Parvatibai Chowgule College of Arts and Science
(Autonomous)
Accredited by NAAC with Grade 'A+'
Best Affiliated College-Goa University Silver Jubilee Year Award

DEPARTMENT OF BOTANY

SYLLABUS FOR THREE/FOUR YEAR UNDERGRADUATE DEGREE HONOURS PROGRAMME IN B.Sc. Botany

(Implemented from the Academic Year 2023-2024 onwards)

COURSE STRUCTURE

SEMESTER	MAJOR (4 credits/course)	MINOR/ VOCATIONAL (4 credits/course)	MDC (3credits/course)	SEC (3 credits/course)
I	**UG-BOT-101** Diversity of Lower Plants (Microbes, Algae, Fungi)	**UG-BOT-101** Diversity of Lower Plants (Microbes, Algae,Fungi)- (Minor same as major)	**UG-BOT-MDC 1** Plant Animal Interaction	**UG-BOT- SEC 1** Basics in Horticulture
II	**UG-BOT-102** Cell Biology and Biomolecules	**UG-BOT-102** Cell Biology and Biomolecules- (Minor same as major)	**UG-BOT-MDC 2** Ethno botanical Concept	**UG-BOT-SEC 2** Algal Biotechnology
III	**UG-BOT-201** Diversity of Lower Plants II (Bryophytes, Pteridophytes, Gymnosperms) **UG-BOT-202** Economic Botany	**UG-BOT-203** Plant pathology	**UG-BOT-MDC 3** Evolutionary biology	**UG-BOT-SEC 3** Microbiology
IV	**UG-BOT-204** Plant Anatomy **UG-BOT-205** Cytogenetics **UG-BOT-206** Plant breeding and Biostatistics **UG-BOT-207** Ecology and conservation	**UG-BOT-VOC 1** Horticulture, Floriculture & Landscaping		
V	**UG-BOT-301** Plant Physiology **UG-BOT-302** Systematics of flowering plants **UG-BOT-303** Techniques and Instrumentation	**UG-BOT-VOC 2** Herbal Cosmetology		
VI	**UG-BOT-305** Plant Genetic engineering **UG-BOT-306** Plant Molecular biology **UG-BOT-307**	**UG-BOT-VOC 3** Applied Mycology		

*** Implementation of fourth year (Semester VII & VIII) is subject to approval from DHE**

	Plant tissue culture **UG-BOT-PRJ:** Minor Project			
VII	**UG-BOT-401** Plant Drug Technology and Pharmaco gnosy **UG-BOT-402** Bioinformatics **UG-BOT-403** Enzymes and Molecular pathways **UG-BOT-404** Organic Farming	**UG-BOT-405** Ethno botanical Concept		
VIII	**UG-BOT-406** Plant Biotechnology **UG-BOT-407** Plant Embryology **UG-BOT-408** Plant Biochemistry **UG-BOT-409** Industrial Botany	**UG-BOT-410** Bioresource Management		

SEMESTER I

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE: DIVERSITY OF LOWER PLANTS (MICROBES, ALGAE, FUNGI) (THEORY)

COURSE CODE: UG-BOT-101
MARKS: 100 (75 theory + 25 Practical)
CREDITS: 4 (3 theory + 1 Practical)
COURSE DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XII preferred.

COURSE OBJECTIVES:
This paper provides knowledge on basic knowledge of the lower group of organisms. (microbes, algae and fungi)

COURSE OUTCOMES:
Upon successful completion of the course, students will be able:
CLO1: State, describe and explain the characters and evolutionary aspects of different groups of lower plants upto fungi.
CLO2: Define, Describe, correlate and compare the algae and fossils.
CLO3: Position a given alga as per the classification studied.
CLO4: Sketch the morphology and anatomy of selected algae and fungi.

MODULE I: MICROBES		15 lecs
1.1	Cell types, prokaryotic and eukaryotic cells. Evolution of cells. Endosymbiotic theory: Origin of plastids, oxygen revolution	
1.2	Microbes from the environment (Air, soil and water). Structure of Virus, bacteriophage and TMV.	
1.3	Five kingdom classification	
1.4	Distribution, systematic position and life cycle of Cyanophyceae: *Nostoc*.	

MODULE II: ALGAE AND FUNGI		**15** lecs
2.1	ALGAE: Classification of algae (Cyanobacteria, Chlorophyta, Phaeophyta and Rhodophyta) following Lee (1999) upto groups with general characters and examples	
2.2	Type study: Charophyta: *Chara*, Chlorophyta: *Chlamydomonas or Chlorella*, Rhodophyta: *Polysiphonia*, Phaeophyta: *Sargassum*.	

2.3	FUNGI: General characteristics, Classification, economic importance. Systematic position, life history of *Puccinia* and *Penicillium*	

MODULE III: PALEOBOTANY, LICHENS, MYCORRHIZAE AND ECONOMIC IMPORTANCE. **15** lecs

3.1	Fossils and fossilization, importance of fossils, Birbal Sahni institute	
3.2	Lichens: Structure, Ecological and economic importance of Lichens	
3.3	Mycorrhizae: Types and significance	
3.4	Economic and/or ecological importance of Viruses, Bacteriophage, TMV, Cyanobacteria, algae and fungi	
	TOTAL	**45**

COURSE TITLE: DIVERSITY OF LOWER PLANTS (MICROBES, ALGAE, FUNGI) (PRACTICAL)

COURSE CODE: UG-BOT-101

MARKS: 25

CREDITS: 1

PRACTICAL SESSION: 15 (*Inclusive of 3 PA*)

1.	Observation and study of Bacterial colonies	1
2.	Isolation and observation of microorganisms from different habitats: Air, soil and water.	3
3.	Morphological study of algal and Blue green algal forms: *Oscillatoria / Nostoc, Chara / Spirogyra, Sargassum, Polysiphonia*	3
4.	Morphological study of fungal forms: *Puccinia, Penicillium, Albugo* and *Rhizopus*	3
5.	Observation of Mycorrhizal root colonization	1
6.	Study of lichens (Permanent slide/ specimen)	1
7.	Study of fossils: (Permanent slide/ specimen)	1
8.	Mini project: i. Collection and field study of locally available Algae, fungi and Lichens	2
	TOTAL	**15**

MANDATORY REFERENCES:

1. Alexopoulos, Constantine J.;Mims, Charles W. (1983). *Introductory Mycology*; 3rd edition; New Delhi: Wiley Eastern Limited.
2. Fritsch, F.E.,(1956). *The structure and reproduction of the Algae*; Volume I and II. Cambridge University Press.

3. Gupta, P.K. (1999). A Text-book of Cell and Molecular Biology. Rastogi Publications, Meerut, India.
4. Kar, Ashok Kumar; Gangulee, Hirendra Chandra (2006). *College Botany:* Volume II; 2nd Edition; Kolkata: New Central Book Agency (P)Ltd.
5. Prescott, H. (2008). *Microbiology*. Boston: McGraw-Hill Higher Education.
6. Verma P.S. and Agarwal V. K. (1998).Cell Biology, Genetics, Molecular Biology, Evolution and ecology. Edn.14

ONLINE RESOURCES:

1. https://www.pdfdrive.com/the-structure-and-reproduction-of-the-algae-d34383978.html
2. https://www.pdfdrive.com/virus-an-illustrated-guide-to-101-incredible-microbes-d158088974.html

MULTDISCIPLINARY COURSES (MDC)

Plant Animal Interaction

COURSE TITLE: PLANT ANIMAL INTERACTIONS

COURSE CODE: UG-BOT-MDC 1

MARKS: 75

CREDITS: 3

DURATION: 45 HOURS

COURSE OBJECTIVES:

To bridges the gap between Plants and animal interactions (various disciplines, viz. botany, zoology, microbiology. etc) and apply this knowledge in the area of Biodiversity, Conservation, pollination, crop productivity, biological control and bioprospecting.

COURSE OUTCOME

CLO1: Would have understood intricate evolutionary relationship between plants and animals including their interdependence.

CLO2: Should have learnt the role herbivory in phytochemical evolution and it's importance in plant based drugs.

CO3: Would have understood the importance of multicultural practices in the control of pests, organic farming and reduction of synthetic pesticides.

CLO4: Able to appreciate the ecosystem services through this plant animal interaction.

CLO5: Able to work in field of Research, Forestry and Biodiversity Management.

MODULE I: DIVERSITY OF PLANT-ANIMAL INTERACTIONS **15** lecs

1.1	Plant animal interactions- Mutualism, Antagonism, Commensalism, Competition, Multi-trophic level interactions; Coevolution and co-speciation of plants and animals;

1.2	Evolutionary history of interactions and evidences in the geological past; principle of allocation. Adaptive radiation.	
1.3	Plant communities as animal habitats- Adaptations, ecological segregation within and between habitats.	
1.4	Mechanisms of habitat selection, habitat selection theory, Plant-animal interactions in agricultural ecosystems; future directions.	

MODULE II: POLLINATION BIOLOGY & FRUITS, SEEDS AND DISPERSAL AGENTS **15** lecs

1.1	Pollination: Importance of cross pollination. Special differentiation associated with pollinator attraction – advertisement and reward (pollen. Nectar, elaiophores, resin glands, osmophores, optical displays and visual clues).	
1.2	Floral adaptation to different pollinators; insect visitors, birds, bats, non-flying animals. Sapromyiophily, Broodsite pollination; fig-wasp interaction and pollination.	
1.3	Pollination biology and gene flow: foraging theory, foraging strategies and time-niche strategies.	
1.4	Plant adaptations - Fruit chemistry (chemical compartmentalization - pulp and seed, nutritional aspect of pulp, palatability inhibitors and toxins). Seed coat, seed toxins. Phenology; signals, fruit size and fruit production. Dispersers: range of seed dispersers, frugivores as foragers.	
1.5	Animal adaptations – External and internal morphology, digestive physiology, behaviours.	
	TOTAL	**30**

COURSE TITLE: PLANT ANIMAL INTERACTIONS

COURSE CODE: UG-BOT-MDC1

MARKS: 25

CREDITS: 1

PRACTICAL SESSION: 15 ***(Inclusive of 3 PA)***

1.	Study of trap mechanisms in carnivorous plants 1. Pitfall traps of Pitcher plants (*Nepenthes*) 2. Flypaper of Sundews (*Drosera*) 3. Snap traps (or steel traps) of the Venus flytrap *(Dionaea muscipula)* 4. Suction traps, of bladderworts (*Utricularia*)	**2**
2.	Techniques for the identification of osmophores in flower.	**1**
3.	Estimation of sugars in nectar using Benedict's reagent.	**2**
4.	Study of plant defence against herbivores. 1. Trichomes *(Urtica dioica)* 2. Raphids in plant tissue. ***(****Colocasia /Commelina)*	**2**
5.	Sampling of nectar by centrifugation and estimation of sugar content in nectar.	**2**
6.	Visit to wildlife sanctuary and observing plant animal interactions in nature	**2**
7.	Mini project: 1. Study of Principal groups of dispersers and their salient characteristics. 2. Ant-plant symbioses [granivores ants, ant gardens (Fungus growers) and leaf-cutting ants] 3. Mimicry in plants 4. Foliar signals in plants	**4**
	TOTAL	**15**

MANDATORYREFRENCES

1.Abrahamson, W.G. (ed.). 1989. Plant-animal interactions.McGraw-Hill Book Company, NY.

2.Burslem, D., M.Pinard and S.Hartley. 2005. Biotic Interactions in the Tropics: Their Role in the Maintenance of

3.Species Diversity. Cambridge University Press. Crawley, M.J. 1986. Plant Ecology. Blackwell ScientificPublications.

4.Endress, P.K. 1994. Diversity and Evolutionary biology oftropical flowers. Cambridge University Press.

5.Harborne, J.B. 1988. Introduction to ecological biochemistry.Academic Press.

6.Herrera, Carlos M. and Olle Pellmyr (eds.). 2002. PlantAnimal Interactions: An Evolutionary Approach. BlackwellScience.

7.Holldobler, B. and Wilson, E.O. 1990. The Ants. SpringerVerlag.

8.Lloyd, D.G. and Barret, S.C.H. 1996. Floral Biology: studies on Floral evolution in Animal pollinated plants. Chapman &Hall.

9.Price, P.W., T.M. Lewinsohn, G.W.Fernandes and W.W. Benson. 1991. Plant-Animal Interactions: Evolutionary

10.Ecology in Tropical and Temperate Regions. A Wiley Interscience publication

11.Proctor, M., Yeo, P. and Lack, A. 1996. The Natural History of Pollination. Harper Collins Publishers.

12.Richards, A.J. 1986. Plant Breeding systems. George Allen &Unwin, London.

13.Schaefer, M.H. and G.D. Ruxton. 2011. Plant-AnimalCommunication. Oxford University Press.

14.Seckbach, J. and Z. Dubinsky. 2010. All Flesh Is Grass:Plant-Animal Interrelationships. Springer Science &Business Media.

15.Smith, R.L. 1990. Ecology and field biology. Harper Collins

16.Knaebe, Silvio & Mack, Pierre & Chen², Ang & Bocksch, Sigrun. (2015). 2.11 Available methods for the sampling of nectar, pollen, and flowers of different plant species. Julius-Kühn-Archiv. 131-138.

ONLINE RESOURCES:

1. https://botany.org/home/resources/carnivorous-plants-insectivorous-plants.html

2. https://www.researchgate.net/publication/302580569_211_Available_methods_for_the_sampling_of_nectar_pollen_and_flowers_of_different_plant_species

SKILL ENHANCEMENT COURSE (SEC)

COURSE TITLE : BASICS IN HORTICULTURE (THEORY)
COURSE CODE : UG-BOT-SEC 1
CREDITS : 3 (2 Theory + 1 Practical)
MARKS : 75 (50 T+25P)
DURATION : 30

PREREQUISITE COURSES : Nil

COURSE OBJECTIVES
Is to provide entrepreneur opportunities.

COURSE LEARNING OUTCOMES
Upon completion of the course, the student will be able to :
CLO1: Explain the basics of Horticulture, floriculture and landscaping. Inculcate the technique of vegetative propagation of plants.
CLO2: Outline the requirements for building up nurseries, garden, etc.
CLO3: Identify and relate the scope of these fields in building up career
CL O 4: Identify and relate the scope of these fields in building up career

MODULE I: TOOLS AND TECHNIQUES IN HORTICULTURE,FLORICULTURE AND PROPAGATION METHODS		**15**
1.1	Definition and importance; Pomoculture, Olericulture, Floriculture.	
1.2	Fertilizers: inorganic, Organic – biofertilizers: vermicomposting, green manure, algal culture, FYM.	
1.3	Irrigation: Surface, Sprinkle, Drip and Gravity irrigation	
1.4	Introduction to Green house, Poly house, Moist chamber, Net frame, Introduction to Hydroponics.	

1.5	Introduction to sexual methods (seed propagation) – Definition, Merits and Demerits, Criteria for selection of seeds.	
1.6	Asexual (Vegetative) propagation – Definition, and types- Cutting (root, stem, leaf), Layering (simple, air), Grafting (Whip, Approach) and Budding (T, patch), Stock –scion relationship in important horticultural crops. Use of plant growth regulators in horticulture	
MODULE II: LANDSCAPING		**15**
1.1	Locations in the garden- edges, hedges, fence, lawn, flower beds.	
1.2	Avenue, water garden (with two examples of each). Focal point. Auto CAD in garden designing.	
1.3	National parks, Botanical gardens, water garden, rockery plants, Bonsai techniques, Hydroponics.	
1.4	Lawn making: type of lawn grasses and maintenance. Plants suitable for hedges. Aftercare: Weeding, top dressing methods of pruning and topiary	
	TOTAL	**30**

COURSE TITLE: BASICS IN HORTICULTURE (PRACTICAL)

PAPER CODE : UG-BOT-SEC 1
MARKS: 25 Marks
CREDITS: 1 credit

1.	Familiarizing gardening tools and implements	01
2.	Preparation of nursery bed and polybag filling	01
3.	Preparation of potting mixture – Potting, repotting	02
4.	Methods in vegetative propagation (cutting, grafting, budding, layering)	02
5.	Garden designing using Auto CAD software/any app	01
6.	Preparation of organic compost & vermicompost	02
7.	Establishment of vegetable garden using organic compost & vermi-compost	03
8.	Flower arrangement	01
9.	Improving the shelf life of cut flowers using chemicals.	01
10.	Visit to nurseries, gardens and Report.	01
	Total	**15**

MANDATORY REFRENCES

1.Swarup V. (1997). Ornamental horticulture. MacMillan India Limited, NewDelhi.

2.Randhava, G.S, (1973) – Ornamental horticultural in India Today andTomorrow Printers and Publishers, NewDelhi.

3.Trivedi TP (2007). Ornamental horticultural in India. Indian Council of Agricultural Research NewDelhi.

4.Nayak,K.C.South Indian fruits and their culture P.L. Varadaraj&Co.,&LingichettiStreet,Madras.

5. Edment Senn Andrews (1994) Fundamentals of Horticulture – Tata McGraw Hill Publishing Co., Ltd., Delhi.

ONLINE RESOURCES:

1. http://agritech.tnau.ac.in/horticulture/horti_index.html

SEMESTER II

DISCIPLINE SPECIFIC CORE COURSE

COURSE TITLE: CELL BIOLOGY AND BIOMOLECULES (THEORY)
COURSE CODE: UG-BOT-103

MARKS: 100 (75 Theory+ 25 Practicals)
CREDITS: 4 (3 Theory+ 1 Practical)
COURSE DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.

This course will provide a detailed discussion on a wide range of topics in Cell biology & Bio- molecules emphasizing experimental approaches and key experiments that have provided important insights. The course is aimed at conveying an understanding of how cellular structure and function arise as a result of the properties of cellular macromolecules. Emphasis will be on the dynamic nature of cellular organization, structure and function.

COURSE OUTCOME:

Upon successful completion of the course, students will be able:

CLO 1: Recognise, classify cell, explain cell theory, evolution and biogenesis

CLO 2: Define, describe, classify and explain cytoskeleton, cell organelle, biomolecules.

CLO 3: Define, describe, compare, explain, illustrate cell wall and plasma membrane

CLO 4: Predict and interpret the importance of cell

MODULE I: INTRODUCTION TO CELL, ULTRA-STRUCTURE AND FUNCTION OF CELL WALL AND PLASMA MEMBRANE **15 lecs**

1.1 Discovery and basic properties of cells
1.2 Structure and functions of cytoskeleton
1.3 Structure and function of Microtubule, Intermediate filaments, Microfilaments
1.4 Structure and function of cell wall, Chemical composition of cell wall
1.5 Extracellular matrix and cell interactions, Gap -Junctions & plasmodesmata
1.6 Structure and function of plasma membrane, Active and Passive transport of solute (channels & pumps).

MODULE II: STUDY OF CELL ORGANELLES **15 lecs**

2.1 Structure & functions of Chloroplast, Mitochondria, Peroxisome, Glyoxysome & Lysosomes; Semi autonomy and gene control
2.2 Nucleus and its Organization; Nuclear envelope, nuclear pore complex, Nuclear matrix, Chromosomes and chromatin structure
2.3 Structure and function of ribosome
2.4 Endomembrane systems- Endoplasmic reticulum and Golgi complex

MODULE III: BIOCHEMISTRY OF MINO ACIDS AND PROTEINS CARBOHYDRATES, LIPIDS	**15 lecs**
3.1 Definition & importance of biomolecules; types of bonds in bio- molecules; pH and buffers; Water as a biological solvent	
3.2 Classification and biological functions of carbohydrates and lipids	
3.3 Classification and biological functions of amino acids, proteins.	
TOTAL	**45**

COURSE TITLE: CELL BIOLOGY & BIOMOLECULES (PRACTICAL)
COURSE CODE:UG-BOT-102

MARKS: 25

CREDITS: 1

PRACTICAL SESSION: 15 (*Inclusive of 3 PA*)

1.	Study of cell structure in *Hydrilla* and *Tradescantia* staminal Hairs	**1**
2.	Examination of prokaryotic cell, eukaryotic cell and cell organelles by EM graphs	**1**
3.	Preparation of temporary slides to observe different types of cells	**2**
4.	Staining and Preparation of slides: i. Cytochemical staining of Nucleus- Acetocarmine ii. Cytochemical staining of polysaccharides- Periodic Acid Schiff's (PAS) iii. Cytochemical staining of Mitochondria – Jannis Green iv. Cytochemical staining of Total proteins Bromophenol blue v. Cytochemical staining of Histones – Fast Green	**6**
5.	Qualitative detection of Macromolecules (Carbohydrates, Proteins, Lipids)	**3**
6.	Prepararions of solutions (Normal, Molar, PPM) and Buffers	**2**
TOTAL		**15**

REFERENCES:
List of books recommended for reference

MANDATORY READING:

1. Gupta, P.K. (1999). *A Text-book of Cell and Molecular Biology*. Meerut, India: Rastogi Publications.
2. Karp, G. (1999). *Cell and molecular Biology*, *Concepts and experiments.* 2nd edition. USA: John Wiley and Sons Inc.

3. U. Satyanarayana and U. Chakrapani. (2000). *Biochemistry*, 4th edition., Kolkata: Elsevier Pub.

4. Verma P.S. and Agarwal V. K. (1998). *Cell Biology*, *Genetics*, *Molecular Biology*, *Evolution and ecology*. 14th Ed. New Delhi: S Chand Publishers.

Supplementary Reading

1. David L. Nelson & Michael M. Cox. (2013). *Lehninger Principles of Biochemistry*, 4th ed. New York: W.H. Freeman & Co.

2. Donald Voet., Judith G. Voet and Charlotte W. Pratt. (2002). *Fundamentals of Biochemistry*, 2nd edition, John Wiley and Sons Pvt Ltd.

3. Robert A. Horton. (2006). *Principles of Biochemistry*.4 th ed. Pearson Prentice Hall.

4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (2002). *Biochemistry* 5th edition, New York; W.H.Freeman & Company

5. Paul Flinch (1999). *Carbohydrate structure, Synthesis & Dynamics.* The Netherlands: Kluwer Academic Pub.

6. Randall J. Weselake Email author Stacy D. Singer Guanqun Chen. (2018, July 19). *Introduction to Plant Biomolecules and Cellular Metabolism.* Retrieved February 13, 2020, from Springer: https://link.springer.com/chapter/10.1007/978-1-4939- 8616-3_2

7. 2013, November 11). Retrieved February 13, 2020, from NPTEL: https://nptel.ac.in/courses/102103012/

8. BIOLOGY JUNCTION. (2017, April 21). Retrieved February 13, 2020, from Structure & Function of the Cells: https://www.biologyjunction.com/cell++notes+bi.html.

ONLINE RESOURCES

1. www.britannica.com
2. https://www.springer.com
3. https://www.biologydiscussion.com
4. www.cellbiologyjournal.org
5. www.academia.edu

MULTIDISCIPLINARY COURSES (MDC)

COURSE TITLE: ETHNO-BOTANICAL CONCEPTS (THEORY)

COURSE CODE: BOT-I.GEC-3.

MARKS: 100 (75 theory + 25 Practical)

CREDITS: 4 (3 theory + 1 Practical)

COURSE DURATION: 45 HOURS

PREREQUISITE COURSES: Biology at XIIth preferred.

COURSE OBJECTIVES: This course will deals with the origin, utilization, cultivation and uses of plants known in traditional herbal medicine; endangered and rare useful plants, it also deals with the various methods of ethnobotanical studies and roles of ethnobotany in biodiversity conservation and socio-economic development.

COURSE OUTCOMES

CLO1.Enumerate the concept, scope and objectives of ethnobotany with reference to tribal lifestyle

CLO2. Analyse the role of various plants in traditional and modern medicine

CLO3. Infer the legal aspects of ethnobotany

CLO4. Evaluate different ethnobotanical methodologies

MODULE I: INTRODUCTION TO ETHNOBOTANY **15**

1.1 Introduction, concept, scope and objectives.

1.2 Ethnobotany as an interdisciplinary science.

1.3 Major and minor ethnic groups or Tribals of India, and their life styles.

1.4 Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

15

MODULE II: ROLE OF ETHNOBOTANY IN MODERN MEDICINE

2.1 Medico-ethnobotanical sources in Goa, India.
Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) *a) Azadiractha indica b) Ocimum sanctum c) Vitex negundo. d) Gloriosa superba e) Pongamia pinnata f) Cymbopogon citratus.*

2.2 Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina, Curcuma longa, Garcinia indica, Syzygium cumini*

2.3 Role of ethnic groups in conservation of plant genetic resources.

MODULE III: ETHNOBOTANY AND LEGAL ASPECTS **15**

3.1 Ethnobotany as a tool to protect interests of ethnic groups.

3.2 Sharing of wealth concept with few examples from Goa, India.
Biopiracy, Intellectual Property Rights and Traditional Knowledge.

TOTAL **45**

COURSE TITLE: ETHNO-BOTANICAL CONCEPTS (PRACTICAL)
COURSE CODE: BOT-I.GEC-3
MARKS: 25
CREDITS: 1
COURSE DURATION: 15 SESSIONS (*inclusive of 3 PA*)

1.	Collection, processing and preservation of ethnobotanical specimens; *Aahatoda varcca, Aegle marmelo, Boerhaavia diffusa, Cassia tora, Selaginella sp, Ficus religiosa, Ficus benghalensis, Azadirachta indica.*	4
2.	Identify and document plant parts used in preparation of crude drugs/herbal formulations.	2
3.	Preparation of natural Holi colours using Turmeric, Hibiscus, Marigold, *Chrysanthemums.*	2

4.	Virtual demo of Halotherapy.	1
5.	Visit temples and sacred groves of Goa and understand the culture and ecology and report submission.	2
6.	Mini projects 1. Survey for collection of Archaeological Resources from local tribes, Folk songs, folk tales and proverbs. 2. Traditional germplasm management: in situ and ex-situ conservation 3. Observation of archaeobotanical remains and collection of data.	4
	TOTAL	15

MANDATORY REFRENCES

1. S.K. Jain, (1995) Manual of Ethnobotany, Scientific Publishers, Jodhpur.
2. S.K. Jain (1981) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi
3. Lone et al,Palaeoethnobotany
4. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
5. S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur.
6. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons-Chichester
7. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah.
8. Rajiv K. Sinha (1996)– Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur

ONLINE REFERENCES:

https://www.forestessentialsindia.com/blog/how-to-prepare-natural-colours-for-the-festivities-of-holi.html

SKILL ENHANCEMENT COURSE (SEC)

COURSE TITLE: ALGAL BIOTECHNOLOGY (THEORY)

COURSECODE: UG-BOT-SEC 2

MARKS: 75(50Theory+25Practicals)

CREDITS: 3(2Theory +1Practical)

COURSE DURATION: 30 HOURS

COURSEOBJECTIVES:
This course provides knowledge on diversity of algal types in Goa and understands the potential significance of algal resources as food, fodder, fuel and environment sustenance.

COURSEOUTCOMES: Students will be able to

CLO1: Apprise the students to the methods of algal culture techniques.
CLO2: Assess, compare and manage algal in water bodies
CLO3: Explore algal bio-resources and understand their commercial lapplications.
CLO4: Understand opportunities for start-ups through eco-friendly bio- fertilizer production using algae.

MODULE I: METHODS OF ALGAL ISOLATION, CULTURE AND ALGAL POLLUTION **15**

UNIT1: METHODSOFALGALISOLATION, CULTURE

1.1 Introduction to Algal Biotechnology, freshwater and marine algae

1.2 Methods of algal isolation

1.3 Types of algal cultures (synchronous, continuous, mass culture)

1.4 Maintenance and multiplication of algae(Cyanophyta)

UNIT 2: ALGALPOLLUTION

2.1 Algae as indicator of pollution

2.2 Eutrophication and its impact on water quality, Algal Blooms and their control

2.3 Phycoremediation

MODULEII:COMMERCIALAPPLICATIONSOFALGALTECHNOLOGY **15**

3.1 Single cell algal proteins

3.2 Algae as food and fodder

3.3 Algae in pharmaceutical industries

3.4 Algae in biofuels and bioplastics

3.5 Algae as Biofertilizers

COURSE TITLE: ALGAL BIOTECHNOLOGY (PRACTICALS)
PAPER CODE: UG-BOT-SEC 2
MARKS: 25

CREDITS:1

COURSEDURATION: 15 SESSIONS

1.	Sterilization of glassware, preparation of media (freshwater algae)	2
2.	Culturing of freshwater algae	1
3.	Chromatographic separation of algal pigments	2
4.	Isolation and estimation of algal proteins	2
5.	Preparation of algal biofertilizer (powdered and liquid)	2
6.	Visit to NIO and submission of report	1
	Mini Projects 1. Collection, culturing and maintenance of commonly found algae in Goa (Fresh & marine water, one each) 2. Survey of market products of algal material	5
	Total	**15**

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1. Becker, S. W. (1994). *Micro Algae Biotechnology and Microbiology.* Cambridge UniversityPress.
2. Ignacimuthu, S. (1996). *Basic Biotechnology*. New Delhi: Tata McGraw Hill PublishingLimited.
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- Aziz M.A. and Ng W.G. (1993). Industrial wastewater treatment using an activated algae-reactor.*WaterSci.Technol.* ***28:71–76.***
- ThomasD.G.,MinjN.,MohanN.andRaoP.H.(2016.)Cultivationofmicroalgaeindomestic wastewater for biofuel applications – An upstream approach. *J. Algal BiomassUtln.****7(1):62-70***
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