

**SYLLABUS (CBCS) AND SCHEME OF EXAMINATION OF M. Sc. DEGREE COURSE
IN BOTANY UNDER CBCS SEMESTER 2014-15**



Submitted

to

TUMKUR UNIVERSITY

B-H Road

Tumkur - 572 103

By

BOARD OF STUDIES IN BOTANY (PG)

TUMKUR UNIVERSITY

TUMKUR

TUMKUR UNIVERSITY

Proceeding of the Board of Studies Meeting, Botany (PG) held on 30th and 31st December, 20013 at Tumkur University, University Constituent College, Tumkur.

Members present		Signature
1. Prof. Y. N. Seetharam	Chairman	Sd/-
2. Prof. M. Krishnappa	External Member	Sd/-
3. Prof. Sridhar K. R.	External Member	Sd/-
4. Prof. L. Rajanna	External Member	Sd/-
5. Dr. Rajkumar H. Garampalli	External Member	Sd/-
6. Prof. Jayaramu, M.	Internal Member	Sd/-
7. Smt. B. R. Shalini	Internal member	Sd/-

Members absent

1. Prof. H.Niranjanamurthy (External member)

The Chairman of Board of Studies in Botany (PG) formally welcomed the members to the meeting and thereafter the agenda was taken up for discussion.

1. Syllabi for M.Sc. I Semester, II Semester, III Semester and IV Semester was prepared and approved.
2. Syllabi is prepared for CBCS system to be implemented from the academic year 2014-2015.
3. Question papers model of M. Sc. Botany were scrutinized and corrections were made and approved by BOS for future reference of BOE.
4. Panel of Examiners for M. Sc. examinations to be held during Academic year 2014-2015 was prepared and approved.

It is recommended to forward the syllabus to the Registrar, Tumkur University, Tumkur, for placing the same in the Academic council for approval.

Chairman, BOS in Botany (PG)
Tumkur University, Tumkur

SCHEME OF EXAMINATION OF M. Sc. DEGREE COURSE IN BOTANY UNDER CBCS
SEMESTER 2014-15

FIRST SEMESTER

Paper No	Title of paper	Instruction Hrs/week	No. of Credits	Duration of the Exam.	Marks		
					Internal Assessment	Theory/ Practical	Total Marks
CORE	PAPER THEORY						
BOT- CPT. 1.1	Diversity of Viruses, Bacteria, Algae & Fungi	4	4	3 Hrs	20	80	100
BOT-CPT- 1.2	Diversity of Bryophyta, Pteridophyta & Gymnospermae	4	4	3 Hrs	20	80	100
BOT-CPT- 1.3	Plant systematics & Economic Botany	4	4	3 Hrs	20	80	100
SPECIAL	PAPER THEORY						
BOT-SPT- 1.4.1	Ecology & Environmental Biology	4	4	3 Hrs	20	80	100
BOT-SPT- 1.4.2	Evolution and Phytogeography	4	4	3 Hrs	20	80	100
CORE	PAPER PRACTICAL						
BOT-CPP-1.5 (1.1)	Diversity of Viruses, Bacteria, Algae & Fungi	2	2		10	40	50
BOT- CPP – 1.6 (1.2)	Diversity of Bryophyta, Pteridophyta & Gymnosperms	2	2		10	40	50
BOT- CPP- 1.7 (1.3)	Plant systematics & Economic Botany	2	2		10	40	50
SPECIAL	PAPER PRACTICAL						
BOT- SPP- 1.8.1 (1.4.1)	Ecology & Environmental Biology	2	2		10	40	50
BOT-SPP- 1.8.2 (1.4.2)	Evolution and Phytogeography	2	2		10	40	50
	Total	24	24				600

SECOND SEMESTER

Paper No	Title of paper	Instruction Hrs/week	No. of Credits	Duration of the Exam.	Marks		
					Internal Assessment	Theory/ Practical	Total Marks
CORE	PAPER THEORY						
BOT-CPT. 2.1	Plant Anatomy & Embryology	4	4	3 Hrs	20	80	100
BOT-CPT – 2.2	Cell Biology, Genetics and Biostatistics	4	4	3 Hrs	20	80	100
SPECIAL	PAPER THEORY						
BOT-SPT – 2.3.1	Microbial Technology	4	4	3 Hrs	20	80	100
BOT-SPT – 2.3.2	Plant Breeding & Propagation	4	4	3 Hrs	20	80	100
OPEN	ELECTIVE THEORY						
BOT-OET- 2.4	Medicinal plants and utilization	4	4	3 Hrs	20	80	100
CORE	PAPER PRACTICAL						
BOT-CPP-2.5(2.1)	Plant anatomy & Embryology	2	2		10	40	50
BOT-CPP- 2.6	Cell Biology, Genetics	2	2		10	40	50

(2.2)	and Biostatistics						
SPECIAL	PAPER PRACTICAL						
BOT-SPP- 2.7.1 (2.3.1)	Microbial Technology	2	2		10	40	50
BOT-SPP – 2.7.2 (2.3.2)	Plant Breeding & Propagation	2	2		10	40	50
OPEN	ELECTIVE PRACTICAL						
BOT-OEP 2.8 (2.4)	Medicinal Plants and utilization	2	2		10	40	50
	Total	24	24				600

THIRD SEMESTER

Paper No	Title of paper	Instruction Hrs/week	No. of Credits	Duration of the Exam.	Marks		
					Internal Assessment	Theory/ Practical	Total Marks
CORE	PAPER THEORY						
BOT-CPT. 3.1	Plant Physiology	4	4	3 Hrs	20	80	100
BOT-CPT – 3.2	Molecular Biology	4	4	3 Hrs	20	80	100
SPECIAL	PAPER THEORY						
BOT-SPT – 3.3.1	Methods in Plant Sciences	4	4	3 Hrs	20	80	100
BOT-SPT – 3.3.2	Plant tissue culture and Genetic Engineering	4	4	3 Hrs	20	80	100
OPEN	ELECTIVE THEORY						
BOT-OET- 3.4	Biofertilizers and Biopesticides	4	4	3 Hrs	20	80	100
CORE	PAPER PRACTICAL						
BOT-CPP-3.5(3.1)	Plant Physiology	2	2		10	40	50
BOT-CPP–3.6(3.2)	Molecular Biology	2	2		10	40	50
SPECIAL	PAPER PRACTICAL						
BOT-SPP- 3.7.1 (3.3.1)	Methods in plant sciences	2	2		10	40	50
BOT-SPP – 3.7.2 (3.3.2)	Plant Tissue culture & Genetic engineering	2	2		10	40	50
OPEN	ELECTIVE PRACTICAL						
BOT-OEP 3.8 (3.4)	Biofertilizers & Biopesticides	2	2		10	40	50
	Total	24	24				600

FOURTH SEMESTER

Paper No	Title of paper	Instruction Hrs/week	No. of Credits	Duration of the Exam.	Marks		
					Internal Assessment	Theory/ Practical	Total Marks
CORE	PAPER THEORY						
BOT-CPT. 4.1	Plant Pathology & Plant protection	4	4	3 Hrs	20	80	100
BOT-CPT – 4.2	Plant Biotechnology and Bioinformatics	4	4	3 Hrs	20	80	100
SPECIAL	PAPER THEORY						
BOT-SPT- 4.3.1	Medicinal Plants & Phytochemistry	4	4	3 Hrs	20	80	100
BOT-SPT – 4.3.2	Biodiversity Conservation	4	4	3 Hrs	20	80	100

CORE	PAPER PRACTICAL						
BOT-CPP-4.4 (4.1)	Plant pathology & Plant Protection	2	2		10	40	50
BOT-CPP-4.5 (4.2)	Plant Biotechnology and Bioinformatics	2	2		10	40	50
SPECIAL	PAPER PRACTICAL						
BOT-SPP- 4.6.1 (4.3.1)	Medicinal plants & Phytochemistry	2	2		10	40	50
BOT-SPP – 4.6.2 (4.3.2)	Biodiversity Conservation	2	2		10	40	50
BOT- CPMP- 4.7	CORE PAPER MAJOR PROJECT	6	6				
BOT- CPMP 4.7	Project Evaluation				30	100	130
	Vivo Voce					20	20
	Total	24	24				150
							600

Internal assessment Marks allotment basis

1 st test for 10 Marks	
2 nd test for 10 Marks: Average of two tests for marks	: 05
Seminar	: 05
Extra activities	: 05
Punctuality & Attendance	: 05
Total	: 20

FIRST SEMESTER

CORE	PAPER THEORY
BOT-CPT. 1.1	Diversity of Viruses, Bacteria, Algae & Fungi
BOT-CPT – 1.2	Diversity of Bryophyta, Pteridophyta & Gymnospermae
BOT-CPT – 1.3	Plant systematics & Economic Botany
SPECIAL	PAPER THEORY
BOT-SPT – 1.4.1	Ecology & Environmental Biology
BOT-SPT – 1.4.2	Evolution and Phytogeography
CORE	PAPER PRACTICAL
BOT-CPP-1.5 (1.1)	Diversity of Viruses, Bacteria, Algae & Fungi
BOT-CPP – 1.6	Diversity of Bryophyta, Pteridophyta & Gymnospermae
BOT-CPP- 1.7	Plant systematics & Economic Botany
SPECIAL	PAPER PRACTICAL
BOT-SPP- 1.8.1	Ecology & Environmental Biology
BOT-SPP – 1.8.2	Evolution & Phytogeography

SECOND SEMESTER

CORE	PAPER THEORY
BOT-CPT. 2.1	Plant Anatomy & Embryology
BOT-CPT – 2.2	Cell Biology, Genetics & Biostatistics
SPECIAL	PAPER THEORY
BOT-SPT – 2.3.1	Microbial Technology
BOT-SPT – 2.3.2	Plant Breeding & Propagation
OPEN	ELECTIVE THEORY
BOT-OET- 2.4	Medicinal plants and Utilization.
CORE	PAPER PRACTICAL
BOT-CPP-2.5	Plant anatomy & Embryology
BOT-CPP – 2.6	Cell Biology, Genetics & Biostatistics.
SPECIAL	PAPER PRACTICAL
BOT-SPP- 2.7.1	Microbial Technology
BOT-SPP – 2.7.2	Plant Breeding & Propagation
OPEN	ELECTIVE PRACTICAL
BOT-OEP 2.8	Medicinal Plants a Utilization

Third semester

CORE	PAPER THEORY
BOT-CPT. 3.1	Plant Physiology
BOT-CPT – 3.2	Molecular Biology
SPECIAL	PAPER THEORY
BOT-SPT – 3.3.1	Methods in Plant Sciences
BOT-SPT – 3.3.2	Plant tissue culture & Genetic Engineering
OPEN	ELECTIVE THEORY
BOT-OET- 3.4	Biofertilizers & Biopesticides
CORE	PAPER PRACTICAL
BOT-CPP-3.5	Plant Physiology
BOT-CPP – 3.6	Molecular Biology
SPECIAL	PAPER PRACTICAL
BOT-SPP- 3.7.1	Methods in plant sciences
BOT-SPP – 3.7.2	Plant Tissue culture & Genetic engineering
OPEN	ELECTIVE PRACTICAL
BOT-OEP 3.8	Biofertilizers & Biopesticides

Fourth semester

CORE	PAPER THEORY
BOT-CPT. 4.1	Plant Pathology & Plant protection
BOT-CPT – 4.2	Plant Biotechnology and Bioinformatics.
SPECIAL	PAPER THEORY
BOT-SPT- 4.3.1	Medicinal Plants & Phytochemistry
BOT-SPT – 4.3.2	Biodiversity Conservation
CORE	PAPER PRACTICAL
BOT-CPP-4.4 (4.1)	Plant pathology & Plant Protection
BOT-CPP – 4.5 (4.2)	Plant Biotechnology & Bioinformatics.
SPECIAL	PAPER PRACTICAL
BOT-SPP- 4.6.1 (4.3.1)	Medicinal plants & Phytochemistry
BOT-SPP – 4.6.2 (4.3.2)	Biodiversity Conservation
BOT- CPMP-4.3	CORE PAPER MAJOR PROJECT
	Dissertation
Bot- CPMP 4.7	Vivo Voce
	Internal assessment
	Total

Dr. Y. N. Seetharam
(Chairman, BOS in Botany, PG)
Tumkur University, Tumkur

56 hours

Unit –I**12 hrs**

Viruses: General characters, Morphological and structural diversity, classification, nomenclature and ultrastructure of TMV and Bacteriophages, Reproduction, Infection and multiplication of Phage (Lytic cycle). Viroids and Prions. Viral diseases: TMV, YBMV and PRSV (Papaya ring spot).

Mycoplasma: General Characters, Ultrastructure studies and classification.

Mycoplasma diseases and management: Little leaf of *Vinca rosea*, Grassy shoot of Sugarcane.

Phytoplasma – a brief account. Mycoplasma like organisms (MLOs).

Unit II**12 hrs**

Bacteria: General characters, classification, Ultrastructure of bacterial cell, Reproduction in Bacteria: Fission, sexual reproduction (genetic Recombination)– Conjugation, Transformation and Transduction. Role of Bacteria in Agriculture and Nitrogen fixation. Bacterial diseases: Citrus canker, Black arm, boll rot and blight of Cotton, Bacterial leaf blight of paddy. Bacterial Plasmids and their characteristics.

Unit III**14 hr**

Algae: General characters, morphological diversity, pigmentation in algae, evolution in plastids, Classification (Fritsch, 1945). Morphological, structural diversity, thallus organisation and reproduction in Cyanophyceae (*Microcystis*, *Nostoc*, *Oscillatoria* and *Scytonema*), Chlorophyceae (*Chlorella*, *Spirogyra*, *Volvox*, *Desmids* and *Coleochatae*), Charophyceae (*Chara* and *Nitella*), Xanthophyceae (*Vaucheria* and *Botrydium*), Bacillariophyceae (Pennales and Centrales), Phaeophyceae (*Ectocarpus*, *Porphyra* and *Sargassum*) Rhodophyceae (*Batrachospermum* and *Polysiphonia*). Economic importance and Cultivation of Algae- a brief account. Contribution of Indian Phycologists- a brief account.

Unit IV**18 hr**

Fungi: General characteristics, Classification (Alexopolus), morphological, structural diversity and reproduction in Myxomycotina (*Stemonitis*), Mastigomycotina (*Saprolegnia*) Zygomycotina (*Mucor* and *Rhizopus*), Ascomycotina (Yeast, *Aspergillus*, *Peziza*), Basidiomycotina (*Puccinia*, *Agaricus*, *Lycoperdon*) Deuteromycotina (*Cercospora*, *Alternaria* and *Rhizoctonia*). Economic importance of fungi: Agriculture- biofertilizers and biopesticides, Pharmaceuticals- antibiotics and hormones, Industrial- organic acids and mushroom cultivation, Nutrition- edible fungi.

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56 hours

Unit-I

16 hr

Bryophyta: General Characters, Classification (Rothmuler), origin and distribution, Morphological, structural diversity and reproduction in Marchantiales (*Marchantia*), Jungermanniales (*Porella*), Metzgeriales (*Aneura*), Anthoceratales (*Anthoceros*), Sphagnales (*Sphagnum*), Bryales (*Funaria* and *Polytrichum*). Ecology and economic importance of Bryophytes. Fossil Bryophytes.

Unit II

10 hr

Pteridophyta : General characters, Classification, origin and distribution, Morphological, structural diversity and reproduction in Psilotales (*Psilotum*), Lycopodiales (*Lycopodium*), Selaginellales (*Selaginella*), Equisetales (*Equisetum*).

Unit -III

10 hr

Protileptosporangiatae (*Ophioglossum*), Leptosporangiatae (*Osmunda*, *Pteris*, *Marsilea* and *Salvinia*). Stellar Evolution in Pteridophyta, Heterospory and seed habit in Pteridophyta. Fossil Pteridophyta: Psilophytales (*Rhynia*, *Psilophyton*), Calamitales, Sphenophyllales, Lepidodendrales. Economic importance of Pteridophytes.

Unit IV

20 hr

Gymnospermae: General Characters, Classification, Distribution, morphological and structural diversity and reproduction in Cycadales (*Cycas*, *Zamia* and *Encephalartos*), Ginkgoales (*Ginkgo*), Coniferales (Pinaceae (*Pinus*), Podocarpaceae (*Podocarpus*), Araucariaceae (*Araucaria* and *Agathis*), Taxales (*Taxus*), Gnetales (*Gnetum*, *Ephedra* and *Welwitschia*). Fossil Gymnosperms: Lyginopteridaceae, Caytoniaceae, Medullosaceae, Ginkgoites, Voltziaceae, Palyssiaceae, Lebachiaceae. Origin and Evolution in Gymnospermae- a brief account. Economic importance of Gymnosperms.

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Unit I**10 hrs**

A general account of morphology leaves, inflorescence, flower, fruits and seeds of angiosperms. Herbarium: preparation of herbarium, maintenance and their importance, Index herbariorum, Important herbaria of India, Botanical Survey of India – a brief account on the organisation. Botanical garden: Botanical gardens of the world and India and their importance.

Unit II**10 hrs**

Classification systems: Pre-Darwinian- a brief account, Post Darwinian systems: Engler and Prantl, Cronquist, Takhtajan, Thorne and Angiosperm Phylogeny Group (APGIII). ICBN- Brief account on the historical development of ICBN, Principles of Nomenclature, Rules and Recommendations (Rank of taxa, Name of Taxa, Typification, Valid publication, Rule of Priority, Rejection and Retention of names,) Provisions for Modifications. ICNCP – Naming of Hybrids, registration of cultivated species.

Unit III**20 hrs**

Origin of Angiosperms – Fossil history of angiosperms, probable ancestors, Monophyly and Polyphyly. Importance and Role of characters sources in taxonomy: Micromorphological characters, Pollen morphology, Embryology, Anatomy, Cytology, Molecular systematics, Numerical taxonomy, Species concept. Botanical Literature: Flora, Revisions, Nomenclators, Monographs, Role of computer in Taxonomy.

Salient features and economic importance of the following families: Magnoliaceae, Ranunculaceae, Caryophyllaceae, Polygalaceae, Meliaceae, Lythraceae, Cactaceae, Rubiaceae, Oleaceae, Asclepiadaceae, Solanaceae, Bignoniaceae, Scrophulariaceae, Rhizophoraceae, Casuarinaceae, Aristolochiaceae, Lauraceae, Euphorbiaceae, Arecaceae, Typhaceae, Cyperaceae, Poaceae, Liliaceae, Orchidaceae.

Unit IV**16 hrs**

Economic Botany – a brief account on the history of agriculture, National and International organisation involved in improvement of crops plants and evolution of hybrids. Food crops and their cultivation practice, important hybrids of Cereals (Rice, Wheat), Pulses (*Cicer arietinum*, *Cajanus cajan*), Spice (*Cardomum*), Beverages: Coffee, Oil yielding plants – Ground nut, Safflower, Sunflower, Rubber yielding plants – *Hevea brasiliensis*, *Ficus* sp., Biofuel plants – *Jatropha*, *Euphorbia*, and others. Major and minor forest products and economics.

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Unit –I**14 hr**

Ecology: Definition , Principles and Scope of ecology, Ecosystem concept, principles, structure and components of an ecosystems, classification of ecosystems, terrestrial (Forest & Grass land), aquatic (Fresh water, Marine and estuaries), Ecosystems of the world and ecosystems India and Karnataka, Food chain, food web, trophic levels and ecological pyramid, Productivity- primary productivity and its measurement.

Unit II**14 hrs**

Basic laws of energy flow in an ecosystem, laws of thermodynamics, flow model, biogeochemical cycles. Water bodies and their classification, importance of rain water harvesting. Population ecology: Population structure and growth, intra and inter specific interactions, Community ecology- structure and characteristics (analytical and synthetic), Concept community analysis, community stability, dynamics, equilibrium, Methods of studying plant communities, Plant succession- Types, components, climatic climax concept, types, monothetic and polythetic climaxes. Ecological adaptations: Xerophytes, Mesophytes, Hydrophytes, Epiphytes, Parasites and Mangroves.

Unit III**14 hrs**

Phytosociology- Interactions among Plants- Competition, Commensalism and Parasitism, Mutualisms, allelopathy, Plant-insect interaction- Pollination, Herbivory, Carnivory, Symbiosis. Pollution- air, water, land pollution. Sources of pollutants and their effect on plants. Green house gases, its effect and ozone depletion. Aerobiology and its applications.

Unit IV**14hrs**

Natural resources- renewable and non renewable resources, deforestation studies, mineral resources extraction and exploitation, Energy resources, conventional and non conventional energy resources, alternative source of energy, Remote sensing application in hydrology and vegetation analysis. Pedology: Soil formation, soil profile, properties, soil erosion and soil conservation. Environmental protection Acts- air, water, wildlife.

References:

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5. Camughley G et. al. Conservation Biology in theory and practice, Blackwell Publications, London, 1995.
6. Clements F.E.1916 Plant succession, an analysis of the development of vegetation. Carnegie Institute, Washington.
7. Eiseth G D et.al., Population Ecology, Van Nos, Stand Co., 1981.
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9. Kormondy EJ, Concepts of Ecology, Prentice Hall, 1989.
10. Kumar H D, General Ecology, 1st Edition, Vikas Publishing House Pvt. Ltd., 1995
11. Odum E P, Fundamentals of Ecology, 3rd Edition, Saunders, 1971.
12. Sharma, P.D. 1999 Ecology and environment.
13. Sharma. PD, Environmental Biology, 1st edition, Rastogi and Company, 1995

BOT:SCT 1.4.2 Evolution and Phytogeography**56 hours**

Unit I**10 hrs**

Nature of Evolution: Theories of origin of Universe, origin of Earth and origin of life; Development of Evolutionary Thoughts: Before Darwin, Darwin's Evolutionary Theory, Evolutionary Theories after Darwin, Neo-Darwinism. Evidences for the theory of organic evolution: Palaeontology, Biogeography, Taxonomy, Comparative Anatomy and Embryology, Comparative Physiology and Biochemistry.

Unit II**16 hrs**

Natural Selection: Natural Selection- Selective forces, Types of Natural Selection, Selection models, Selection Pressure. Speciation and origin of higher categories Isolating Mechanism and speciation, Polyploidy and speciation. Gene Pool, Hardy-Weinberg law equilibrium, Mutation Pressure and Genetic Equilibrium, Genetic Drift. polymorphism, Mimicry and coloration.

Unit III**14 hrs**

Phytogeography: Aims, Methods and Principles of phytogeography, Scope of phytogeography. Phytogeographical regions of the world and India, General characteristics of Indian flora, native taxa, invasive species. Floristic studies of the world and India. Continental drift theory, tectonic movement, Plant distribution: continuous and disjunct distribution, endemic species.

Unit IV**16 hrs**

Vegetation types in India and Karnataka. Study of phytogeography, vegetation and soil characteristics of Tumkur district. Floristic Ecological plant geography; Ecological crop geography; Plant dispersal, migrations & barriers, isolation vicarious species, relict species, isofloras, polytopy - endemic plants of Western ghats; Origin, Distribution and acclimatization of coffee, cardamom, sugarcane, cashew, ragi, maize, wheat, rice & cotton; Remote sensing, study of vegetation by GIS (Geosynchronous Information system);

References:

1. Barucha, F.R. Text book of the plant geography of India.
2. Boulger, G.S. 1912, Plant Geography.
3. Brown, 1999. Genomes, Bios,
4. Daniel Hartal and Andrew Clark. Population genetics, 3rd edition.
5. Jobling *et al*, 2004. Human Evolutionary Genetics, Garland,
6. Shiva Manikant Dube 2011 Advanced Plant geography, Swastik publications.
7. Strickberger, 2000. Evolution, Jones and Barlett,
8. Walter, H. S-W Breckle 2002. Walters Vegetation of the Earth: Ecological systems of the Geo-Biosphere (4th Edn.)
9. Good, R. 1974. The Geography of flowering plants. Longman, London

Practicals

BOT : CPP. 1.5 (1.1) Diversity of Viruses, Bacteria, Algae and Fungi.

Unit –I

1. Preparation of stains and fixatives.
2. Study of morphology and reproductive structures of Fungi (*Aspergillus*, Septate and non-septate fungi).
3. Staining Bacteria: Simple, Negative and Gram staining.
4. Study of Algae: Characterization and identification- *Oscillatoria*, *Spirogyra*, *Chara*, *Sargassum*, *Polysiphonia*.
5. Culturing of algae in laboratory.

Unit II

6. Study of Bacterial motility by hanging drop method.
7. Microbial count using Haemocytometer.
8. Media preparation and isolation of Fungi from soil by serial dilution plate method.
9. Study of local plant disease caused by viruses and bacteria.

Note: Every student has to submit 5 specimens/herbaria at the practical examination in addition to certified practical record.

BOT: CPP. 1.6 (1.2) Diversity of Bryophyta, Pteridophyta and Gymnospermae.**Unit –I**

1. Thallus structure, anatomy and reproductive features of *Marchantia*, *Anthoceros*, *Porella*, *Funaria* and *Polytrichum*.
2. Habit, anatomy and reproductive features of *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum*, *Ophioglossum* and *Osmunda*.

Unit –II

3. Habit anatomy and reproductive features of *Pteris*, *Marselia*, and *Salvinia* .
4. Habit anatomy and reproductive features of *Zamia*, *Ginkgo*, *Araucaria*, *Podocarpus*, *Agathis*, *Ephedra* and *Gnetum*.
5. Types of fossils and fossiliferous rocks.
6. Study of available fossil specimen and slides of Pteridophytes and Gymnosperms.

Note: Submission of Herbarium specimen (05).

BOT:CPP. 1.7 (1.3) Plant systematics and economic Botany**Unit –I**

1. Description of plants using technical terms.
2. Identification of plants to family level.
3. Identification of plants to species level using flora.
4. Preparation of dichotomous key for identification.
5. Listing of endangered species.

Un it II

6. Study of locally available economically important plant species.
7. Map indicating the origin of crop plants.
8. Preparation of herbarium of locally available plants.
9. Extraction of essential oil using Clevenger's apparatus.
10. Estimation of carbohydrates in cereals, proteins in pulses.

Note: Submission of 5 herbarium/ photographs of plant specimen during practical examination.

BOT: SPP- 1.8.1 (1.4.1) Ecology and Environment Biology

Unit – I

1. Determination of leaf area by Planimeter method.
2. Determination of available soil moisture by Moisture meter.
3. Determination of stomatal index.
4. Determination of organic content of soil.
5. Determination of soil pH using pH meter.

Unit II

6. Water quality analysis- DO, COD, BOD, Chlorides, Sulphates, TDS, Carbon dioxide.
7. Determination of minimum size of the quadrat by species area curve method.
8. Study of frequency of herbaceous plants by applying Law of frequency.
9. Study of plant abundance and density by quadrat method.
10. Meteorological instruments and their working principles.

BOT:SPP-1.8.2 (1.4.2) Evolution and Phytogeography**Unit –I**

1. Floristic regions of India.
2. Listing local plants of the campus.
3. Listing wild edible plants.
4. Listing local medicinal plants.
5. Listing of exotic/ invasive species of the region.
6. Seed dispersal mechanism in plants.
7. Studying species distribution and its measurement.

Unit II

8. Drawing maps of continental drift.
9. Geologic time scale and evolution of land plants.
10. Evolutionary concept.
11. Models of natural selection, isolation and speciation.
12. Models and photographs related to organic evolution
13. Polyploidy and evolution
14. Evolutionary mathematics problems

Note: submission of 5 maps/photographs/herbaria during practical examination. Botanical study tour of about seven days is compulsory during first semester.

BOT- CPT2.1 Plant Anatomy and Embryology.**56 hours****Plant anatomy**

Unit I**12hrs**

Organization of primary plant body, **Apical meristems and primary growth**, Primary xylem – composition, Primary phloem - composition, **Shoot Apex**: Apical Cell Theory, Tunica Corpus Theory, Cyto-histological Zonation Theory. **Root Apex**: Histogenic boundaries; Quiescent center. Structure and development of the cell wall – Structure (light microscopic and ultramicroscopic structure), composition of the cell wall, Cell wall development. The effect of hormones on cell differentiation, Genetic control of cell growth and development, Role of the cytoskeleton in cell growth and development, Cell shaping by microtubules.

Unit II**16 hrs**

Development of the secondary vascular system of the stem and root. Role of the vascular cambium, the effect of secondary growth on the primary body on leaf and branch traces. **Secondary Xylem**: Structure of secondary xylem, Secondary xylem of gymnosperms and dicotyledons. Patterns of distribution of xylary elements and rays, Tyloses, Genetic control of differentiation of secondary xylem. Evolution in secondary xylem of dicotyledons. **Secondary phloem**: Gross and Ultra structure, development of the phloem. Nature and development of the cell wall of sieve elements. Nature of protoplast of sieve elements, Nature and function of P-protein, Distinctive features of phloem of gymnosperms, The nature and function of companion cells and Strasburger cells, Nodal anatomy, Anamalous secondary growth: *Aristolochia*, *Boerhaavia*, *Dracaena*, Periderm, Secretary tissues in plants.

Unit III:**14 hrs**

Introduction, Brief history of Embryology with particular reference to the contribution of Indian embryologists, **Male gametophyte**: Microsporogenesis, tapetum, types, function of tapetum. Pollen morphology – structure, stratification, unit of dispersal, aperture, types arrangement, classification NPC system. **Female gametophyte**: Types of embryosac development, organisation of an embryosac, Ultrastructural studies, Embryosac haustoria. **Pollination**: Structure of the style and stigma, histochemical studies, pollen - pistil interaction, compatability/ incompatability ,pollen germination, pollen embryosac.

Unit IV**14 hrs**

Fertilization: Post pollination events; Path pollen tube, site of pollen discharge, double fertilization, **Embryogenesis**: Monocot (*Najas*), Dicot embryo development (*Capsella*), genetics of embryo development (*Arabidopsis*), **Endosperms**: Types, structure, development and function of Endosperm, Endosperm haustoria. **Polyembryony & Apomixis** – a brief account, **Experimental Embryology**: Intra ovarian pollination, *in vitro* Pollination and *in vitro* fertilization, ovule and embryo culture and somatic embryogenesis.

References

1. Beck, C. 2010. An Introduction to plant structure and Development. 2nd ed. Cambridge Univ. Press. New York.
2. Bhojwani S. S. and Bhatnagar S. P. (2000) The Embryology of Angiosperms. Vikas Publishing House. New Delhi
3. Chand, S. 2005. **Plant Anatomy**, S, Chand and Company Ltd., New Delhi.
4. Cutler Botha and Stevenson (2007)-Plant anatomy and applied approach. Blackwell Publishing, USA.
5. Cutter, D.G. 1971. **Plant anatomy- Part-1. Cell and Tissues**. Edward Arnold, London.
6. Cutter, D.G. 1971. **Plant Anatomy, Part II, Cell and tissues**, Edward Arnold, London.
7. Cutter, E. G. (1969 & 1971) Plant anatomy: Experiments and interpretations vol I & II. Edward Arnold, London.
8. Eames E. J. and Macdaniels (1947) An introduction to plant anatomy. Mc Graw Hill, New York & London.
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15. Pandey, plant anatomy
16. Raghavan V. (1997) molecular embryology of flowering plants. Cambridge University press, Cambridge.
17. Santra S. C., Chatterjee, T.P. & Das A.P. College Botany practical vol. I. New central book agency, Calcutta.
18. Shivanna K.R. and Sawhney V.K. (eds) 1997. Pollen Biotechnology for crop production and improvement. Cambridge University Press, Cambridge.

Unit – I**11 hrs**

Cell: Introduction and structure of prokaryotic and eukaryotic cells, Structure and functions of lysosomes, ER, Ribosomes, plastids, Golgibodies. Biogenesis of Mitochondria and Chloroplast. Cytoskeletons and cell movements- microtubule, microfilaments and intermediary elements, motor proteins. Cell cycle: Regulations of CDK-cyclin activities, molecular basis of cellular check points. DNA replication in prokaryotes and Eukaryotes. Enzymes of DNA replication, replication fork, fidelity of replication, proof reading and error correction, DNA damage and repair. RNA synthesis, processing.

Unit-II**11 hrs**

Organisation of chromatin- Euchromatin and heterochromatin, constitutive and facultative heterochromatin, rearrangement, repetitive and non-repetitive DNA, transposable elements, C value paradox, Nucleosome model, structure and organisation of telomere, centromere and kinetochore. Cytological and molecular basis of crossing over, chromosome mapping. Mitochondrial and chloroplast genomes, interaction between nuclear and cytoplasmic genes (Rubisco and Cytochrome oxidase). Chromosomal aberration- Structural and numerical.

Unit III**18 hrs**

Pre-Mendelian, Mendelian- law of independent assortment, segregation law of dominance and Post-Mendelian genetics- Discovery of genetic material. Interaction of genes: Complementary, Epistasis, inhibitory, lethal and additive interaction of genes, Alleles- multiple alleles, pseudoalleles, complementation test, incomplete dominance, penetrance, expressivity and phenocopy. Chromosomal and molecular basis of heredity. Sex determination: Chromosome theory of sex determination, hormonal influence on sex differentiation, Dosage compensation, sex linked inheritance, sex determination in plants. Cytoplasmic inheritance: Chloroplast (*Mirabilis jalapa*, *Zea mays*), Mitochondria (Petite yeast and Cytoplasmic male sterility in plants). Quantitative genetics- polygenic inheritance, heritability and its measurements, QTL mapping. Mutation- types of mutation, Mutagenesis- physical and chemical mutants.

Unit IV**14 hrs****Biostatistics:**

Test of Significance- Statistical hypothesis, Type-1 and Type-2 errors, level of significance, size and power of a test, Definition of Chi-square, t and F distribution, Central limit theorem, Tests for the means, equality of two means, variance (for large and small samples), Large samples tests for proportions, Chi-square test for goodness of fit and for independence of attributes in contingency tables, Confidence interval.

References:

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2. Altenberg, E. 1965. Genetics. Oxford IBH Publishing company, Calcutta.
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6. Fransworth, M.D. 1978. Genetics. Wiley Eastern Ltd. New Delhi.
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10. Gupta, P.K. Genetics. Rastogi Publication. Meerut
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13. Jha, A.P. 1993. Genes and Evolution- Mac Millan Indian Ltd. New Delhi.
14. Klug, W.S. and M. R. Cummings. Concept of Genetics 5th edition. Prentice hall international. INC.
15. Powar, C.B. 1981. Cell Biology- Himalaya Publishing House, Bombay.
16. Rothwell, N.V. Understanding Genetics : A Molecular approach. Wiley liss. A John wiley and son. INC Publication N. Y.
17. Russel, P.J. Genetics 5th edition. An Important of Addison wiley longman, INC publication N. Y.
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21. Snustad, D.P., M. J. Simmons, J. B. Jenkins. Principle of Genetics. Jonh wiley and sons.
22. Stent, G.S. and Calendar, R. 1986. Molecular Genetics. An introductory narrative II edn. CBS publishers, New Delhi.
23. Stent, G.S. and R. Calandar. Molecular Genetics 2nd edition CBS Publishing and distributors Delhi.
24. Strickberger, M.W. 2010. Genetics, 3rd edition Pearson Education, Inc. USA.
25. Winchester, A.M. 1969. Genetics. III edn. Oxford and IBH, New Delhi.

Unit –I **15 Hrs**

Methods of studying microorganisms: Isolation, Identification, classification, staining, cultivation and preservation of selected bacteria and fungi (water, soil and milk). Factors affecting growth and death of microbes (temperature, pH, salinity and O-R potential). Sterilization: Wet and dry methods, filter sterilization and radiation. Chemical disinfectants, their advantages and limitations.

Unit II **20 Hrs**

Water microbiology: Water-borne pathogens, analysis of microbial load (coliforms) in surface and ground waters. Sewage – Processing and treatment of sewage. **Soil microbiology:** Soil-borne pathogens. Beneficial bacteria (*Azotobacter*, *Rhizobium* and *Bacillus thuringiensis*), cyanobacteria (*Anabaena* and *Nostoc*), actinobacteria (*Frankia*) and fungi (*Trichoderma*, endomycorrhizae and ectomycorrhizae). Pathogenic microbes (*Clostridium* and *Pythium*). Phosphate solubilizers. **Dairy microbiology:** Milk-borne pathogens, assessment of bacterial load in milk (dye reduction test), pasteurization and assessment (turbidity test and phosphate test). **Food microbiology:** Food-borne pathogens, microbial food spoilage and prevention, toxigenic microbes (endo and exotoxins) and their prevention.

Unit III **12 Hrs**

Industrial microbiology: Sources of industrially valuable microbes. Production of organic solvents (ethanol, citric acid and lactic acid), amino acids, enzymes (Cellulase, amylase, pectinase, protease and Lipase), vitamins and antibiotics. Large scale production of biofertilizers and biopesticides.

Unit IV **9 Hrs**

Microbes in nutrition: Cultivation and utilization of bacteria (Lactobacilli), cyanobacteria (*Spirulina*), algae (*Scenedesmus*) and fungi (*Rhizopus*). Single cell proteins (SCP). Cultivation of edible mushrooms. Silage.

References:

1. Agarwal & Parihar. Industrial Microbiology.
2. Ananthanarayan, A. & Panikar, C.K.J. Text Book of Microbiology 6th ed.
3. Bitton, G. Waste water Microbiology.
4. Doyle, Beuchet & Montville. Food Microbiology.
5. Gupta, R. & Mukerji, K.G. Microbial Technology.
6. Hurst, C.J. et al. Manual of Environmental Microbiology.
7. Jay, J.M. Modern Food Microbiology.
8. Jogdand, S.N. Environmental Biotechnology.
9. Joshi, V.K. and Asok Panday. Biotechnology- Food fermentation Vol.1.
10. Nester, E.W et al Microbiology – A human perspective.
11. Patel, A.H. Industrial Microbiology.
12. Powan & Daninawala. General Microbiology.
13. Prescott & Dunn. Industrial Microbiology 4th ed.
14. Rangaswami & Bhagyaraj. Agricultural Biotechnology.
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16. Sharad, S. & Singhal, V. Advances in General Microbiology.
17. Tortora, Funke & Case Microbiology an Introductipon. 3rd ed.

BOT SPT. 2.3.2 – Plant Breeding and Propagation**56 hours**

Unit –I**10hr**

History of plant breeding: Objectives of plant breeding. Plant breeding techniques: Breeding methods in self pollinated plants, cross pollinated plants, vegetatively propagated and apomictic plants. Evolution in crop plants and centers of crop origin. National and international institutes engaged in crop improvement, NBPGR.

Unit II**14hr**

Selection and hybridization, emasculation, mass selection, pure line selection, bulk method, pedigree method of selection, Backcross method of breeding and their merit and demerits. Mutation breeding- artificial mutation in plants, use of induced techniques in crop improvement, limitation of mutation breeding. Resistance breeding; abiotic: Drought, salinity, genetics of drought resistance. Biotic: Disease resistance, Genetics of disease resistance.

Unit III**16hr**

Inbreeding depression- Role of heterosis and hybrid vigour in plant breeding, genetic basis of heterosis, male sterility and self incompatibility and its significance, Somaclonal variation in crop improvement, Molecular marker in plant breeding, Seed certification and quarantine.

Unit IV**16hr**

Introduction to the principles, techniques, and facilities used to propagate crop plants and ornamental plants. Seed Propagation, biology and techniques of cuttings, buddings, divisions, layering and Micropropagation techniques and applications.

References:

1. Allard, R.W. 1999. Principles of plant breeding. 2nd ed. John Wiley & Sons. Inc.
2. Elliot, F.C. 1958. Plant Breeding and Cytogenetics. McGrawhill Book Co. New York.
3. Falconer, D.S. 1989. Introduction to Quantitative Genetics. 3rd ed. Longman Group Ltd. UK.
4. Khokhlov, S.S. (ed) 1976. Apomixis and Plant breeding. Amarind Publishing Co. Pvt Ltd. New Delhi.
5. Poehlman, J.M. 1987. Breeding field crops. 3rd ed. Van Nostrand-Reinhold Co. New York.
6. Simmonds, N.W. (ed.) 1976. Evolution of Crop plants. Longman, London.
7. Singh, P. 2006. Essential of Plant Breeding 3rd ed. Kalyani Publishers, New Delhi.
8. Singh, P. 2009. Plant Breeding Molecular and New approaches. Kalyani Publishers, New Delhi.

Unit –I**18 hrs**

Medicinal plants: classification, Ayurveda: History, origin, development, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments/ therapy, polyherbal formulations, Tibetan system of medicine, and Homeopathy.

Unit II**12 hrs**

Medicinal value of food plants (Nutraceuticals) - few examples from cereals, pulses, spices, fruits, vegetables and wild food plants. Medicinal and nutritive values of Mushrooms.

Unit III**12 hrs**

Herbal remedies: Plants used for treatment of heart and blood circulation, nervous disorders, respiratory and internal disorders, jaundice, urinary, skin, hair, diabetics, cancer, gynaecological disorders and infertility. Plants used as general tonics and aroma therapy.

Unit IV**14 hrs**

Ethnobotany and ethnomedicine: Importance of ethnobotany and ethnomedicine in modern health care system. Methods of collecting traditional knowledge on medicinal plants. Conservation of medicinal plants: *In situ* conservation: Biosphere reserves, sacred groves, MPCA, National Parks; *Ex situ* conservation: Herbal Gardens, Ethnomedicinal plant Gardens.

References

1. Harborne, J. 1984 Phytochemical methods. Ed Chapman & Hall, London.
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3. Mann, J., Davidson, R.S. Hobbs, J.B., Benthorpe, D.V. and Harborne Natural Products, Longman Scientific and Technical Co. Essex.
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6. Smith, P.M. 1976 The chemotaxonomy of plants Edward Arnold, London.
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8. Vaidya, B. 1982 Some controversial drugs in Indian Medicine. Chaukambica Orientalia, Varanasi, Oxford & IBH publishing Co, New Delhi.

Practicals

BOT:CPP 2.5 (2.1) Plant anatomy and Embryology**Unit –I**

- a. Preparation of fixatives and stains for anatomical studies.
- b. Preparation of double stained permanent slides.
- c. Preparation and identification of the Transverse section of the following plants:
Tridax procumbens, Boerhaavia diffusa, Nyctanthus arborterrestris, Leptadenia reticulata, Aristolochia indica, Salvadora persica.
- d. Preparation and identification based on TS, TLS and RLS of the following wood:
Michelia champaca, Dalbergia sisso, Tectona grandia, Azadirachta indica, Mangifera indica and Tecoma stans.
- e. Epidermal studies- trichomes and stomata

Unit -II

- f. Preparation of Microtome section and staining procedure.
- g. Identification of different developmental stages of Embryosac.
- h. Identification of different developmental stages of Anther.
- i. Histochemical studies for cellulose, callose, chitins, PAS reaction, Lignin.
- j. Embryo and endosperm mounting.

Note: submission of 10 permanent slides.

BOT:CPP 2.6(2.2) Cell biology, Genetics and Biostatistics**Unit-I**

1. Preparation of fixatives and stains for cytological studies.
2. Mitotic and meiotic division.
3. Micrometry in chromosomal studies and Karyotyping
4. Structural and Numerical changes induced by EMS and Colchicine.

Unit II

5. Genetic problems.
6. Preparation of Polytene chromosomes.
7. Barr body staining.
8. Biostatistics problems.

BOT: SPP- 2.7.1(2.3.1) Microbial Technology**Unit -I**

1. Isolation of Bacteria, fungi, and actinomycetes.
2. Production of Citric acid.
3. Extraction and Chromatographic separation of aflotoxins.
4. Estimation of extracellular amylase activity.
5. Estimation of extracellular protease activity.

Unit-II

6. Sterilization methods.
7. Demonstration of Microbial antagonism.
8. Isolation of Rhizobium and VAM.
9. Isolation of Cyanobacteria.
10. Determination of Spore concentration (haemocytometer).
11. Phytoplankton sampling and identification.

BOT SPP- 2.7.2(2.3.2) Plant Breeding and Propagation**Unit- I**

1. Study of Gynoecium and Androecium of selected crop plants

2. Emasculation and hand pollination.
3. Noting of superior traits.

Unit - II.

4. Study and listing of parthincarpic fruits.
5. Demonstration of plant propagation technique by Cutting, Budding, Grafting, Layering
6. Micropropagation technique- *In vitro* propagation

BOT-OEP- 2.8 (2.4) Medicinal plants and utilization**Unit-I**

1. Collection and identification of endemic medicinal plants.
2. Documentation of plants used in Ayurveda, Sidda, Unani, Tibatian and Homeopathy

Unit-II

3. Pharmacological and Pharmacognostic analysis of crude plant drug.
4. Study of medicinal fruits, vegetables and aromatic plants.

Unit-I **14 hrs**
Transport and Translocation of Water and Solutes: Water potential, osmotic potential, pressure potential, membrane and their permeability mechanism for water and ion absorption, SPAC concept. Mineral nutrition: Importance of nutrients, major and minor mineral elements, deficiency symptoms and treatment. Passive and active absorption of solutes across membranes, mechanism of translocation of photo-assimilation, Source and sink concept.

Unit-II **14 hrs**
Plant growth hormones: Discovery, Biosynthesis, Metabolism, transport and Physiological effects of plant hormones and their applications; Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid. A brief account of commercial applications of growth hormones. Seed dormancy, germination and Senescence. Phytochrome: Photochemical and Biochemical properties of phytochrome, cryptochromes, phototropins, Role played in signal transduction pathway, stomatal physiology, Photoperiodism- phototropism, geotropism and thigmotropism.

Unit –III **14 hrs**
Photosynthesis: General Concepts and historical background. Structure of photosynthetic apparatus; Mechanisms of electron and proton transport processes. Photophosphorylation and ATP synthesis. Calvin, and Hatch-Slack cycles; Crassulacean acid metabolism in plants, Photorespiration. **Respiration:** Overview of plant respiration. Glycolysis, Krebs's cycle, Electron transport, Oxidative phosphorylation and ATP synthesis.

Unit IV **14 hrs**
Nitrogen metabolism and fixation: Assimilation of Nitrate and Ammonium ions. Molecular mechanism of nitrogen fixation- the role of Leghemoglobin, *nif*, *nod* and *hup* genes. **Temporal organization:** Origin and characteristics of biological rhythms-biological clocks. **Stress physiology:** Stressful environment, Mechanism of plant responses to Drought, Salinity, Heat, and Cold stress.

References:

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BOT CPT– 3.2 Molecular Biology

56 hours

Unit –I**10 hr**

Introduction: Scope and objectives, Plants as model organisms in molecular biology (*Arabidopsis*), Genome organization in plants, **Gene concept:** Classical and modern concept, Cistron, recon and muton. Fine structure of gene, concept of split genes. Overlapping gene, pseudogene and cryptic gene. **Genetic code:** Properties of Genetic code, Nirenberg and Khorana's work, Wobble hypothesis, New genetic code in mitochondria.

Unit –II**12 hr**

Regulation of gene expression in prokaryotes and eukaryotes: Operon concept, lactose metabolism and tryptophan operon (repressible system) in *E. coli*. Transcription- activator and repressor: promoters, enhancers, transcription factor, transcription termination and anti-termination. DNA methylation, RNA processing, capping, polyadenylation, splicing and splicesomes and Ribozyme translation- structure and composition of ribosomes in prokaryotes and eukaryotes, role of RNA in protein synthesis, RNA-Polymerases, Environmental regulation of gene expression.

Unit III**16 hr**

Transposable genetic elements: Eukaryotic transposons, Insertion sequence and composite transposons in prokaryotes, Ac-Ds system in maize, P-elements in *Drosophila*, transposable elements in man, Retrotransposons, Application of transposons in research and health care system. **Mutation:** Molecular basis of spontaneous and induced mutations, Tautomeric shifts, Base analogues, Molecular basis of gene mutation and evolution.

Unit IV**18 hrs**

Genetics of Cancer: Cancer cell cycle, Molecular basis of cancer, tumor and suppressor genes, proto-oncogenes, oncogenes and their protein products. Gene and immunity: Natural and acquired immunity, Immune response- humoral and cell mediated immunity, antibody structure, antibody genes, immune system mal functions. Human genome: Human genome project, Genetic disorders, Genetic testing, Gene therapy, clinical genetics, prenatal diagnosis, genetic counselling, ethical issues.

References:

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56 hours

Unit –I

16 Hrs

Microscopy: Light, phase contrast, inverted phase contrast, electron microscope (SEM & TEM), confocal microscope, scanning tunneling microscope, fluorescent microscope. Micrometry and Flow cytometry. **Microbial Technique:** Sterilization, fungal and Bacterial stains, Staining techniques- simple, negative and Gram's staining and endospore, isolation of microbes from soil, air, water and other substrates. Microbial enumeration techniques- Heamocytomter, Dilution plate technique, selective culture media. Aerobiological technique: spore sampling technique, slide, petridish, vertical spore cylinder, Anderson Sampler, Burkard spore trap, Isolation of *Rhizobium* from Legumes.

Unit II

14 Hrs

Chromatography: Principle, Types of chromatography (Paper, TLC, Column, Gas chromatography, HPLC, HPTLC etc. Applications of chromatography. **Spectroscopy:** Principles of spectroscopy, Beer Lambert laws. Colorimetry, spectrophotometry (UV, VIS), Flame photometry. **Centrifugation:** Principles of Centrifugation, Factors affecting sedimentation, sedimentation coefficient, sedimentation constant, types of centrifuges. Hydroponics and Aeroponics.

Unit III

14 Hrs

pH Meter: Glass electrode, Reference electrode, combination electrode, working principles of pH meter. **Electrophoresis:** Principles, component, factors affecting electrophoresis, Buffers used, detection and assay. Recording and storing, Types of electrophoresis and their application. **Polymerase Chain Reaction:** Working principle of PCR, cycling reaction, constraints of PCR, Inverse PCR, RT-PCR, Real time PCR. Application of PCR. Nuclear Magnetic Resonance: Mass spectroscopy, IR spectrometry, Flow cytometry.

Unit IV

12 Hrs

Biostatistics: Measures of central tendency and dispersal, Probability distribution (Binomial, Poission and normal), Sampling techniques, correlation, t-test, Analysis of variance, X^2 test, Statistical packages.

References:

1. Gordon M.H and Macrae, M 1998. Instrumental analysis in biological sciences., Blackie and sons Ltd. London,.
2. Vanholdem W.C. and Johnson, P.S1998 Principles of physical biochemistry.. Printice Hall,.
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BOT-SPT- 3.3.2 Plant tissue culture and genetic engineering

56 hours

Unit – I**10 hrs**

History of plant tissue culture, concept of totipotency, Development of tissue culture. Discovery of auxins and cytokinins. Requirement of tissue culture: Basic laboratory organisation, instruments and equipments, General composition of culture medium (Major and minor salts, carbon source, Vitamins, growth regulators and other additives). Concept of cellular totipotency: Totipotency of cell differentiation, dedifferentiation, callogenesis, organogenesis, hormonal control of callogenesis and organogenesis.

Unit II**16 hrs**

Clonal propagation: Techniques of multiplication by apical, axillary and adventitious shoots, rooting, and acclimatization of plants, transferred to soil. **Organ culture:** Meristem culture and production of virus free plants. Leaf, root, ovule, embryo culture, Embryo rescue. **Haploid culture:** Anther and pollen culture, pathways of pollen germination, use of haploids in crop improvement. Protoplast culture and somatic hybridisation. Isolation, purification and culture of protoplast. **Somatic hybridization:** Production of Somatic hybrids and Cybrids, selection of hybrids, application and limitation. Somatic embryogenesis: Induction, maturation and germination, factors effecting somatic embryogenesis, physiological and biochemical aspects of somatic embryogenesis, application, artificial/ synthetic seeds.

Unit III**12 Hrs**

Genetic Engineering: Concepts and scope of genetic engineering. Enzymes in genetic engineering - Restriction endonucleases- types and action, DNA modifying enzymes. Cloning vectors: Plasmids isolation and purification- Ti Plasmid, pBR322, pUC –series. Phage vectors-M13 phage vectors, Cosmids-Types, Phasmids or Phagemids, Shuttle vectors-types. YAC and BAC vectors, Lambda phage vectors, Lamda phage DNA as a vectors. Cloning vectors and expression vectors. Vectors for Plant cells, Baculovirus vectors- adenoviruses Retroviruses, Transposons as vectors. Synthetic construction of vectors. Importance of gene manipulation in future perspectives.

Unit IV**18 hrs**

Recombinant DNA technology: Gene cloning principles and techniques, construction genomic cDNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA fingerprinting. **Genomics and Proteomics:** Molecular markers for introgression of useful traits, artificial chromosomes, functional genomics, micro arrays, protein profiling and its significance. Strategies for development of transgenics (with suitable examples), *Agrobacterium* – mediated transformation, Gene delivery techniques, chloroplast transformation and its utility. Techniques of selecting cell lines with increased secondary metabolites- Elicitation, Hairy root and production of secondary maetabolites, Factors determining accumulation of secondary metabolites. Biotransformation using cell cultures. **Bioreactors** : concept, types and use of plant cell culture. **Intellectual property rights**, possible ecological risks and ethical concerns.

References:

1. Bhojwani, S.S. & Razdan, M.K. (1996). Plant tissue culture: Theory and Practice (a revised edition). Elsevier Science Publishers, New York, USA.
2. Brown, T.A. (1999). Genomics. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
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7. Collins, H.A. and Edwards, S. (1998). *Plant Cell Culture*. Bios Scientific Publishers, Oxford, UK.
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15. Primrose, S.B. (1995). *Principles of Genome analysis*. Blackwell Science Ltd., Oxford, UK.
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18. Shantaram, S. and Montgomery, J.F. (1999). *Biotechnology, Biosafety and Biodiversity*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
19. Vasil, I.K. and Thorpe, T.A. (1994). *Plant Cell and Tissue Culture*. Kluwer Academic Publishers, The Netherlands.

Unit I**14 Hrs**

Biofertilizers: Definition, Classification, Advantages and Constraints, Role of biofertilizers in Modern Agriculture. Bacterial Biofertilizers: a general account of *Azospirillum*, *Azatobacter*, *Frankia*, *Phosphobacteria* and *Rhizobium* and their symbiotic association. Mass production and methods of utilization of *Azospirillum*, *Azatobacter*, Phosphate solubilising bacteria.

Unit II**14 Hrs**

Cyanobacteria (BGA) as Biofertilizer: General account of *Anabaena*, *Cylindrospermum*, *Gloeocapsa*, *Lygnbya*, *Nostoc*, *Plectonema*, *Tolypothrix*. Symbiotic association of Cyanobacteria, Field application of Cyanobacteria, Methods of cultivation and use of *Azolla* as inoculant.

Unit III**14 Hrs**

Mycorrhizae as Biofertilizer: General account and application of mycorrhizae. Methods of isolation and multiplication- wet sieving and decanting method, inoculum production through trap culture. Culturing of Mycorrhizae in modified Melin-Norkran's agar medium (MMN).

Unit IV**14 Hrs**

Biopesticides: Use and limitations of biopesticides and their application. Advantages over chemical pesticides, Biocontrol of plant diseases, Cross protection. Fungal and Bacterial biopesticides- Use of *Bacillus thuringensis*, *Trichoderma viridae*, *T. harzianum*. BioInsecticides: Insecticidal plants – Neem, Merigold, Crysanthemum and others. Baculovirus, *Bacillus* sp. and Protozoans.

References:

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9. Subba Rao, N.S. and Dommergues, Y.R. 1998. Microbial interaction in Agriculture and Forestry. Vol.1. Oxford & IBH publishing Co. New Delhi
10. Verma, A. 1999. Mycorrhiza, Springer Verlag, Berlin.
11. Walland, T. et al 1997. Mycorrhizae Backleys Publisher, The Netherlands.

Practicals**BOT: CPP- 3.5(3.1) Plant Physiology**

Unit –I

1. Estimation of protein in seeds by Lowry Method.
2. Estimation of activity of lipase in seeds.
3. Quantitative estimation of carbohydrates by Benedict's and DNS method.
4. Estimation of total fat content in seeds.
5. Demonstration of experiments on growth hormones.

Unit II

6. Determination of water potential of tissue by plasmolytic/gravimetric methods.
7. Study of Kranz anatomy in C4 plant leaves.
8. Quantitative estimation of Chl a, Chl.b and total chlorophyll in plant tissue.
9. Study of absorption spectrum of plant chlorophylls.
10. Determination of diurnal fluctuation in TAN of CAM plants.
11. Effect of red and far red light on seed germination.

BOT:CPP- 3.6(3.2) Molecular Biology**Unit –I**

1. Cultivation of E.coli.
2. Isolation of DNA from prokaryotes.
3. Isolation of DNA from Eukaryotes.
4. Quantification of DNA.
5. Electrophoretic separation of DNA.

Unit I

6. Plasmid culturing.
7. Regulation of lac-operon genes.
8. Quantification and electrophoresis of RNA.
9. Electrophoretic separation of enzymes/protein.

BOT: SPP. 3.7.1(3.3.1) Methods in Plant Sciences**Unit-I**

1. Demonstration of sterilizing methods.
2. Demonstration of serial dilution technique
3. Isolation of bacteria and fungi from soil and plant parts.

Unit-II

4. Plasmid culture.
5. Demonstration of pH meter, UV spectra, Chromatography and PCR.
6. Chromatography- separation of pigments.
7. Study of statistical packages

BOT: SPP. 3.7.2 (3.3.2) Plant tissue culture genetic engineering.

Unit-I

1. *In vitro* plant tissue culture on different media.
2. Isolation of DNA from plants using CTAB method and quantification of DNA.
3. Isolation of plasmid DNA by alkali lysis method and its separation by electrophoresis.
4. Restriction digestion of DNA.

Unit –II

5. Amplification of DNA using PCR technique.
6. Demonstration of RAPD technique using random primers.
7. Genetic transformation using *Agrobacterium tumefaciens*.
8. Genetic transformation using *Agrobacterium rhizogenes* and development of hairy roots.

BOT: OEP. 3.8(3.4) Biofertilizers and Biopesticides.**Unit-I**

1. Isolation and culturing of Cyanobacteria (BGA): *Anabaena*, *Cylindrospermum*, *Gleocapsa*, *Lyngbya*, *Nostoc*, *Plectonema*, *Tolypothrix*.
2. Cultivation of *Azolla*.
3. Isolation of Nitrogen fixing bacteria- *Azotobacter* and *Azospirillum*.
4. Demonstration and isolation of root nodules (*Rhizobium*).
5. Arbuscular mycorrhizal fungi – root staining

Unit –II

6. Isolation and identification of AM fungal spores from rhizosphere soil of crop plants
7. Isolation and identification of fungal and insect bio-control agents.
8. Isolation and culturing of *Aspergillus*, *Trichoderma* and *Bacillus* sp.
9. Experiments on fungal and bacterial antagonism.
10. Trap crops, Mixed crops and crop rotation practices.

BOT: CPT. 4.1 - PLANT PATHOLOGY AND PLANT PROTECTION

Unit-I**14 Hrs**

History and development of plant pathology, Disease concept in plants. Disease classification, Causal factors - biotic and abiotic, disease diagnosis, Koch's postulates. Defense Mechanism in plants: Structural and Biochemical. Genetics of Host – Pathogen interaction. Gene to gene and polygene hypotheses. Immune and hypersensitive reaction. Role of environment.

Unit II**14 Hrs**

Physiological specialization in pathogens. Epidemiology: Traditional and modern concepts of disease triangle. Role of host, pathogen and environment in disease development. Plant diseases and crop losses; Parasitism and Disease Development, Defense Mechanism in Plants; Plant Disease Epidemics and Plant Disease forecasting.

Unit II**14 Hrs**

Aerobiology in relation to Epidemiology. Methods of monitoring splash borne and air – borne inoculum. Methods of assessment of disease incidence and disease severity and estimation of yield loss. Study of plant diseases of major crops of Tumkur region caused by fungi, Bacteria, Viruses, Mycoplasma, nematode and angiosperm parasites (with reference to symptoms, etiology and control).

Unit III**14 Hrs**

Principles of plant disease control: Regulatory methods: Plant quarantine regulation, inspection and certification. Physical methods: Heat and cold treatment (Hot water, Hot air, Radiation treatment). Cultural methods: Crop rotation, Flooding, Solarization, trap crops. Chemical methods: Surface protectants and systemic protectants. Seed treatment, soil treatment. Control of post harvest disease, disinfection of warehouses. Methods of fungicide application Biological methods : Use of antagonistic microorganisms AM fungi and control of soil borne diseases. Plant immunization, Phytoalexins and cross protection.

References:

1. Agrios, G.N. 1997. Plant Pathology, Fourth Edition, Academic Press, U S A.
2. Aneja, K.R. 1993. Experiments in microbiology, Plant Pathology and Tissue culture, Wiswa Prakashan, New Delhi.
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10. Pathak, V.N. 1984. Laboratory Manual of Plant Pathology (2Ed.) Oxford and IBH Publishers, New Delhi.
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12. Singh, R.S. Introduction to Principles of Plant pathology, Oxford and IBH, New Delhi Square, Aylesbury, Bucks.
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14. Wheeler, B.E.J 1972.. An Introduction to Plant diseases, John Wiley & Sons Ltd., U K.

Willingford, UK.

15. Wolfe, M.S. and C. E. Caten 1987 (Eds.) Population of Plant Pathogen Black well Scientific Publication. Oxford.

BOT-CPT –4.2 Plant Biotechnology and Bioinformatics

56 hours

Unit – I

16 Hrs

Introduction, scope and importance of Biotechnology, Biotechnology scenario in India. Biotechnology- Safety, Social, moral and ethical consideration.

Restriction endonucleases, ligases, polymerases, Kinases and Phosphatases, DNA methylases and Topoisomerases. Expression vectors, vectors for cloning PCR products, Binary and Shuttle vectors. Genetically modified organisms.

Unit II

12 Hrs

Methods of DNA delivery: PEG mediated DNA uptake, electroporation, Biolistic transfer, Microinjection, organelle transformation, Mechanism of integration of DNA into plant genomes, cDNA libraries- Construction, size full length cDNA cloning.

Unit III

12 Hrs

Nucleic acid hybridization, Southern, Northern and Western blotting techniques, Enzyme biotechnology- isolation, purification, Immobilation, production and uses of amylases, proteases, and lipases.

Unit IV

16 Hrs

Bioinformatics- tools of bioinformatics, data bases and data base management, Nucleic acid and protein sequence databases, data mining methods for sequence analysis, web-based tools for sequence searches, Bioinformatics in taxonomy, biodiversity, agriculture. Bioinformatics in drug design and drug discovery.

References

1. Attwood, T.K. and Parry-Smith, D.J. 1999. Introduction to Bioinformatics. Addison Wesley Longman, Harlow Essex.
2. Bajaj, Y.P.S. (Ed.) **Biotechnology in agriculture and forestry**. Various volumes published time to time. Springer-Verlag, Berlin
3. Barry L., and Batzing, **Industrial Microbiology**. State University College of New York, Cortland
4. Bernard. R. Glick and Jack J. Pasternak, 2000. **Molecular Principles and Applications**. 2nd edition, ASM Press, Washington: DC
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Unit –I**14 Hrs**

Classification of medicinal and aromatic plants, difficulties in establishing the taxonomic identities from indigenous informations, taxonomic and nomenclatural problems. Exotic medicinal plants Pharmacognosy: raw drug analysis, microscopic, macroscopic characteristics, preliminary chemical analysis, qualitative and quantitative analysis of raw drug using colorimetry, spectrophotometry, chromatography, (*Senna Datura, Cinchona, Ginger, Nuxvomica, Withania, Rauwolfia, Emblica*).

Unit –II**12 Hrs**

Quality control of raw drug, criteria for purity and adulterants. Cultivation of medicinal and aromatic plants: cultivation practice, disease and pest control, harvesting, storage of medicinal plants, post-harvest care, deterioration and disintegration of active compound during storage and its control (*Dioscorea, Isabgol, Senna, Liquiorice, Rauwolfia, Costus, Withania, Citronella, Vetiver, Davana, Acorus, Vanilla*). Economic evaluation and marketing: demand and supply of medicinal plants,(crude drugs) import and export policies, cost benefit of medicinal plant cultivation, marketing of raw drugs, royalties and costs of marketing, adoption of GATT, market potential of plant drugs.

Unit –III**16 Hrs**

Ethnobotany and ethnomedicine: Brief account at world level and in India, establishment of herbal cultures. Medicinal and aromatic uses of bacteria, algae, fungi, lichens, bryophytes, pteridophytes and gymnosperms. A brief account of the therapeutic values of Indian plant food and important plant drugs of different taxonomic groups. Intellectual property right: IPR related to medicinal and aromatic plants, natural resources right of countries, geographical areas, government rights organisations, communities and individuals. IPR on traditional knowledge, new varieties, new uses and processes. Cosmetic herbs; natural cosmetics in the medical system. Controversial drugs and safety control of herbal drugs.

Unit IV**14 Hrs**

Occurrence, classification and properties of alkaloids, steroids, terpenoids, lectins, non-protein amino acids. Pesticidal and insecticidal properties of compound of plant origin. Poisonous plants and toxicology: Poisons, toxins, venoms, toxicology- a brief account of poisonous plants and disease treatment, plants as antidotes, poison, toxin/venoms. Plants with stimulatory, intoxicating and hallucinating activity. Medicinal oil: occurrence, distribution and importance of aromatic and non aromatic oils of plant source. Use of vegetable oil as food, medicine and industry. Plants in the treatment of stress, heart diseases, cancer, AIDS, fertility, anti-microbial activity.

References

1. Kirtikar K.R. and Basu,B.D. 1932 Indian medicinal plants. Oxford & IBH publishing Co, New Delhi
2. Nadkarni, A.K. 1954 Indian Materia medica Vol I & II, Orientalia, Varanasi
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- 5 Sivarajan, V.V. and Indira, B. 1994 Ayurvedic drugs and their plant sources.
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BOT-SPT-4.3.2 BIO-DIVERSITY CONSERVATION**56 hours**

Unit –I **14 Hrs**
Species concept: Concept and importance of biodiversity, Earth summit 1992, and Agenda 21, species diversity, genetic diversity, ecosystem diversity. Maintenance and loss, magnitude and distribution of diversity, speciation and extinction, environmental impact assesment, sustainable development. Hotspots of the world and India, Mega biodiversity centres of the world and India.

Unit –II **15 Hrs**
Loss of biodiversity: Causal factors of threat, habitat loss, habitat fragmentation, categories of threat- endangered, vulnerable, rare, threatened, extinct, data deficient. **Conservation:** Habitat conservation, sustainable use of natural resources, international and national organisation for conservation of natural resources. Criteria for conserving and the conservation status, Red Data Book, Red Data Sheet, *insitu* – national parks, sacturies, *exsitu* – botanical gardens medicinal conservation parks, herbal gardens etc. Trade of natural resources- trade restriction, economics, legal and ethical implications, DNA fingerprinting and its implications.

Unit III **15 Hrs**
 Natural resources- Renewable and non-renewable resources, forest resources- use and over exploitation, deforestation, Timber extraction , mining, dams and their effects on forests and tribal people; Water resources- use and over utilization of surface and ground water, floods, drought, conflicts over water, dams, benefits and problems; Mineral resources- use and exploitation, environmental effects of extraction and use of mineral resources, case studies; Agricultural resources- Land resources- Land as a resource, Land degradation, landslides, soil erosion and desertification.

Unit IV **12 Hrs**
 Human Population and Environment- Population explosion, Environment and Human health, Human rights, Iformation technology and encvironmental health, case studies; Environmental Protection Act (EPA)- Air, Water, Wildlife, Forest conservation Acts, Public awareness. National Biodiversity Authority, National Biodiversity Board, Plant Biodiversity Registrar.

Reference:

1. Agarwal KC. 1986 Environmental Biology.
2. Agarwal VG, 1985 Forest in India, Oxford and IBH, New Delhi.
3. Camughley G et. al.1995 Conservation Biology in theory and practice, Blackwell Publications, London.
4. Jones A.M. et.al.,1997 Environmental Biology, Routledge, London.
5. Sharma. PD,1995 Environmental Biology, 1st edition, Rastogi and Company.
6. Shobanlal, Ecology, 1992.

Practicals

BOT:CPP.4.4(4.1) Plant pathology and plant protection.

Unit-I

1. Study of locally available diseases.
2. Preparation of Herbarium of disease specimen.
3. Study of Koch's postulates.
4. Assessment affected leaf area by Stover's method.
5. Field visits to assess disease incidence and severity.

Unit -II

6. Estimation per cent of spore germination.
7. Experiment to show fungicidal inhibition of spore germination.
8. Spore trap.
9. Isolation of fungi from disease plant/parts.

BOT: CPP. 4.5(4.2) Plant Biotechnology**Unit-I**

1. Preparation of medium, autoclaving and sterilization technique.
2. Sterilization of plant material and induction of callus.
3. Induction of organogenesis and whole plant.
4. Initiation of somatic embryogenesis and production of synthetic seeds.

Unit-II

5. Isolation of protoplast and culture.
6. Induction and estimation of secondary metabolites.
7. Induction of suspension culture.

BOT: SPP. 4.6(4.3.1) Medicinal plants and Phytochemistry**Unit-I**

1. Identification of medicinal plants.
2. Extraction of plants metabolites,
3. Preliminary tests for the occurrence of secondary metabolites.

Unit-II

4. Separation of alkaloids.
5. Estimation of Phenols.
6. Estimation of essential oils.
7. Identification of raw drugs- Pharmacognostic studies.
8. Identification of controversial drugs.

BOT: SPT. 4.6(4.3.2) Biodiversity Conservation.**Unit-I**

1. Field survey of important plants of the region.
2. Study of the characters and threatened plants included in theory.
3. Survey of important timber yielding trees of the region.
4. Determination of minimum size of the quadrat suitable for an area using species area curve method.

Unit-II

5. Determination of Important value index (IVI) of the plant species in the community.
6. Study of Phytogeography maps of the world and India.
7. Maps of Hot spots, continental drift.
8. Study of Endangered plants.

PROJECT 4.7.

Prof. Y. N. Seetharam
Chairman, BOS in Botany (PG)
Tumkur University, Tumkur

Model Question Paper
I Semester M. Sc. Examination,
(CBCS Scheme)
BOTANY
Paper Code:

Time: 3 Hrs

Max. Marks 80

Q1. Answer the following in four or five sentences

3 x 5 = 15

- a.
- b.
- c.
- d.
- e.

Write short notes on any four of the following

4 x 5 = 20

- Q2.
- Q3.
- Q4.
- Q5.
- Q6.
- Q7.

Give a comprehensive account on any three of the following

15 x 3 = 45

- Q8.
- Q9.
- Q10.
- Q11.

PRACTICAL QUESTION PAPER PATTERN

Time 4 Hours.

Max Marks = 40

- | | |
|---|----------|
| 1. Experiments, Spotting, Demonstration | 35 marks |
| 2. Records and submission | 05 marks |

Chairman of BOS in Botany
Approved in BOS meeting held on
30 & 31st Dec 2013. and Signed by all
the members

