making,	10
3	Conservational strategy of forest and natural resources (hotspot areas, wildlife sanctuaries, national parks, biosphere reserve). In situ and Ex situ conservation, Effect of Global warming and Green House gas on forests. Red Data Book, IUCN Red List of plant biodiversity	10
4	National Forest Policy: 1894, 1952 and 1988 (Relevance and scope) Forest laws: Indian Forest Act 1927 (general provision); Forest Conservation Act 1980, Wildlife Protect Act 1972.. Intellectual Property right	10

Practical List:

- Study the different method of sampling.
- Estimation of productivity of forest ecosystem.
- Collection and preservation of plant specimen present in nearest forest area.
- Study litter production and decomposition rate of selected plant community
- Calculation of Frequency, Density and abundance of plant community.
- Visit to National parks, wildlife sanctuaries, botanical gardens and make a record on vegetation.

Text Book:

- Dwivedi AP. 1992. Agroforestry: Principles and Practices. Oxford and IBH.
- Dwivedi AP. 1993. A Text Book of Silviculture. International Book Distributors, Dehradun.
- Khanna LS. 1996. Principle and Practice of Silviculture. International Book Distributors.
- Smith DM, Larson BC, Ketty MJ & Ashton PMS. 1997. The Practices of Silviculture-Applied Forest Ecology. John Wiley & Sons.
- Chaturvedi AN & Khanna LS. 1994. Forest Mensuration. International Book Distributor.
- Ram Parkash 1983. Forest Surveying. International Book Distr.
- Sharpe GW, Hendee CW & Sharpe WE. 1986. Introduction to Forestry. McGraw-Hill.
- Simmons CE. 1980. A Manual of Forest Mensuration. Bishen Singh Mahender Pal Singh, Dehradun.
- Mehta T. 1981. A Handbook of Forest Utilization. Periodical Expert Book Agency.
- Krishnamurthy T. Minor Forest Products of India. Oxford & IBH.

SEMESTER VI

Ecology

(Disciplinary Specific Course)

Course Learning Outcome: At the end of this course, the students will be able to

CO1. Understand the complex interrelationship between organisms and environment.

CO2. Understand and make other aware with sustainable natural resource management and biodiversity conservation.

CO3. Understand method for studying vegetation, community pattern and process, ecosystem functions, and principles of phyto-geography.

CO4. Determine Frequency, density and abundance of components

CO5. Differentiate the Hydrophytes, Xerophytes and Halophytes on the basis of Anatomical characters.

CO6. Understand the difference in pH in different soil and can calculate pH of soil.

CO7. Start soil testing laboratory to for livelihood

PO-CO Mapping:

PO	CO-01	CO-02	CO-03	CO-04	CO-05	CO-06	CO-07	CO-08	CO-09
PO-01	√				√				
PO-02									
PO-03	√			√	√				
PO-04			√			√			
PO-05		√				√			
PO-06									
PO-07					√				
PO-08			√	√					
PO-09							√		
PO-10		√					√		
PO-11		√							

B.Sc. (BOTANY)		VI TH SEMESTER	
COURSE CODE: DSCBOT -06		COURSE TYPE: DSC	
COURSE TITLE: ECOLOGY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u>			
xlv.			
bjective type questions			
xlv. Short answer type questions: Word limit 70-100 words			
xlvii. Middle answer type questions: Word limit 200-250 words			
xlviii.Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Ecology & Ecosystem: Our environment, Definition of Ecology, Ecological Factors; Concept of an ecosystem, structure, function and types. Soil: Formation, types, Soil Profile, Properties, Soil Microorganisms. Biogeochemical cycle: Nitrogen, Carbon, Sulfur Cycle	15
2	Ecological niche, Ecotype and Ecotone; Law of tolerance. Ecological Adaptations – Hydrophytes and Xerophytes. Population ecology: Density, Mortality, survivorship curve, Dispersion, Age structure, Age pyramid	10
3	Food chains and food webs; Trophic Level; Law of energy transfer; Ecological pyramids and types. Keystone and umbrella species Ecological Succession (Definition, types and Processes); Hydrosere and Xerosere Succession..	10
4	Biodiversity and its conservation: Definition (genetic, species, and ecosystem diversity); Hot spots; threats to biodiversity; IUCN categories. Conservation of Biodiversity: Ex-situ and in-situ conservation (botanical	10

	gardens, National park, Sanctuaries, Seed Bank and Gene Bank)	
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Practical List:

- Study of Ecological Adaptation Characters through slide preparation Hydrophytes, Xerophytes.
- Study of morphological adaptations of hydrophytes and xerophytes.
- Study of biotic interactions of: Stem parasite (Cuscuta), Root parasite (Orobanchae) Epiphytes, Predation (Insectivorous plants).
- Determination of pH of various soil and water samples.
- To estimate bulk density and porosity of Garden soils
- To determine moisture content & water holding capacity of Garden Soils.
- Study of community structure by quadrat method and determination of Frequency, density and abundance of components.
- Comparative anatomical studies of leaves from polluted and less polluted areas.

Text Book:

- Verma, P.S. & Agarwal, U.K. Concept of Ecology, Latest Ed., S. Chand & Company.
- Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders.
- Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications.
- Ambast, R.S. & Ambast, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors.
- Mani, M.S. Bio-Geography of India, Latest Ed., Springer-Verlag.
- Mackenzie et al. Ecology, Latest Ed., Viva Books.
- Gurevitch, J. (et al.), The Ecology of plants, 2002, Sinauer Associates.
- Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
- Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Aquatic and Marine Botany

(Disciplinary Specific Elective Course)

Course Learning Outcome:

At the end of this course, the students will be able to

CO1. Develop their understanding on commonly occurring marine and limnetic algae of Indian coast along with the current understanding of its biology.

CO2. Analyse the properties of mangroves, other aquatic angiosperms and micro algae.

CO3. Reflect upon the values and uses of aquatic plants

CO4. Understand the techniques of microscopy and good lab practices.

CO5. Develop skills for sampling.

CO6. Can initiate his laboratory of microscopic sample collection and can sell the sample to the research institution.

CO7. Understand the hydrophytic diversity of that area.

PO-CO Mapping:

PO	CO-01	CO-02	CO-03	CO-04	CO-05	CO-06	CO-07	CO-08	CO-09
PO-01	√						√		
PO-02							√		
PO-03	√	√							
PO-04				√	√				
PO-05			√						
PO-06									
PO-07			√						
PO-08					√				
PO-09				√		√			
PO-10						√			
PO-11		√							

B.Sc. (BOTANY)		VI TH SEMESTER	
COURSE CODE: DSEBOT -04		COURSE TYPE: DSEC	
COURSE TITLE: AQUATIC AND MARINE BOTANY			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u>			
xlix.			
bjective type questions			
l. Short answer type questions: Word limit 70-100 words			
li. Middle answer type questions: Word limit 200-250 words			
lii. Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Marine and Limnetic Macro Algae: Common seaweeds of Indian subcontinent i.e. <i>Ulva</i> , <i>Cladophora</i> , <i>Sargassum</i> and <i>Polysiohonia</i> etc. Their Life cycle, ecology and species identification features. Common terrestrial algae including cyanobacteria: its life cycle.	10
2	Mangroves: Famous mangrove forests of India including Sundarbans, Pichavaram, Kerala Mangroves, Rathnagiri mangroves. Life cycle of common species of mangroves and mangrove associated plants <i>Rhizophora</i> , <i>Sonneria</i> , etc. Ecological significance of mangroves.	10
3	Phytoplanktons, Cyanobacteria, and Diatoms: Common marine micro algae of India including phytoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial cyanobacteria of India.	10
4	Aquatic Vascular plants: Common aquatic vascular plants of India including Lotus, waterlilly, Waterhyacinth and Azolla etc. Important characteristics responsible for water adaptation. Values and uses of aquatic plants: Economic importance of aquatic plants.	15

Practical List:

- Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable).
- Visit to nearby lentic ecosystem (pond/lake), collection and identification of aquatic plants by morphology and microscopy.
- Visit to nearby lotic ecosystem (river, streams), collection and identification of aquatic plants by morphology and microscopy.
- Collection and identification of diatoms from soils and muddy streams and its photomicroscopy.
- Collection and identification with the help of microscopic observation of phytoplanktons and cyanobacteria.

*More Practical may be added depending on the local habitats and available facilities

Text Book:

- Lee, R.E. (2008). Phycology. 4th edition. Cambridge University Press, Cambridge.
- Wile, J.M., Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
- Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
- Hoek, C. Van, D. (1999) An Introduction to Phycology. Cambridge University Press.
- Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, Delhi.
- Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd.
- Gangulee H. S. and K. Kar 1992. College Botany Vol. I and II. (New Central Book).
- Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut, India.
- Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press

Nursery and Gardening **(General Elective Course)**

Course Learning Outcome: At the end of this course, the students will be able to:

CO1. Understand the concept of Nursery its types and component.

CO2. Understand and make other aware with sustainable natural resource management and biodiversity conservation with the help of Nursery and gardening.

CO3. Understand the importance of a plant nursery and basic infrastructure to establish it.

CO4. Explain the basic material, tools and techniques required for nursery.

CO 5. Demonstrate expertise related to various practices in a nursery.

CO 6. Comprehend knowledge and skills to get an employment or to become an entrepreneur in plant nursery sector

PO-CO Mapping:

PO	CO-01	CO-02	CO-03	CO-04	CO-05	CO-06	CO-07	CO-08	CO-09
PO-01	√			√					
PO-02									
PO-03	√								
PO-04			√			√			
PO-05				√	√				
PO-06			√						
PO-07									
PO-08									
PO-09					√	√			
PO-10		√				√			
PO-11		√							

B.Sc. (BOTANY)		VI TH SEMESTER	
COURSE CODE: GECBOT -04		COURSE TYPE: GE	
COURSE TITLE: NURSERY AND GARDENING			
CREDIT:		HOURS:	
THEORY: 3	PRACTICAL: 1	THEORY: 45	PRACTICAL: 30
MARKS			
THEORY: 80+20		PRACTICAL:50	
<u>Scheme of Paper in Semester Exam:</u> liii.Objective type questions liv.Short answer type questions: Word limit 70-100 words lv. Middle answer type questions: Word limit 200-250 words lvi.Long answer type questions: Word limit 500-600 words.			

Unit	Content of the Course	No of Periods
1	Introduction to Plant nursery: Definition, importance, scope.; Different types of nurseries (on the basis of duration, plants produced); Basic facilities for a nursery; layout and components of a good nursery. Gardening: definition, objectives and scope; different types of gardening (landscape and home gardening)	15
2	Necessities for nursery: Nursery beds and its types, growing media, nursery tools, containers for plant nursery, Seeds and other vegetative material used to raise nursery. Seed: structure and types- seed dormancy; Causes and methods of breaking dormancy; factors affecting seed viability	10
3	Vegetative propagation: air-layering/soil layering, cutting, selection of cutting, selection of stock plant, collecting season, treatment of cutting, rooting medium and planting of cuttings. Storage and marketing procedures.	10
4	Management of nursery and garden: Seasonal activities and routine operations in a nursery; watering, weeding and nutrients; pests and diseases. Economics of nursery development; pricing and record maintenance; Online nursery information and sales systems.	10

Practical List:

- To Study of germination of dormant & non-dormant seeds (Pea, tomato, maize, bean).
- To estimate bulk density and porosity of Garden soils
- To determine moisture content & water holding capacity of Garden Soils.
- To determine the pH of the Garden Soils.
- Study of different types of tools & accessories for Nursery.
- Study of different methods of vegetative propagation: a) propagation by specialized organs b) propagation by cutting c) layering d) grafting e) budding

Text Book:

- Bose T.K. & Mukherjee, D. 1972. Gardening In India, Oxford & IBH Publishing Co., New Delhi.
- Sandhu, M.K. 1989. Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
- Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications. Nagercoil.
- Edmond Musser & andres, Fundamentals of Horticulture, McGraw Hill., New Delhi.
- Agrwal, P.K. 1993. Hand Book Of seed Technology, Dept, Of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
- Janick Jules.1979.Horticultural Science , W.H.Freeman and Co. San Franciso, USA
- Ratha Krishnan, M., et.al. (2014) Plant nursery management: Principles and practices, Central Arid Zone Research Institute (ICAR), Jodhpur, Rjasthan
- Kumar, N., (1997) Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
- Kumar Mishra, K., N.K. Mishra and Satish Chand (1994) Plant Propagation, John Wiley & Sons, New Jersey