

# **SACRED HEART COLLEGE (AUTONOMOUS)**

**Department of BOTANY**

**MASTER OF SCIENCE IN BOTANY**

**Course plan**

**Academic Year 2015 – 16**

**Semester I**

## MICROBIOLOGY AND PHYCOLOGY

### Course Objectives

To enable the students to identify macro and micro algae

To equip the students with advanced knowledge on Algae including their uses in day to day life

To facilitate the students with advanced knowledge in Phycology including Algal Biotechnology

To have a detailed understanding about microbial diversity, their cell structure, their helpful and harmful effects to human beings

To help in gathering detailed understanding about different scopes of Microbiology at a broader spectrum

To have advanced knowledge about some of the dreadful diseases such as AIDS, SARS, etc.

To become aware of the multiple scopes and applications of these organisms

### Basic Reference

1. Bilgrami K L, Sinha L (2005). *Essentials of Microbiology*. C&S Publishers and distributors
2. Black, J. G (2008). *Microbiology: Principles and Explorations* (vii<sup>th</sup>edn). JOHN WILEY & SONS, INC.
3. Carpenter P L (1967). *Microbiology* II<sup>nd</sup> edition. W B Saunders Co. Philadelphia.
4. Dube H C (2008). *Fungi, Bacteria and Viruses*. Agrobios.
5. Kanika Sharma (2005). *Manual of Microbiology: Tools and Techniques*. Ane Books
6. Desikachary T.V. (1959). *Cyanophyta*. ICAR, New Delhi.
7. Desikachary, T.V., Krishnamurthy, V. and Balakrishnan, M.S. 1990. *Rhodophyta Vol.I&II*. Madras Science Foundation, Chennai.
8. F E Fritsch (Vol. I, II) (1977). *The structure and reproduction of Algae*. Cambridge University Press.
9. Gilbert M Smith (1951). *Manual of Phycology*.
10. Gilbert M Smith (1971). *Cryptogamic Botany (Vol. 1): Algae and Fungi*. Tata McGraw Hill Edition.

1.	Date	Topic	Method	Remark
1	Session 1	(a) Bacterial morphology. Classification of Bacteria according to	Presentation/Chalk and Board/Assignment	
2.	Session 2	Bergey's manual of systematic bacteriology.Modern trends in		
3	Session 3	bacterial taxonomy- DNA barcoding. (b) Ultra structure of Gram positive and Gram negative bacteria; cell membrane, cell wall, External structures-flagella, pili, fimbriae, capsule (glycocalyx) and slime, Internal/cytoplasmic structures- Nucleoid, ribosome and endospores, .		
4	Session 4	(c) Major groups of Bacteria: Spirochaetes, Rickettsias,	Assignment Presentation/Chalk and Board	
5	Session 5	Chlamydias, Mycoplasmas,		
6	Session 6	Actinomycetes,		
7	Session 7	Myxobacteria, Archaeobacteria. Extremophiles - thermophilic, halophilic, acidophilic and alkalophilic bacteria. (d) Nutritional types - Photolithotrophs, chemolithotrophs, photoorganotrophs, and chemoorganotrophs.		
8	Session 8	(e) Bacterial Genetics: Organization and replication of genetic material in	Presentation/Chalk and Board	
9	Session 9	bacteria – bacterialchromosome, plasmid. Recombination in bacteria -		
10	Session 10	conjugation, transformation and transduction.Sexduction. Application of bacteria in ecombinant technology and genomics. (f)Culture of microorganisms: Methods for isolating pure cultures,		

		types of culture media, enrichment culture techniques, maintenance and preservation of pure cultures.		
11	Session 11	(a) Host-Microbe relationships and diseases	Presentation/Chalk and Board	
12	Session 12			
13	Session 13	(b) Food Microbiology: food spoilage and preservation methods, Microbiology of fermented foods, Microorganisms as source of food-SCP.		
14	Session 14			
15	Session 15	(c) Agricultural Microbiology: Management of agricultural soils, bio-fertilizers, bio-pesticides.  (d) Industrial Microbiology: Production of alcohol, vinegar, antibiotics, vitamins, steroids, vaccines, organic acids and amino acids.		
16	Session 16	Nomenclature and classification, distinctive properties of viruses, morphology (symmetry) and a general account on different kinds of viruses. Capsid and their arrangements, types of envelopes and their composition. Viral genome	Presentation/Chalk and Board	
17	Session 17			
18	Session 18			
19	Session 19			
20	Session 20			
21	Session 21	Structure of bacteriophages belonging to 'T' series. Lytic and Lysogenic phages.Ultra structure of TMV and HIV.  (c) Sub viral particles - prions, viroids, virusoid.  (d) Pathogenesis of viral infection: Stages of infection, Epidemiology and transmission of HIVandHPV.Viral oncogenesis.	Presentation/Chalk and Board	
22	Session 22			
23	Session 23		Presentation/Chalk and Board	
24	Session 24			

25	Session 25	History of algal classification. Detailed study of the classification by F. E. Fritsch and G. M. Smith. Modern trends and criteria for algal classification- DNA barcoding. (b) Centers of algal research in India. Contributions of Indian phycologists – M O P Iyengar, V Krishnamurthy, T V Desikachary, M.S. Randhawa.	Presentation/Chalk and Board Assignment	
26	Session 26			
27	Session 27	Details of habit, habitat and distribution of Algae. (b) Algal components: Cell wall, flagella, eye-spot, pigments, pyrenoid, photosynthetic products. (c) Range of thallus structure and their evolution. (d) Reproduction in algae: Different methods of reproduction, evolution of sex organs. (e) Major patterns of life cycle and post fertilization stages in Chlorophyta, Phaeophyta and Rhodophyta. (f) Fossil algae	Presentation/Chalk and Board Assignment	
28	Session 28			
29	Session 29			
30	Session 30			
31	Session 31			
32	Session 32			
33	Session 33			
34	Session 34			
35	Session 35			
36	Session 36	Ecological importance of Algae. Productivity of fresh water and marine environment. Algae in symbiotic association, Algae in polluted habitat, Algal indicators, Algal blooms.	Presentation/Chalk and Board	
37	Session 37			
38	Session 38	Algae as food, fodder, aquaculture, biofertilizer, biofuel, medicine, industrial uses, source of restriction endonuclease, pollution control and phycoremediation and other useful products. Harmful effects of algae. (b) Use of Algae in experimental studies	Presentation/Chalk and Board	
39	Session 39			
40	Session 40			
41	Session 41	(a) Methods and techniques of collection, preservation and staining of Algae. (b) Algal culture: Importance, methods; Algal culture media.	Presentation/Chalk and Board	
42	Session 42			

**PRACTICALS**

43	Session 43	Preparation and sterilization of various microbial culture media and inoculation. 2. Differential staining of bacteria using Gram stain. 3. Isolation of Rhizobium from root nodules. 4. Isolation of microbes from soil: Serial dilution - pour plate/spread plate method. 5. Streak out a bacterial culture on an agar plate and isolation of colonies. 6. Antibacterial assay - disc diffusion/agar well method	Laboratory/Demonstration	
44	Session 44			
45	Session 45			
46	Session 46			
47	Session 47			
48	Session 48			
49	Session 49	Critical study of diagnostic features and identification of the following genera based on morphological, anatomical and reproductive parts; (a) Cyanophyceae - Gleocapsa, Gleotrichia, Spirulina, Microcystis, Oscillatoria, Lyngbya, Anabaena, Nostoc, Rivularia, Scytonema. (b) Chlorophyceae - Chlamydomonas, Gonium, Eudorina, Pandorina, Volvox, Tetraspora, Ulothrix, Microspora, Ulva, Shizomeris, Cladophora, Pithophora, Coleochaete, Chaetophora, Drapernaldia, Drapernaldiopsis, Trentepohlia, Frittschiella, Cephaleuros, Oedogonium, Zygnema, Mougeotia, Desmedium, Bryopsis, Codium, Caulerpa, Halimeda, Neomeris, Chara, Nitella. (c) Xanthophyceae - Vaucheria. (d) Bacillariophyceae - Biddulphia, Pinnularia. (e) Phaeophyceae - Ectocarpus, Colpomenia, Dictyota, Padina, Sargassum, Turbinaria.	Laboratory/Demonstration	
50	Session 50			
51	Session 51			
52	Session 52			
53	Session 53			
54	Session 54			
55	Session 55			
56	Session 56			
57	Session 57			
58	Session 58			
59	Session 59			
60	Session 60			
61	Session 61			
62	Session 62			
63	Session 63			

		(f) Rhodophyceae - Batrachospermum, Comosopogon, Gelidium, Amphiroa, Gracilaria, Polysiphonia. 2. Students are to collect and identify algae from different habitat or visit an Algal research station. Prepare and submit a report of the field work/research station visit.		
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## M. SC. BOTANY SEMESTER 1

### MYCOLOGY AND CROP PATHOLOGY

#### COURSE OBJECTIVES:

- To enable the students to collect, preserve, identify and classify different micro and macro fungi.
- To have a better understanding on different classification systems and their applications.
- To enrich the significance of mycotic diseases
- To have advanced learning about fungal associations, their usefulness and harmfulness
- To develop advanced theoretical and practical knowledge about phytopathogens and their control.

#### Basic Reference

1. C J Alexopoulos, M Blackwell, C W Mims (1996). Introductory Mycology (IV Edn).
2. Jim Deacon (2006). Fungal Biology (IV Edn). Blackwell Publishing.
3. L N Nair (2010). Methods of microbial and plant biotechnology. New Central Book agency (P) Ltd.
4. Kanika Sharma (2005). Manual of microbiology: Tools and techniques.
5. G C Ainsworth, K F Sparrow, A S Sussman (1973). The fungi: An advanced treatise.
6. H C Dube (1983). An introduction to fungi. Vikas Publ. New Delhi.
7. M E Hale (1974). The biology of lichens.
8. A Misra, P R Agarwal (1994). Lichens.
9. M C Nair, S Balakrishnan (1986). Beneficial fungi and their utilization. Sci. publ. Jodhpur.

10. V Ahamjian, M E Hale (1973). The Lichens.
11. R Dayal (2000). Predaceous Fungi. Commonwealth Publishers.
12. Hibbet et al. (2007). A higher level phylogenetic classification of the fungi. Mycological Researcher 111 (2007) pp. 509-547.

1.	Date	Topic	Method	Remarks/Reference
1	Session 1	General characters of fungi.	PPTs and Lectures	
2.	Session 2	Economic and ecological importance of fungi.	Assignments	
3	Session 3	<b>Module 1: General introduction</b> General characters of Fungi and their significance. Principles of classification of fungi, Classifications by G C Ainsworth (1973) and C. J. Alexopoulos . Classification of true fungi (down to the level of class) according to the current 'AFTOL' scheme (Hibbett et al. 2007). Brief account of DNA barcoding in fungi.	Presentation / Chalk and Board/ Videos	
4	Session 4			
5	Session 5			
6	Session 6			
7	Session 7	<b>Thallus structure and reproduction in Fungi</b> Mycelial structure and reproduction of; Myxomycota – Acrasiomycetes, Hydromyxomycetes,	Presentation/Chalk and Board	
8	Session 8	Myxomycetes, Plasmodiophoromycetes.		
9	Session 9	Mastigomycotina - Chytridiomycetes, Hyphochytridiomycetes		



10	Session 10	Oomycetes	Presentation/Chalk and Board	
11	Session 11	Zygomycotina - Zygomycetes, Trichomycetes.		
12	Session 12	Ascomycotina		
13	Session 13	Hemiascomycetes, Pyrenomycetes,	Presentation/Chalk and Board	
14	Session 14	Plectomycetes, Discomycetes,		
15	Session 15	Laboulbeniomyces, Loculoascomycetes.		
16	Session 16	Basidiomycotina	Presentation/Chalk and Board	
17	Session 17	Teliomycetes, Hymenomycetes,	Presentation/Chalk and Board	
18	Session 18	Gastromycetes		
19	Session 19	Deuteromycotina		
20	Session 20	Blastomycetes, Hyphomycetes, Coelomycetes.	Presentation/Chalk and Board	
21	Session 21	Types of fruiting bodies in fungi.	PPTs and Lectures, Assignments and Seminars Discussions	
22	Session 22	Symbionts - Lichens, Mycorrhiza, Fungus-insect mutualism.		
23	Session 23	Parasites - Common fungal parasites of plants, humans, insects and nematodes.		
24	Session 24	Saprophytes - Fungal decomposition of organic matter, coprophilous fungi, cellulolytic fungi, lignolytic fungi.		
25	Session 25	Agricultural significance of Fungi		
<b>PRACTICALS</b>				
26	Session 26	<b>Practical</b> 1. Critical study of the following types by preparing suitable micropreparations; Stemonitis, Physarum, Saprolegnia, Phytophthora, Albugo, Mucor, Aspergillus, Penicillium, Pilobolous,	Laboratory, Practical and Discussion	
27	Session 27			
28	Session 28			
29	Session 29			
	Session 30			
	Session 31			

	Session 32	Saccharomyces, Taphrina, Xylaria,		
	Session 33	Peziza, Phyllochora, Puccinia, Pleurotus,		
	Session 34	Auricularia, Polyporus, Lycoperdon,		
	Session 35	Dictyophora, Geastrum, Cyathus,		
	Session 36	Fusarium, Alternaria, Pestalotia,		
	Session 37	Tremella, Entoloma, Marasmius,		
	Session 38	Hexagonia, Ganoderma, Graphis,		
	Session 39	Parmelia, Usnea.		
	Session 40	2. Isolation of fungi from soil and water		
	Session 41	by culture plate technique.		
	Session 42	3. Estimation of mycorrhizal colonization		
	Session 43	in root.		
	Session 44	4. Collection and identification of		
		common field mushrooms (5 types).	Assignment on	
			collection of common	
			fungi	
30	Session 45	Field Trip	Campus and near by	
			markets	
31	Session 46	<b>Introduction to the Course</b>	PPTs and Lectures	
32	Session 47	A brief history of plant pathology, Koch's		
33	Session 48	postulates, Concept of Disease. Classification		
34	Session 49	of plant diseases based on (a) Major causal		
35	Session 50	agents - biotic and abiotic, (b) General		
		symptoms, (c) Occurance		
36	Session 51	(a) Disease triangle, Mazz's Disease Pyramid		
		(b) Development of disease in plants:		
		disease cycle(survival or persistence of		
		pathogen between crops and during		
		unfavorable seasons, dissemination of		
		the pathogen, inoculation, recognition		
		between host and pathogen, entry of		
		pathogen(prepenetration&penetration),		
		colonization)		

37	Session 52	(c) Strategies used by pathogens to attack plants. (d) Mechanism of infection- Penetration and entry of pathogen into host tissue – mechanical, physiological and enzymatic.	PPTs and Lectures	
38	Session 53	(e) Host-parasite interaction	PPTs and Lectures	
39	Session 54	(f) Role of biochemicals in pathogenesis: enzymes, toxins (Tabtoxin, Phaseolotoxin, Tentoxin, Cercosporin, Victorin, T Toxin, HC Toxin), growth regulators and polysaccharides. (g) Detoxification of low molecular weight antimicrobial molecules produced by plants, suppression of plant defense responses Pathogenicity and virulence factors in viruses and viroids (h) Physiology of Parasitism: Effect of pathogens on the following processes of the host plant – photosynthesis, transpiration, translocation of water and nutrients, respiration, cell membrane permeability, transcription and translation, growth and reproduction	PPTs and Lectures	
40	Session 55			
41	Session 56	(a) Non-host resistance, horizontal resistance, vertical resistance	PPTs and Lectures	
42	Session 57	(b) Pre-existing defense mechanisms: structural and biochemical (Inhibitors released by the plant in its environment, inhibitors present in plant cells before infection, Defense through lack of essential factors)	PPTs and Lectures	
43	Session 58	(c) Post-Infection/Induced/Dynamic defense mechanisms: structural (cell wall defense structures, histological defense structures) and biochemical (Defense through Production of Secondary Metabolites, Pathogen elicitors, Hypersensitive defense reaction)	PPTs and Lectures	
44	Session 59	Mass action concept by Horsfall; Autonomous or direct or active dissemination (seed, soil & plant organs) & Passive or indirect dissemination (through Animate & inanimate agents); Spread and	PPTs and Lectures	
45	Session 60			

		transmission of plant diseases by wind, water, seeds and vectors.		
46	Session 61	Effect of, temperature, moisture, wind, light, soil pH, host plant nutrition,	PPTs and Lectures	
47	Session 62	(a) Prophylatic methods - Exclusion, eradication and protection.	PPTs and Lectures	
48	Session 63	(b) Therapeutic Method Chemical means of disease control – common fungicides, antibiotics and nematicides. pesticides, and bactericides, types of pesticides based on toxicity- red, blue, yellow, green labels and residual effect. Method of application, different types of sprayers and their working.		
49	Session 64	(c) Biological means of disease control - ( <i>Psudeomonas, Trichoderma, Bruvaria, PGPR, VAM</i> )control of fungal plant pathogens by mycofungicides. (d) Production &use of disease resistant hybrids	PPTs and Lectures	
50	Session 65	(e) Immunization of plants against pathogens – defense through plantibodies, induction of plant defenses by artificial inoculation with microbes or by treatment with chemicals	PPTs and Lectures	
51	Session 66	(e) Transgenic approaches to disease resistance. Defense through genetically engineering disease resistant plants – Biotechnological approaches to disease resistance	PPTs and Lectures	
52	Session 67	Cereals: Rice - blast disease, bacterial blight; Wheat - black rust disease.	PPTs and Lectures	
53	Session 68	(a) Vegetables: Chilly - leaf spot; Ladies finger - vein clearing disease, mosaic disease; Tomato - Damping off, Serpentine leaf miner, fusarium wilt; Cucurbita- Epinauca disease; Root knot in vegetables.	PPTs and Lectures	
54	Session 69	(b) Fruits: Banana - bacterial leaf blight, leaf spot, Pseudo stem borer; Mango - Anthracnose; Fruit borer; Citrus - bacterial canker;Papaya – mosaic, mealy bug disease,	PPTs and Lectures	

		<p>(c) Spices: Ginger - rhizome rot; Pepper - quick wilt; Cardamom - marble mosaic disease.</p> <p>(d) Oil seeds: Coconut - grey leaf spot, bud rot disease.</p> <p>(e) Rubber yielding: <i>Hevea brasiliensis</i> - abnormal leaf fall, powdery mildew.</p>		
55	Session 70	<p>(f) Sugar yielding: Sugarcane - red rot; root knot nematode.</p> <p>(g) Cash crops: Arecanut - nut fall disease.</p> <p>(h) Beverages: Tea - blister blight; Coffee - rust.</p> <p>(i) Ornamental plants: Anthurium – Bacterial wilt; Rose – Fungal Black Spot; Mite attack; Orchids- bud fall</p>	PPTs and Lectures	
56	Session 71	Make suitable micropreparations and identify the diseases mentioned with due emphasis on symptoms and causative organisms.	Laboratory, Practical and Discussion	
57	Session 72	Calculation of Spore load on seeds using Haemocytometer.	Laboratory, Practical and Discussion	

## BRYOLOGY AND PTERIDOLOGY

### COURSE OBJECTIVES:

To help students to understand the diversity of primitive land plants.

To get familiarized with the morphological and anatomical features of bryophytes and pteridophytes.

To identify the main characteristics of bryophytes and pteridophytes.

To chart the development of land adaptations in the bryophytes and pteridophytes.

To get acquainted with various lifecycle events in the bryophyte and pteridophytes.

To understand the evolutionary trends primitive plant groups.

To enable the identification skills.

### Basic Reference

1. Kashyap S R (1932). *Liverworts of Western Himalayas and the Punjab plains* (Vol. I & II). Research Co. Publications.
2. Chopra R N, P K Kumar (1988). *Biology of Bryophytes*. Wiley Eastern Ltd.
3. Chopra R S, S S Kumar (1981). *Mosses of Western Himalayas and adjacent plains*. Chronica Botanica.
4. Kumar S S (1984). *An approach towards phylogenetic classification of Mosses*. Jour. Hattori Bot. Lab. Nichinan, Japan.
5. Rashid A (1981). *An Introduction to Bryophyta*. Vikas publishing house Pvt. Ltd.
6. Richardson D H S (1981). *Biology of Mosses*. Blackwell Scientific publications, Oxford.
7. Sheffield W B (1983 – '84). *Introduction to Bryology* (Vol. 1, 2). Jour. Hattori Bot. Lab, Nichinan, Japan.
8. Vashishta B R, A K Sinha, A Kumar (2003). *Bryophyta*. S Chand & Co. Ltd.
9. Rashid A (1976). *An introduction to Pteridophytes*. Vikas Publishing House.
10. Sporne K R (1982). *Morphology of Pteridophytes*. Hutchinson university Press.
11. Surange K R (1964). *Indian Fossil Pteridophytes*. CSIR.
12. Louis J D (1977). *Evolutionary patterns and processes in ferns: Advances in Botanical Research*.
13. Scott. *Studies in Fossil Botany*. Haffner publications.
14. Smith, Gilbert (1972). *Cryptogamic Botany* (Vol. II). Tata McGraw Hill publications.
15. Nayar B K, S Kaur (1971). *Gametophytes of homosporous ferns*. Bot. Rev.

1.	Date	Topic	Method	Remarks/Reference
1	Session 1	Introduction to bryophytes, their fossil history and evolution. Concept of algal and pteridophytic origin of bryophytes. General characters of bryophytes.	Presentation/Chalk and Board	
2.	Session 2			
3	Session 3	History of classification of bryophytes. Modern trends in classification of bryophytes. DNA barcoding of bryophytes	Presentation/Chalk and Board/Assignment	
4	Session 4			
5	Session 5	Systematic way of collection, preservation and identification of bryophytes with special reference to mosses. Conservation biology of bryophytes.	Presentation/Chalk and Board	
6	Session 6	Bryophyte habitats. Water relations - absorption and conduction, xerophytic adaptations, drought tolerance, desiccation and rehydration, ectohydric, endohydric and myxohydric bryophytes.	Presentation/Chalk and Board Assignment	
7	Session 7			
8	Session 8			
9	Session 9	Ecological significance of bryophytes - role as pollution indicators.	Presentation/Chalk and Board	
10	Session 10	Economic importance of bryophytes; i) Sphagnum as 'Peat Mossii) Medicinal Usesiii) as source of foodiv) as pollution indicators v) in experimental studies vi) Horticultural uses.	Presentation/Chalk and Board	
11	Session 11			
12	Session 12	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective.	Presentation/Chalk and Board	
13	Session 13			
14	Session 14			
15	Session 15			

16	Session 16	<p>Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary).</p> <p>(a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).</p>		
17	Session 17			
18	Session 18			
19	Session 19			
20	Session 20	<p>Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective.</p> <p>Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary).</p> <p>(b) Anthocerotopsida (Anthocerotales).</p>	Presentation/Chalk and Board	
21	Session 21			
22	Session 22			
23	Session 23			
24	Session 24			
25	Session 25			
26	Session 26			
27	Session 27			
28	Session 28	<p>Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective.</p> <p>Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the</p>	Presentation/Chalk and Board/Assignment	
29	Session 29			
30	Session 30			
31	Session 31			
32	Session 32			
33	Session 33			
34	Session 34			
35	Session 35			



		<p>practical (development of sex organs not necessary).</p> <p>(c) Bryopsida (Sphagnales, Polytrichales, and Bryales)</p>		
36	Session 36	<p>Introduction, origin, general characteristics and history of the classification of pteridophytes. Brief account on Smith's classification (2006). DNA barcoding of pteridophytes.</p>	Presentation/Chalk and Board	
37	Session 37	<p>Distribution, habitat, range, external and internal morphology of sporophytes, spores, mechanism of spore dispersal, gametophytic generation, sexuality, embryogeny of the following classes of Pteridophytes with reference to the genera mentioned (development of sex organs is not necessary):</p> <p>(a) Psilopsida (i) Rhyniales; Rhynia</p> <p>(b) Psilotopsida (i) Psilotales; Psilotum</p> <p>(c) Lycopsidea (i) Protolpidodendrales; Protolpidodendron (ii) Lycopodiales; Lycopodium, (iii) Isoetales; Isoetes (iv) Selaginellales; Selaginella.</p> <p>(d) Sphenopsida (i) Hyeniales (ii) Sphenophyllales; Sphenophyllum (iii) Calamitales; Calamites (iv) Equisetales; Equisetum.</p> <p>(e) Pteropsida (A) Primofilices: (i) Cladoxylales; Cladoxylon (ii) Coenopteridales. (B) Eusporangiatae: (i) Marattiales; Angiopteris (ii)</p>	Presentation/Chalk and Board	
38	Session 38			
39	Session 39			
40	Session 40			
41	Session 41			
42	Session 42			

		Ophioglossales; Ophioglossum. (C) Osmundales; Osmunda. (D) Leptosporangiatae: (i) Marsileales; Marsilea (ii) Salviniales; Salvinia, Azolla (ii) Filicales; Pteris, Lygodium, Acrostichum, Gleichenia, Adiantum.		
43	Session 43	Stelar organization, soral and sporangial characters, gametophytes and sporophytes of Pteridophytes in an evolutionary perspective, an account on DNA barcoding of pteridophytes.	Presentation/Chalk and Board	
44	Session 44			
45	Session 45			
46	Session 46			
47	Session 47	Ecological and economic significance of Pteridophytes.	Assignment	
<b>PRACTICALS</b>				
48	Session 48	1. Detailed study of the structure of gametophytes and sporophytes of the following genera of bryophytes by suitable micropreparation: Riccia, Targionia, Cyathodium, Marchantia, Lunularia, Dumortiera, Reboulia, Pallavicinia, Fossombronia, Porella, Anthoceros, Sphagnum, Pogonatum, Bryum, Fissidens. Hyophila.. 2. Students are expected to submit 5 bryophyte specimen's herbarium and also a report of field trip to bryophyte's natural habitats to familiarize with the diversity of bryophytes	Laboratory	
49	Session 49			
50	Session 50			
51	Session 51			
52	Session 52	1. Study of morphology and anatomy of vegetative and reproductive organs using clear whole mounts/sections of the following genera: Psilotum, Lycopodium, Selaginella, Equisetum, Angiopteris, Ophioglossum, Marsilea,	Laboratory	
53	Session 53			
54	Session 54			
55	Session 55			

		<p>Salvinia, Azolla, Lygodium, Acrostichum, Gleichenia, Pteris, Adiantum, Polypodium and Dryopteris.</p> <p>2. Study of fossil Pteridophytes with the help of specimens and permanent slides.</p> <p>3. Field trips to familiarize with the diversity of Pteridophytes in natural habitats and preparation of 5 pteridophyte herbarium and submit the report along with the record.</p>		
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### SEMESTER 1

## ECOLOGY, ENVIRONMENTAL BIOLOGY, PHYTOGEOGRAPHY AND RESEARCH METHODOLOGY

### COURSE OBJECTIVES:

Enable the students to have a better understanding of the environment

Enrich the students with advanced theoretical and practical knowledge on ecology and environmental science

Enable the students to have detailed understanding about the environmental problems.

To provide the students detailed learning about the origin of the Western Ghats and diversity and conservation in the Western Ghats

To facilitate the students to have advanced learning about biodiversity, phytogeography, ecosystem functioning etc.

To enrich the students with the principle, necessity and methods of conservation managements of natural ecosystems and rare, endemic and threatened species in the Western Ghats.

To develop scientific aptitude and apply methodologies to pursue scientific researches.

### Basic Reference

1. Ahmedullah M, Nayar M P (1987). *Endemic plants of India*.
2. APHA, Awwa, Wep (2005). *Standard methods for the examination of water and waste water*.

3. Barbour M D, et. al., (1980). *Terrestrial plant ecology*. The Benjamin-Cummings Pub. Com.
4. Benton A H, Werner W E (1976). *Field biology and Ecology*. Tata McGraw Hill.
5. Clarke G L (1954). *Elements of Ecology*. John Wiley Pub.
6. Dash M C (1993). *Fundamentals of Ecology*. Tata McGraw Hill.
7. Eldon D, Enger, Bradley, Smith F (1995). *Environmental Science*. W C Brown publications.
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9. Furley P A et. al., (1983). *Geography of the biosphere: An introduction to the nature, distribution and evolution of the world life zones*. Butterworths.
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1.	Date	Topic	Method	Remarks/Reference
1	Session 1	Definition, history and scope of ecology, sub divisions of ecology, ecology vs environmental science. Interdisciplinary nature of environmental science	Presentation/Chalk and Board	
2.	Session 2			
3	Session 3	Scope of ecology; interdisciplinary aspects of ecology, applications of ecology in different fields (EIA, Research, education, agriculture, healthy life, etc	Presentation/Chalk and Board/Assignment	
4	Session 4			
5	Session 5	Characteristics of populations - ecological amplitude - population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure; Competition and coexistence, intra-specific interactions, interspecific interactions, scramble and contest competition		

		model, mutualism and commensalism, prey-predator interactions		
6	Session 6	Genecology - ecads, ecotypes, ecospecies, coenospecies; k-selection and r-selection populations; Molecular ecology, genetic analysis of single and multiple population, molecular approach to behavioural ecology, conservation genetics	Presentation/Chalk and Board	
7	Session 7			
8	Session 8		Assignment	
9	Session 9	Ecological processes of community formation, ecotone, edge effect. Classification of communities - criteria of classification, dynamic system of classification by Clement  Special plant communities - quantitative, qualitative and synthetic characteristics of plant communities, Sorenson's Index of similarity, coefficient of communities  Species diversity and its measurements - characteristics of plant communities, Alpha diversity and Beta diversity; definition and measures (Mergalef's index, Fishers Alpha, Shannon and Simpson diversity indices) of Alpha diversity with comparative data. Beta diversity, Jaccard's similarity/dissimilarity index, Evenness.	Presentation/Chalk and Board	
10	Session 10			
11	Session 11		Presentation/Chalk and Board	
12	Session 12			
13	Session 13	Guild and its functioning in the community.  Functional aspects of community; co-existence, resource partitioning, spatial correlates of communities, inter specific interactions, co evolution and coexistence. Community network; examples of interspecific interactions:	Presentation/Chalk and Board	
14	Session 14			

		<p>competition, Predation, mutualism, symbiosis, commensalism, ammensalism.</p> <p>Dynamic community characteristics – cyclic replacement changes and cyclic no-replacement changes. Modelling the interspecific interactions by using network analysis approach.</p>		
15	Session 15	<p>The concept – autogenic and allogenic succession, primary and secondary, autotrophic and heterotrophic</p> <p>(b) Retrogressive changes or the concept of degradation, concept of climax or stable communities, resilience of communities, ecological balance and survival thresholds</p>	Presentation/Chalk and Board	
16	Session 16			
17	Session 17	<p>Comparative study of the major world ecosystems: Different aquatic and terrestrial ecosystems with regard to their productivity, biodiversity, energy flow, food chains and trophic levels</p>	Presentation/Chalk and Board/Assignment	
18	Session 18			
19	Session 19	<p>Pollution Control- bioremediation, Phytoremediation, bioaugmentation, biofilms, biofilters, bioscrubbers and trickling filters. Use of bioreactors in waste management</p>	Presentation/Chalk and Board	
20	Session 20			
21	Session 21	<p>Climate Change and other Global Environmental issues - Factors responsible for climate change, Climate change mitigation – global conventions and protocols on climate change - El-Nino and La Nina phenomenon and its consequences - Environmental laws and biosafety, environmental monitoring and bio</p>	Presentation/Chalk and Board	
22	Session 22			

		indicators, environmental safety provisions in Indian constitution, major environmental laws in free India –UNEP – IPCC, UNFCCC, annual environment summits – 1973 Stockholm conference to 2015 Paris Conference – new developments of annual UNFCCC meetings in the coming years - Future Earth Programme.		
23	Session 23	Definition, principles governing plant distribution, factors affecting plant distribution, theories of distribution, different types of distribution of vegetations on the earth, continuous and discontinuous distribution  Climate, vegetation and botanical zones of India; Floristic provinces in the world  Remote sensing of vegetational characteristics – principle, data acquisition; GIS and GPS and their application in vegetation studies	Presentation/Chalk and Board	
24	Session 24			
25	Session 25	Definition –Genetic, Species and ecosystem diversity – alpha, beta and gamma diversity - concept of endemism and hot spots - role of IUCN - rare, endangered and threatened species, key stone species, flag-ship species; reasons for biodiversity loss; red data book	Presentation/Chalk and Board	
26	Session 26			
27	Session 27	Basic principles of conservation - ex-situ and in-situ conservation techniques – principles, methods and uses of remote sensing in conservation of natural resources; International conventions on	Presentation/Chalk and Board	
28	Session 28			

		biodiversity – CITES; national wildlife conservation policy and action plan, national forest policy		
29	Session 29	Importance, origin, geology, vegetation, diversity, resources, Concept of hotspot (The Western Ghats as a biodiversity hotspot). Conservation biology based on case studies from the Western Ghats. Vegetation types of the Western Ghats. Sustainable development based on the resources of the Western Ghats. Mangrove ecosystem and its significance in the western coast of Peninsular India	Presentation/Chalk and Board/Assignment	
30	Session 30			
31	Session 31	Any two relevant publications from peer reviewed journals	Presentation/Chalk and Board	
32	Session 32			

#### PRACTICALS

33	Session 33	<ol style="list-style-type: none"> <li>1. Analysis of water quality (a) Dissolved CO<sub>2</sub> (b) Dissolved oxygen (c) COD (d) Total dissolved minerals (e) Quantitative estimation of dissolved mineral anions and cations in water (f) Total alkalinity &amp; Salinity (g) conductivity (h) Colorimetric/Spectrophotometric estimation of Nitrogen/Phosphorus in water samples.</li> <li>2. Physico-chemical analysis of soil: Total water soluble mineral ions</li> <li>3. Quantitative and qualitative community analysis. Carry out a project on species structure and the frequency, abundance, density of different species and similarity index, basal area, IVI and evenness of different communities in a natural system.</li> <li>4. Statistical analysis of diversity indices by using apt softwares</li> </ol>	Laboratory/Demonstration	
34	Session 34			
35	Session 35			



		5. Phytoplankton counting using Sedgwick Rafter counter.		
36	Session 36	6. To determine organic 'C' and organic matter (biomass) in different (at least 3) locations (forest, agro ecosystem and polluted area. 7. Network analysis to find out the possible interspecific interaction in any local plant community. 8. Interpretation of GIS/remote sensing data for landscape differentiation 9. Field visit to natural ecosystem and identification of trophic levels, food webs and food chains, plant diversity (species and community) 10. Students should be aware of the common environmental problems, their consequences and possible solutions.	Laboratory/Demonstration	
37	Session 37			
38	Session 38			
39	Session 39			