

MANGALORE UNIVERSITY

BOTANY

(CORE AND GROUP-II ELECTIVE COURSES)

SYLLABUS

FOR

B.SC. UNDER GRADUATE (UG) PROGRAM

UNDER CBCS SCHEME

With effect from

Academic Year

2018-19

Course Objectives:

After studying and successful completion of different courses of Botany, a student is expected to have gained:

1. Understanding of the History and scope of botany, and the major contributions of Indian Botanists
2. Understanding of different aspects of botanical science, such as the diversity of microbes and plants, their classification and nomenclature, structural and functional aspects of plants and their reproduction, economic and ecological importance of plants, etc.
3. Understanding of modern botanical techniques and technologies like tissue culture, mushroom cultivation, herbal technology and transgenic plant production and their applications
4. Ability to identify and distinguish between important groups of microbes and plants
5. Understanding of botanical laboratory practices and ability to conduct botanical experiments
6. Ability to analyse, organize and communicate botanical concepts, employing modern communication tools
7. Ability to design and perform basic field/laboratory based projects/research activities in botany, both individually and in teams
8. Awareness about the need for and methods of conservation of biodiversity and natural ecosystems, as a moral, ethical and constitutional responsibility.

COURSES AND CREDITS
B.Sc. with Botany as an Optional Subject

	Semester-wise Paper Topics	Teaching hrs/ week	Exam duration (Hrs)	Marks			No. of Credits
				I.A	Exam	Total	
SEMESTER - I							
Group I	BSCBOC131 Microbes and Algae (T)	4	3	20	80	100	02
	BSCBOP132 Microbes and Algae(P)	3	3	10	40	50	01
Group II	BSCBOE133 Elective Course:	2	2	10	40	50	01
SEMESTER - II							
Group I	BSC BOC181 Fungi, Bryophytes, Histology and Anatomy(T)	4	3	20	80	100	02
	BSC BOP182 Fungi, Bryophytes, Histology and Anatomy (P)	3	3	10	40	50	01
Group II	BSCBOE183 Elective Course:	2	2	10	40	50	01
SEMESTER - III							
Group I	BSCBOC231 Pteridophytes, Gymnosperms and Angiosperm embryology(T)	4	3	20	80	100	02
	BSCBOP232 Pteridophytes, Gymnosperms and Angiosperm embryology(P)	3	3	10	40	50	01
Group II	BSCBOE233 Elective Course:	2	2	10	40	50	01
SEMESTER - IV							
Group I	BSCBOC281 Taxonomy and Economic Botany (T)	4	3	20	80	100	02
	BSCBOP282 Taxonomy and Economic Botany (P)	3	3	10	40	50	01
Group II	BSCBOE283 Open Elective Course:	2	2	10	40	50	01
SEMESTER - V							
Group I	BSCBOC331 Ecology and Environmental Biology (T1)	3	3	20	80	100	02
	BSCBOC332 Plant Physiology (T2)	3	3	20	80	100	02
	BSCBOP 333 Ecology, Environmental Biology and Plant Physiology	4	4	10	80	100	02
SEMESTER - VI							
Group I	BSCBOC381 Cytology, Molecular Biology and Genetics(T1)	3	3	20	80	100	02
	BSCBOC382 Plant Propagation and Plant Biotechnology (T2)	3	3	20	80	100	02
	BSCBOP383 Cytogenetics, Molecular Biology, plant propagation and Biotechnology	4	4	20	80	100	02
	T= Theory, P=Practicals					Total Credits	28

List of Elective Courses:

BSCBOE133Mushroom Cultivation Technology

BSCBOE183Herbal Technology

BSCBOE233Vegetative and Reproductive Morphology of Angiosperms

BSCBOE283Plant Diversity for Human Welfare

Note:

1. IA marks to be awarded based on 02 tests or 01 test and 01 seminar/home assignment/ any other activities in theory and one practical test, in practicals.
2. Field study/ Industrial Tours / Field based Projects / Visit to Research Institutes to be undertaken wherever necessary and specified to provide experiential learning opportunities and first hand exposure to students

SEMESTER – I
BSCBOC131 Microbes and Algae – Theory

Course Outcome:

- Understanding the scope and contributions of Indian Scientists to Botany
- Understanding the basis of classification of organisms into kingdoms
- Understanding of diversity of microbes and algae
- Understanding the economic importance of microbes and algae

Unit	Topics	Teaching Hours
I	<p>Introduction to Botany: Introduction to Botany, main branches and scope. Contributions of Indian Botanists – Sir J. C. Bose, Birbal Sahni, P. Maheshwari, B.G.L. Swamy, E. K. Janaki Ammal and M. S. Swaminathan. Whittaker’s Five kingdom system of classification of organisms with examples.</p> <p>Viruses, Viroids and Prions: Discovery of viruses, General characters of viruses -living and non-living features, Classification based on hosts and nature of genetic material. Ultra structure and multiplication of TMV. Symptoms and control measures of banana bunchy top disease, tobacco mosaic disease and yellow mosaic of beans. Viroids – structure, symptoms and control of Potato spindle tuber disease. A brief account of Prions.</p> <p>Phytoplasma: Structure, symptoms and control of little leaf of brinjal and sandal spike disease.</p>	12
II	<p>Bacteria: Types based on cellular morphology, flagellation and mode of nutrition. Ultra structure of Bacterial cell. Reproduction: binary fission and endospore formation. Genetic recombination in bacteria - conjugation, transformation and transduction (generalized type). Economic importance of bacteria- Useful and harmful aspects. Symptoms and control measures crown gall and citrus canker diseases.</p> <p>Algae: Occurrence with examples: aquatic, terrestrial and extreme habitats. Thallus organization with examples: unicellular- <i>Chlorella</i>, <i>Chlamydomonas</i>, colonial- <i>Volvox</i>, filamentous- <i>Oedogonium</i>, <i>Cladophora</i>, pseudo parenchymatous- <i>Polysiphonia</i>, siphonaceous - <i>Vaucheria</i>, parenchymatous - <i>Ulva</i>. General methods of reproduction with examples: vegetative –fission, fragmentation, hormogones and tubers. Asexual - exospore, endospore, nannospore, akinetes, zoospores, aplanospores, hypnospores and tetraspores. Sexual – isogamy, anisogamy and oogamy.</p>	12
III	<p>Algae – contd.: Types of life cycles in algae (only schematic representations) with an</p>	12

	<p>example to each type: haplontic, diplontic, isomorphic, heteromorphic and triphasic.</p> <p>Fritsch's classification of algae up to the level of classes with examples.</p> <p>Pigmentation in different classes of algae.</p> <p>Myxophyceae (Blue green algae): Ultra structure of cyanobacterial cell and heterocyst. Thallus structure of <i>Gloeocapsa</i>, <i>Nostoc</i>, <i>Oscillatoria</i> and <i>Scytonema</i>.</p> <p>Chlorophyceae: Classification, thallus structure and reproduction of <i>Volvox</i>, <i>Oedogonium</i> and <i>Chara</i>.</p>	
IV	<p>Xanthophyceae: Classification, thallus structure and reproduction of <i>Vaucheria</i></p> <p>Bacillariophyceae: Types of diatoms with examples: pennales and centrales. Classification, thallus structure and reproduction of a pennales diatom (<i>Pinnularia/Navicula</i>).</p> <p>Phaeophyceae: Classification, thallus structure and reproduction of <i>Sargassum</i>.</p> <p>Rhodophyceae: Classification, thallus structure and reproduction of <i>Polysiphonia</i>.</p> <p>Economic importance of algae: Useful aspects- food, SCP, industrial products, medicine, sewage treatment, bio-fertilisers, pollution indicators and energy source. Harmful aspects- algal blooms, algal toxins and parasitic algae.</p>	12

SUGGESTED REFERENCE BOOKS:

1. SURESH NARAYAN and PULLAIAH, 2010, **EMINENT INDIAN BOTANISTS – PAST AND PRESENT**, REGENCY PUBLICATIONS, NEW DELHI.
2. DUBEY, R. C., and MAHESHWARI, D. K., 2009, **A TEXT BOOK OF MICROBIOLOGY**, S CHAND PUBLISHERS.
3. SINGH, PANDE and JAIN, 2015, **A TEXT BOOK OF BOTANY**, RASOGI PUBLICATIONS
4. DEY S. N. and P. S. TRIVEDI. 1977. **A TEXT BOOK OF BOTANY VOL I** VIKAS.
5. GANGULEE, DAS and DATTA 2002, **COLLEGE BOTANY VOL II** NCBA (P) LTD
6. SUNDARA RAJAN S., 2009, **COLLEGE BOTANY VOLUME 1**, HIMALAYA PUBLICATIONS
7. KUMAR H. D. and H.N. SINGH. 1996. **A TEXT BOOK OF ALGAE**, EAST WEST PRESS. NEW DELHI.
8. PELCZAR M. J., E.C.S CHAN and N. R. KRIEG. 2008. **MICROBIOLOGY 5TH EDITION**. MC GRAW HILL.
9. PUROHIT S. S 1989, **VIRUSES, BACTERIA and MYCOPLASMAS**, AGROBOTANICAL PUBL.
10. SMITH G. M. 1955. **CRYPTOGAMIC BOTANY VOL I. ALGAE and FUNGI**. MCGRAW HILL BOOK CO. INC. 2ND EDITION.
11. SMITH K. M 1990. **PLANT VIRUSES 6TH EDITION** UNIVERSAL BOOK STALL NEW DELHI.
12. VASHISTHA B.R., SINHA A. K. and SINGH V.P. 2004. **BOTANY FOR DEGREE STUDENTS, ALGAE**

SEMESTER – I
BSCBOP132 Microbes and Algae –Practicals

Course Outcome:

1. Ability to properly handle and use dissection and compound microscopes and related laboratory skills like slide preparation, staining, laboratory safety, etc.
2. Ability to identify common microbes and algae based on their morphological features using microscopes.

Practical No.	Experiment
1	Microscopy technique: Study of Light compound and Dissecting microscopes – Parts, working Principle, handling and preparation of temporary mountings
2	Study of TMV and Phytoplasma with the help of electron micrographs. Study of viral and phytoplasma diseases mentioned in theory with the help of specimens/photographs.
3	Microscopic observation of Bacterial cells by simple staining (Positive-Crystal violet, Negative- Nigrosine or Indian Ink)
4	Differential staining of Bacteria - Gram's staining. Study of Bacterial diseases mentioned in theory with the help of specimens/photographs.
5	Study of thallus structure of <i>Nostoc</i> , <i>Oscillatoria</i> and <i>Scytonema</i>
6	Study of thallus and reproductive structures of <i>Volvox</i> and <i>Oedogonium</i>
7	Study of thallus and reproductive structures of <i>Chara</i>
8	Study of thallus and reproductive structures of <i>Vaucheria</i> and <i>Diatoms</i>
9	Study of thallus and reproductive structures of <i>Sargassum</i>
10	Study of thallus and reproductive structures of <i>Polysiphonia</i>

SEMESTER – II

BSCBOC181Fungi, Bryophytes, Histology and Anatomy –Theory

Course Outcome:

- Understanding of Diversity of fungi, and bryophytes
- Understanding the economic importance of fungi
- Understanding the different plant tissues and internal structure of plants

Unit	Topics	Teaching Hours
I	<p>Fungi: Salient features, mycelial organization- prosenchyma, pseudo parenchyma, rhizomorph and sclerotium. General methods of reproduction with examples: vegetative -fragmentation, fission and budding. Asexual – zoospores, chlamydo spores, oidia and aplanospores. Sexual – planogametic copulation, gametangial contact, gametangial copulation, spermatization and somatogamy. Alexopoulos system of classification up to the level of classes with examples. Classification, thallus structure and reproduction of <i>Phytophthora</i>, <i>Rhizopus</i>, <i>Penicillium</i>, and <i>Puccinia</i>.</p>	12
II	<p>Plant-Fungal Interactions and Economic importance of Fungi: Fungal diseases in plants-causative organism, symptoms and management of Koleroga of arecanut, Stem bleeding of Coconut, Blast disease of Rice, Leaf rust of Coffee and Wilt of Pepper. Lichens: Classification- asco and basidiolichens. Morphological types with examples- crustose, foliose and fruticose. Internal structure of thallus – homeomerous and heteromerous types. Structure of fruiting bodies - soredium, cephalodium, isidium, apothecium and perithecium, Economic importance. Mycorrhizae: definition, types – ecto and endomycorrhizae, significance to plants and fungi. Economic importance of Fungi: Useful aspects – food value, industrial products, medicinal products, bio control agents. Harmful aspects- pathogens, food spoilage, toxins, poisonous fungi.</p>	12
III	<p>Bryophytes: Salient features, Rothmaler’s classification to the level of classes with examples. Classification, thallus morphology, anatomy and reproduction of <i>Riccia</i>, <i>Porella</i>, <i>Anthoceros</i> and <i>Funaria</i>. Evolution of sporophytes in bryophytes – theory of progressive sterilization and simplification.</p>	12
IV	<p>Plant Histology and Anatomy: Introduction to tissues, general classification of tissues. Meristematic tissues: definition, classification based on origin, function and position. Theory of shoot organization – tunica corpus theory, Theory of root organization - histogen theory. Permanent Tissues: simple permanent tissues - structure, types and functions</p>	12

<p>of parenchyma, sclerenchyma and collenchyma. Complex permanent tissues - structure, composition and functions of xylem and phloem. Secretory tissues: Glandular trichomes, nectars, glands, laticifers and resin ducts. Primary anatomy of dicot and monocot root, stem and leaf. Normal secondary growth in dicot stem and root.</p>	
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SUGGESTED REFERENCE BOOKS:

1. ESAU. K. (1980) : PLANT ANATOMY, (2ND EDITION) WILEY EASTERN LTD., NEW DELHI, BANGALORE, BOMBAY, CALCUTTA, MADRAS, HYDRABAD
2. FAHN, A. (1997) : PLANT ANATOMY PERGAMON PRESS, OXFORD-
3. GANGULEE, DAS and DUTTA 2002, COLLEGE BOTANY VOL IINCBA(P) LTD.
4. PANDEY S.N, S.P MISRA and P.S RIVEDI 1972. A TEXT BOOK OF BOTANY VOL II. 2/3 VIKAS PUBL.
5. KUMARESAN and ANNIE REGINALD, 2013, PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY, SARAS PUBLICATIONS
6. VASHISHTA, PC, 1990, GYMNOSPERMS
7. SRIVASTAVA H.N., PANDEY S.N. S.P MISRA and P. S TRIVEDI 1972. A TEXT BOOK OF BOTANY VOL II. 2ND EDITION VIKAS PUBLICATIONS.
8. SRIVASTAVA H.N 1998. BRYOPHYTA.
9. VASHISTA P.C 1994, PLANT ANATOMY, PRADEEP PUBLICATIONS ,NEW DELHI
10. SINGH, PANDE and JAIN, 2015, A TEXT BOOK OF BOTANY, RASTOGI PUBLICATIONS
11. TAYAL, M.S., 2012, PLANT ANATOMY, RASTOGI PUBLICATIONS
12. SINGH, PANDE and JAIN, 2015, STRUCTURE, DEVELOPMENT AND REPRODUCTION IN ANGIOSPERMS, RASTOGI PUBLICATIONS
13. SUNDARA RAJAN S.,2009, COLLEGE BOTANY VOLUME 2, HIMALAYA PUBLICATIONS
14. SUNDARA RAJAN S.,2009, COLLEGE BOTANY VOLUME 3, HIMALAYA PUBLICATIONS
15. BENDRE A. M. AND A. KUMAR, 2014. PRACTICAL BOTANY VOLUME – 1and 2, RASTOGI PUBLICATIONS.
16. ALEXOPOULOS C.J. 1962. INTRODUCTORY MYCOLOGY WILEY EASTERN LTD.,
17. DUBE H.C 1983, AN INTRODUCTION TO FUNGI VIKAS PUBLICATIONS.
 BENDRE A. M. AND A. KUMAR, 2014. PRACTICAL BOTANY VOLUME – 1, RASTOGI PUBLICATIONS

SEMESTER – II

BSCBOP182Fungi, Bryophytes, Histology and Anatomy – Practicals

Course Outcome:

1. Ability to identify common fungi and bryophytes based on their morphological and anatomical features using microscopes.
2. Ability to cut histological sections of plant tissues, prepare microscopic slides and identify the tissues

Practical No.	Experiment
1	Study of <i>Phytophthora</i> and <i>Rhizopus</i>
2	Study of <i>Penicillium</i> and <i>Puccinia</i>
3	Study of fungal diseases : koleroga of Arecanut, Blast disease of Rice, Stem bleeding of Coconut, Rust of Coffee , wilt of pepper (specimens or photographs)
4	Study of Lichens- morphological types, internal structure and reproductive structures using specimens and permanent slides
5	Study of structure and reproduction of <i>Riccia</i> and <i>Porella</i>
6	Study of structure and reproduction of <i>Anthoceros</i> and <i>Funaria</i>
7	Study of permanent tissues – types of parenchyma, sclerenchyma, collenchyma, xylem and phloem using permanent slides/sections/macerations
8	Study of Primary anatomy of dicot and monocot stem with the help of hand cut stained sections
9	Study of Primary anatomy of dicot and monocot root with the help of hand cut stained sections
10	Study of anatomy of dicot stem/root by double staining procedure

SEMESTER – III

BSCBOC231Pteridophytes, Gymnosperms and Angiosperm Embryology – Theory

Course Outcome:

- Understanding of Diversity of Pteridophytes and Gymnosperms
- Understanding the importance of pollination and pollinators in nature
- Ability to identify the pollination mechanisms based on floral morphology

Unit	Topics	Teaching Hours
I	<p>Pteridophytes: Salient features, Smith’s system of classification up to the level of classes with examples. <i>Psilotum</i>:Morphology of sporophyte and gametophyte, anatomy of stem and synangium.. <i>Lycopodium</i>:Morphology of sporophytes of both sub-genera Urostachya and Rhopalostachya. Stem anatomy of <i>L. cernuum</i>, <i>L. clavatum</i> and <i>L. phlegmaria</i>. Morphology and anatomy of strobilus of <i>L. cernuum</i>, selago-condition. Structure of different types of gametophytes. <i>Selaginella</i>:Morphology of sporophyte, anatomy of stem, rhizophore and strobilus.Heterospory and its significance. <i>Equisetum</i>:Morphology of sporophyte, anatomy of intermodal part of stem. Structure of cone- L.S. of cone, sporangiophore and spore.</p>	12
II	<p>Pteridophytes (contd.) and Palaeobotany: <i>Ophioglossum</i>: Morphology of sporophyte, Structure of spike- L.S and T.S.. <i>Osmunda</i>- Morphology of sporophyte,Structure of tassel – T.S. <i>Pteris/Pteridium</i>:Morphology of sporophyte, anatomy of stem and sporophyll, structure of gametophyte. <i>Marsilea</i>:Morphology of sporophyte, anatomy of stem, structure of sporocarp – H.L.S. Palaeobotany: Introduction,Geological time scale, Types of plant fossils – compressions, impressions, incrustations, petrifications and actual remains with examples. Fossil Pteridophytes: <i>Rhynia</i> – Morphology of sporophyte, anatomy of stem, structure of sporangium. <i>Lepidodendron</i> – Morphology of sporophyte, anatomy of stem.</p>	12
III	<p>Gymnosperms: Salient features,Sporne’s system of classification up to the level of classes with examples. Fossil Gymnosperm: <i>Lyginopteris</i>- T.S. of stem <i>Cycas</i>: Indian species, morphology of male and female sporophytes, morphology and anatomy of coralloid root, anatomy of leaflet and young stem, secondary growth and anatomy of old stem. Reproduction – vegetative and sexual*. <i>Pinus</i>:Indian species, morphology of sporophyte, morphology and anatomy of needle. Sexual reproduction*. <i>Gnetum</i>: Indian species, morphology of sporophyte, anatomy of young stem, secondary growth and anatomy of old stem. Sexual reproduction*. Economic importance of Gymnosperms.</p>	12

	(*Study of developmental aspects related to the process of reproduction are not included).	
IV	<p>Angiosperm embryology: Morphology and anatomy of mature anther, microsporogenesis, structure and development of male gametophyte, structure of mature pollen grain. Types of ovule, structure of orthotropous ovule, placentation, megasporogenesis- tenuinucellate and crasinucellate types, development of monosporic female gametophyte – <i>Polygonum</i> type. Structure of 7-celled female gametophyte. Pollination: Definition, self and cross pollination and their types, contrivances for self and cross pollination, types of pollination based on agents, modification of plants/flowers for hydrophily, anemophily, entomophily and zoophily. Fertilization: Steps, process and significance of double fertilization. Endosperm: Structure and development of cellular, free nuclear and helobial endosperms, functions of endosperm. Structure of dicot and monocot embryos and seeds.</p>	12

SUGGESTED REFERENCE BOOKS:

1. Bhoojwani S.S and Bhatnagar S.P 2000. The Embryology of Angiosperms –Vikas Publishing House New Delhi
2. M.S Tayal 2016; Plant Anatomy- Rastogi Publications
3. Charles B.Beck -2011 : An Introduction to Plant Structure and Development Cambridge University Press
4. Dr. Manisha Majumdar-2011; Plant Anatomy – PHI Publishers
5. B.P. Pandey-2008: Botany for Degree students-S. Chand Publications
6. Shukla A.K – 1999 Biology of Pollen. Atlas Books and Periodicals.
7. B.P. Pandey-2000: Simplified course in Botany -S. Chand Publications

SEMESTER – III

BSCBOP232Pteridophytes, Gymnosperms and Angiosperm embryology – Practicals

Course Outcome:

1. Ability to identify common Pteridophytes and Gymnosperms based on their morphological and anatomical features.
2. Ability to identify plant embryological slides using microscopic features.

Practical No.	Experiment
1	Study of <i>Psilotum</i> (morphology of sporophyte, T.S of stem, T.S. of synangium) and <i>Lycopodium</i> (morphology of sporophyte, stem anatomy, L.S. of strobilus).
2	Study of <i>Selaginella</i> (morphology of sporophyte, T. S. of stem, T,S. of rhizophore, L.S. of strobilus) and <i>Equisetum</i> (external morphology, anatomy of stem, L.S. and T.S. of strobilus).
3	Study of <i>Ophioglossum</i> (morphology of sporophyte, L.S. and T.S. of spike) and <i>Osmunda</i> (morphology of sporophyte, TS. of tassel)
4	Study of <i>Pteris/Pteridium</i> (morphology of sporophyte, T.S. of rhizome, T.S. of sporophyll) and <i>Marselia</i> (morphology of sporophyte, T.S. of rhizome, H.L.S. of sporocarp)
5	Study of <i>Cycas</i> (external morphology of sporophyte, coralloid root anatomy, leaflet anatomy, male cone, microsporophyll, megasporophyll and V.S. of ovule)
6	Study of <i>Pinus</i> (external morphology of sporophyte, needle anatomy, male and female cones, pollen grains)
7	Study of <i>Gnetum</i> (external morphology of sporophyte, male and female cones, V.S. of ovule)
8	Study of types of plant fossils, and examples of Pteridophyte and Gymnosperm fossils included in the syllabus, with the help of slides / photographs.
9	Study of T.S. of anther, morphology of pollen grains, types of ovules and placentation – with the help of permanent slides or temporary mountings
10	Study of monocot and dicot embryos by temporary mountings and permanent slides, Study of pollination mechanisms.

BSCBOC281 Taxonomy and Economic Botany – Theory

Course Outcome:

- Understanding of the importance and history of plant taxonomy and nomenclature
- Understanding the outlines of Bentham and Hookers system of Angiosperm classification
- Understanding of vegetative and floral characters of selected plant families
- Understanding of economic importance of plants

Unit	Topics	Teaching Hours
I	<p>Fundamentals of Plant Taxonomy: Introduction to Taxonomy, systems of classification: artificial - Carolus Linnaeus, natural- Bentham and Hooker, phylogenetic - Engler and Prantl, their merits and demerits. Brief introduction to cytotaxonomy, chemotaxonomy, numerical taxonomy and molecular taxonomy, DNA barcoding of plants. A brief study of APG system of plant classification with focus to latest APG IV system. Botanical nomenclature: Binomial nomenclature, a brief introduction to ICBN – principles and rules, ranks of taxa and taxonomic types. Herbaria and herbarium techniques, digital herbaria. Botanical Survey of India, Botanical gardens and their functions.</p>	12
II	<p>Plant families -I: Distinguishing features, local examples and economic importance of the following families of angiosperms, according to Bentham and Hooker system: Polypetalae- Annonaceae, Malvaceae, Fabaceae and its sub-families, Rutaceae, Anacardeaceae, Myrtaceae, Cucurbitaceae and Apiaceae.</p>	12
III	<p>Plant families-II: Distinguishing features, local examples and economic importance of the following families of angiosperms, according to Bentham and Hooker system: Gamopetalae- Rubiaceae, Asteraceae, Apocynaceae, Solanaceae and Lamiaceae. Monochlamydeae – Amaranthaceae and Euphorbiaceae. Monocotyledonae- Orchidaceae, Arecaceae and Poaceae.</p>	12
IV	<p>Economic Botany: Introduction to economic botany. Cereals: Significance as food, classification-major and minor cereals with examples. Botany*, products and uses of Rice and Wheat. Pulses: Significance as food. Botany and uses of Mung bean and Pigeon pea Spices and condiments: Definition. Botany and uses of Asafoetida, Cinnamon, Clove, Black pepper, Cardamom and Nutmeg. Beverages: Definition. Botany, processing and uses of Tea, Coffee and Cocoa. Oil yielding plants: Types of plant oils with examples -fatty oils and essential oils. Botany, extraction/processing and uses of Coconut, Groundnut, Rose and Sandalwood oils. Fiber yielding plants: Types of plant fibers – bastfibers, surface fibers and leaf fibers. Botany, processing and uses of Cotton and Jute fibers. Timber yielding plants: General properties of wood, important timber yielding</p>	12

<p>plants of India and their uses. Rubber yielding plants: Botanical source, extraction/processing and uses of Hevearubber. Medicinal plants: Botany and uses of <i>Rauwolfia serpentina</i>, <i>Centella asiatica</i>, <i>Gymnema sylvestre</i>, <i>Tinospora cordifolia</i> and <i>Aloevera</i> A general account of outdoor and indoor ornamental plants. A general account of ethnobotany: definition, branches and significance.</p> <p>Note: *Botany includes botanical name, family, place of origin and parts used.</p>	
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SUGGESTED REFERENCE BOOKS:

1. S.K .Jain1995. Manual of Ethnobotany. Scientific publishers.
2. Dutta, S.C 1988. Systemic Botany, Wiley Eastern, New Delhi.
3. Sing. G 1999. Plant Systematics;Theory and Practical. Oxford and IBH, New Delhi
4. S. Sundar Rajan-2007. College Botany Vol-V, Part 1:Taxonomy and Economic Botany Himalaya Publishing House.
5. Susil Kumar Mukharjee-2004. College Botany Vol-III. New Central Book agency, London
6. A.V.S.S Sambamurthy2009. Taxonomy of Angiosperm. I.K International Pvt. Ltd. New Delhi
7. B.K. Verma 2011. Taxonomy of Angiosperms. PHI Learning Pvt.Ltd. New Delhi.
8. Saxena and Saxena 2014. Plant Taxonomy, PragatiPrakashan Meerut.
9. B P Pandey-2014. Modern Practical Botany Vol II. S. Chand Publication
10. P.Vasanth Kumar2014. **Economic Botany**. Sonali Publications New Delhi.
11. A.K Sharma 2015. Taxonomy of Angiosperms and Utilization of Plants. PragatiPrakashan Meerut.
12. O.P Sharma2016. Plant Taxonomy. Mc.Graw Hill Education. Pvt. Ltd. New Delhi.
13. K. GopalakrishnaBhat 2014. Flora of South Kanara, Published by the author.
14. Singh V. and Jain D. K. 2016. Taxonomy of Angiosperms. Rastogi Publications.

SEMESTER – IV

BSCBOP282 Taxonomy and Economic Botany -Practicals

Course Outcome:

1. Ability to dissect an angiosperm flower and write floral formula, draw floral diagram.
2. Ability to identify a plant to its family level, based on its vegetative and floral characters, using Flora.

Practical No.	Experiment
1	Study of Annonaceae and Malvaceae
2	Study of Fabaceae sub- families
3	Study of families Rutaceae and Anacardeaceae
4	Study of Myrtaceae, Cucurbitaceae and Apiaceae
5	Study of families Rubiaceae and Asteraceae
6	Study of families Apocynaceae, Solanaceae and Lamiaceae
7	Study of families Amaranthaceae and Euphorbiaceae
8	Study of families Orchidaceae, Arecaceae and Poaceae
9	Study of economically important plants and collection/observation of economic botany products listed in theory syllabus- cereals, pulses, spices/condiments, timbers, beverages and medicinal plants
10	Study of different types of plant fibers and oils. Study of tapping/processing of rubber with the help of charts.

Activities:

1. Field visits to study the botanical name, family, common names and economic/ethno botanical importance of local angiosperms found in flowering. A brief report of such field visits with the list of plants observed and field photographs/diagrams should be included in the practical record.
2. Visits to local plantations or extraction/processing units of economically important plants/products listed in the syllabus to study the cultivation practices, harvesting procedures, extraction/processing steps, product diversity, etc. A report should be produced at the time of practical examination

SEMESTER V, PAPER 1

BSCBOC331 Ecology and Environmental Biology–Theory

Course Outcome:

- Understanding the interrelationships and interactions between living and non-living factors
- Understanding the basic concepts of an ecosystem
- Understanding the importance of natural resources and their conservation
- Understanding the various environmental concerns and methods to control them.

Unit	Topics	Teaching Hours
I	<p>Ecological factors and adaptations: Climatic factors: Influence of light, temperature, precipitation, humidity and wind on vegetation. Edaphic factors: Soil and its types, soil texture, soil profile, soil formation, physico-chemical properties of soil -mineral particle, soil pH, soil aeration, organic matters, soil humus and soil microorganisms. Ecological adaptations: Morphological and anatomical adaptations of hydrophytes, xerophytes, epiphytes and halophytes.</p>	09hrs
II	<p>Ecosystems: Introduction, types of ecosystem with examples -terrestrial and aquatic, natural and artificial. Structure of ecosystem: Biotic and Abiotic components, detailed structure of a pond ecosystem. Ecosystem functions and processes: Food chain-grazing and detritus, Food web, Ecological pyramids -Pyramids of energy, biomass and number. Principles of Energy flow in ecosystem. Bio-geo chemical cycles: Gaseous cycles -carbon and nitrogen, Sedimentary cycle- Phosphorus. Ecological succession: Definition, types- primary and secondary. Hydrosere and xerosere.</p>	09hrs
III	<p>Phytogeography and environmental issues:: Phytogeographical regions of India, Vegetation types of India with special reference to Karnataka- composition and distribution of evergreen, semi-evergreen, deciduous, scrub, mangroves, shola forests and grasslands. Causes, consequences and control of Airpollution, Water pollution and Soil pollution. Causes, consequences and control of Green house effect and ozone depletion. Global climatic changes and its consequences.</p>	09hrs
IV	<p>Natural resources and their management: Biodiversity: Definition, types of biodiversity - habitat diversity, species diversity and genetic diversity, Global and Indian species diversity. Concept of endemism in plants, endemic plants of Western Ghats Concept of Biodiversity Hotspots, Biodiversity hot spots of India. Concept of Rare, Endangered and Threatened plants (RET plants), RET plants of Western Ghats.</p>	09hrs

	Soil resources–soil erosion and its prevention, maintenance of soil fertility. Water resources- problem of water scarcity, rain water harvesting, watershed management. Forest resources:Ecological and economical importance of forests. Deforestation-causes and effects. In-situ and ex-situ conservation of forests and wildlife –reserve forests, sacred groves, national parks, sanctuaries, biosphere reserves, seed banks, gene banks and botanical gardens.	
Total		36 Hours

SUGGESTED REFERENCE BOOKS:

1. Daubenmire, R.F. (): Plants & Environment (2nd Edn.) John Wiley & Sons., New York 22
2. Puri, .G.S. (1960): Indian Forest Ecology (Vol.I& II) Oxford Book Co., New Delhi & Calcutta.
3. Billings, W.B. (1965): Plants and the Ecosystem Wadsworth Publishing Co., Inc., Belmont.
4. Misra, R. (1968): The Ecology work Book Oxford & INH Publishing Co., Calcutta
5. Odum E.P. (1971): Fundamentals of Ecology (2nd Edn.) Saunders & Co., Philadelphia & Natraj Publishers, Dehradun.
6. Odum E.P. (1975): Ecology By Holt, Rinert& Winston.
7. Oosting, H.G. (1978): Plants and Ecosystem Wadworth Belmont.
8. Kochhar, P.L. (1975): Plant Ecology. (9th Edn.) New Delhi, Bombay, Calcutta-226pp.,
9. Kumar, H.D. (1992): Modern Concepts of Ecology (7th Edn.) Vikas Publishing Co., New Delhi.
10. Kumar H.D. (2000): Biodiversity & Sustainable Conservation Oxford & IBH Publishing Co Ltd. New Delhi.
11. Newman, E.I. (2000): Applied Ecology Blackwell Scientific Publisher, U.K.
12. Chapman, J.L&M.J. Reiss (1992): ecology (Principles & Applications). Cambridge University Press, U.K.

SEMESTER –V, Paper 2

BSCBOC332 Plant Physiology THEORY

Course Outcome:

- Understanding of importance of water to plants
- Understanding of plant mineral nutrition and enzymes
- Understanding the mechanism of photosynthesis and growth in plants
- Understanding of vegetative and reproductive growth

Unit	Topics	Teaching Hours
I	<p>Plant – Water relations: Fundamental concepts: Diffusion, Imbibition, Osmosis- endosmosis, exosmosis and osmotic pressure. Plasmolysis and Deplasmolysis. Water potential and its components,. Water absorption by plants: Soil water and its types, Mechanism of water absorption- Passive and Active absorption. Path of water movement- symplast, apoplast and transmembrane movement of water. Ascent of sap: Definition, path of ascent of sap, mechanism- root pressure theory and transpiration pull theory. Transpiration: Types – cuticular, lenticular and stomatal. Structure of stomata, mechanism of stomatal transpiration – starch hydrolysis and proton pump theories. Factors influencing transpiration. Significance of transpiration. Anti-transpirants and their practical applications. A brief account of Guttation.</p>	09hrs
II	<p>Mineral Nutrition and Enzymes: Essential elements: Classification - Macro and Micronutrients. Functions and deficiency symptoms of macro elements- N, P, K and Mg. Functions and deficiency symptoms of Micronutrients- Zn, Mn and B. Hydroponics and its applications. Mechanism of mineral salt absorption: Passive absorption – diffusion, ion exchange. Active absorption- Cytochrome pump theory, Protein Lecithin theory. Enzymes: General properties of enzymes, IEC system of enzyme classification and nomenclature, mechanism of enzyme action, models of enzyme action - lock and key and induced fit models, enzyme inhibition- competitive and non-competitive, factors regulating enzyme action.</p>	09hrs
III	<p>Photosynthesis, Organic translocation and Respiration: Photosynthesis: Photosynthetic reaction, photosynthetic pigments, photosystems I and II. Mechanism of photosynthesis - Light reaction and Dark reaction. Absorption spectrum and Action spectrum. Red drop and Emerson's effect. C₄ pathway and its significance. Factors affecting photosynthesis and law of limiting factors, Translocation of organic solutes: Path of translocation - Girdling experiment and isotopic studies. Mechanism of translocation- Protoplasmic streaming theory and Mass flow theory. Respiration: Definition and overall reaction, types of respiration- aerobic, anaerobic/ fermentation. Mechanism of aerobic respiration – glycolysis, Krebs's cycle and terminal oxidation. Anaerobic respiration – alcoholic and lactic acid fermentation. ATP yield during aerobic and anaerobic respirations. Respiratory quotient.</p>	09hrs
IV	<p>Plant growth, Flowering, Movements and Dormancy: Plant growth: Definition, Phases of growth, Growth curve. Plant growth regulators: Growth promoters – Physiological effects of auxins, gibberellins</p>	09hrs

	<p>and cytokinins. Growth inhibitors –Physiological effects of ethylene and abscisic acid. Practical applications of growth regulators in the field of agriculture and horticulture Physiology of flowering:Photoperiodism - short day, long day and dayneutral plants. Phytochrome theory. Vernalisation and its practical applications. Plant movements:Nastic movements – nyctinastic, chemonastic and seismonastic. Tropic movements –phototropic, hydrotropic, geotropic and thigmotropic.</p> <p>Dormancy in plants:Definition and types. Bud dormancy - induction and breaking.Seed dormancy – causes and methods of breaking.</p>	
Total		42 Hours

SUGGESTED REFERENCE BOOKS:

1. Mukherjee, S. A.K. Ghosh(1998) Plant Physiology ,Tata McGraw Hill Publishers(P) Ltd., New Delhi.
2. Salisbury, F.B & C.W. Ross (1999): Plant Physiology CBS Publishers and Printers, New Delhi.
3. Pandey, SN and Sinha, BK (2001). Plant Physiology. Third revised edition, Vikas publishing House Pvt. Ltd, New Delhi
4. Devlin, RM (1974). Plant Physiology, Affiliated East West Press Pvt. Ltd
5. Noggle, GR. and Fritz, GJ (1976). Introductory Plant Physiology, Prentice-Hall, India.
6. Jain, VK (2007).Fundamentals of Plant physiology, S. Chand &Compamy ltd, New Delhi.
7. Nobel, PS (1970). Introduction to Biophysical Plant Physiology. W. H. Freeman and Company, San Francisco
8. Verma,V(2008).Text book of plant Physiology, Ane's student edition, Newdelhi
9. SundaraRajan S (2012). College Botany, Vol. VI. Part 2- Plant Physiology. Himalaya Publications.

Semester V

BSCBOP333 Ecology, Environmental Biology and Plant Physiology - Practicals

Course Outcome:

1. Ability to analyse soil/water samples for their physico-chemical properties like pH and salinity.
2. Knowledge of working principles and ability to use field instruments used during ecological studies
3. Ability to identify the ecological habitat of plants based on morpho-anatomical features, in the laboratory,
4. Ability to explain important plant physiological phenomena with the help of suitable laboratory experiments.
5. Ability to design and conduct basic botanical field-based projects/research and prepare reports.

Part A: List of Practicals in Ecology and Environmental Biology (10 Practicals of 2hr each)

Practical No.	Experiments
1	Determination of pH of different types of Soils
2	Estimation of salinity of soil/water samples.
3	Study of Ecological instruments – Wet and Dry thermometer, Altimeter, Hygrometer, Soil thermometer, Rain Gauge, Barometer, etc
4	Hydrophytes: Morphological adaptations in <i>Pistia</i> , <i>Eichhornia</i> , <i>Hydrilla</i> , <i>Nymphaea</i> . Anatomical adaptations in <i>Hydrilla</i> (stem) and <i>Nymphaea</i> (petiole).
5	Xerophytes: Morphological adaptations in <i>Asparagus</i> , <i>Casuarina</i> , <i>Acacia</i> , <i>Aloe vera</i> , <i>Euphorbia tirucalli</i> . Anatomical adaptations in phylloclade of <i>Casuarina</i> .
6	Epiphytes: Morphological adaptations in <i>Acampe</i> , <i>Bulbophyllum</i> , <i>Drynaria</i> . Anatomical adaptations in epiphytic root of <i>Acampe/ Vanda</i> . Halophytes: study of Vivipary in mangroves, Morphology and anatomy of Pneumatophores.
7	Study of local vegetation types by field trips
8	Project work
9	Project work
10	Project work

***PROJECT WORK ON ECOLOGY:**

Students should undertake a short project related to any of the following ecological aspects, either individually or in groups, and submit the report at the time of practical examination along with the certified class record.

Project Reports to be prepared according to the Format provided.

Projects may be undertaken on:

- Structure of local ecosystems - pond ecosystem /forest ecosystem/grassland ecosystem/river ecosystem/marine ecosystem.
- Enumeration/documentation of local biodiversity
- Listing of local RET species of plants, assessment of their population status, etc.
- Documentation of local conservation practices
- Documentation/Assessment of local pollution issues, etc.

Part B: List of Practicals in Plant Physiology (10 Practicals of 2hr each)

Practical No	Experiments
	Major Experiments:
1	Experiment to measure the solute potential of the cell sap by plasmolytic method.
2	Demonstration/ Determination of rate of transpiration using Ganong's Potometer
3	Demonstration of transpiration pull/Suction force due to transpiration.
4	Separation of plant pigments by paper chromatography method.
5	Determination of RQ of germinating seeds using Ganong's Respirometer
6	Demonstration of activity of Peroxidase/Catalase enzyme
7	Estimation of Protein by colorimetric method
8	Estimation of sugar by colorimetric method
	Minor Experiments/Demonstrations
1	Potato osmoscope /Thistle funnel experiment to demonstrate osmosis
2	Demonstration of unequal transpiration from leaf surfaces using Garreaus Potometer
3	Demonstration of imbibition pressure using germinating seeds
4	Demonstration of O ₂ liberation during photosynthesis by bubbling method
5	Measurement of growth using arc auxanometer
6	Demonstration of plant movements – Heliotropism, Geotropism, Hydrotropism
7	Demonstration of transpiration using bell jar
8	Demonstration of fermentation using Kuhn's Fermentation vessel

SEMESTER –VI, PAPER 1

BSCBOC381 Cytology, Molecular Biology and Genetics –Theory

Course Outcome:

- Understanding the types and structure of cells
- Understanding the basis of heredity
- Understanding the historical aspects of genetics and contribution of Mendel
- Understanding the structure, function and variations in chromosomes

Unit	Topics	Teaching Hours
I	<p>Cytology: Structure of plant cell, Ultra-structure and functions of cell wall, plasma membrane-fluid-mosaic model, endoplasmic reticulum, chloroplast, ribosomes, golgi complex, mitochondria, peroxisome and vacuole. Ultrastructure of nucleus - nuclear membrane, nuclear pore complex and nucleolus. Ergastic substances in plant cells.</p> <p>Cell Division and Chromosomes: Types of chromosomes based on centromere position, Autosomes and Allosomes, structure of metaphase chromosome, Ultra structure of Chromosomes- Nucleosome model. Cell cycle, Mitosis in plant cells– karyokinesis and cytokinesis, Meiosis in plant cells, mechanism of crossing over, significance of mitosis and meiosis.</p>	09 hrs
II	<p>Structure, Chemistry and Expression of Gene: Experiments to prove DNA as genetic material – Griffith experiment, Avery. McCarty and MacLeod experiment, Hershey - Chase experiment DNA: Chemical composition, types -A, B and Z DNA, structure-Watson & Crick model, Semiconservative replication. RNA: Structure and functions of m RNA, t RNA and r RNA. Structure of Gene: cistron, recon and muton concept. Prokaryotic and eukaryotic genes. Genetic code and its properties. Gene Expression: Transcription and Translation in prokaryotes, process of Gene splicing. Regulation of gene expression in prokaryotes- Lac operon model. Gene regulation in eukaryotes- transcriptional and post-transcriptional.</p>	9 hrs
III	<p>Genetics: Introduction to genetics, Brief biography of Mendel and his experiments on pea plants. Monohybrid cross and law of segregation, dihybrid cross and law of independent assortment. Test cross and back cross-monohybrid and dihybrid. Incomplete dominance- flower color in <i>Mirabilis</i>. Multiple alleles – self sterility in tobacco. Gene Interactions with plant examples: Complimentary -9:7, Supplementary -9:3:4</p>	09hrs

	and Epistasis – Dominant, 12:3:1 ratio. Polygenic inheritance - kernel color in wheat. Linkage and its types – cis and trans, complete and incomplete. linkage in Maize. Mechanisms of sex determination in Plants – <i>Melandrium</i> , <i>Cocciniaindica</i> , <i>Asparagus</i> and <i>Maize</i> .	
IV	Genetic variations and Extra nuclear genome: Gene mutations: Spontaneous mutations, Induced mutations - physical and chemical mutations. Molecular basis of mutations- base substitutions and frameshift mutations. Chromosomal Aberrations: Types and cytological consequences of Deletion, Duplication, Inversion and translocation. Variation in chromosome number: Aneuploidy and its types, Euploidy and its types. Polyploidy in plants: Auto and allopolyploids - natural and artificial with examples, significance of polyploidy. Extra nuclear genome-features and functions of plastid and mitochondrial DNA. Transposable genetic elements in Maize.	09hrs
Total		36 Hours

SUGGESTED REFERENCE BOOKS:

1. S SundaraRajan, 2004, Genetics, Anmol Publications Ltd.
2. Gupta P.K 1999. A text book of Cell and Molecular Biology. Rastogi publication Meerut
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, WashinPTon, D.C.; Sinauer Associates, MA.
4. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. 2008. Principles of Genetics. 8th Edition Wiley India.
6. Griffiths, AJF., Wessler, SR., Lewontin, RC. and Carroll, SB.. Introduction to Genetic Analysis. IX Edition W.H. Freeman and Co.
7. Burns G.W. 1983. The Science of Genetics - An Introduction to Heredity. 5 edition Mac Millan Publ.
8. David Freifilder 1996. Essentials of Molecular biology Panima Publishing company New Delhi.
9. Gardner E.J., M.J. Simmons & D.P. Snustad. 1991. Principles to Genetics 8th edition. John Wiley & Sons
10. Gupta P.K. 2000 Genetics and Cytogenetics. Rastogi Publishers.
11. Iug W.S. & M.R. Gummings 2003. Concepts of Genetics 7 edition. Pearson Edition 482, F.I.E. Patparganj Delhi -110092
12. Kumar H.D. 2000. Molecular Biology. Vikas Publishers.
13. Malacinski G.M. & D. Freifelder 1998. Essentials of Molecular Biology. Jones & Bartlatt Publ. Boston. 3 edition
14. Powar C.B. 2005, Cell Biology 3 edition Himalaya Publishing New Delhi.
15. Sambamurty A.V.S.S. 1999. Genetics Narosa Publ House.
16. Sheeler P. & D.E. Bianchi 1987. Cell and Molecular Biology 3 edition John Wiley & Sons.
17. Singh B.D. 2004. Genetics. Kalyani Publ.
18. Strickberger M.W. 2005 Genetics 3 edition. MacMillan Publ.

19. Vasishta P.C. & P.S. Gill 1998. Cell Biology & Molecular Biology, Pradeep Publications
 20. Verma P.S. & V.K. Agarwal 2006. Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S. Chand & company New Delhi.

SEMESTER –VI PAPER II

BSCBOC382 Plant Propagation and Biotechnology THEORY

Course Outcome:

- Understanding of traditional plant breeding and propagation techniques
- Understanding of modern botanical techniques like plant tissue culture and plant biotechnology
- Understanding of environmental biotechnology

Unit	Topics	Teaching Hours
I	<p>Plant Propagation and Plant Breeding: Methods of Plant propagation: Cutting -Root, Stem and Leaf, Grafting-Wedge, Whip, Approachand Crown, Layering- Underground and Air Layering . History and Objectives of plant breeding. Methods of Plant breeding: Introduction, Selection- Pure line, Clonal and Mass line. Polyploidy breeding, Mutation Breeding, Hybridization - types and technique. Male sterility-Types, production and significance in plant breeding.</p>	09 hrs
II	<p>Plant Tissue Culture: History and Scope, concept of cellular totipotency. Tissue culture laboratory and Equipments Basic aspects of plant tissue culture- Sterilization, Culture media and its preparation. Role of growth hormones in plant tissue culture. Types of cultures-Callus culture and Organogenesis. Pollen culture and haploid plant production. Embryo culture. Somatic embryogenesis and synthetic seeds.Protoplast culture and somatic hybridization techniques. Application of plant tissue culture in Agriculture, Forestry, Industries and plant conservation</p>	09 hrs
III	<p>Plant Biotechnology: Introduction to Plant Genetic Engineering. Tools used in genetic engineering: Enzymes- Restriction endonucleases, DNA ligase, Vectors - pBR 322, Ti and Ri plasmid vectors, artificial chromosomes, difference between cloning and expression vectors. General steps of recombinant DNA technology using plasmid vectors and bacterial host cell. Gene transfer methods to plant cells: Agrobacterium based gene transfer technique, Directgene transfer – microinjection, electroporation, microprojectile techniques. Plant regeneration from transformed cells. Transgenic plants: Definition and examples, Steps involved in the production of golden rice and Bt cotton. Applications and threats from transgenic plants.</p>	09 hrs
IV	<p>Environmental Biotechnology: Introduction and scope of environmental biotechnology. Biotechnology in air pollution control – biofilters and their applications.</p>	09hrs

	<p>Biotechnology in waste water treatment: Aerobic and anaerobic treatment methods with examples.</p> <p>Bioremediation and phytoremediation, biocomposting.</p> <p>Biopesticides- types and applications. Biofertilisers- types and applications.</p> <p>Biofuels- Production and applications of biogas, bioethanol, biodiesel and algal biofuels.</p> <p>Biomining and bioleaching – methods and applications.</p> <p>Biodegradable plastics – plastics from cellulose, chitin, microbes and transgenic plants.</p>	
Total		36 Hours

SUGGESTED REFERENCE BOOKS:

1. Allard R.W(1999): The Principles of Plant Breeding, John & Wiley and Sons.
2. Poelman J.M: Breeding Field Crops, Springer.
3. George Acquaah(2012):Principles of Plant Genetics & Breeding: Wiley-Blackwell.
4. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
5. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
6. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. institution)
7. Pullaiah. T. and M.V.SubbaRao. 2009. Plant Tissue culture. Scientific Publishers, New Delhi.
8. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
9. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
10. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
11. Gupta P.K. (2010), Plant Biotechnology, Rastogi Publications, Meerut.
12. Monica Jain (2014), Environmental Biotechnology, Narosa Publishing House, New Delhi.
13. Mohapatra, P. K. (2007), Textbook of Environmental Biotechnology, IK International, New Delhi.

Semester VI: BSCBOP383 Cytogenetics, Molecular Biology, Plant Propagation and Biotechnology - Practicals

Course Outcome:

1. Ability to demonstrate the cytological processes like mitosis and meiosis using appropriate laboratory techniques
2. Ability to study cells and measure their size using microscopic tools
3. Understanding of modern botanical techniques like plant tissue culture and plant biotechnology
4. Ability to propagate plants using different plant propagation techniques.
5. Ability to analyse and solve genetic problems using Punnet square and other methods.

Part A: List of practicals in Cytology, Genetics and Molecular Biology (10 practicals of 2 hr each)

Practical No.	Experiments
1	Study of Cell structure from Onion /Rheo leaf peel under light compound microscope
2	Study of ergastic substances - starch (potato), aleurone (wheat grain), calcium oxalate (Pistia), calcium carbonate (Ficus leaf), oil globules (castor seed) and Raphides (Colacasia petiole).
3	Measurement of length and Breadth of cells by micrometry technique (Using Onion or Rheo leaf cells)
4	Study of different stages of mitosis by squash technique using Onion root tip cells
5	Study of different stages of meiosis using Rheo or Onion flower buds
6	Observation of permanent slides of mitosis and meiosis
7	Genetic problems related to laws of Mendel (Minimum 04 problems)
8	Genetic problems related to incomplete dominance and multiple allelism (Minimum 04 problems)
9	Genetic problems related to interaction of genes (Minimum 02 problems each for 9:7 and 9:3:4 ratio)
10	Genetic problems related to interaction of genes (Minimum 02 problems each for 12:1 ratio and Polygenic interaction)

**Part B: List of Practicals in Plant Propagation and Biotechnology
(10 Practicals of 2 hr each)**

Practical No.	Experiments
1	Study of plant propagation methods-Cutting, Layering and Grafting
2	Techniques of emasculation, artificial pollination and bagging
3	Estimation of percentage of pollen viability (In-vitro method) by hanging drop method.
4	Study of tissue culture lab equipments – autoclave, laminar air flow cabinet, hot air oven, incubator
5	Preparation of Synthetic seeds by alginate encapsulation
6	Preparation of tissue culture media (MS), surface sterilization, Inoculation and callus induction.
7	Demonstration of DNA isolation from plant tissues.
8	Demonstration of Electrophoresis.
9	Study of transgenic plants and their production with the help of charts.
10	Study of designs of waste water treatment plants

Field Activities:

1. Visits to waste water treatment plants and composting sites to study the operations involved.
2. Visits to biofertiliser and biopesticide production sites in the locality to study the production methods.
3. Visits to local nurseries and institutions involved in plant breeding to study the various methods and techniques employed.

Mangalore University
B.Sc. I semester -Practical Examination
Microbes and Algae

Question paper and Scheme of evaluation

Time: 3 hrs. Batch..... Date..... Time:am/pm Max. Marks: 40

- | | |
|--|-----------|
| 1. Prepare a stained slide of specimen A. Sketch, label and identify with reasons. Leave the preparation for inspection | 06 |
| 2. Identify B & C giving reasons | 3+3= 06 |
| 3. Write critical notes on D & E with labelled sketches | 3+3= 06 |
| 4. Prepare a stained slide of the given bacterial sample F. Show the preparation to the examiner and write the report (Procedure writing is not required). | 03 |
| 5. Sketch, label and identify the slides G, H & I, with reasons | 3+3+3 =09 |
| 6. Record, Submission of Specimens and Field Notes | 10 |

1	A		Prep. Sk Id Cl Rea 2 1½ ½ ½ 1½ =6	<u>Reg. No. of Candidates Assigned</u>
2	B		Id. Reasons 1 2 = 3 each Sketch and Classification not required	<u>Reg. No. of absentees:</u>
	C			<u>Total examined:</u>
3	D		Id* Sk. Crt. Nts. ½ 1 1½ = 3 each	<u>Name and Signature of Examiners:</u>
	E		Classification not required	
4	F		Prep - 3	
5	G			1.Internal
	H		Sk Id Cl Rea 1 ½ ½ 1 = 3 each	

	I			
6	a	Record	07	=10
	b	Specimens	02	
	c	Field notes	01	
2.External				

Instruction to Examiners:

A -Any algal specimen,

B and C- Any algal specimen

D and E -pathology materials infected by bacteria or Virus / Phytoplasma (colour photographs may also be used)

F - Bacterial culture/curd sample/ root nodule suspension,

G,H and I- Slides. At least 01 slide should be from Cyanophyta.

Mangalore University
B.Sc. II semester - Practical Examination
Fungi, Bryophytes, Histology and Anatomy
Question paper and Scheme of evaluation

Time: 3 hrs. Batch..... Date..... Time.....am/pm Max. Marks: 40

1. Prepare a temporary stained section of the material A. sketch, label and identify with reasons.
Leave the preparation for inspection 06
2. Identify B & C giving reasons 3+3= 06
3. Write critical notes on D & E with labelled sketches 3+3= 06
4. Sketch, label and identify with reasons the slides F, G, H & I 3+3+3+3 =12
5. Record and Submission- 2 permanent slides of Anatomy 7+3=10

1	A		Prep. 2 Sk 1½ Id ½ Cl ½ Rea 1½ = 6	Reg. No. of Candidates Assigned
2	B C		Id 1 Rea 2 = 3 each Sketch and Classification not required	
3	D E		Id* ½ Sk 1 Crt. 1 Nts. 1½ = 3 each Classification not required	Reg. No. of <u>absentees:</u> <u>Total examined:</u>
4	F G H I		Sk 1 Id ½ Cl ½ Rea 1 = 3 each	<u>Examiners:</u> 1.Internal
5	a b	Record Permanent slides	07 03 =10	2.External

Instruction to Examiners:

A from dicot or monocot stem/root. B and C from Fungi

D and E from pathology and Lichens

F,G,H and I - one slide each from Fungi and Histology and two slides from Bryophyta

Mangalore University
B.Sc- III Semester Botany- Practical Examination
Pteridophytes, Gymnosperms and Angiosperm Embryology
Question paper and Scheme of evaluation

Time: 3 hrs. Batch..... Date..... Time.....am/pm Max. Marks: 40

1. Prepare a temporary stained section of the material A. Sketch, label and identify.
Leave the preparation for inspection. 06
2. Sketch, Label, and identify specimens B and C 3+3=6
3. Write critical notes on D, E and F with identification and labeled sketches. 3+3+3=9
4. Sketch, label and identify with reasons the slides G, H, and I. 3+3+3=9
5. Class Record 7+2+1=10

1	A		Prep Sk ID	03 02 01 <hr/> 06 each	Reg. No. of Candidates Assigned	
2	B		Sk ID	01 01		
	C		Reason	<hr/> 01 03 each		
3	D		Sk ID	01 $\frac{1}{2}$		
	E		CN	<hr/> 01 $\frac{1}{2}$ 03 each		
	F					
4	G		Sk Id Cl Rea 1 $\frac{1}{2}$ $\frac{1}{2}$ 1	= 3 each	<u>Reg. No. of absentees:</u>	
	H					<u>Total examined:</u>
	I					<u>Examiners:</u>
5		Record		10	1.Internal 2.External	

Instruction to Examiners:

A from Pteridophyta/ Gymnosperms

B and C - one each from Pteridophytes and Gymnosperms

D, E and F one specimen each from Pteridophyta ,Gymnosperms and fossil forms (slide/Photograph may also be used)

G, H & I- two slides from Pteridophyta and one from Embryology

Mangalore University
B.Sc. -IV Semester- Practical Examination
TAXONOMY & ECONOMIC BOTANY
Question Paper and Scheme of evaluation

Time: 3 hrs. Batch..... Date..... Time.....am/pm Max. Marks: 40

1. Systematically assign the plants **A**, **B** and **C** to their respective families, giving diagnostic features. 4X3=12
2. Describe the plant **D** in technical terms. 06
3. Give the floral diagram and floral formula of **E** 03
4. Give the economic importance of **F**, **G** and **H** mentioning the common name, botanical name, family and parts used. 3+3+3=09
5. a) Class records 07+03=10

b) Herbarium with field notes

1	A		Derivation 01 Family Name 01 Characters <u>02</u> 04 each	Reg. No. of Candidates Assigned
	B			
	C			
2	D		Description 06	Reg. No. of absentees:
3	E		Fl. Dia 02 Fl. Form <u>01</u> 03 each	
4	F		Com. Name ½ Bot. Name ½ Family ½	Total examined: Examiners: 1. External
	G		Parts used ½ Eco. Imp. <u>01</u> 03 each	
	H			
5		a) Records	07	2. Internal
		b) Herbarium /Field notes	03	

Instruction to Examiners:

A, B and C- one each from Polypetalae, Gamopetalae and Monochlamydeae/Monocots
D from Polypetalae/Gamopetalae
E from Polypetalae/Gamopetalae
F, G and H from different groups of economically important products

Mangaluru University
B.Sc.Semester V Practical Examination

BSCBOP 333 Ecology, Environmental Biology and Plant Physiology

Question Paper Pattern and Scheme of evaluation

Time: 4 hrs. Batch..... Date..... Time.....am/pm Max. Marks: 80

1. Prepare a stained temporary mount of the T. S of material **A**. Draw a labelled diagram and list the anatomical features of ecological significance. Leave the slide for inspection. 08

2. List out the materials required to set the given major experiment **B**. Write the principle and procedure of the experiment, draw a labelled sketch of the set up. Set up the experiment, demonstrate the results and write the inference. Leave the set up for inspection. 12
3. Estimate the carbohydrate / protein present in the given sample C 10
4. a. Identify the ecological instrument D, describe its working mechanism and uses. 05
- b. Write the aim, procedure and the expected results of the given minor experiment **E** 05
5. Project work report and viva-voce 20
6. Practical Records 20

1	A		Prep 02 Sk 02 Features <u>04</u> 08	Reg. No. of Candidates Assigned
2	B		Requirements 01 Sketch 02 Procedure 02 Principle 01 Setting 04 Results and 02 Inference <u> </u> 12	<u>Reg. No. of absentees:</u> <u>Total examined:</u>
3	C		Procedure 4 Tabular column, Calculations and Result (+ or – 10% error allowed) 6 Total 10	<u>Examiners:</u> 1.External
4	D		Identification 01 Working Principle & uses 03 Sketch <u>01</u> 05	2.Internal
	E		Aim 01 Sketch 01 Procedure, 03 Result <u> </u> 05	
5		Project report & Viva -voce	15+05 =	20
6		Class Records	10+10=	20

Instruction to Examiners:

A: Any Hydrophyte/Xerophyte/ Epiphyte/ Halophyte

B: One major physiology experiment, as per lots

C: Protein or Sugar sample, along with prepared standard solution to be given

D: Any Ecological instrument

E: Any one minor physiology experiment to be displayed.

- Project Report assessment and Viva has to be conducted by both Internal and External Examiners, in consultation with each other and to be restricted to the work conducted by students. Maximum 05 questions only.

Mangaluru University
B.Sc.Semester VI Practical Examination

**BSCBOP383Cytogenetics, Molecular Biology, Plant Propagation and
Biotechnology**

Question Paper Pattern and Scheme of evaluation

Time: 4 hrs. Batch..... Date..... Time.....am/pm Max. Marks: 80

1. Prepare a slide of material A by squash method for the study of mitosis/meiosis. Identify and show any one stage. Draw a labelled sketch of the identified stage. 10
2. Estimate the percentage of pollen viability in the given flower B. Show the prepared slide to examiner. 10
3. Solve the given genetic problems C and D. 5+5= 10
4. Identify the cytological stages/ergastic materials in the slides E and F with labelled diagrams

5. Identify and comment on **G, H, I** and **J**.
 6. Practical Records

$$5+5=10$$

$$5+5+5+5=20$$

$$10+10=20$$

1	A		Squash prepn 05 Stage Idntfn02 Sketch <u>03</u> 10	Reg. No. of Candidates Assigned	
2	B		Pollen slide Prepn 05 Calculation & Result05 Total 10		
3	C		Answer with proper explanation and Checker board 5		<u>Reg. No. of absentees:</u>
	D				
4	E		Idntification 01 Sketch 02		<u>Total examined:</u>
	F		Features <u>02</u> 05		
5	G		Identification 01 Sketch 02 comments <u>02</u> 05	<u>Examiners:</u> 1.External 2.Internal	
	H				
	I				
	J				
6		Class Record	10+ 10		

Instruction to Examiners:

A: Onion root tip or flower buds

B: Unopened flowers (*Datura/Catharanthus/Alamanda*) with intact anthers must be provided
 Onion/ Rheo leaf peal

C and D:One problem each from Mendelism and interaction of genes (same or similar to those worked out in the practical class)

E and F:One slide from mitosis/meiosis and any slide of an ergastic substance.

G,H,I and **J:** One each material/photograph related to plant breeding, tissue culture, transgenic plants and electrophoresis to be displayed.

Elective Course 1

BSCBOE 133: Mushroom Cultivation Technology

Course Outcome:

- Understanding of structure and diversity of mushrooms
- Understanding of and ability to identify edible and cultivated mushrooms
- Knowledge of mushroom cultivation methods

Unit	Topics	Teaching Hours
I	<p>Introduction: What are mushrooms, general structure, diversity, food and medicinal importance of mushrooms. Edible and non-edible mushrooms - Features and examples. Edible mushrooms commercially cultivated in India Paddy straw (<i>Volvariella volvacea</i>) Oyster (<i>Pleurotus</i> spp) and white button (<i>Agaricus bisporus</i>)- Important Morphological features.</p> <p>Cultivation Technology: History. Infrastructure- substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, stove, sieves, culture rack, mushroom unit (Thatched house), water sprayer, tray.</p> <p>Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation (Oyster mushrooms) - paddy straw, sugarcane trash, banana leaves, areca sheath and coconut leaves.</p> <p>Composting technology in mushroom production – long and short methods.</p>	12
II	<p>Cultivation :General Steps involved in cultivation of Oyster and Button Mushrooms.</p> <p>Storage: Short-term storage (Refrigeration – upto 24 hours), Long term Storage (canning, pickling, papad making), drying, storage in salt solutions.</p> <p>Chemical composition and nutritional values (In general): Proteins - amino acids, minerals, carbohydrates, vitamins and crude fiber.</p> <p>Food Preparation: Types of foods prepared from mushrooms</p> <p>Research Centers - National level and Regional level.</p>	12

References:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Elective Course II

BSCBOE 183Herbal Technology

Course Outcome:

- Awareness about traditional plant based health systems and medicinal importance of plants
- Knowledge and ability to identify important medicinal plants and their parts by different techniques
- Understanding of herbal drug adulteration and evaluation.

Unit	Topics	Teaching Hours
I	Medicinal Plants: History and scope, role of medicinal plants in traditional and modern systems of medicine; Medicinal plant cultivation and trade – global and Indian scenario. Pharmacognosy - systematic position, medicinal uses, active principles and pharmacognostic features of the following: <i>Ocimum sanctum</i> , <i>Gingiber officinale</i> , <i>Trigonella graceum</i> , <i>Phyllanthus emblica</i> and <i>Saraca asoca</i> General methods of herbal extraction with examples.	12
II	Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).	12

Reference:

1. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book - Distributors.
- 2 Herbal plants and Drugs Agnes Arber, 1999.Mangal Deep Publications.
3. Ayurvedic drugs and their plant source. V.V. Sivarajan and BalachandranIndra 1994. Oxford IBH - publishing Co.
4. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998.Banarsidass, Delhi.
5. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
6. Pharmacognosy, Dr.C.K.Kokate et al. 1999. NiraliPrakashan. of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R

Elective Course III

BSCBOE233Vegetative and Reproductive Morphology of Angiosperms

Course Outcome:

- Understanding of plant morphological structures and modifications
- Understanding of reproductive morphology of plants.

Unit	Topics	Teaching Hours
I	Angiosperms: Introduction, parts of plant body and their functions. Roots- Types, modifications and functions. Stem- types, modifications and functions. Leaf – Morphological structure and types, phyllotaxy, modifications and functions. Inflorescence- types.	12
II	Flower - General structure, insertion of floral parts; calyx, corolla and their variations. Androecium-structure and its variations. Gynoecium- structure and its variations. Fruits and their types Seeds – structure of dicot and monocot seeds; albuminous and exalbuminous seeds.	12

References:

1. Akhil Baruah, 2008. Advanced morphology of Angiosperms, Aavishkar Publishers, New Delhi.
2. Narayana Rao B.N. 1972. Plant Modifications, Wisdom Publications, Mysore.
3. Singh, Pandey and Jain, A text book of Botany, Rastogi Publications.
4. Eams A.J. 2011, Morphology of Angiosperms, Nabu Press
5. Pandey, B.P., 2007. Botany for Degree Students, S. Chand Publishers.

Elective Course IV

BSCBOE 283 Plant Diversity for Human Welfare

Course Outcome:

- General awareness on the concept of biodiversity and its types.
- Understanding of importance of plants as source of food, medicine and other products essential for human survival.
- Understanding the cultural and ecological importance of plants and the need for their conservation.

Unit	Topics	Teaching Hours
I	<p>Diversity and values of Plants: The Concept of Biodiversity, types of biodiversity-genetic, species and ecosystem diversity. Species diversity of plants – global, Indian and Karnataka. General values of plants and forests with examples- ethical value, consumptive use value, productive use value, ecosystem services value, aesthetic value and optional use value.</p> <p>Plants as sources of food and medicine: Plants as sources of protein, carbohydrate and dietary fibres. Important cereals and pulses. Agrobiodiversity and its importance. Brief history of domestication of rice. Plant based medicinal systems – Ayurveda, sidda, unani and folk medicine. Diversity of medicinal plants of India. Plants in beauty care. Contribution of medicinal plants to modern medicine – Important plant derived modern medicines and their uses. History of development of <i>Rauwolfia serpentina</i>, <i>Cinchona officinalis</i> and <i>Catharanthus roseus</i> based drugs.</p>	12
II	<p>Plants in industry, culture and climate regulation: Industrially and commercially important plants and their products- paper, rubber, timber, cane, spices, beverages and sugar. Plants as sources of biofuel. Garden and ornamental plants. Religious and cultural use of plants. Role of plants and forests in climate and environment regulation- carbon sequestration and control of global warming, flood control, pollution control, regulation of water cycle and water purification.</p> <p>Conservation of plant diversity: Major threats to plant diversity and forests- habitat destruction, over exploitation and natural extinction. Rates of plant extinctions with examples. Concept of endangered and endemic plants. Methods of plant and forest conservation- botanical gardens, sacred groves, reserve forests, national parks and biosphere reserves.</p>	12
Total		24 Hours

SUGGESTED REFERENCE BOOKS:

1. Daubenmire, R.F. (): Plants & Environment (2nd Edn.) John Wiley & Sons., New York 22
2. Billings, W.B. (1965): Plants and the Ecosystem Wadsworth Publishing Co., Inc., Belmont.
3. Misra, R. (1968): The Ecology work Book Oxford & INH Publishing Co., Calcutta
4. Odum E.P. (1971): Fundamentals of Ecology (2nd Edn.) Saunders & Co., Philadelphia
5. S.K .Jain1995. Manual of Ethnobotany. Scientific publishers.

6. S. Sundar Rajan-2007. College Botany Vol-V, Part 1:Taxonomy and Economic Botany Himalaya Publishing House.
7. Susil Kumar Mukharjee-2004. College Botany Vol-III. New Central Book agency, London
8. P.Vasanth Kumar2014. **Economic Botany**. Sonali Publications New Delhi.
9. Erach Bharucha, 1998. Environmental Studies for UG Students. Universities Press, New Delhi.

Question Paper Pattern
Elective Course in Botany
Mushroom Cultivation Technology
Code: BSCBOE 133

Max Marks: 40 Max Time: 2 hours

Instructions: Draw diagrams wherever necessary

I. Answer **ANY FIVE** of the following in 2-3 sentences each. 2x5=10

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

II. Answer **ANY SIX** of the following.

5X6=30

- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

Note:

QI: 4 short answer type questions form each unit of the syllabus.

QII: 4 descriptive answer type questions form each unit of the syllabus

The same pattern may be followed for all Elective Courses of Botany
