KUVEMPU UNIVERSITY

M.Sc., BOTANY PROGRAMME

CHOICE BASED CREDIT SYSTEM
Course Curriculum and Scheme of Evaluation
2020-2021

DEPARTMENT OF APPLIED BOTANY
JNANASAHYADRI, SHANKARAGHATTA-577451
SHIMOGA DIST, KARNATAKA

KUVEMPU UNIVERSITY

M. Sc. BOTANY Course Syllabus, Department of Applied Botany,

CHOICE BASED CREDIT SYSTEM(CBCS)

Semester-I

Course structure and scheme of Examination

Paper Code No	Titles of Theory Paper	Total Credits per week	Theory Examination marks	Internal Assessment marks	Total marks
BO1.1 Hard Core-1	Phycology and Mycology	04	75	25	100
BO1.2 Hard Core-2	Biology of Bryophytes, Pteridophytes and Gymnosperms	04	75	25	100
BO1.3 Hard Core-3	Plant Taxonomy , Phytogeography and Evolutionary Biology	04	75	25	100
BO1.4 Soft Core.1	Palaeobotany and Palynology	04	75	25	100
BO1.5 Soft Core-2	Bio fertilizers	04	75	25	100
BO1.6 Practical:HC-1	Phycology and Mycology	02	-	-	50
BO1.7 Practical:HC-2	Biology of Bryophytes, Pteridophytes and Gymnosperms	02	-	-	50
BO1.8 Practical:HC-3	Plant Taxonomy Phytogeography and Evolutionary Biology	02	-	-	50
BO1.9 Practical: SC.1	Palaeobotany and Palynology	02	-	-	50
BO1.10 Practical: SC.2	Bio-fertilizers	02	-	-	50
	Total marks for Theory Total Practical marks (I Sem) Grand Total marks for I Semester				400 200 600

Note : 1. HC-Hard Core paper, SC –Soft Core paper

2. Students shall choose on soft core paper

Semester-II

Paper Code No	Titles of Theory Paper	Total Credits per week	Theory Examination marks	Internal Assessment marks	Total marks
BO2.1 Hard Core-1	Plant Ecology and Environmental biology	04	75	25	100
BO2.2 Hard Core-2	Cell Biology, Genetics and Plant breeding	04	75	25	100
BO 2.3 Soft Core-1	Techniques in Plant Biology	04	75	25	100
BO 2.4 Soft Core-2	Plant Pathology	04	75	25	100
BO 2.5 Practical:HC.1	Plant Ecology and Environmental biology	02	-	-	50
BO 2.6 Practical:HC.2	Cell Biology, Genetics and Plant breeding	02	-	-	50
BO 2.7 Practical:SC.1	Techniques in Plant Biology	02	-	-	50
BO 2.8 Practical:SC.2	Plant Pathology	02	-	-	50
	Inter Disciplinary Elective(IDE) *				
BO.2.9	Floriculture	02	40	10	50
	Total marks for Theory Total Practical marks (II Sem) Grand Total marks for II Semester				300 150 500

1. Students shall choose on soft core paper

* Shall be chosen by other department students.

Semester-III

Paper Code No	Titles of Theory Paper	Total Credits per week	Theory Examination marks	Internal Assessment marks	Total marks
BO3.1 Hard Core-1	Plant Morphogenesis and Reproductive biology of Angiosperms	04	75	25	100
BO3.2 Hard Core-2	Plant Physiology and Biochemistry	04	75	25	100
BO3.3 Soft Core-1	Plant Diversity and Human Welfare	04	75	25	100
BO3.4 Soft Core-2	Plant Bio Technology	04	75	25	100
BO3.5 Practical Hard Core-1	Plant Morphogenesis and Reproductive biology of Angiosperms	02	-	-	50
BO3.6 Practical HardCore-2	Plant Physiology and Biochemistry	02	-	-	50
BO3.7 Practical Soft Core-1	Plant Diversity and Human welfare	02	-	-	50
BO3.8 Practical Soft Core-2	Plant Bio technology	02	-	-	50
	Inter Disciplinary Elective*				
BO3.9	Plants for Human Welfare	02	40	10	50
	Total marks for Theory				300
	Total Practical marks (III Sem.)				150
	Grand Total for III Semester				500

* Shall be chosen by other department students.

Semester-IV

Paper Code No	Titles of Theory Paper	Total Credits per week	Theory Examination marks	Internal Assessment marks	Total marks
BO4.1 Hard Core-1	Ethnobotany, Medicinal plants, and Plant Resource conservation.	04	75	25	100
BO4.2 Hard Core-2	Molecular Biology and Genetic Engineering of plants.	04	75	25	100
BO4.3 Practical Hard Core-1	Ethnobotany, Medicinal plants, and Plant Resource conservation.	02	-	-	50
BO4.4 Hard Core-2	Molecular Biology and Genetic Engineering of plants.	02	-	-	50
BO4.5 Project Work	Dissertation	04	75	25	100
	Total marks for Theory Total marks for Practical Total marks for Project				200 100 100
	Grand Total marks for IV Semester				400

Total marks and credits semester wise

Sl.No.	Semester	Total Marks	Total Credits
1	Total of I Semester	600	26
2	Total of II Semester	500	22
3	Total of III Semester	500	22
4	Total of IV Semester	400	12
	Grand Total marks	2000	82

****

Dept. of Applied Botany, Kuvempu University

MASTER OF SCIENCE IN BOTANY

Semester I

Course Code: BO1.1 Hard Core-1

Phycology and Mycology

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 Lectures/Unit

Course Objectives:

This course aims to introduce to students to understand the lower plant diversity and range of their thallus organization and reproduction and also to understand their role in ecosystem, genetic and cultural diversity, uses and their conservation.

Course Learning Outcomes:

The students will be learning

1. Classification of algae and fungi.
2. Morphology and reproduction of lower plants such as algae, lichens and fungi.
3. Variations and comparison among two groups.
4. Understand ecology and economic importance of these lower plant groups.

Course Contents

Unit-1:

Introduction to Phycology as a subject, dealing with a polyphyletic group of organisms collectively name as Algae. Diversity of habitat, cell structure, thallus organization and reproduction among algae. Position of algae in two, five, six and eight kingdoms classifications. Features taken into considerations for classification of algae: chemical nature of the stored food, Cell wall composition, presence or absence of motile (flagellate) cells, structure of flagella and flagellar roots, pattern of mitosis and cytokinesis, number of chloroplast membranes, type of life cycle.

Unit-2:

Systematics of algae: sub-groups and their interrelationships. Range of form, structure and life cycles of different groups: Cyanophyta, Glaucophyta, Rhodophyta, Heterokontophyta, Chrysophyceae, Parmophyceae, Xanthophyceae, Bacillariophyceae, Raphidophyceae, Dictyophyceae and Phaeophyceae. Chlorarachniophyta and Chlorophyta. Economic, ecological and biotechnological importance of algae: historical perspectives, algae as experimental systems and as sources of colloidal polysaccharides, nitrogenous compounds, pharmaceutical and nutraceuticals, biotechnological potential of symbiotic algae, genetic modification of

algae and its potential, algae as the most efficient CO_2 fixers, algae for bioremediation and as bio fertilizers.

Unit-3 :

Position of fungi in modern systematics, modern approaches towards classification of fungi. Ultrastructural features of fungal cell structures-nucleus and its division, cell wall and its biochemical composition, tissue organization, modifications of fungal hyphae. Mastigomycotina : A comprehensive knowledge with emphasis on occurrence of sex hormones and sporangia to conidia transition. Ascomycotina : A comprehensive knowledge with emphasis on types of ascocarps and methods of spore dispersal. Basidiomycotina : A comprehensive knowledge with emphasis on fruiting structures and methods of spore dispersal. Deuteromycotina : A general account with emphasis on sporulating structures of the members, classification with special reference to conidial ontogeny.

Unit-4:

Life cycle patterns and basic pattern of sexuality, sexual mechanisms and their correlations in different groups of fungi, Parasexual cycle-basic concept. Fungal symbionts: Mycorrhizae-basic concept and their applications. Lichen Phycobiont and mycobiont, histology, biology and physiology of lichen thallus, economic importance of lichen. Beneficial uses of fungi, industrial production of alcohol and penicillin. Edible Mushrooms-cultivation technology, nutritional and medicinal properties of mushrooms.

Suggested Laboratory Exercises

BO1.1 HC-1: Phycology and Mycology

Phycology:

1. Range of vegetative organization in cyanobacteria with examples.
2. Reproductive bodies of cyanobacteria.
3. Range of vegetative organization in algae with representative examples.
4. Different types of asexual reproduction in algae.
5. Different types of sexual reproduction bodies in algae.
6. Freshwater, marine and benthic plankton.
7. Any other experiments from phycology which are not listed here.

Mycology:

1. Isolation of VAM from root and soil samples.
2. Study on lichens and its partners.
3. Isolation of rhizosphere and rhizoplane fungi.
4. Spore dispersal mechanisms.
5. Study on asexual and sexual fungal fruiting bodies.
6. Isolation of fungi by serial dilution techniques.
7. Isolation of cellulose and lignin degrading fungi from soil.
8. Isolation of fungi from pesticide contaminated soil.
9. Pure culture – identification of fungi based on conidia and mycelial morphology.
10. Any other experiments from mycology which are not listed here.

Suggested Readings:

1. A. Rashid, 1998. Introduction to Bryophyta. Vikas publishing house Pvt. Ltd. New Delhi.

2. Garbary., David, J. and South G. Robin. 1990. Evolution bio geography of the marine algae of the North Atlantic, Published by London Springer verlag. -6-

3. Geider. Richard, J.Osborne and Bruce, A. 1991.Algal photosynthesis. Landon:Chapman and Hall Ltd.,

4. Pandey, S.N., Misra, S.P. and Trivedi, P.S. 1977. Text book of Botany, Bryophyta, Pteridophyta, Gymnosperms and Paleobotany. 2nd edition. Vikas publishing house. New Delhi.

5. Pandey,S.M., Trivedi,P.S. 1995. Text book of Algae. Vikas publishing house, New Delhi.

6. Sambamurthy, A.V.S.S. 2005. A text book of Bryophyta, Pteridophyta, Gymnosperms and paleo botany. IK International Pvt. Ltd. New Delhi.

7. Sundarlingam,V.S., 1989. Marine algae; Morphology, Reproduction and Biology. Bishan Singh. Mahendrapal Singh. Dehradun.

8. Trivedi and Pravin chandra. 2001. Algal bio technology. Jaipur pointer publishers.

9. Chamberlain, C.J. 1935. Gymnosperms – Structure and Evolution.

10. Dallimore, W. and Jackson A.B. 1961. A Handbook of coniferales & Ginkgoales.

11. Foster A.S & Gifford E.M 1959. Comparative morphology of vascular plants.

12. Greguss F 1955. Identification of living gymnosperms on the basis of xyletmy.

13. Maheshwari P. & konat R. N.1971. Pinus, Monograph.

14. Maheshwari P. & Vasil- Gnetum, Monograph.

Dept. of Applied Botany, Kuvempu University

Semester I

Course Code: BO1.2 Hard Core-2

BO1.2 : Biology of Bryophytes, Pteridophytes and Gymnosperms

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 Lectures/Unit

Course Objectives:

This course aims to introduce to students to understand the lower plant diversity and range of their thallus organization and reproduction and also to understand their role in ecosystem, genetic and cultural diversity, uses and their conservation.

Course Learning Outcomes:

The students will be learning

1. Classification of Bryophytes, Pteridophytes and Gymnosperms
2. Morphology and reproduction of lower plants.
3. Variations and comparison among three groups.
4. Understand ecology and economic importance of these lower plant groups.

Course contents

Unit-1 :

Bryophytes: characters and classification, structural organization of gametophytes and sporophytes, thallus organization and reproductive features, morphology, anatomy, life cycle of Sphaerocarpus (Sphaerocarales), Marchantia (Marchantiales), Porella (Jungarmaniales), Anthoceros (Anthocerotales), Sphagnum (Sphagnales), Andrea (Andreales), Funaria (Funariales) and Polytrichum (Polytrichales). Evolution and affinities of the bryophytes, fossil bryophytes, origin of bryophytes, ecology and cytological aspects of bryophytes, amphibian's adaptations and bryophytes as the indicators of water and air pollution.

Unit-2 :

Pteridophytes: characteristics and classification, morphology, anatomy and reproduction in *Psilotum, Selaginella, Equisetum, Lycopodium, Pteridium* and *Salvinia*. origin of Pteridophytes, evolution of the pteridophyte taxa, fossil pteridophytes, evolution of the stele, heterospory and seed habitat.

Unit-3:

Economic importance of pteridophytes, rare, endangered and endemic pteridophytes with reference to India. Conservation with reference to *in situ* and *ex situ* conservation, horticultural importance of pteridophytes, weed problems, aquatic and terrestrial weeds of pteridophytes, medicinal and edible pteridophytes, *Azolla* as a bio fertilizers and pteridophytes are ecological indicators.

Unit-4 :

Gymnosperms: characteristics and classification, morphology, anatomy and reproduction in *Cycas, Pinus, Araucaria, Ginkgo, Ephedra* and *Gnetum*. General account on Pteridopsermopsida, Cycadofilicales, Glosso-pteridales and Caytoniales, economic importance of gymnosperms, affinities of gymnosperms with reference to Gnetum.

Suggested Laboratory Exercises

BO1.2 Semester I : HC-2

Biology of Bryophytes, Pteridophytes and Gymnosperms

Bryophytes

1. Vegetative organization and morphology.
2. Anatomical structures.
3. Archegonia, antheridia and their organization.
4. Sporophytes of Bryophytes – A Comparative Study.

Pteridophytes

5. Structure of plant body (habit).
6. Anatomical organization of different parts of the plants.
7. Sporangia and their types.
8. Spores, structure, size and ornamentation.
9. Fossil pteridophytes.

Gymnosperms

10. Morphology and Anatomical Features.
11. Male and Female Reproductive Bodies / Organs.
12. Seeds of Gymnosperms.
13. Fossil Gymnosperms.

Suggested Readings :

1. Campbell, H.D. The Evolution of Land Plants. (Embryophyta).
2. Chamberlain, C.J. 1935. Gymnosperms – Structure and Evolution.
3. Champman, V.J. Sea Weeds and their Uses. Methew and Co., London.
4. Chopra, R.N. and Kumar, P.K. Biology of Bryophytes. Wiley Eastern Limited.
5. Dallimore, W. and Jackson, A.B. 1961. A Handbook of Coniferales and Ginkgoales.
6. Fogg, G.E. Stewart, W.D.P. Fay and Walshy, A.E. The Blue Green Algae. Academic Press.
7. Foster, A.S. and Gifford, E.M. 1959. Comparative Morphology of Vascular Plants.
8. Gangulee, H.R. and Ashok Kumar. 1989. College Botany. Vol. II. Revised edition, Reprint 1994. New Central Book Agency (P.) Ltd., 8/1 Chinkmoni Das Lane, Calcutta – 700 009.
9. Garbary, David, J. and South G. Robin. 1990. Evolution, Biogeography of the Marine Algae of the North Atlantic. Published by London Springer Verlag.

10. Geider, Richard J. Osborne and Bruce, A. 1991. Algal Photosynthesis. Chapman and Hall Ltd., London.

11. Greguss, F. 1955. Identification of Living Gymnosperms on the Basis of Xyletmy.

12. Kashyap, A.K. and Kumar, H.D. Recent Advances in Phycology. Rastogi and Company.

13. Maheshwari, P. and Konat, R.N. 1971. Pinus, Monograph.

14. Maheshwari, P. and Vasil. Gnetum, Monograph.

15. Misra and Aparayel, R.P. 1978. Lichens.

16. Pandey, S.M. Trivedi, P.S. 1995. Textbook of Algae. Vikas Publishing House, New Delhi.

17. Pandey, S.N., Misra, S.P. and Trivedi, P.S. 1977. Textbook of Botany, Bryophyta, Pteridophyta, Gymnosperms and Paleobotany. 2nd Edition. Vikas Publishing House, New Delhi.

18. Rashid, A. 1998. Introduction to Bryophyta. Vikas Publishing House Pvt., Ltd., New Delhi.

19. Sambamurthy, A.V.S.S. 2005. A Textbook of Bryophyta, Pteridophyta, Gymnosperms and Paleobotany. IK International Pvt., Ltd., New Delhi.

20. Smith, G.M. Cryptogamic Botany. Vol. I, McGraw Hill Book Company, New Delhi.

21. Smith, G.M. Cryptogamic Botany. Vol. II, McGraw Hill Book Company, New Delhi.

22. Sundarlingam, V.S. 1989. Marine Algae ; Morphology, Reproduction and Biology. Bishan Singh, Mahendrapal Singh Dehradun.

23. Surenge, K.R. 1996. Indian Fossil Pteridophytes. CSIR Monograph, New Delhi.

24. Trivedi and Pravin Chandra. 2001. Algal Biotechnology. Jaipur Pointer Publishers.

25. Vashishta, B.R. 1990. Botany for a Degree Students – Bryophytes. 7th edition, S. Chand and Company Ltd., Ramnagar, New Delhi – 110 055.

Dept. of Applied Botany, Kuvempu University

Semester I

Course Code: BO1.3 Hard Core -3

Plant Taxonomy, Phytogeography and Evolutionary Biology

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)

Duration-64 hours. Teaching hours: 16 lectures/Unit

Course Objectives:

This course aims to introduce the students to the advanced concepts and principles of taxonomy, evolutionary inference of important morphological characters, distribution of plants, Important families of flowering plants, their classification and important characters.

Course Learning Outcomes:

The students will be learning

1. Classification of plants based on certain approaches
2. Principles of nomenclature. How it is governed by the ICN?
3. What important morphological characters delineate flowering plant families and their classification.
4. Distribution patterns of plants.
5. Principles and theories of evolution of land plants.

Course contents:

Unit-1 :

Plant Taxonomy: Historical background of plant classification: Major systems of classification; Artificial system-Carolus Linnaeus. Natural system- deJussieu, de Candolle and Bentham and Hookers classification. Phylogenetic systems- Engler and Prantle, Hutchinson, Armen Takhtajan and Cronquist systems of classification, Taxonomical evidences: Chemotaxonomy, cyto taxonomy, palynology, embryological evidence and Numerical taxonomy. Angiosperm Phylogeny Group(APG), Plant Molecular Systematics: DNA sequence data, Types of sequence data, Sequence alignment, Phylogenetic analysis (parsimony, Maximum Likelihood, Bayesian approaches, Neighbor-Joining), DNA barcoding and its practical implications.

Unit-2 :

Literature in taxonomy: Classics, taxonomic indexes, floras, monographs and revisions, catalogues, review serials, periodicals, dictionaries and glossaries, maps and cartography, icons. Botanical Nomenclature: ICN(ICBN) Principles, Names of taxa, type method, author citation, effective and valid publication, rejection of names, names of hybrids and cultivated plants. IAPT. Methods of herbarium, importance of herbarium, major herbaria of the world, Botanical gardens and their importance, Botanical survey of India.

Unit-3 :

Study of the plant families with their phylogeny as per modern classification: Amborellaceae, Magnoliaceae, Ceratophyllaceae, Ranunculaceae, Juglandaceae, Myristicaceae, Apiaceae,Solanaceae, Velloziaceae, Lythraceae, Burseraceae, Loranthaceae,Viscaceae, Podostomaceae, Icacinaceae, Asteraceae, Alismataceae , Orchidaceae, Liliaceae, Zingiberacae,Cyperaceae, Poaceae.

Unit-4 :

Phytogeography: Principles and importance of plant geography- Phytogeography regions of the world with a detailed study of Indian vegetation- Patterns of distribution. Theories of present day distribution of plants- Continental drift hypothesis-factors involved in distribution- Endemism, invasion and introduction. Plant migration, vicanance and disjunction. Evolution: Development of Organic evolution, Direct evidences of Evolution(Fossils), Indirect evidences(Taxonomy). Theory of organic evolution, Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Neo Lamakism and Neo Darwinism, mutations theory. Origin of plants. The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale, molecular evolution.

Suggested Laboratory Exercises

1. Introduction to literature in Plant taxonomy: Floras, Manuals, Monographs, Journals, Review articles.
2. Study of vegetative plant morphology-I: Typical Roots, Stems, and Leaves.
3. Study of vegetative plant morphology- II: Modified Roots, Stems, and Leaves.
4. Study of floral plant morphology –I: Inflorescence types
5. Study of floral plant morphology –II: Fruit types
6. Construction of floral diagrams and floral formulas two plants each from dicot and monocot plants.
7. Collection of plants and learning herbarium techniques.
8. Classification and identification of angiosperm plants which are available from plants from any local families.
9. Identification of plants in field through field experience.
10. Construction of dichotomous keys for identification of plants.
11. Identification of plants through online resources from computerized keys.
12. Critical comment on a research paper for reporting new species by taking a published research article.
13. Identification and comment on fossils and plant distribution maps of world and India.
14. Distribution of plants: mapping of distributions on world, India, and Karnataka maps.

Suggested Readings:

1 Agarwal. S.K.S. Tiwari and P.S. Dubey. 1966. Biodiversity and Environment. APH. Pub. Corp., New Delhi.

2 Bentham, G. and J.D. Hooker. 1862-83. Genera *Plantarum*. Vol.3. London.

3 Bhattachargya, B. and B.M. Johri. 1998. Flowering Plants-Taxonomy and Phylogeny. Narosa Pub. House, New Delhi. p. 753.

4 Cronquist, A. 1988. The Education and Classification of Flowering Plants. 2nd ed., Botanical Gardens, Bronx, New York.

5 Cronquist. A. 1968. The Evolution and Classification of Flowering Plants. Thomas Nelson, Edinburgh, London, pp. 1-396.

6 Hooker, J.D. 1894. The Flora of British India., Reeve and Co. London. Vol. 6:1-792

-12-

7 Hutchinson J. 1926. The Families of Flowering Plant. Vol.1 Dicotyledons, McMillan, London, pp. 1-328.

8 Hutchinson. J. 1964-67. The Genera of Flowering Plants. Clarandon, Oxford, Vol 2.

9 Kormondy, E.J. 1986. Concepts of Ecology. 3rd ed. Prentice Hall of India, New Delhi, pp. 1-10.

10 Lawrence. G.H.M. 1967. Taxonomy of Vascular Plants. Oxford and IBH, New Delhi.

11 Myers, N.R.A. Mittermeier, C.G. Mittter Meri and G.A.B. Kents. 2000. Biodiversity Hotspots for Conservation Priorities, *Nature,* 403: 553-858.

12 Myers. N. 1988. Threatened Biotas: Hotspots in Tropical Forestry. *The Environmentalist*, 8:1-20.

13 Pulliah, T. 1998. Taxonomy of Angiosperms. Regency Publications, New Delhi.

14 Shukla, P. and S.P. Misra. 1985. An Introduction to Taxonomy of Angiosperms. Vani Educational Books, New Delhi (Internet).

15 Singh G., Misri, B. and P. Kachroo. 1972. Achieve Morphology: An Aid to the Taxonomy of India Plants *Compositae, Liguliflorae. J. Ind. Bot. Soc.* 51(3-4): 235-242.

16 Singh, G. 1999. Plant Systematics : Theory and Practice. Oxford and IBH Co. Pvt. Ltd., New Delhi, Calcutta, pp. 359.

17 Pramod Tandon. 2009. Biodiversity and its Significance. I.K. International Publishing House Ltd. New Delhi.

Dept of Applied Botany, Kuvempu University

Semester-I

Course Code: BO1.3 Soft Core-1

Palaeobotany and Palynology

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 Lectures/Unit

Course Objectives:

This course aims to introduce the students to study and understand paleobotany and pollen grains of Higher plants. Available fossils detail to understand evolution of plants. Morphological variation and characters of pollen grains and importance.

Course Learning Outcomes:

The students will be learning

1. Processes of fossilization in ancient eras.
2. Prebiotic environment and origin of plant groups.
3. Concept of Gondwana land movements and continental drift.
4. Pollen morphology.
5. Uses of pollen grains in taxonomy, fossil fuel, honey and crime detection.

Course contents:

Unit 1:

History of Paleobotany in India. Work of Birbal Sahani, Paleobotany Institute of India. International Code of Botanical Nomenclature with special reference to the nomenclature of fossil plants. Prebiotic environment; chemical evolution and origin of life; Precambrian lifeforms. Indian Precambrian stratigraphy; Diversification of algae, fungi and bryophytes through ages. Siluro-Devonian land floras; Permo-Carboniferous floral provinces; Devonian and Carboniferous floras of North-West India. Early Mesozoic floras of Molteno and Chinle formations, later Mesozoic floras of Yorkshire and Jura.

Unit 2 :

Concept of Indian Gondwana Sequence, stratigraphy and correlation of Gondwana Sequence in Peninsular Indian basins, mega- and microfloristics of Peninsular Indian Gondwana formations; Indian Peri gondwana floras. Angiosperm paleofloristics; Distribution of Tertiary strata in India. Life as a fuel maker; sources of natural fuels; peat; coal and its varieties, constitution of coal, coal palynology; petroleum, its origin, migration and concentration, palynology in oil exploration. Archaeobotany of Indian cultivated plants.

Unit. 3 :

Palynology :Stenopalynous and Uripalynous pollen grains, Microspore tetrads and polarity of spores and pollen grains. Spore-pollen morphology: Symmetry, shape, size, aperture patterns, NPC System for numerical expression of aperture details, exine stratification, surface structures and sculptures of sporoderm stratification. Chemical nature of sporopollenin, development of pollen wall, pollen units, exineless pollen grains. Exinous wall material - perine, viscin-threads. pollen-kitt.

Unit. 4 :

Melisso palynology. objectives of melisso palynological studies. Indian species of honey bees, importance of pollen grains as constituent of bee-bread, pollen-collecting mechanism of honey bees, analysis of pollen load and honey sample in understanding bee forage.Application of palynology in taxonomic and phylogenetic studies. Aeropalynology with reference to aero allergens, study of air spora, geo palynology, forensic palynology.

Suggested Laboratory Exercises

1.Pollen morphological studies of some pterodophytes, gymnosperms, and angiosperms representing different morphological types using acetolysis / alkali maceration method.
2. Extraction of pollen grains from honey sample and study of the frequency of different morpho-types.
3. Study of in vivo and in vitro germination of pollen grains.
4. Morpho-anatomical study of stigma and style.
5. Study of the growth of pollen tube through stigma and style.
6. Study of Stenopalynous and Uripalynous pollen grains from plant families.
6. Study of some fossils (slide and megafossils).

Suggested Readings:

1. R. Cuneo, S. Archangelsky (1986). "Feruglіocladaceae, a new conifer family from the Permian of Gondwana". Review of Palaeobotany and Palynology. 51 (1–3): 3–30.
2. Rothwell, Gar W (1982). "New interpretations of the earliest conifers". Review of Palaeobotany and Palynology. 37 (1–2): 7–28.
3. Donoghue, Michael (1986). "Seed plant phylogeny and the origin of angiosperms: An experimental cladistic approach". The Botanical Review. 52 (4): 321–431.
4. Khanna, Sunita Khanna (2004). "The Man That Was" (PDF). Newsletter, Birbal Sahni Institute of Paleobotany. 7: 7.
5. Sitholey, R.V. (1950). "(Sahni Memorial Volume) Paleobotany in India - VII. Professor Birbal Sahni 1891-1949". The Journal of the Indian Botanical Society. 29 (1).
6 Raghavan, V. (1997). Molecular Embryology of Flowering Plants. Cambridge. University Press. 9. Raghavan, V. (2000). Developmental Biology of Flowering Plants, Springer, Netherlands
7 Shivanna, K.R. (2003). Pollen Biology and Biotechnology, Science Publishers.
8 Shivanna, K.R. and Rangaswamy, N.S. (1992). Pollen Biology: A Laboratory Manual, springer Verlag
9 Whitelam, G.C. and Halliday, K.J. (2007). Light and plant development; Blackwell Publishing; 325p; ISBN : 978-1-4051-4538-1

Semester-I

BO1.4 : Soft Core-2

Bio fertilizers

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 Lectures/Unit

Course Objectives:

This course aims to introduce the students to study of bio fertilizers for ecofriendly crop productions.

Course Learning Outcomes: The students will be learning

1. Types of bio fertilizers.
2. Importance of soil microorganisms.
3. Symbiotic nitrogen fixation and assimilation.
4. Plant growth promoting fungi and Bacteria.
5. Importance of Mycorrhizae and commercial production of bio fertilizers.

Course Contents:

Unit-1 :

Bio-fertilizers: Classification of bio-fertilizers microorganisms used in bio-fertilizers production. Growth characteristics of various microbes used in bio-fertilizers production. Importance of soil microorganisms – factors affecting the activities of soil microorganisms. Algal fertilizers: BGA and Azolla, occurrence and agronomic significances, symbiotic nitrogen fixers: Root nodules, organisms and their host specificity, Role of Nif and Nod gene in Biological Nitrogen fixation, Organisms and their importance.

Unit-2:

Nitrogenase, heterocyst differentiation, structural significance, physiological and biochemical adaptation for Nitrogen fixation, NR, NiR, GS, GOGAT, and AspAT enzymes biosynthesis, structure and their functions, nitrogen fixation and photosynthesis-relationship, nitrate reduction and assimilation in algae, assimilation of organic nitrogen in algae: urea, amino acids and amides.

Unit- 3:

Microbial transformation of Phosphorus - Rhizosphere – R: S ratio – Microbial inter-relationship in soil, beneficial and harmful relationship. Biofertilizers- *Rhizobium, Azospirillum, Azotobacter, Gluconacetobacter, Azorhizobium*, phosphobacteria - Plant Growth Promoting Rhizobacteria (PGPR) - Production and quality control of bio-fertilizers. Phosphate solubilizing bacteria, siderophores and their importance, PGPF and its importance.

Unit-4 :

Mycorrhizae – introduction, kinds of mycorrhizae, biology of mycorrhizae, inoculation of mycorrhizae, ecto-mycorrhizae and endo-mycorrhizae, AM, Ericarean mycorrhizae, orchidaceous mycorrhizae, mycorrhizal plant interaction and its importance in plant growth and biological control of plant pathogens. Endosymbiosis

: detection of endophytes of plants and their taxonomy, endophytic mutualism, Importance of Trichoderma spp., Pseudomonas spp. and Bacillus spp. as a biocontrol agent. Cross inoculation groups amongst Rhizobium, Methods used for the studying selection of efficient strain of Rhizobium. Strategies of Mass multiplication and marking and registration with CIB of bio agents and bio-pesticides. Bio-pesticides, importance, kinds of bio-pesticides.

Suggested Laboratory Exercises

1 Enumeration of different kinds of microorganisms in soil – qualitative and quantitative methods
2. Decomposition of organic matter.
3. Isolation of rhizosphere microorganisms.
4. Isolation of nitrogen fixing microorganisms. *Rhizobium, Azospirillum* and *Azotobacter.*
5. Isolation of phosphobacteria
6. Observation of mycorrhiza roots.
7. Bio fertilizers inoculant production – mother culture and starter culture – carrier materials – mixing and curing process.
8. Production of *Azolla* and BGA.
9. Production of commercial biofertilizers viz. *Rhizobium, Azotobacter, Azospirillum* and *Acetobacter* : selection of efficient strains, carriers and their sterilization, mother culture preparation, mass multiplication using shake culture method, mixing of culture and carriers and preparation of packets.
10. Production of carrier based and grain based phosphate solubilizing bio fertilizers.

Suggested Readings:

1. Postage, J. 1998. Nitrogen fixation. 3rd Edition, Cambridge University press, Cambridge.

2. Deshmukh, A.M. 2003. Bio-fertilizers and Bio-pesticides. ABD Publishers, Jaipur. India.

3. Subba Rao, N.S. 1998. Bio-fertilizers in Agriculture. Oxford and IBH Publ. Co., New Delhi.

4. Gaur, A.C., Neelakantan, S. and K.S. Dargan. 1984. Organic manures. 2nd ed., ICAR, New Delhi.

5. Cook, R.J. 1993. Making greater use of introduced microorganisms for biocontrol of plant pathogens. Annual Review of *Phytopathol.*, 31: 53-80.

6. Gupta, P.K. 1994. Elements of biotechnology. Rastogi and Campany. Meerut, India.

7. Dubey, R.C. 1996. A textbook of Biotechnology. S Chand and Company Ltd., New Delhi.

8. Trivedi *et al.* 1989. In plant microbe interactions (Biligrame, K.S. ed.), Focal theme (Botany), ISCA Symposium, Narendra Publication house, New Delhi.

Semester-II

Course Code BO2.1: Hard Core - I

Plant Ecology and Environmental Biology
Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 lectures/Unit

Course Objectives:

This course aims to introduce the students to the concepts and principles of ecology, biological diversity, conservation, sustainable development, population, community and ecosystem structure and function, application of these concepts to solve environmental problems.

Course Learning Outcomes:

The students will be learning

1. Limiting factors controlling distribution and growth of organisms.
2. Characteristics of organisms as population, community and ecosystems.
3. What are the ecosystem functions?
4. Applications of ecological knowledge of ecological successions.
5. Problems of pollution and its management.

Course Contents:

Unit-1:

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of meta population – demes and dispersal, interdemic extinctions, age structured populations.

Unit-2 :

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).

Unit-3 :

Water pollution: classification, chemical properties of water-effects of water pollution, indicators of water pollution, management and control measures., environmental

pollution, pollution of water bodies, eutrophication, toxicity, microbes and pollution, indicators of pollution and control measures. Air pollution: classification and properties of air pollutants, effects of air pollution (health, vegetation and material damage), pollutant measurement, and management and control measures. Solid waste: introduction characteristics features, classification and disposal, Greenhouse effect, smog, CFC, ozone depletion, Elnino and Lanino effect, acid rain, thermal, noise, radioactive pollution and management. Remote sensing and GIS: Basic and fundamental concepts of remote sensing.

Unit-4 :

Environmental Impact Assessment: Introduction, process and methods of impact analysis. Hazardous waste management characteristics and types, sources of generation, composition, hazardous waste; soil pollution and indicators of soil pollution. Microbial degradation, and biotransformation, pesticide pollution and degradation. International biological program: UNESCO, MAB. UNEP.

Suggested Laboratory Exercises

BO2.1 Ecology and Environmental biology –Hard core -1

01. Analysis of water samples of lotic and lentic water bodies with reference to.
    a. Corbon dioxide b. Dissolved oxygen
    c. Total hardness d. Phosphate
    e. Sulphate f. Nitrates
02. Effect of So2 gasses on plants.
03. Microscopic examination of different soil types
04. Water holding capacity of different soil samples
05. Determination of organic content, carbonates, exchangeable bases and oxidizable organic content of soils
06. Study of vegetation by quadrat and transect method
07. Ecological Instruments-Anemometer, Lux meter, Rain gauze, Max and min thermometer
08. Visit to meteorological station
09. Drinking water purification
10. Ecological adaptations in hydrophytes, Xerophytes, Halophytes.
11. Any other experiments related to Ecology and Environmental biology not listed here.

Suggested Readings:

Ambasht, K.S. 1969. Plant Ecology. Published by Student's Friends and Co., Lanka Varanasi, India.

Anji Reddy, M. 2006. "A Textbook of Remote Sensing and Geographical information System". 03rd Edition B.S. Publications.

Botkin, D.B. and E.A. Keller. 2004. Environmental Science. 5th ed. John Wiley and Sons.

Bernhardsen, T. 1999. Geographic Information System : An Introduction. 02nd Edition, John Wiley and Sons.

Canter, L.W. 1996. *Environmental Impact Assessment.* McGraw Hill, New York.

Charan and Anil, K. 1992. Plant Geography. Rawat Publications. Jaipur.

Chhatwal, G.R. and M.C. Mehra. 1989. Environmental Air Pollution and its Control. Anmol Publ., New Delhi.

Curran, P. 1985. Principles of Remote Sensing. Longman, Loudon.

Eug. Warming. 1998. Ecology of Plants. Ambey Publications, New Delhi.

Eugene P. Odum. 1996. Ecology. Sinauer Associates Inc Publishers, Sunderland, USA.

Goel, P.K. 1997. Water Pollution Causes, Effects and Control. New Age International Pvt., Ltd., new Delhi.

Kumar, A., Bohra, C. and L.K. Singh. 2003. Environment, Pollution and Management. A.P.H. Publishing Corporation, New Delhi.

Mido, Y. and S.A. Iqbal. 1995. Chemistry of Air and Air Pollution. Discovery Publishing House, New Delhi.

Mohan P. Arora. 1995. Ecology. Himalaya Publishing House, Bombay.

Ross, R.D. 1998. Air Pollution and Industry. Van Norstrand Company Publication.

Sapru, R.K. 1987. Environment Management in India. Patel Enterprises, New Delhi.

Shukla, S.K. and P.R. Srivastava. 1992. Concepts in Environmental Impact Analysis. Common Wealth Publishers, New Delhi.

Tripathy, D.P. 1999. Noise Pollution. A P H Publishing Corporation, New Delhi.

Verma. P.S. and Agarwal, V.K. 1992. Principle of Ecology. Published by S. Chand and Company Ltd., New Delhi.

Williams, I. 2001. Environmental Chemistry. John Wiley and Sons, Ltd., New York.

Dept. of Applied Botany, Kuvempu University

Semester-II

Course Code BO2.2: Hard Core-2

Cell Biology, Genetics and Plant Breeding

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration:64hours. Teaching hours: 16 lectures/Unit.

Course Objectives:

This paper is aimed at understanding the basic concepts of cell studies helping the students to develop their analytical, quantitative and problem-solving skills of genetics and plant breeding.

Course Learning Outcomes:

The students will be learning

1. Membrane structure and function.
2. Structural organization and function of intracellular organelles
3. Structure chromosomes and gene, regulation of cell cycle.
4. Laws of inheritance.
5. Experimental methods in genetics and plant breeding.

Course Contents:

Unit-1:

Membrane structure and function (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes). Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

Unit-2:

Organization of genes and chromosomes (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons). Cell division and cell cycle. Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.Introduction and scope of genetics. Laws of Inheritance (Diploid organism- Pea, Haploid organism- *Chlamydomonas*/*Neurospora*), Interaction of Genes: multiple alleles, multigene inheritance, cytoplasmic inheritance.

Unit-3 :

Classical gene concept: Fine structure of genes, Split genes. - Introns and Exons, overlapping genes. Linkage, maps, genetic and cytological mapping of chromosomes. Chromosome number (euploidy, monoploidy, polyploidy-autopolyploidy, alloploidy). Sex linked inheritance, characteristics of sex linked inheritance, examples of X-linked gene inheritance and Y-linked gene inheritance.

Extra nuclear inheritance: Variegation in 4 'O' clock plant, Lojop in Maize, Poky in Neurospora, Petite in *Sacharomyces.*

Unit-4:

Breeding systems in crop plants, techniques and methods of plant breeding. Breeding of Self-pollinated and cross-pollinated crops by introduction, selection, and hybridization, selection, principles of selection, types of selection. Methods of breeding: hybridization- pedigree method, bulk method, back cross, procedures, advantages of incompatibility, male sterility, barriers to cross sterility. Breeding for disease and insect resistance. Mutation breeding, classification of mutation and mutagens, procedure for mutation breeding in self-pollinated crop, cross-pollinated crops. Heterosis or hybrid vigour-Types of heterosis, causes of heterosis. Techniques of production of hybrid seed.

Suggested Laboratory Exercises

B)2.2 : Hard core-2 : Cell biology, Genetics and Plant breeding

Mendelian Genetics: Problems on monohybrid, di hybrid and tri hybrid crosses. Multiple alleles, cytoplasmic inheritance, epistasis, sex linked inheritance. Laboratory exercises in probability and chi-square; Demonstration of genetic principles using laboratory organisms; Chromosome mapping using three-point test cross; Tetrad analysis; Induction and detection of mutations through genetic tests.

1 Selfing and hybridization techniques in Bajra, maize and Sorghum.
2 Floral biology of Bajra and Maize.
3 Estimation of pollen viability and pollen size.
4 To study stigmatal receptivity and pollination period in self-pollinated crops.
5 To determine LD 50 value for certain chemical mutagens.
6 To test seed viability by TTC method.
7 B-chromosomes and polytene chromosomes.
8 Mitosis and Meiosis
9 Self-pollination, cross pollination, emasculation, bagging 10. Breeders kit.
11 Any other experiments related to this paper which are not listed here.

Suggested Readings:

1. Stickberger, M.W. 1977. Genetics. 2nd Ed., Macmillan, New York .
2. Swanson, C.P., Mertz, T. and W.J. Yound. 1988. Cytogenetics. 2nd Englewood Cliff, New Jersey.
3. Watson, J.P. 1975. Molecular Biology of the Gene. 3rd Ed., Benjamin, New York.
4. Darlington, C.D. 1985. Cytology. Churchill, London.
5. Henry, R.J. 1997. Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK.
6. Old, R.W. and S.B. Promrose. 1989. Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford, UK.
7. Chawla, H.S. 2002. Plant biotechnology. 2nd Ed., Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Science Ltd., Oxford, U.K.
9. Raghavan, V. 1997. Molecular Biology of Flowering Plants. Cambridge University Press, New York, USA.

10 George M. Malacinski. 1986. Molecular Genetics of Mammalian cells. MacMillan Publishing Co., New York.
11 Tobin, A.K. 1992. Plant organelles compartmentation of Metabolism in Photosynthetic tissue. Cambridge University, Press.
12. Bhamaah, H.S. 1990. Molecular cell Biology. Anmol Publication, New Delhi.
13. Rogerl Miesfeld. 1999. Applied Molecular Genetics. Wiley's Liss Publication.
13. Rastogi, S.C. 1995. Concepts in Molecular Biology.
14. Reeta Arora. 1998. Cell Biology. Anmol Publications, New Delhi.
15. Shanmugam, G. 1998. Cell Biology Lab Manual. MacMillan India Ltd., Madras.
16. Sharad Srivastava. 1997. Molecular Genetics, Anmol Publication, New Delhi.
17. Madhusudan W Pandit. 2007. Scientonic Tell-Tale of Genome and DNA. International Publishing.
18. David A. Micklos. 2005. DNA Science: A First Course, Second Edition V
19. Michael Wink. 2006. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology. Springer Publishing Company.
20. Nick Talbot. 2005. Molecular and Cellular Biology of Filamentous Fungi: A Practical Approach. Oxford,
21. Rakesh K. Mishra. 2009. Chromosomes to Genome. I.K. International Publishing.

Semester-II

Course Code BO2.3 Soft Core-1

Techniques in Plant Biology

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration:64 hours. Teaching hours: 16 lectures/Unit.

Course Objectives:

This paper is aimed at understanding the Botanical techniques used in industries for the production certain biological compounds. Methods of plant transformations, production of virus free, stress free plants. Students will be learning high end laboratory Instruments and how to use them.

Course Learning Outcomes:

The students will be learning

1. Tissue and organ culture of important plants.
2. Crop improvement methods through biotechnological methods.
3. How to transfer the gene for production transgenic plants.
4. *In vitro* technology and pharma industries requirements.
5. Experimental methods in biosynthetic pathways and elicitation of compounds

Course Contents:

Unit 1:

SI System of measurement: Fundamental and derived units. Making solutions: Moles and molarity, stock solutions and dilutions, making media and reaction mixtures, pH measurements and preparation of buffers. Radioactive techniques: Isotopes and their half-life, Specific activity of radioisotopes, making radioisotope solutions, detection and measurement of radioactivity - radiation counters, liquid scintillation counters, autoradiography. DNA, RNA and protein isolation and sequencing, gel-doc.

Unit 2:

Microtomy: Principle of tissue fixation for microtomy, types of microtome, serial sectioning and staining. Microscopy and microscopic techniques: Light, phase contrast, fluorescence, electron, confocal microscopy. Micrometry. Flow cytometry. Spectroscopic techniques: Visible, UV, IR spectrophotometry, spectro fluorimetry, NMR and ESR spectroscopy, circular dichroism, atomic absorption and mass spectrometry.

Unit 3 :

Chromatographic techniques: Paper, thin layer and column chromatography, gel filtration, ion exchange and affinity chromatography, high pressure liquid chromatography, gas chromatography. Electrophoretic techniques: Supports, ecto endo osmosis, electrophoresis under native, dissociating and denaturing conditions, isoelectric focusing, staining, activity staining. 2-D electrophoresis, MALDI-TOF.

Unit 4 :

Immunological techniques: Immune response. Antibodies and their specificity, antigen - antibody interactions, immunodiffusion and immune electrophoresis techniques, immunoassays, western blotting. Centrifugation techniques: High speed centrifuges, rotors, ultra-centrifugation, density gradient centrifugation. Electrochemical techniques: Construction and working of equipment for measurement of electrical conductivity, pH meter.

Suggested Readings

1. David L. Nelson, Michael M. Cox Lehninger Principles of Biochemistry; W. H. Freeman 6th edition edition 2013.
2. David M Freifelder Physical Biochemistry: Applications to Biochemistry and Molecular Biology (Life Sciences/Biochemistry, W. H. Freeman; 2nd Revised edition, 1983.
3. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer Biochemistry, W. H. Freeman.
4. Ashhara, A., Crozier, A. and Komamine, A. (2011). Plant Metabolism and Biotechnology. John Wiley and Sons, England (UK).
5. Buchanan, B.B., Gruissem, W. and Jones, R.L (2015). Biochemistry and molecular biology of plants. John Wiley and Sons Ltd., UK.
6. Butenko, R.G. (2000). Plant Cell Culture, University Press of Pacific.
7. Davies, P.J. (2004). Plant Hormones, Kluwer Academic Publishers, Netherlands.
8. George, E.F., Hall, M.A. and De Klerk, G.J. (2008). Plant Propagation by Tissue Culture (3rd Edition), Springer, Netherlands.

Suggested Laboratory Exercises

1. Electron microscope
2. PCR unit
3. Gel documentation
4. Isoelectric focusing
5. Protein / amino acid analysis
6. Paper and Column chromatography
7. ELISA
8. Isolation of DNA
9. Secondary metabolite extraction and detection of antifungal secondary metabolites produced by plant tissues.
10. Polyacrylamide electrophoresis of proteins, Blotting techniques.
11 DNA, RNA and protein sequencing methods.
12 Protein separation by PAGE.
13 DNA amplification by PCR.
14. Study of chromatograms (HPLC, NMR, IR, MS).
15. Any other experiments related to this paper which are not listed here.

Dep.t of Applied Botany, Kuvempu University

Semester-II

Course Code BO2.4: Soft Core-2

Plant Pathology

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64hours. Teaching hours: 16 lectures/Unit.

Course Objectives:

This paper is aimed at understanding the fungal diversity and diseases of crop plants and how to manage them. Students will be learning how to culture fungi and produce mushrooms.

Course Learning Outcomes:

The students will be learning

1. General characters of true fungi.
2. Classification of fungi and plant diseases
3. Genetic mechanisms in fungal adaptations.
4. Disease epidemiology.
5. Management of Bacterial, fungal and virus diseases.

Course Contents:

Unit-1:

Introduction, scope and significance of plant pathology, significant contributions of plant pathologists. Plant diseases and world crop production and yield loss. Classification of plant diseases. Koch's postulations. Methods of studying plant diseases.

Unit 2 :

Pathogenesis: penetration - indirect entry of pathogens through natural openings, wounds, root hairs, buds, direct penetration. Role of toxins in pathogenesis- Introduction, microscopic system, bioassay, Host-relation toxins, non-host selective toxins, control of toxin biosynthesis. Mode of transmission of pathogens by seeds air, soil, water, vectors, contagious, animals. Effect of environmental factors on disease development disease epidemiology and forecasting.

Unit 3 :

Detection and diagnosis of plant pathogenesis- Introduction host range and symptomatology, morphology of the causal organism, selective media, biochemical markers-substrate metabolism, fatty acid profiles (FAME analysis), protein analysis, serological techniques, nucleic acid techniques, choice of diagnostic techniques.

Unit 4 :

Study of important crop plant diseases and their management. Fungal: blast of paddy, wheat rust, grain smut of sorghum, downy mildew of sorghum, smut of maize, anthracnose of beans, leaf spot of chilli, powdery mildews of cucurbits, frog eye spot leaf spot of tobacco. Bacterial: leaf blight of paddy, Citrus canker, angular leaf spot of cotton. Viral: Mosaic, leaf curl, pepper wilt, bunchy top of banana, katte disease of cardamom. Mycoplasma: little leaf of brinjal, grassy shoot of sugar cane.Nematode: root knots of brinjal/tomato.Angiospermicparasites:loranthus,viscum, cuscuta.Management of plant diseases by conventional methods: cultural, chemical and biological.

Suggested Laboratory Exercises

Plant Pathology

1. Studying of following diseases.
2. Fungal:blast of paddy, wheat rust, grain smut of sorghum, downy mildew of sorghum, smut of maize, anthracnose of beans, leaf spot of chilli, powdery mildews of cucurbits, Downy mildew of pearl millet,Leaf rust of coffee.
   Bacterial: Bacterial blight of paddy,Citrus canker.Viral: Mosaic, leaf curl, pepper wilt, bunchy top of banana, katte disease of cardamom.Mycoplasma:little leaf of brinjal, grassy shoot of sugar cane.Nematode: root of brinjal/tomato.Angiospermic parasites: loranthus, viscum, cuscuta.
3. Pure culture – identification of fungi based on conidia and mycelial morphology.
4. Spore release by wash-off method.
5. Disease assessment of an infected leaf.
6. Anthracnose disease in French bean/ Cluster bean
7. Downy mildew of pearl millet.
8. Leaf rust of coffee.
9. Disease of crop plants - Fungal, mycoplasmal, bacterial, nematodal, viral, angiosperm parasitic diseases (other than above mentioned disease)
10. Any other experiments related to this paper which are not listed here.

Suggested Readings:

1. Singh, R.S. 1973. Plant Disease. Oxford and IBH Pub. Co., New Delhi.
2. Agrios, G.N. 1994. Plant Pathology. 2nd Edn. Academic Press New York.
3. Johnston, A. and Both, C. 1983. Plant Pathologists Pocket Book. 2nd Edn. Commonwealth Mycological Institute, Oxford and IBH Pub. Co., Calcutta.
4. Rangaswamy, G. and Mahadevan, A. 2002. Diseases of Crop Plants in India. Prentice Hall of India Pvt.Ltd., New Delhi.
5. Mehrotra, R.S. 1983. Plant Pathology. Tata McGraw Hill Pub. Co., Ltd., New Delhi.
6. Vidhyasekaran, P. 2004. Encyclopedia of Plant Pathology. Viva Books Pvt. Ltd., New Delhi.

Dept. of Applied Botany, Kuvempu University

Semester-II

Course Code: BO2.5:IDE :Inter Discipline Elective

Floriculture

Marks: 40 (Theory final exam 40 + internal assessment 10)
Duration: 32hours.Teaching hours: 8 Lectures/Unit.

Course Objectives:

This paper is aimed at importance of flower diversity and focus on cultivation and marketing opportunities in India and abroad.

Course Learning Outcomes:

The students will be learning

1. General nature of ornamental flowers.
2. Cut flower industry.
3. Commercial flower production in India.
4. Management of flower cultivation.
5. Management of diseases and pests of flower production.

Unit-1 :

Introduction to floriculture science – principles of floriculture, floriculture industry and its importance, (plant nomenclature, botany - plant structures, flowers, fragrance in flowers, genetics) cut flowers, wild flowers.

Unit-2 :

a) World cut flower industry – overview of industry, international trade, exports, products, international and domestic consumption, characteristics of floriculture industry. b) Cut flower industry in India, commercial cut flowers of India and Karnataka, area, production, yield and value of certain commercial flowers in Karnataka, floriculture industries/companies in India, governmental support (NABARD, NHB, APEDA).

Unit-3 :

Soil and fertilizers application – soil properties, fertilizer requirement. Plant propagation – propagating materials, propagation by asexual and sexual means, seed production. Nursery production – planting material, soil, and other media, containers, irrigation and fertilization, pest control and disease management.

Unit-4 :

Pest and disease management – common pests of ornamental plants and flowers and their damage to plants/flowers and control, diseases caused by different agents damage and their control, weeds and their control and integrated pest management. Floriculture in green house – to set up green house facilities, green house operation and management. Post-harvest handling of flowers– collection, delivery, transportation, protection from adverse climate (low temperature containers, humidity, packing, maintenance, air circulation and proper packaging), preservatives.

Suggested Readings:

1. Prasad S and Kumar U 1998. Commercial Floriculture. Agro Botanica, Bikaner, India.
2. Alex Laurie and Victor, H.R. 2001. Floriculture-Fundamental Practices. Agrobios, Jodhpur, India.
3. Anon. 2004. Horticultural Crop Statistics of Karnataka State at a Glance. Directorate of Horticulture, Karnataka State Govt. Bangalore.
4. Anon. 2000. Improved Horticultural Practices for High Yield (Kannada). GKVK Campus, University of Agricultural Sciences. Bangalore.
5. Lyon, T.L. and Buckman, H.O. 1937. The Nature and Properties of Soil. The Macmillan Co. New York.
6. Van Slyke, L.L. 1932. Fertilizers and Crop Production. Orange Judd Publish. Co. Inc., New York.
7. Reddy, Y.T.N., Janakiram, T. and Satyanarayana Reddy, D. 2001. Scientific Nursery Management (Fruit and Ornamental Plants). The House of Sarpan (Media), Bangalore.
8. www.google.com ERS/USDA/floriculture crops or IMPAC: Asian references.
9. www. india agronet.com.
10. www. dial india.com.

Dept. of Applied Botany, Kuvempu University

Semester-III

Course Code: BO3.1: Hard Core-1

Plant Morphogenesis and Reproductive Biology of Angiosperms

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 lectures/Unit.

Course Objectives:

In order to understand the growth and development one has to look into the various aspects of growth, development and reproduction. This course aims at making the students acquainted with the fundamentals and present understanding of the mechanisms associated with development and differentiation of various plant organs and embryological detail.

Learning Outcomes: Students will be able to

1. Understand a shoot apical meristem transforms into an inflorescence and floral meristems and how these domains developmentally maintained.
2. How the male and female germ lines are established and how a variety of tissues coordinate to form gametes?
3. How seed development is accomplished and what are the mechanisms by which rejection reaction occurs during the progamic phase?
4. Understand fertilization necessary for a seed to be formed? How does a fertilized egg and central cells lead to embryo and endosperm formation?

Course Contents:

Unit-1:

Key concepts in growth and development, plant growth vs animal growth, Positive and negative regulatory networks; coordination of growth, isotropic and anisotropic growth, polarity, proliferation and termination of growth, Growth and development of three dimensional structures, developmental plasticity. Meristems: Different types, RAM, SAM, Cell fate determination, lineage decisions, developmental patterning.

Unit-2:

Differentiation of cells: stomata, trichomes, trachieary elements; Development of organs: organ identity, key regulatory mechanisms in development of size and shape of specific organs such as leaf, stem, shoot and root.

Unit-3:

Development and evolution of form and its diversity, Plant architecture: growth of main stem and lateral organs, branching pattern and apical dominance, root and shoot architecture, phyllotaxy and types, determinate and indeterminate growth. Transition to flowering; formation of inflorescence and floral meristems, physiology and chemistry of flowering, maintenance of domains; floral homeotic mutations in *Arabidopsis*, *Antirrhinum* and *Petunia.*

Unit-4:

Regulation of anther and ovule development, pollen wall development, development of microsporangium, role of tapetum in pollen development microsporogenesis and microgametogenesis, scope of palynology, megasporagium(ovule) development, megasporogenesis and megagametogenesis. Progamic phase, *in vitro* pollen germination, pollen tube growth and guidance, double fertilization, self-incompatibility mechanisms, incongruity.

Polarity during embryogenesis, pattern mutants, *in vitro* fertilization, endosperm development, apomixis, polyembryony, embryogenesis(monocot and dicot), Fruit and seed, parthenocarpy, special structure of seed(Nucellus, Perisperm,Caruncle, Operculum and aril).

Suggested Laboratory Exercises

1 Study of stem cells in plants: shoot apical meristem and root meristem in *Ceratophyllum* and *Hydrilla* species.

2 Study to show polarity in stem cuttings in lower and higher plants.

3 Study to demonstrate regeneration in succulents (*Byrophyllum).*

4 Phyllo taxi: Opposite, decussate, whorled and spiral.

5 Microsporangium: Slides: anther sac, wall layers; tapetum; two-celled & three-celled pollen; pollen tetrads.

6 Preparation of pollen grains to study external morphology by acetolysis method.

7 Pollen grain germination studies in *Balsam, Delonix, Hibiscus* and *Ipomea* plants.

8 Megasporangium: Slides –different types of embryo sacs , 4-nucleate 8-nucleate stages; mature embryo sac.

9 Micro dissection and endosperm mounting : *Cucumis sativus, Grevellia robusta.*

14 Embryo: Slides: Monocot and dicot plants.

15 Dissection and embryo mounting: *Crotalaria*

12 Observation of seed appendages: operculum, caruncle, aril of nutmeg, perisperm.

Suggested Readings:

1. Bhojwani, S.S., and Razdan, M.K. (1996). Plant Tissue Culture: Theory and Practice, Elsevier
2. Beck, C.B. (2010). An Introduction to Plant Structure and Development, II edition
3. Pua, E-C. and Davey, M.R. (2010). Plant Developmental Biology-Biotechnological perspectives

4. Fosket, D.E. (1994). Plant, Growth and Development: A Molecular Approach, Academic Press.
5. Hopkins, W.G. (2006). The Green World: Plant Development, Chelsea House Publication

6. Howell, S.H. (1998). Molecular Genetics of Plant Development, Cambridge University Press.
7. Leyser, O. and Day, S. (2003). Mechanism of Plant Development, Blackwell Press, 241p.
8. Raghavan, V. (1997). Molecular Embryology of Flowering Plants. Cambridge. University Press. 9. Raghavan, V. (2000). Developmental Biology of Flowering Plants, Springer, Netherlands
10 Shivanna, K.R. (2003). Pollen Biology and Biotechnology, Science Publishers.
11 Shivanna, K.R. and Rangaswamy, N.S. (1992). Pollen Biology: A Laboratory Manual, springer Verlag
12 Whitelam, G.C. and Halliday, K.J. (2007). Light and plant development; Blackwell Publishing; 325p; ISBN : 978-1-4051-4538-1
13 Wolpert, L., Jessell, T., Meyerowitz, E., Robertson, E. and Smith, J. (2007). Principles of Development; Oxford, Oxford University Press.

Dept. of Applied Botany, Kuvempu University

Semester-III

Course Code: BO.3.2 Hard Core-2

Plant Physiology and Biochemistry

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 lectures/Unit

Course Objectives:

This course aims to educate student on concepts of proteins, enzymes, basic plant signaling mechanisms, sensory photobiology. The course further deals with physiology of nutrient uptake, photosynthesis and nitrogen metabolism.

Course Learning Outcomes:

1. Students will be taught about proteins, their biosynthesis, folding into specific structures, post translational modifications and degradation mechanisms.
2. The course will deal with various phyto hormones and their role in physiology of growth and development. This course will introduce students to physiological advances in sensory photobiology.
3. Students will gain the knowledge on reproductive strategies in higher plants along with physiology of flowering, molecular and hormonal basis of flowering mechanism.
4. Able to understand carbohydrate and amino acid metabolism.

Course Contents:

Unit- 1:

Water relations: Internal factors, cytoplasmic, gametic, environmental. Water requirement, transpiration, factors affecting transpiration, transpiration control and anti transpirants, stomatal movement. Mechanism of ion uptake, transportation and accumulation, Donnan's equilibrium, translocation of solutes. Mineral nutrition, mineral deficiency diseases.

Unit-2:

Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photo protective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway. Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis.

Unit-3:

Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action (Auxins, Gibbirllines, Cytokinin). Sensory biology - Structure, function and mechanisms of action of phytochromes, cryptochromes and

phototropins; photoperiodism and biological clocks. Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Stress physiology; Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Unit-4 :

Structure of atoms, molecules and chemical bonds. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).

Suggested Laboratory Exercises

1. Measurement of water potential.
2. Membrane permeability-effect of temperature and temperature and ion.
3. Paper chromatographic separation of chloroplast pigments and amino acids
4. Extraction of proteins from different plant organs & estimation.
5. Effect of light and potassium ion on stomatal opening.
6. Extraction and estimation and total phenolic compounds.
7. Isolation of chloroplasts and measurement of Hill reaction.
8. Demonstration of carbon dioxide fixation by estimating the dry matter yield.
9. Extraction of enzymes from plant tissues and study the effects of :

   a) PH b) Temperature

   c) Substrate concentration d) Enzyme concentration

   e) Inhibitors f) Promoters
10. Isolation of mitochondria and estimation of succinate dehydrogenase
11. Experiments to demonstrate the Crassullacean acid metabolism
12. Experiments to demonstrate physiological changes under stress proline accumulation
13. Extraction and estimation of IAA oxidase from the tissues.
14. Quantitative estimation of amino acids by spectrophotometric method using ninhydrin reagent.
15. Quantitative estimation of protein by spectrophotometric method using Folin-Ciocalteau reagent.
16. Quantitative estimation of carbohydrate by spectrophotometric method using Anthrone reagent. Determination of Acid value of fat sample.
17. Determination of total titratable acidity of cell sap.

18. Preparation of a standard curve for IAA and determination of unknown concentration of IAA.
19. Preparation of a standard curve for phenolic compound and determination of the concentrations of unknown phenolic compound.
20. Spectrophotometric estimation of reducing sugar by 3, 5, - dinitrosalicylic acid
21. Finding Arithmetic Mean, Median, Mode form given data

Suggested Readings

1. Salisbury F. B. & C.W Ross, Plant Physiology, Wadsworth Publishing Co., 1986.
2. Noggle, G.R. & G.J. Fritz, Introductory Plant Physiology, Prentice Hall- 1983.
3. Stupf, P.K.&E.E. Conn (Editors in Chief). The Biochemi-stry of Plant. Vol. 1-8, 1981. academic press.
4. Wilkins M.B. Advanced Plant Physiology. Pitman Publishing Co. 1984.
5. Douce R. Mitochondria in Higher Plants: Structure, Function and Biogenesis. Academic press, 1985.
6. Davios D. D. The Biochemistry of Plants, Academic press, 1987.
7. Thompson W. W. J. B. Mudd & m. Gibbs, Biosynthesis and Function of Plant Lipids. Amer. Soc. Plant Physiol., 1983.
8. Timmermann B. N. C. Steelink & F. A. Loewus, Phutocho-mical inadaptions to stress. Plenum publ. 1984.
9. Bewley J. B. & M. Black, Physiology and Biochemistry of seeds in relation to germination. Vol. 1-2. Springer-Verlag, 1982-83.
10. Bhojwani S. S. & Bhatnagar S.P the Embryology of Angiosperms, New-Delhi.1977.
11. Bhojwani S. S. & Rayden M. K. Plant Tissue culture theory and Practice, Elsevier, Amstordam, 1983.
12. Annual Reviews of Plant Physiology (Published every year).
13. Raghavan V. Experimental embryogenesis in vascular plants. Mac Graw- Hill, N. Y. 1976.
14. White P.R. Cultivation of animal and plant cells Ronald press co. 1963.
15. Steward F. C. (Ed). Plant Physiology-A treation Vol. 513. Acad. Press, New-York, 1969.

Dept. of Applied Botany, Kuvempu University

Semester-III

Course Code: BO3.3: Soft core -1

Plant Diversity and Human Welfare

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 lectures/Unit

Course Objectives:

The course aims to have understanding of plant diversity, significance of diversity, need of classification, bases of classification, Plant adaptations, distribution of plants, curious plants, indicator species.

Course Learning Outcomes:

The students will be learning

1. What is the significance of plant diversity?
2. What are the adaptations in plants in relation to habitat conditions?
3. Plant diversity at different levels.
4. Geographic indications

Unit 1:

Plant diversity and Classification, Levels of biodiversity, various Phyla of Plants and their characteristics (Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms- Present status in India). Indigenous people and plant diversity, Traditional plant conservation practices, Plants in Indian tradition and culture, Plant- animal interactions.

Unit 2:

Ecosystem services, Human Food and Plant diversity, Terrestrial Plant diversity, Marine Plant diversity, Inland water diversity, Rain Forest ecosystem and plant diversity, Landscape diversity. Plant diversity and plant resource economy in India. Indicator plants of metals and resources, vertical gardening, green buildings, plants, plants in bioterrorism and biosecurity.

Unit 3:

Biodiversity Hotspots, Keystone species, flagship species. Threats to Plant diversity, human population growth, diseases, Desertification, fire, Endangered plants, Plant invasions, Loss of Plant diversity, Plant Restoration. Endemic plants of Western Ghats and Eastern Himalayas.

Unit 4:

Taming of wild plants by man: Beginning of Agriculture- when, where and how; Story of transforming wild plants to modern day crops; Role of plants in evolution of human civilization; Influence of plants on language, religious and cultural practices, folklore, fine arts etc,. Plant diversity and Politics: Specific plants/plant related issues and politics; *Amaranthus* in indigenous civilizations of Mesoamerica and Spanish invasion- consequences, Vavilov vs Lysenkism; Indigo revolt and origin of India non-violent struggle for independence, Chipko movement. Green revolution and its impact on Indian agriculture. Contributions of Norman Borlaug and M.S. Swaminathan.

Suggested Laboratory Exercises

1. Determination of density, abundance, frequency in plant communities.
2. Assessment of basal area of a small patch of forest.
3. Determination of species diversity (α- diversity) index in plant community.
   a. Shannon–weisner
   b. Simpson etc.
4. Measurement of similarity index (β- diversity) in two different plant communities by a) Jaccard measure (Qualitative), 2) Morista Horn (Quantitative)
5. Determination of Importance Value Index (IVI) of plant species in plant community by quadrate, line and belt transect methods.
6. Indigenous practices.
7. Mapping of hot spots of India and the world.
8. Indigenous use of sacred plants.
9. Plant related issues such turmeric, basmati rice, bt-brinjal and such other plants.
10. Observation of endemic plants of Western Ghats areas.

Suggested Readings:

1. Kumar, U. and Sharma, A.K. (2001). Plant biotechnology and Biodiversity conservation. Agrobios, Jodhpur.
2. Dobson, A. (1996). Conservation and Biodiversity. Palgrave MacMillan
3. Levin, S.A. (2001). Encylopedia of Biodiversity Vol 1 to 5. Academic Press New York
4. Groombridge, B. and Jenkins, M.D. (2002). World Atlas of Biodiversity, Earth living resources in the 21st Century. University of California Press
5. Singh, J.S., Singh, S.P. and Gupta, S.R. (2008). Ecology, Environment and Resource conservation. Anamaya Publications, New Delhi
6. Krishnamurthy, KV. (2003). Text Book of Biodiversity. Science Publishers
7. Mapes, Christina and Eduardo Espitia, 2001, Amaranth, in *The Oxford Encyclopedia of Mesoamerican Cultures*, vol. 1, edited by David Carrasco, Oxford University Press. pp: 13-14
8. Sauer, Jonathan D., 1967, The Grain Amaranths and Their Relatives: A Revised Taxonomic and Geographic, *Annals of the Missouri Botanical Garden*, Vol. 54, No. 2, pp. 103-137

Semester-III

Course Code: BO3.4: Soft core -2

Plant Biotechnology

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours : 16 lectures/Unit

Course Objectives:

This course would provide students with an understanding of principles and techniques of plant tissue culture, concepts and methods associated with development and analysis of transgenic plants, and their applications in basic and applied research. In addition, students would be exposed to the economic importance and current research paradigms in various categories of commercially cultivated plants.

Course Learning Outcomes:

The students will learn about

1. Concepts, tools and techniques related to *in vitro* propagation of plants.
2. Various case studies related to basic and applied research in plant sciences using biotechnology.
3. Principles and methods used for phenotypic, genetic and molecular analysis of transgenic plants
4. Uses and current research paradigms in various plants of economic value.

Course contents

Unit 1 :

Scope and importance of tissue culture techniques. Basic aspects of plant tissue culture, tissue culture media components, growth regulators, growth retardants. Explants, sterilization, inoculation, sub-culturing. Different types of cultures, callus formation, different types of suspension cultures, single cell culture, organogenesis-different types, factors affecting organogenesis. Micropropagation, different stages of micropropagation, rooting and establishments in herbs & woody plants. Restoration of degraded land through micropropagation, and development of stress tolerant plants.

Unit 2 :

Somaclonal and androclonal variation and their importance. Somatic embryogenesis - different methods, factors affecting embryo maturation, application of somatic embryogenesis, synthetic seeds - its significance. Protoplast isolation and culture, factors affecting. Protoplast fusion and somatic hybridization, fusion methods, fusion products, cybrids, applications of protoplast fusion. Haploids-different methods, anther and pollen culture, significance in crop improvement, ovary, ovule, endosperm and embryo culture, importance, *in vitro* fertilization and its significance.

Unit 3 :

Applications of genetic transformation – case studies on use of transgenic technology for basic studies and crop/plant improvement; phenotypic, genetic and molecular analysis of transgenic plants; factors influencing transgene expression levels; transgene silencing; marker-free transgenics; genome editing for crop improvement; environmental, social and legal issues.

Unit 4 :

Production of pathogen free plants, different methods, meristem culture and its importance in commercialization, development of disease - free tissue culture plants. Different types of secondary metabolites, production, factors, affecting yield, biotransformation, different types with examples, immobilization techniques and advantages, biosensor and biochips, secondary metabolites production centers in India.

Suggested Laboratory Exercises

Instruments:

1. a) Hot air oven, b) Autoclave, c) pH meter, d) Laminar air flow, e) Culture racks, f) Inverted microscope, g) Filtration unit and h) Accessories
2. Types of media and their constituents
3. Explants preparation – Monocot and Dicot
4. Media and explants sterilization
5. T/S of root and shoot primordia
6. Preparation of synthetic seeds
7. Isolation of protoplast and viability testing
8. Micropropagation – stem, leaf, meristem, flower bud, haploid culture (anther), embryo culture
9. Isolation of plasmid from *E. coli* by alkaline lysis method and its quantitation spectrophotometrically.
9. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
10. Isolation of protoplasts from various plant tissues and testing their viability.
11. Effect of physical (e.g. temperature) and chemical (e.g. osmoticum) factors on protoplast yield.
12. Demonstration of protoplast fusion employing PEG.
13. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seed.
14. Demonstration of androgenesis in *Datura.*
15. Electroporation of protoplasts and checking of transient expression of the reporter gene.
16. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.
17. Other experiments which are not listed here pertaining to this paper.

Suggested Readings:

1. Adrian, S., Nigel, W.S. and Mark, R.F. (2008). Plant Biotechnology: The genetic manipulation of Plants, Oxford University Press.
2. Buchanan, B.B., Gruissem, W. and Jones, R.L. (2015). Biochemistry and Molecular Biology of Plants, John Wiley and Sons Ltd., UK.
3. Butenko, R.G. (2000). Plant Cell Culture, University Press of Pacific.
4. Davies, P.J. (2010). Plant Hormones, Kluwer Academic Publishers, Netherlands.
5. Halford, N. (2006). Plant Biotechnology - Current and future applications of genetically modified crops, John Wiley and Sons, England.
6. Kirakosyan, A. and Kaufman, P.B. (2016). Recent Advances in Plant Biotechnology, Springer, UK.
7. Kochhar, S.L. (2016). Economic Botany: A comprehensive study, Fifth edition, Cambridge University Press, NY.
8. Primrose, S.B. and Twyman, R.M. (2016). Principles of Gene Manipulation, 8th edition, John Wiley and Sons Ltd., Chicester, UK.
9. Ricroch, A., Chopra, S. and Fleischer, S.J. (2014). Plant Biotechnology: Experiences and future prospects, Springer International Publishing AG, Springer, Switzerland.
10. Wickens, G.E. (2004). Economic Botany: Principles and Practices, Springer, ISBN 978-0- 79236781-9.

Dept. of Applied Botany, Kuvempu University

Semester-III

Course Code: BO3.9: Inter Disciplinary Elective

Plants for Human Welfare

Marks: 50 (Theory final exam 40 + internal assessment 10 (Credits-2)

Duration: 32 Hrs. Teaching hours: 8 lectures/Unit

Course Objectives:

The course aims to introduce the plant resources that help human society to sustain and benefit from their use, Knowledge of biodiversity and its importance, Agricultural diversity and biodiversity loss and biodiversity management.

Course Learning Outcomes:

The students will be learning

1. the useful plants to human society
2. identification feature of such resources
3. The students would be able to judge the value of biodiversity and its role in stabilizing the climate and economy. They would know the causes and consequences of loss of biodiversity and planning of conservation strategies.

Course Contents:

Unit- 1

A general overview of economically important plants and their role in human welfare as food, oil, drugs, nutraceuticals, beverages, fibre, timber, biofuels, ornamental and as environment protection through carbon sequestration.

Food crops: Cereals; Origin, cultivation and food values of important crops e.g., wheat, rice, maize, grain legumes (Pulses).

UNIT-2:

Medicinal and nutraceuticals: Traditional plants as source of drugs used against several serious diseases such as cancer, diabetes, malaria, dengue, psoriasis, etc. Characterization of bioactive metabolites; elicitation of secondary metabolites from anticancerous plants such as *Podopyllum, Taxus, Cathranthus, Psoralia, Nardostachys*. Nutraceuticals and functional foods; Important plants such as *Aloe vera, Moringa, piper* spp

UNIT-3:

Edible and non-edible oils: Classification of oils, Oil yielding plants, processing and purification of different edible oils such as mustard, olive, sunflower oil, safflower peanut oil; Non-edible oils; such as Jojoba (*Simmondsia chinensis), Sesamum indicum* oil, Linseed oil,

Citrus oil, etc.Essential oils; Lavender oil, rosemary oil, almond oil, clove oil cinnamomum oil, *Eucalyptus* oil.

UNIT-4:

Plants as a source of timber: e.g., *Tectona grandis, Salix* sp., *Dalberia sisso* (sheesham) and fuel wood, type and resources. Fibre yielding plants: Cotton (*Gossypium* sp.), Jute (*Corchorus* sp.), sun-hemp (*Crotalaria* sp). Plants used for Horticulture, floriculture & ornamental values: Brief introduction of different type of horticultural and ornamental plants (Gerbera, Carnation, Anthurium, Chrysanthemum, Orchids,etc.) and their commercial aspects.

Suggested readings:

1. Kochhar, S.L. (2016). Economic Botany. Fifth Edition. Cambridge University Press, UK. ISBN 978-1-316-63822-4. 664pp.
2. Nakar, R.N., Dhaduk, H.L. and Chovatia, V.P. (2016). Medicinal plants-Cultivation and Uses, Daya Publishing House, India.
3. Prakash, J. and Pierik, R.L.M. (1991). Horticulture - New Technologies and Applications (Current Plant Science and Biotechnology in Agriculture). Kluwer Academic Publishers.
4. Kayser, O. and Quax, W.J. (2007). Medicinal Plant Biotechnology, From Basic Research to Industrial Applications, Vol. I &II. Wiley-VCH, Weinheim.
5. Watt, G. (2014). A Dictionary of Economic Products of India.v.5, Linum to Oyster.
6. Wink, M. (2011). An Introduction to Molecular Biotechnology. Wiley Blackwell, Germany.

Dept. of Applied Botany, Kuvempu University

Semester-IV

Course Code: BO4.1: Hard Core-1

Ethnobotany, Medicinal Plants and Plant Resource conservation

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50

Duration: 64 Hrs. Teaching hours: 16 lectures/Unit.

Course Objectives:

This course would provide students with an understanding of principles and methods of ethnobotany and traditional knowledge plants. Students will know important medicinal plants of India and their conservation. In addition, students would be exposed to the economic importance and conservation natural resources.

Course Learning Outcomes:

The students will learn about

5. Ethnobotanical knowledge.
6. Importance of medicinal plants, their diversity, in treating various diseases.
7. Recent knowledge and status of medicinal plants.
8. Natural resources and their conservation.
9. Uses and current research prospects in various plants of economic value.

Unit 1 :

Ethnobotany; Introduction, and development of ethno botanical study, current scope and potential application. Traditional botanical knowledge; Diagnostic feature, identification tools, and general ethno botanical technique. Ethno botanical food plants and ethno botanical medicinal plants. Collection, preparation and preservation of ethno botanical specimen; Cultural, ethical and practical consideration. Plants in human affairs; Ethno pharmacology and drug discovery. New medicine from ancient wisdom. Botanical medicines and their application. Applied ethno botany; commercialization, conservation and in sustainable development. Ethno botanical information resources; Books, Journals, www, CD- ROMs.

Unit 2 :

Classification and nomenclature of medicinal plants - Classification based on origin (plant, animal, and minerals) and nature of plants (medicinal, poisonous plants and aromatic plants). Commercial medicinal plants in therapeutics - *Catharanthus roseus, Aconitum ferax, Rauwolfia serpentina, Stychnos nux-vomica, Withania somnifera, Vetivera zizinoides.* Reasons for commercialization, curative aids, chemical nature. Plant based medicines. Overexploitation and consequences. Medicinal Plant Research Institutes, CIMAP, NBRI,CDRI. Aromatic plants as medicine - extraction and processing,

export potential and medicinal uses, eg., *Santalum album, Cinnamomum camphora, Cymbopogon, Eucalyptus, Jasminum* spp.,*Lavendula officinalis, Rosa damascena, Pogostemon perilloides* (Potcholi), *Rosamarinus officinalis.*

Unit: 3:

Conservation of Plant resources: concept, ethics and philosophy of conservation. Plant diversity in India - a brief account of diversity of major groups of plants (Algae, Fungi, Bryophytes, Pteridophyta, Gymnosperms and Angiosperms). Ecosystem diversity, species diversity, genetic diversity.

Unit:4

Threats to natural resources: Human population growth, Habitat loss, Pollution, introduced species, Fires, Diseases, impact of GMO on local biodiversity. Strategies of conservation *Ex-Situ* and *In-Situ* Conservation. Hotspots of biodiversity. International organizations for biodiversity conservation- IUCN, Species survival commission (SSC), convention on biological diversity (CBD), CITES, TRAFFIC, WWF. Plant genetic resources: Conservation, gene bank- methods, types, NBPGR, IPGR.

Suggested Laboratory Exercises

1. Study of medicinal plants
   1) *Clerodendron infortunatum* 2) *Cassia mimosoids*
   3) *Solanum xanthocarpum* 4) *Argyria cuneata*
   5) *Lantana cranulata* 6) *Santalum album*
   7) *Lawsonia inermis* 8) *Holorrhena antidysentrica*
   9) *Aloe berbadense* 10) *Centella asiatica*
   11) *Morinda tinctoria* 12) *Plumbago zeylanica*
   13) *Gymnema sylvestre* 14) Other plants
2. Commercial medicinal plants.
3. Vegetative propagation techniques.
4. Diseases and pests of medicinal plants.
5. Visit to sanctuary, National parks, MPCA and Submission of reports.
6. Determination of density, abundances, and frequency of some medicinal plants by quadrat/ Transact/ point frame methods.
7. Determination of density, abundance, frequency in plant communities.
8 Assessment of basal area of a small patch of forest.
10 Determination of species diversity (α- diversity) index in plant community.
   a. Shannon–wiener
   b. Simpson etc.
11 Measurement of similarity index (β- diversity) in two different plant communities by a) Jaccard measure (Qualitative), 2) Morista Horn (Quantitative)
16 Determination of Importance Value Index (IVI) of plant species in plant c
17 Visit to a meteorological station, sanctuary, national park and preparation of a report.
18 Mapping of hot spots of the world, India and Karnataka.
19 Survey of ethnobotanical information by standard questionnaire method.
20 Other experiments which are not listed here pertaining to this paper.

Suggested Readings

1. Acharya,Y.T.(1941)(ed). Charakasamhitha, commentary by Chakrapani, Niranya Sagar Press, Bombay.
2. Aggarwal V.S. and Ghosh B 1985, Drug plants of India (Root Druga) Kalyani publishers, New Delhi,
3. Ambasta, S.P. 1988 (ed). The useful plants of India. CSIR, New Delhi.
4. Anonymous (1922). Five hundred Indian plants and their use in medicine and in the arts(In Karnataka), 3rd Edition, Kanarese mission press, Mangalore.
5. Anonymous, (1948). The wealth of India, CSIR, New Delhi.
6. Anonymous, 1922, Five hundred Indian plants, their use in medicine and in the arts (in Karnataka), 3rd ed. (Ist ed. 1881) Kanarese mission press, Mangalore.
7. Aobarya. Y.T. 1941 (ed). Charaka samhita, commentary by chakrapani, Niranya sagar press Bombay
8. C.K.Kokatae, A.R.Purohit, S.B.Gokhale,D.K.Furia .(1990).Pharmocognosy. Niraliprakashan, Pune.
9. Chopra,R.N., Nayar,S.L. and Chopra,I.C.(1956). Glossary of Indian medicinal plants, CSIR, New Delhi.
10. Cotton C M (1996). Ethnobotany, Principles and applications, John Wiley, New York..
11. Gopalan C, Ramasastri B V and Balasubramanian S C (1985). Nutritive value of Indian foods. National institute of nutrition, Hyderabad.
12. Hughes C C (1968), Ethno medicine. In International encyclopedia of social sciences, Vol 10, MacMillan, New York.
13. Iyengar.M.A.(1991), Study of crude drugs, Director and publishers, KMC Manipal.
14. J .S. Qadry and S.Z. Qadry (1981). A text book of inorganic pharmoceutical and medicinal chemistry.Popular prakashan .Mumbai.
15. Jain,S.K., Sinha,B.K.and Gupta,R.C.(1991), Notable plants in ethno medicine of India. Deepa Publications, New Delhi.
16. K.D.Tripathi. (1985). Essentials of medical pharmacology. Jaypee Brothers medical publishers (P) ltd. Daryaganj. NewDelhi.
17. Kapoor S.L. and Mitra. R. 1980, Herbal drugs in Indian pharmaceutical Industry. NBRI Lucknow
18. Kirtiikar K.R. and Basu B.D. 1933. Indian Medicinal plants IIrd. Allahabad.
19. Bajaj YPS Ed. 1986. Biotechnology in agricultre and forestry. Springer verlag.
20. ogy costed IBN Universities Press (India) Ltd., New Delhi.
21. Jain, S.K. (ed) 1981. Glimpses of Indian Ethnobotany, Oxford & IBH, New Delhi.
22. Jain, S.K. (ed) 1989. Methods and Approaches in Ethnobotanists, Lucknow.
23. Cotton C M (1996). Ethnobotany, Principles and applications, John Wiley, New York.
24. Hughes C C (1968), Ethnomedicine. In International encyclopedia of social sciences, Vol 10, MacMillan, New York.
25. Martin G S (1995), Ethnobotany. Chapman and Hall, London.

Dept. of Applied Botany, Kuvempu University

Semester-IV

Course Code: BO4.2: Hard Core-2

Molecular Biology and Genetic Engineering of Plants

Marks: 150 (Theory final exam 75 + internal assessment 25 + Practical exam 50)
Duration: 64 Hrs. Teaching hours: 16 lectures/Unit.

Course Objectives:

This course would provide students with an understanding of principles and techniques of molecular biology analysis of transgenic plants, and their applications in basic and applied research. In addition, students would be exposed to the economic importance and current research paradigms in various categories of commercially cultivated plants.

Course Learning Outcomes:

The students will learn about

1. Concepts, tools and techniques related to *in vitro* techniques.
2. Different methods used for genetic transformation of plants, use of *Agrobacterium* as a vector for plant transformation, components of a binary vector system.
3. Various case studies related to basic and applied research in plant sciences using transgenic technology.
4. Principles and methods used for phenotypic, genetic and molecular analysis of transgenic plants.
5. Uses and current research paradigms in various plants of economic value.

Course Contents:

Unit 1 :

Organization, structure and functions of plant genome: Nuclear, chloroplast and mitochondrial genomes, evolution of mitochondrial and chloroplast genomes. Information transfer: introduction to nucleic acids- models, evidences to prove DNA and RNA as genetic material, DNA replication. Transcription and translation,post-translation modification of proteins. Regulation of gene action in prokaryotes and eukaryote, operon concept (lac and trp).

Unit 2 :

Eukaryotic genome and gene structure: Nuclear genome: Genomic components: Coding (protein /RNA coding) and non-coding regions. Gene and Promoter structure- introns and exons, and function, enhancers, insulators, silencers; UTRs. Recombinant DNA and Gene cloning: Cloning and expression vectors: plasmids, phages, cosmids, viruses, transposons, YAC, MAC. Molecular probes. Restriction enzymes for cloning; cloning in bacteria and eukaryotes. Molecular markers used in genetic engineering.

Unit 3:

Genomics and Proteomics: Structural Genomics - Genome anatomy of prokaryote and eukaryote, tools and strategy to decipher genome. Functional Genomics - Regulation of Genomic activity, Genome profiling, Microarray, Genome Projects (Arabidopsis & Human). Proteomics - Basic principles and application, 2D Gel analysis, Importance. Molecular probes, southern, northern and western blotting; dot and slot blots; construction and screening of genomic and c DNA libraries; chromosome walking.

Unit 4 :

Principles and methods of genetic transformation – Introduction; direct gene transfer methods: particle bombardment, electroporation, PEG-mediated and floral-dip; marker and reporter genes; *Agrobacterium* biology and biotechnology; plant - *Agrobacterium* interactions. Applications of genetic transformation – case studies on use of transgenic technology for basic studies and crop/plant improvement; phenotypic, genetic and molecular analysis of transgenic plants; genome editing for crop improvement; environmental, social and legal issues.

Suggested Laboratory Exercises

1. Colorimetric estimation of RNA using orcinol.
2. Colorimetric estimation of DNA using diphenyl amine.
3. Isolation of plant genomic DNA and its spooling.
4. Isolation of total RNA from plant tissue and its colorimetric estimation.
5. Preparation of tissue culture media, sterilization and inoculation of plant material.
6. Demonstration of techniques of *in vitro* culture of various explants.
7. Isolation of plant protoplasts (e.g. tobacco, petunia) using enzymes available commercially and estimation of their yield.
8. Demonstration of alkaline phosphate activity of plant chromosome.
9. Chromosome banding technique.
10. Gel electrophoresis study of plant genetic DNA and plant protein.
11. PCR amplification on selected DNA fragment extracted from plant material.
12. Restriction digestion of genomic DNA and construction of restriction map.
13. Transformation of *E. coli* by suitable plasmids, transposon mutagenesis.
14. Micropropagation and induction of embryogenesis (Somatic and Gametic).
15. Demonstration of sophisticated instruments: Ultracentrifuge, fraction collector, Gel documentation, HPLC, PCR, AAS.
16. Other experiments which are not listed here pertaining to this paper.

Suggested Readings:

1 Adrian, S., Nigel, W.S. and Mark, R.F. (2008). Plant Biotechnology: The genetic manipulation of Plants, Oxford University Press.
2 Buchanan, B.B., Gruissem, W. and Jones, R.L. (2015). Biochemistry and Molecular Biology of Plants, John Wiley and Sons Ltd., UK.
3 Butenko, R.G. (2000). Plant Cell Culture, University Press of Pacific.
4 Davies, P.J. (2010). Plant Hormones, Kluwer Academic Publishers, Netherlands.
5 Halford, N. (2006). Plant Biotechnology - Current and future applications of genetically modified crops, John Wiley and Sons, England.

6 Kirakosyan, A. and Kaufman, P.B. (2016). Recent Advances in Plant Biotechnology, Springer, UK.
7 Ricroch, A., Chopra, S. and Fleischer, S.J. (2014). Plant Biotechnology:
8 Experiences and future prospects, Springer International Publishing AG, Springer, Switzerland.
9 Wickens, G.E. (2004). Economic Botany: Principles and Practices, Springer, ISBN 978-0- 79236781-9.

Semester-IV

Course Code: BO4.5

Project Dissertation

Marks: 100 (Dissertation 75 + Viva Voce examination 25) Duration:4 months.

Student shall select a topic from the subject and continue research under a supervisor for 4 months and submit the dissertation. The VIVA-VOCE examination will be conducted by inviting external examiner and research supervisor and be evaluated.

****

M.Sc. First semester Examination-20----------

(CBCS Scheme)

Subject- Botany

PAPER-Hard core-1- PHYCOLOGY AND MYCOLOGY

Note : 1. Answer All Questions.

2. Write diagram wherever necessary.

Time : 3.00 hrs **Max. Marks : 75**

I. Define/explain the following **02 x 10 = 20**

1.from unit 1
2. from unit 2
3. from unit 3
4. from unit 4
5. from unit 5
6. from unit 6
7. from unit 7
8. from any units
9. from any units
10. from any units

II. Write Short notes on any Five of the following **05 x 5 = 25**

11. from unit 1
12. from unit 2
13. from unit 3
14. from unit 4
15. from unit 5
16. from unit 6
17. from unit 7

III. Answer any Three of the following **03 x 10 = 30**

18. from unit 1
19.from unit 2
20.from unit 3
21.from unit 4
22 from remaining units

M.Sc. First semester Examination-20----------

(CBCS Scheme)

Subject- Botany

Soft - Core-2: BIOFERTILIZERS

Model Question Paper

Note : 1. Answer All Questions.

2. Write diagram wherever necessary.

Time : 3.00 hrs **Max. Marks : 75**

I. Define/explain the following **02 x 10 = 20**

1.from unit 1
2. from unit 2
3. from unit 3
4. from unit 4
5. from unit 5
6. from unit 6
7. from unit 7
8. from any units
9. from any units
10. from any units

II. Write Short notes on any Five of the following **05 x 5 = 25**

11. from unit 1
12. from unit 2
13. from unit 3
14. from unit 4
15. from unit 5
16. from unit 6
17. from unit 7

III. Answer any Three of the following **03 x 10 = 30**

18. from unit 1
19.from unit 2
20.from unit 3
21.from unit 4
22 from remaining units

M.Sc. First semester Examination-20----------

(CBCS Scheme)

Subject- Botany **PAPER-** **Course Code: BO3.3: Soft core -1**

Plant Diversity and Human

Model Question Paper

Note : 1. Answer All Questions.

2. Write diagram wherever necessary.

Time : 3.00 hrs **Max. Marks : 75**

I. Define/explain the following **02 x 10 = 20**

1.from unit 1
2. from unit 2
3. from unit 3
4. from unit 4
5. from unit 5
6. from unit 6
7. from unit 7
8. from any units
9. from any units
10. from any units

II. Write Short notes on any Five of the following **05 x 5 = 25**

11. from unit 1
12. from unit 2
13. from unit 3
14. from unit 4
15. from unit 5
16. from unit 6
17. from unit 7

III. Answer any Three of the following **03 x 10 = 30**

18. from unit 1
19.from unit 2
20.from unit 3
21.from unit 4
22 from remaining units

I Semester M.Sc., Practical Examination, May 20——

Subject- Botany

PAPER- BO1.1Hard Core-1: Phycology and Mycology

Time 3h (10 to 1pm) Max. Marks:50

1. Conduct the given experiment 'A', write down the procedure and tabulate the results and leave for evaluation. 10 marks
2. Conduct the given experiment ' B ' and comment on the results. 5 marks
3. Identify and Comment on the specimens 'C ,D and E'. 15 marks
4. Observe the slides F G H and comment on them. 15 marks
5. Class record 5 marks

III Semester M.Sc., Practical Examination, May 20——

Subject- Botany

PAPER- Course Code: BO3.3: Soft core -1

Plant Diversity and Human

Time 3h (10 to 1pm) Max. Marks:50

1 Conduct the given experiment 'A', write down the procedure and tabulate the results and leave for evaluation. 10marks

2.Conduct the given experiment ' B ' and comment on the results. 5 marks

3.Identify and Comment on the specimens 'C ,D and E'. 15 marks

4.Observe the slides F G H and comment on them. 15 marks

5.Class record 5 marks

KUVEMPU UNIVERSITY

Ph.D. IN BOTANY PROGRAMME

NEW REGULATIONS

COURSE WORK CURRICULUM

Department of Applied Botany
Jnanasahyadri, Shankaraghatta-577451
Shimoga Dist, Karnataka

Syllabus and course details for Ph.D. Course Work in Botany

* The applicants for Ph. D programme are provisionally registered after passing of Ph.D entrance test and attending Pre-Registration colloquium successfully.

* After Provisional Registration, all the registered candidates shall take up the course work in the respective P. G Department/recognized research centre of Kuvempu University for a period of six months, and this is compulsory for both full time and part time candidates.

* The course work for Ph.D programme shall comprise of the four courses viz., Course – 1- Research and Publication Ethics (RPE), course 2-Research Methodology, Course -3: Cognate Subject/s (common to all the research candidates in the respective Department), and Course – 4: Field of Specialization (specific to the research candidate).

* Each Course shall have 48 contact hours – Classes for Courses I and II shall be arranged by the Chairman of the P. G Department, and that of Course – III by the concerned Research Supervisor. Both the full-timers and part-timers shall attend at least 75% of the classes in each course to be eligible to appear for examination.

* The candidates who could not attend at least 75% of the classes in each of the courses shall not be eligible to obtain the confirmation of registration for Ph.D programme, and they have to attend the classes again with the next batch.

The following shall be the Structure of Course Work for Ph.D Programme,

Code No	Name of the Course	Contact Hours per Week	Maximum Marks			Examination Hours
			Continuous Assessment	Period-end Examination	Total	
CPE-RPE	Course -1 Research and Publication Ethics (RPE)	03	25	75	100	03
ABPC01	Course - 2: Research Methodology	03	25	75	100	03
ABPC02	Course - 3: Cognate Subject :BOTANY	03	25	75	100	03
ABPC03	Course - 4: Field of Specialization	03	25	75	100	03
	Total		100	300	400	

* Continuous Assessment Marks of the course work shall be awarded by the course teacher based on (a) Assignments – 5 marks, (b) Review of Literature – 5 marks, (c) Seminar – 5 marks, and (d) Tests – 10 marks.

Examination and Evaluation of Answer Scripts

* There shall be a Board of Examiners (Ph.D) constituted by the Vice- chancellor based on the recommendations of the Board of Studies,

* The Chairman of the Board of Examiners shall get the requisite number of questions papers set, get them approved by the BoE, send them to the Registrar (Eval) and arrange for the evaluation of answer scripts. The Chairman of the P. G Department shall conduct the examination.

* There shall be Course-end Examination of three-hour duration (for 75 marks per Course). Each answer script of the Course-end Examination shall be coded and assessed by two examiners (preferably, one internal Course Teacher and another external). The marks awarded to the answer script shall be the average of these two evaluations.

* If the difference in the marks between two evaluations exceeds 20% of the maximum marks, such a script shall be assessed by a third external examiner. The marks allotted by the third examiner shall be averaged with nearer marks of the earlier two evaluations.

Minimum Pass Marks and Improvement Examination

* Minimum for pass in each course shall be 50% considering both the internal assessment marks and course-end examination, out of which a minimum of 26 marks (i.e., 35% of 75 marks) shall be from Course-end Examination.
* Failed candidates are allowed to take only one improvement examination within six months of their first examination. In case of failure of the candidate even after an improvement examination, his/her provisional registration shall get cancelled.

Proceedings of the BOS by circulation of the syllabus of Research and Publication Ethics (RPE)

The syllabus has been circulated by e-mail to BOS members and obtained their approval. As BOS Chairman, I also approved the paper "Research and Publication Ethics (RPE)" for PhD course work in Botany from the academic year 2020-2021.

Yours Sincerely

Chairman
P. G. BOS Applied Botany
Kuvempu University
Shankaragatta-577 451

ವಿ. ವಿಜ್ಞಾನ(18)

KUVEMPU UNIVERSITY

Prof. Y. L. Krishnamurthy
Professor and Chairman BOS
Dept. of P.G. Studies and
Research in Applied Botany
Shankaraghatta – 577 451, Shimoga (Dist.),

Phone No. 08282-256254 (O)
Cell No. 98456 46821

murthy_ylk@yahoo.co.in

Proceedings of the meeting of Board of Studies in PG Botany and Botany (DDE) held on 04th January 2020 in the Chairman's Chamber, Department of Applied Botany.

Meeting of the Board of studies in PG Botany held on 04th January 2020 at 11.30 A.M in the Department of P.G. Studies and Research in Applied Botany.

Agenda :-

1. Approval of M.Sc Botany/Botany (DDE) panel of examiners for 2020-2021 - **Discussed and Approved.**
2. Approval of M.Sc Botany syllabus for the academic year - 2020-2021. - **Discussed and Approved.**
3. Approval of Ph.D Course work panel of examiner for 2020-2021. - **Discussed and Approved.**
4. **Approval of extension of Ph.D. research period.**

Sl. No	Name of students	Guide	Period	Recommendation
01	Mrs. Vasudha Udupa, A.	Prof. M.B. Shivanna	09-01-2020 to 08-01-2021	Discussed and Approved

5. Principal IDSG College, Chikmagalure in his letter requesting **Dr. Chandini, K.C., Ms. Kiranmai** and **Mr. Y.N. Shudhama**. Dept of Botany, requested to include their name in panel of internal member for practical exam in IDSG College Chikmagalure. Based on their teaching experience the board recommended them as internal examiners in the Dept. of Botany, IDSG College, Chikamagalure.

Discussed and Approved.

Members present:-

1. **Prof. G.R. Janardhana** - 4/1/2020
2. **Prof. L. Rajanna** - 04/01/2020
3. **Prof. M. B. Shivanna** -
4. **Prof. Y.L. Krishnamurthy** -
5. **Prof. Raja Naika** -
6. **Dr. Somashekar G. M.** -

Members not-present:-

1. **Prof. S.N. Agadi**
2. **Prof. M. Krishnappa**

4/1/2020
Chairman BOS
PG Applied Botany

Chairman
P. G. BOS Applied Botany
Kuvempu University
Shankaraghatta-577 451