

MANGALORE UNIVERSITY

BOTANY

(CORE, ELECTIVE AND SKILL COURSES)

SYLLABUS FOR

**B.Sc. UNDER GRADUATE (UG)
PROGRAMME**

UNDER SEP SCHEME

With effect from

Academic Year

2024-25

Botany

Programme Outcome:

- **Students will be proficient to comprehend classification, morphology, anatomy, and physiology of various groups of plants.**
- **Students will be able to understand the contribution of botany for human welfare with potential uses of plants along with their conservation and sustainable development.**
- **Students will be enriched by various skills related to Gardening and Floriculture, preparation of biofertilizers, mushroom cultivation and ethnobotanical knowledge.**
- **Students will be able to understand and relate physical features of the environment to the structure of population, community, ecosystem, and sustainable conservation strategies.**

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

	Semester-wise Course Topics	Teaching hrs/ week	Exam duration (hrs)	Marks			No. of Credits
				I.A	Exam	Total	
SEMESTER – I							
Group I	BSCBOC 101: Diversity of Microbes, Algae and Fungi(T)	4	3	20	80	100	03
	BSCBOP 102: Diversity of Microbes, Algae and Fungi (P)	4	3	10	40	50	02
SEMESTER – II							
Group I	BSCBOC 201: Diversity of non-flowering plants and Plant anatomy (T)	4	3	20	80	100	03
	BSCBOP 202: Diversity of non-flowering plants and Plant anatomy (P)	4	3	10	40	50	02
SEMESTER – III							
Group I	BSCBOC 301: Angiosperm Morphology and Reproductive Botany (T)	4	3	20	80	100	03
	BSCBOP 302: Angiosperm Morphology and Reproductive Botany (P)	4	3	10	40	50	02
Group II	BSCBOCE 301: Elective Course: Medicinal Botany	2	2	10	40	50	02
SEMESTER – IV							
Group I	BSCBOC 401: Plant Taxonomy and Economic Botany (T)	4	3	20	80	100	03
	BSCBOP 402: Plant Taxonomy and Economic Botany (P)	4	3	10	40	50	02
Group II	BSCBOCE 401: Elective Course: Gardening and Nursery Techniques	2	2	10	40	50	02
	BSCBOCS401: Skill Paper 1: Floriculture	2	2	10	40	50	02
SEMESTER – V							
Group I	BSCBOC 501: Ecology and Conservation Biology (T1)	3	3	20	80	100	03
	BSCBOC 502: Genetics, Cell and Molecular Biology (T2)	3	3	20	80	100	03
	BSCBOP 503: Ecology and Conservation Genetics, Cell and Molecular Biology (P)	4	3	10	40	50	02
	BSCBOCS501: Skill Paper 2: Mushroom Cultivation Technology	2	2	10	40	50	02
SEMESTER – VI							
Group I	BSCBOC601: Plant Physiology (T1)	3	3	20	80	100	03
	BSCBOC 602: Plant Breeding and Biotechnology(T2)	3	3	20	80	100	03
	BSCBOP 603: Plant Physiology & Plant Breeding and Biotechnology (P)	4	3	10	40	50	02
	BSCBOCS601: Skill Paper 3: Seed Technology	2	2	10	40	50	02
	T= Theory, P=Practical				Total Credits		46

MANGALORE UNIVERSITY
BOTANY SYLLABUS FOR UG PROGRAMS

w. e. f. 2024-25

DISCIPLINE CORE PAPERS (DSC)

Sl. No.	Semester Details	Subject
1	Semester I	Diversity of Microbes, Algae and Fungi
2	Semester II	Diversity of non-flowering plants and Plant Anatomy
3	Semester III	Angiosperm Morphology and Reproductive Botany
4	Semester IV	Plant Taxonomy and Economic Botany
5	Semester V	Ecology and Conservation Biology
		Genetics, Cell, and Molecular Biology
6	Semester VI	Plant Physiology
		Plant Breeding and Biotechnology

ELECTIVE and SKILL PAPERS

Sl No.	Semester Details	Subject: Botany	Credits
1	Semester III Elective	Medicinal Botany	02
2	Semester IV Elective	Gardening and Nursery Techniques	02
	Semester IV Skill paper 1	Floriculture	02
3	Semester V Skill paper 2	Mushroom Cultivation Technology	02
4	Semester VI Skill paper 3	Seed Technology	02

SEMESTER – I
Diversity of Microbes, Algae and Fungi – Theory

Course Objectives:

- To explore and identify microbes, lower plants and to gain adequate knowledge on comparative account of these organisms
- To impart knowledge about the occurrence, distribution, structure and life history of microbes, lower plants such as algae, fungi and lichens,
- To acquaint students with a wide spectrum of plant diseases, cause, symptoms, and control measures

Course Outcome: After completion of the course, the students will be able to;

- Understand the diversity of microbes in nature.
- Know the diversity of algae, fungi, lichens and their uses.
- Identify and classify algae and fungi.
- Develop practical skills in staining techniques and slide preparation.
- Identify plant disease symptoms and management techniques.

Unit	Topics	Teaching Hours
I	<p>Introduction to Botany: Branches and scope, Major historical developments in Botany including contributions of Indian Botanists (Sir J. C. Bose, P. Maheshwari, B.G.L. Swamy, E.K. Janaki Ammal and M. S. Swaminathan) Career opportunities in Botany.</p> <p>Five kingdom and Three domain systems of classification of organisms with examples</p> <p>Viruses: Discovery, General characters -living and non-living features, Classification based on hosts and nature of genetic material. Ultra structure and multiplication of TMV and T4 Phage. A brief account of Viroid's and Prions.</p> <p>Phytoplasma: General characters and structure.</p> <p>Bacteria: Discovery, Types based on cellular morphology, flagellation and mode of nutrition. Classification (Bergey's manual)'- a brief account, Ultra structure of a Bacterial cell. Reproduction: binary fission and endospore formation. Genetic recombination in bacteria - conjugation, transformation and transduction (generalized type), Economic importance of Bacteria.</p>	12
II	<p>Algae -1: Occurrence, thallus organization and general methods of reproduction with examples. Types of life cycles in algae (only schematic representations) with an example to each type: haplontic, diplontic, isomorphic, heteromorphic and triphasic. Pigmentation in algae, Fritsch's classification of algae up to the level of classes with examples.</p> <p>Myxophyceae/Cyanophyceae: Ultra structure of cyanobacterial cell and heterocyst. Structure and reproduction of <i>Nostoc</i>.</p> <p>Chlorophyceae: Thallus structure and reproduction of <i>Oedogonium</i></p> <p>Bacillariophyceae: Types of diatoms with examples- Pennales and Centrales. Thallus structure and reproduction of a Pennate diatom (<i>Pinnularia</i>)</p>	12

III	<p>Algae-2: Phaeophyceae: Thallus structure and reproduction of <i>Sargassum</i> Rhodophyceae: Thallus structure and reproduction of <i>Polysiphonia</i>. Economic importance of algae: Useful aspects- food, SCP, industrial products, medicine, sewage treatment, bio-fertilizers, pollution indicators and energy source. Harmful aspects- algal blooms, algal toxins, and parasitic algae. Fungi: Salient features, occurrence, mycelial organization- prosenchyma, pseudo parenchyma, rhizomorph and sclerotium. General methods of reproduction with example. Alexopoulos system of classification up to the level of classes with examples. Thallus structure and reproduction of <i>Rhizopus</i> (Zygomycetes), <i>Penicillium</i> (Ascomycetes) and <i>Agaricus</i> (Basidiomycetes). Economic importance of Fungi: food value, industrial products, medicinal products, bio control agents and Fungal toxins.</p>	12
VI	<p>Plant Pathology: Concept of a plant disease, types of plant diseases based on cause-infectious and non-infectious. Major groups of phytopathogenic organisms, Disease cycle, General symptoms of plant diseases caused by phytoplasma, virus (Katte disease of Cardamom), bacteria (Bacterial blight of paddy) and fungi (Stem bleeding disease of coconut) with examples. Methods of disease management. Mycorrhizae: definition, types – ecto, endo (VAM) and ectendomycorrhizae, Ecological and economic significance of mycorrhizae. Lichens: Classification- asco and basidiolichens. Morphological types with examples- crustose, foliose and fruticose. Internal structure of thallus – homeomerous and heteromerous types. Structure of fruiting bodies - soredium, isidium, apothecium and perithecium, Economic importance of lichens.</p>	12
	Total	48 hrs

REFERENCE BOOKS:

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

SEMESTER – I
Diversity of Microbes, Algae and Fungi –Practical

Practical No.	Title of practical exercise/experiment
1	Microscopy technique: Study of compound and Dissection microscopes – parts, working principle, handling and preparation of temporary mountings
2	Microscopic observation of Bacterial cells by simple staining (Positive-Crystal violet, Negative- Nigrosine or Indian Ink) Differential staining of Bacteria - Gram's staining.
3	Study of thallus structure of <i>Nostoc</i> , <i>Oscillatoria</i> and <i>Scytonema</i>
4	Study of thallus structure of <i>Volvox</i> , <i>Oedogonium</i> and <i>Cladophora</i>
5	Study of thallus and reproductive structures of <i>Chara</i> and structures of <i>pennate Diatoms</i>
6	Study of thallus and reproductive structures of <i>Sargassum</i> and <i>Polysiphonia</i>
7	Study of vegetative and reproductive structures of <i>Penicillium</i> , <i>Rhizopus</i> and <i>Puccinia</i>
8	Study of symptoms, causative organism and control measures of banana bunchy top disease, citrus canker and Root Knot of brinjal, with the help of specimens/photograph.
9	Study of symptoms, causative organism and control measures of Koleroga of areca nut, Blast disease of rice and Rust of coffee
10	Study of Lichens- morphological types, internal structure and reproductive structures
11	Study of local diversity of algae/fungi and preparation of an inventory with photographs/microphotographs (any five not mentioned in practical syllabus)
12	Listing and Study of common fungal/bacterial/viral diseases of local crop plants/plantation crops (any five not mentioned in practical syllabus)

Mangalore University
B.Sc. I Semester -Practical Examination
Diversity of Microbes, Algae and Fungi
Question paper and Scheme of evaluation

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

- | | |
|---|------------|
| 1. Prepare a stained slide of specimen A . Sketch, label and identify with reasons. Leave the preparation for inspection | 06 |
| 2. Identify B & C giving reasons | 3+3 =06 |
| 3. Identify D & E with reasons and labeled sketches | 3+3 =06 |
| 4. Prepare a stained slide of the given bacterial sample F .
Show the preparation to the examiner and write the procedure | 03 |
| 5. Sketch, label and identify the slides G , H & I with reasons | 3+3+3 = 09 |
| 6. Record Submission and Field Notes | 7+3 = 10 |

1	A	Prep. SkId Cl Rea 2 1½ ½ ½ 1½ = 6	<u>Reg. No. of Candidates Assigned</u>	
2	B C	Id. Reasons 1 2 = 3 each *Sketch and Classification not required	<u>Reg. No. of Absentees:</u>	
3	D E	Id* Sk. reasons. ½ 1 1½ = 3 each *Classification not required		<u>Total examined:</u>
4	F	Prep - 1 Procedure - 2		<u>Name and Signature of Examiners:</u>
5	G H I	SkId Cl Rea 1 ½ ½ 1 = 3each	1. Internal	
6	Record with Field report	10	2. External	

Instruction to Examiners:

A - Any algal specimen

B and **C**- One algal and one fungal specimen

D and **E**- Any Pathological specimen/Morphological types of lichens

F - Bacterial culture/curd sample/root nodule suspension

G, **H** and **I**- Slides (Lichen/Algae/Fungi (one each))

SEMESTER – II

Diversity of non-flowering plants and Plant anatomy

Course objectives:

- To study the structure and function of various tissues and their location in the plant body
- To provide relevant information about Pteridophytes and Gymnosperms along with their evolutionary history, their phylogenetic relationships and fossil wealth of the world and economic importance of selected forms.
- To ascertain the importance of fossilization to relate life forms of earlier era

Course Outcome:

On completion of this course, the students will develop the following skills:

- To identify and classify non-flowering plants.
- Will gain basic knowledge of GTS and plant fossils.
- Observation of variations that exist in the internal structure of various parts of a plant and among different plant groups in support of the evolutionary concept.
- Skill development for the proper description of internal structure using botanical terms, their identification and further classification.
- Induction of the enthusiasm towards the internal structure of locally available plants.

Unit	Topics	Teaching Hours
I	Plant Histology and Anatomy: Introduction to tissues, general classification of tissues. Meristematic tissues: definition, classification based on origin, function, and position. Theory of shoot organization – tunica corpus theory, Theory of root organization - histogen theory. Permanent Tissues: simple permanent tissues - structure, types and functions of parenchyma, sclerenchyma, and collenchyma. Complex permanent tissues - structure, composition and functions of xylem and phloem. Secretory tissues: Glandular trichomes, nectars, glands, laticifers and resin ducts. Primary anatomy of dicot and monocot root, stem, and leaf. Normal secondary growth in dicot stem and root.	12
II	Bryophytes: Occurrence, General characteristics, Rothmaler's classification up to the level of classes with examples. General life cycle of bryophytes. Thallus morphology, anatomy, and reproduction of <i>Riccia</i> , <i>Anthoceros</i> and <i>Funaria</i> . Evolution of sporophytes and gametophytes in bryophytes – theories of progressive sterilization and simplification. Ecological importance of bryophytes.	12

III	<p>Pteridophytes: Occurrence, General characteristics, G. M. Smith's classification up to the level of classes with examples. General life cycle of pteridophytes. Morphology, anatomy and reproduction in <i>Psilotum</i>, <i>Equisetum</i> and <i>Pteris</i> Origin of pteridophytes, Stellar variations in pteridophytes, Heterospory and seed habit. Economic importance of pteridophytes.</p>	12
IV	<p>Gymnosperms: Occurrence, Salient features, Sporne's system of classification up to the level of classes with examples. Morphology, anatomy, and reproduction in <i>Cycas</i> and <i>Gnetum</i>. Economic importance of Gymnosperms. Palaeobotany: Introduction, significance of fossils, Geological time scale and Evolution of plant groups, Types of plant fossils – compressions, impressions, incrustations, petrification with examples. Fossil dating- direct and indirect. Fossil bryophytes, Fossil Pteridophytes- <i>Rhynia</i> – Morphology of sporophyte. Fossil Gymnosperms- <i>Cycadeoidea</i>- Morphology.</p>	12
	Total	48 hrs

REFERENCE BOOKS

1. B.P. Pandey, 2000: Simplified course in Botany. S. Chand Publications
2. Sundara Rajan, S, 2011. College Botany Vol. 3. Himalaya Publishing House.
3. Kumaresan and A. Reginald, 2013. Pteridophytes, Gymnosperms and Paleobotany, Saras Publications.
4. P. C. Vashishta, 2013. Text Book of Gymnosperms. S. Chand Publishers
5. Johri B. M. 2015. Embryology of Angiosperms. Springer Publications.
6. Sambamurthy, AVSS., 2005. Text Book of Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany. JK International Publishers.

SEMESTER – II
Diversity of Non-Flowering Plants and Plant Anatomy – Practical

Practical No.	Title of exercise /experiments
1	Study of structure and reproduction of <i>Riccia</i> , <i>Anthoceros</i> and any moss
2	Study the morphology, anatomy, and reproductive structure of <i>Selaginella</i> and <i>Equisetum</i>
3	Study the morphology, anatomy, and reproductive structure of <i>Pteris</i> and <i>Marselia</i>
4	Study the morphology, anatomy, and reproductive structure of <i>Cycas</i>
5	Study the morphology, anatomy, and reproductive structure of <i>Pinus</i>
6	Study the morphology, anatomy, and reproductive structure of <i>Gnetum</i> Study of plant fossils, and examples of Pteridophyte and Gymnosperm fossils included in the syllabus, with the help of slides / photographs.
7	Study of simple, complex permanent tissue and secretory tissues
8	Anatomy of dicot and monocot stem
9	Anatomy of dicot and monocot root
10	Anatomy of old stem and root of dicot (Normal secondary growth)
11	Anatomy of dicot and monocot leaf
12	Study of local diversity of bryophytes / pteridophytes/Gymnosperms and preparation of an inventory with photographs to be recorded in Record book.

Mangalore University
B.Sc. II Semester - Practical Examination
Diversity of Non-Flowering Plants and Plant Anatomy
Question paper and Scheme of evaluation

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

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

1	A		Prep. 2 Sk 1½ Id ½ Cl ½ Rea ½ 1½ = 6	Reg. No. of Candidates Assigned Reg. No. of Absentees: Total examined: Name and Signature of Examiners: 1. Internal 2. External
2	B		Id 1 Rea 2 = 3 each	
	C		Sketch and Classification not required	
3	D		Id ½ Sk 1 Crt.Nts. 1½ = 3 each	
	E		Classification not required	
4	F		Sk 1 Id ½ Cl ½ Rea 1 = 3each	
	G			
	H			
	I			
5		Record with Field report	10	

Instruction to Examiners:

A from dicot or monocot stem/root

B and **C** one specimen each from Bryophyta and Gymnosperms

D and **E** from Pteridophyta

F, G, H and **I** - one slide each from Histology, Bryophyta, Pteridophyta and Paleobotany/Gymnosperms

SEMESTER –III

Angiosperm Morphology and Reproductive Botany - Theory

Course objectives:

- To study the morphological variations & modifications in vegetative and floral plants
- To study the reproductive methods and life cycle of angiosperms
- To understand the steps involved in embryogenesis in plants.

Course Outcome: On completion of this course, the students will develop the following skills:

- Observation and classification of the floral variations in different plants.
- Able to understand the various reproductive methods and the life cycle of flowering plants
- Observation and classification of the embryological variations in angiosperms.
- Enthusiasm to understand the evolution based on various methods of reproduction.

Unit	Topic	Teaching Hrs
I	Morphology of Vegetative structures Parts of a typical flowering plant, diversity of plant forms – Herbs, Shrubs, Trees, Climbers; annuals, biennials, and perennials. Morphology of vegetative organs: Root: Characteristics, functions, regions of root, types – tap and adventitious, modification of root for storage, mechanical support, and vital functions. Stem: Characteristics, functions, modification – underground, sub aerial and aerial. Leaf: Parts of typical leaf, venation and modifications of leaf, Phyllotaxy.	12
II	Morphology of reproductive structures Inflorescence: Racemose, cymose and special types. Flower: Definition, parts of a typical flower, forms of thalamus, androphore, gynophore, gynandrophore, insertion of floral whorls on the thalamus (hypogyny, perigyny and epigyny), structure, function and modification of calyx, corolla, aestivation, androecium and variations gynoecium and its variations, placentation.	12
III	Reproductive Botany I Introduction, Scope and contributions of Indian embryologists: P. Maheshwari, B G L Swamy. Microsporangium: Morphology and Anatomy of the mature anther; Anther wall layers; Tapetum -types, structure and functions; sporogenous tissue. Microsporogenesis - Microspore mother cells, microspore tetrads and their types; structure of mature pollen; Pollinia. Microgametogenesis – structure and development of male gametophyte. Pollen embryosac (Nemec phenomenon). Megasporangium – Ovule and types of ovules - Anatropous, Orthotropous, Amphitropous, Campylotropous, Detailed Structure of Orthotropous ovule. Megagametogenesis –Female gametophyte/embryosac – tenuinucellate and	12

	crassinucellate; monosporic - Polygonum type (in detail), bisporic – Allium type, tetrasporic - Fritillaria type (Just mentioning the types in brief). Structure of mature 7-celled embryo sac.	
IV	Reproductive Botany II Pollination: Definition, self and cross-pollination and their types, contrivances for self and cross-pollination; types of pollination based on agents and their characteristic features. Fertilization: Steps, process and significance of double fertilization. Significance of double fertilization, Post fertilization events. Endosperm – Types and their biological importance. Free nuclear (<i>Cocos nucifera</i>), cellular (<i>Cucumis</i>), helobial types. Ruminant endosperm. Embryogenesis: Dicot (<i>Capsella bursa-pastoris</i>) and Monocot (<i>Najas</i>) embryo development. Structure of Dicot and Monocot seed. Fruit: Types of fruits. Fruit and Seed dispersal strategies.	12
	Total	48 hrs

References:

- Bhojwani S.S/Bhatnagar S.P. & Dantu P.K The Embryology of Angiosperms, 6th Edition; Vikas Publishing House, 2015
- Pandey S. N. A Textbook of Botany: Angiosperms - Taxonomy, Anatomy, Embryology and Economic Botany.
- Bhojwani. S S. Anatomy, Embryology and Elementary Morphogenesis. Textbook of embryology of Angiosperms. DayaBooks, New Delhi.
- Patil, C. D and Gauri M Rane; Morphology of Angiosperms. Published 2022.
- Bhojwani and Bhatnagar, Introduction to Embryology of Angiosperms –Oxford & IBH, Delhi
- Bhojwani Sant Saran, 2014. Current Trends in the Embryology of Angiosperms, Woong-Young Soh, Springer Netherlands,
- Eames A. J. - Morphology of Angiosperms - Mc Graw Hill, New York.
- Raghavan, V., 2000. Developmental Biology of Flowering plants, Springer, Netherlands.
- Saxena M. R. – Palynology – A treatise - Oxford & I. B.H., New Delhi.
- Nair P. K. - Pollen Morphology of Angiosperms - Scholar Publishing House, Lucknow
- Johri B. M. 2015. Embryology of Angiosperms. Springer Publications.
- Shukla A. K. 1999. Biology of Pollen. Atlas Books and Periodicals.
- Maheshwari P. 1950. An introduction to the Embryology of Angiosperms. TMH Ed.
- Dwivedi J. N. 1990. Embryology of Angiosperms, 2nd Edition. Rstogi & Co. Meerut.
- Online Resources: https://onlinecourses.nptel.ac.in/noc19_bt17/preview

SEMESTER - III

ANGIOSPERM MORPHOLOGY AND REPRODUCTIVE BOTANY – PRACTICAL

Practical No.	Title of exercise /experiments
1	Morphology and modification of root
2	Morphology and modification of stem
3	Study of inflorescences
4	Study of fruits
5	Study of flower and its parts; epigynous, perigynous and hypogynous flowers
6	Pollination types and seed dispersal mechanisms (including appendages - aril and caruncle) using photographs and/ specimens).
7	a. Structure of anther (young and mature) using permanent slides. b. Types of placentation and types of ovules (anatropous, orthotropous, campylotropous) using permanent slides.
8	a. Estimation of pollen viability (<i>in vitro</i> method) by hanging drop method. b. Pollen grain structure – Fresh and acetolyzed, showing ornamentation and aperture (slides/photographs/fresh)
9	Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs). Ultrastructure of mature egg apparatus cells through electron micrographs.
10	Dissection and mounting of the embryo from developing seeds (monocot and dicot). Study of suspensor through electron micrographs
11&12	Mini project: Mini project work in groups of 2-3 students/individual, from the following list. This is to be recorded in the practical record book. i. Leaf morphology (Monocot and Dicot) types and phyllotaxy. ii. Placentation types. iii. Variation in calyx and corolla and their significances. iv. Variation in androecium and gynoecium and their significances. v. Seed dispersal methods.

B.Sc. III Semester, Practical Examination

ANGIOSPERM MORPHOLOGY AND REPRODUCTIVE BOTANY

Question paper

Time: 3 hrs.	Batch.....	Date.....	Marks: 40
1. Estimate the percentage of pollen viability in the given material A by hanging drop method. Write the procedure. Leave the preparation for inspection.			07
2. Dissect and mount the embryo from the given material B and draw a labelled sketch. Identify by giving reasons.			04
3. Identify the specimens C and D, draw a labelled diagram and comment on the morphology/ modification			08
4. Identify the slides E and F with labelled diagram and reasons.			08
5. Identify the structure in the given photograph/slide G with reasons and labelled sketch.			03
6. Practical Record and project report			10

B.Sc. III Semester, Practical Examination
ANGIOSPERM MORPHOLOGY AND REPRODUCTIVE BOTANY

Scheme of evaluation

1	A		Slide preparation 03 Procedure 02 Tabulation, Calculation & result 02	Reg. No. of Candidates Assigned:
2	B		Mounting 01 Identification 01 Labelled sketch 01 Reasons 01	
3	C		Identification 01 Labelled sketch 01 Reasons 02	Reg. No. of absentees:
	D		4x2=08	
4	E		Identification 01 Labelled sketch 01 Reasons 02	Total Examined:
	F		4x2=08	
5	G		Identification 01 Labelled sketch 01 Reasons 01	2. Internal
6		Practical Record & Project Report	7+3=10	

Note to the Examiners:

A – Vinca/Impatiens/any suitable flower.

B – Sweet corn (tender seed)/Crotalaria/ Mustard (tender/ green) seeds

C – Root/Stem modification; & D – Inflorescence/Fruit type/Aril/Caruncle

E & F – Anther, ovule type/Placentation type

G - Electron micrograph of - Ultrastructure of mature egg apparatus/ embryo suspensor/photograph of acetolyzed pollen grain showing ornamentation and aperture.

Open Elective Course: Semester - III

Medicinal Botany

Course outcome: After the successful completion of the course, the student will be able to:

- Understand the medicinal properties of plants and different systems of medicines
- Understand the adulterations in herbal drugs and evaluation of an herbal drug
- Develop interest in the cultivation and conservation of medicinal plants.

Unit	Topics	Teaching Hours
I	Introduction to medicinal Botany, Role of plants in traditional medical systems - Ayurveda, sidda, unani and folk medicine. Contribution of medicinal plants to modern medicine – Important plant derived modern medicines and their uses. Diversity of medicinal plants of India. Medicinal plant trade – global and national scenario. Herbal medicinal industries. A medicinally useful plant part with examples – root, stem, leaf, and fruits/seeds. Chemical constituents of herbal drugs with examples- carbohydrates, alkaloids, glycosides, oils, resins, lipids and fibres. Study of morphology, taxonomy, medicinal uses and commercial products of important Indian traditional medicinal plants (List to be given)	12
II	Adulteration of herbal drugs. Methods of evaluation of herbal drugs – organoleptic, microscopical, chemical, physical, and biological. Concept of herbal nutraceuticals and cosmeceuticals. Collection and processing of herbal drugs – harvesting, drying, garbling, packing, storage, quality management and documentation. Importance of cultivation and conservation of medicinal plants. Medical ethnobotany – definition, History, and scope. Methods of medical ethnobotany and its contributions.	12
Total		24 Hours

SUGGESTED REFERENCE BOOKS:

1. S. K. Jain 1995. Manual of Ethnobotany. Scientific publishers.
2. Ashwin Dutt, 2009. An Introduction to Medicinal Plants, Adhyayan Publishers and distributors
3. Atal and Kapoor, 1982. Cultivation and Utilization of Medicinal Plants, RRL Jammu Tavi.
4. Biren Shah and A K Seth, 2014. Text Book of Pharmacognosy and Phytochemistry. Elsevier Publishers.
5. Trivedi PC, 2009. Medicinal plants Utilization and Conservation. Avishkar publishers, Jaipur, India.
6. Akerele O, Heywood V and Singe H, 1991. The Conservation of Medicinal Plants. Cambridge University Press, Cambridge.
7. Chaudhary AB, 2007. Endangered medicinal plants. Daya Publishing House, Del

SEMESTER – IV

Taxonomy and Economic Botany –Theory

Course objectives:

- To study the methods of identification, classification, and nomenclature of angiosperms
- To know economically important plants and their uses

Course outcome:

After the successful completion of the course, the student will be able to:

- Understand the different systems of plant classification
- Identify, classify, and describe a plant in scientific terms, thereby, identification of plants using dichotomous keys, skill development in identification and classification of flowering plants.
- Interpret the rules of ICN in botanical nomenclature
- Recognize the importance of herbarium and digital herbarium,
- Recognize locally available angiosperm families and plants of economic importance.

Unit	Topics	Teaching Hours
I	<p>Introduction to Taxonomy: History, objectives, scope and relevance of Taxonomy</p> <p>Systems of classification: Artificial - Carlous Linnaeus’s, Natural- Bentham and Hooker’s, Phylogenetic - Engler and Prantl’s, their merits and demerits.</p> <p>A brief study of APG system of plant classification with focus to latest APG IV system and its significance</p> <p>Plant identification: Taxonomic dichotomous keys; brief account of intended (yoked) and bracketed keys.</p> <p>Botanical nomenclature: Binomial nomenclature, a brief introduction to ICBN- principles and rules, ranks of taxa and taxonomic types.</p> <p>Brief introduction to cyto-taxonomy, chemo-taxonomy, numerical taxonomy and molecular taxonomy, DNA barcoding of plants.</p>	12
II	<p>Herbaria and herbarium techniques, digital herbaria.</p> <p>Botanical Survey of India, Botanical gardens, and their functions.</p> <p>Distinguishing features with economic importance of the local examples (any five) of the following families of angiosperms, according to Bentham and Hooker system:</p> <p>Polypetalae- Annonaceae, Malvaceae, Fabaceae and its sub-families, Rutaceae, Anacardeaceae, Myrtaceae, Cucurbitaceae and Apiaceae.</p>	12
III	<p>Distinguishing features with economic importance of the local examples (any five) of the following families of angiosperms according to Bentham and Hooker system:</p> <p>Gamopetalae- Rubiaceae, Asteraceae, Apocynaceae, Solanaceae and Lamiaceae.</p> <p>Monochlamydeae–Amaranthaceae, Euphorbiaceae and Moraceae</p> <p>Monocotyledonae- Orchidaceae, Arecaceae and Poaceae.</p>	12

IV	<p>Economic Botany: Introduction to economic botany: Definition and significance Cereals: Botany*, products and uses of Rice and Wheat. Brief account of millets. Pulses/ Legumes: Botany and uses of Mung bean and Pigeon pea Brief account of fodder legumes. Spices and condiments: Definition. Botany and uses of Cinnamon, Clove, Black pepper, Cardamom, Ginger, and Coriander. Beverages: Definition. Botany, processing and uses of Tea, Coffee, and Cocoa. Oil yielding plants: Types of plant oils with examples -fatty oils and essential oils. Botany, extraction/processing and uses of Coconut, Groundnut, Eucalyptus and Sandalwood oils. Fiber yielding plants: Classification based on origin of fibers. Morphology, extraction and uses of Cotton, Coir and Jute fibers. Timber yielding plants: Important timber yielding plants of India (any five) and their uses. Rubber yielding plants: Botanical source, extraction/processing, and uses of Hevea rubber Sugar yielding plants: Morphology and processing of sugarcane, products, and by-products of sugarcane industry. Medicinal plants: Botany and uses of <i>Rauwolfia serpentina</i>, <i>Centella asiatica</i>, <i>Tinospora cordifolia</i> and <i>Aloe vera</i> A general account of outdoor and indoor ornamental plants. A general account of ethnobotany: definition, branches and significance. Note: *Botany includes botanical name, family, place of origin and parts used</p>	12
	Total	48 hrs

Reference Books:

1. S. K. Jain 1995. Manual of Ethnobotany. Scientific publishers.
2. Dutta, S.C 1988. Systemic Botany, Wiley Eastern, New Delhi.
3. Sing. G 1999. Plant Systematics; Theory and Practical. Oxford and IBH, New Delhi
4. S. Sundar Rajan 2007. College Botany Vol-V, Part 1: Taxonomy and Economic Botany Himalaya Publishing House.
5. Susil Kumar Mukharjee 2004. College Botany Vol-III. New Central Book agency, London
6. A.V.S.S Sambamurthy 2009. Taxonomy of Angiosperm. I.K International Pvt. Ltd. New Delhi
7. B.K. Verma 2011. Taxonomy of Angiosperms. PHI Learning Pvt.Ltd. New Delhi.
8. Saxena and Saxena -2014. Plant Taxonomy, Pragati Prakashan Meerut.
9. B P Pandey 2014. Modern Practical Botany Vol II. S. Chand Publication
10. P. Vasanth Kumar 2014. Economic Botany. Sonali Publications New Delhi.
11. A.K Sharma 2015. Taxonomy of Angiosperms and Utilization of Plants. Pragati Prakashan
12. O.P Sharma 2016. Plant Taxonomy. Mc.Graw Hill Education. Pvt. Ltd. New Delhi.
13. K. Gopalakrishna Bhat 2014. Flora of South Kanara, Published by theauthor.
14. K. Gopalakrishna Bhat 2003. Flora of Udupi, Published by theauthor.
15. Bendre Kumar 2000: Economic Botany Rastogi Publications, Shivaji Road, Meerut
16. Singh V. and Jain D. K. 2016. Taxonomy of Angiosperms. Rastogi Publications.
17. Kochhar, S.L. 2011. Economic Botany in the Tropics, MacMillan Publishers, India Ltd., New Delhi. 4th Edition.

SEMESTER – IV
Taxonomy and Economic Botany-Practical

Practical No.	Experiments
1	Study of families Annonaceae and Malvaceae
2	Study of Fabaceae sub- families
3	Study of families Myrtaceae and Apiaceae
4	Study of families Rubiaceae and Asteraceae
5	Study of families Apocynaceae and Lamiaceae
6	Study of families Amaranthaceae and Euphorbiaceae
7	Study of families Arecaceae and Poaceae
8 & 9	Botany and uses of economically important plants with observation of plants/plant products listed as follows: Rice, wheat flour, Bengal gram Cinnamon, Clove, Black pepper, Cardamom, Ginger and Coriander, Tea powder, Coffee powder, Cocoa fruit, Cotton, Coir and Jute fibers, Rubber, Jaggery, <i>Centella asiatica</i> and <i>Aloe vera</i> .
10	Study of outdoor and indoor ornamental plants (two each) with photographs.
11 & 12	Mini project report in groups of 2-3 students, from any one of the following lists to be recorded in the practical record. a) Study of the members of the family Cucurbitaceae (any 5) b) Study of the members of the family Anacardiaceae (any 5) c) Study of Orchid flower. d) Preparation of digital herbarium for plant specimens (any 2) e) Chart preparation on processing/extraction of any one essential oil

Activities:

Field visits to study the botanical name, family, common names and economic/ethno botanical importance of local angiosperms found in flowering. A brief report of such field visits with the list of plants observed and field photographs/diagrams should be included in the practical record.

Mangalore University

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

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

- | | | |
|----|--|----|
| 1. | Derive and describe the specimen A, B & C taxonomically | 12 |
| 2. | Explain the specimen D using technical terms with the family name | 05 |
| 3. | Write the floral diagram and floral formula of the given specimen E | 05 |
| 4. | Write botanical name, common name, family and part used of F, G, H & I | 08 |
| 5. | Practical Record with field visit and mini project report | 10 |

1	A B C		Derivation 01 Family name 01 Description 02 <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> 04each	Reg. No. of Candidates Assigned
2	D		Family name 01 technical description 04 <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> 05	<u>Reg. No. of absentees:</u>
3	E		Fl.formula 02 Fl.diagram 03 <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> 05	
4	F G H I		Botanical name 1/2 Common name 1/2 Family name 1/2 Part used 1/2 <hr style="width: 50%; margin-left: auto; margin-right: 0;"/> 02 each	1.External
5		Practical Record with field visit &Project report	10	2.Internal

A B & C Each from Polypetalae, Gamopetalae and Monochlamydeae

D Plant specimen with inflorescence from any of the family studied.

E Plant Specimen from any of the family studied.

F, G, H & I Plant/plant product from any of the specimen mentioned in the practical syllabus.

Open Elective Course: Semester - IV

Gardening and Nursery Management

Course outcome: After the successful completion of the course, the student will be able to:

Understand the nursery techniques and management

Develop the knowledge of different types of gardens and garden plants and their management.

Unit	Content of Theory Elective Course	Teaching Hours
I	Nursery: Definition, objectives and scope and general practices and building up of infrastructure for nursery, planning and Seasonal activities. Planting-direct seeding and transplants, Soil free/soilless/synthetic growth mediums for pot sand nursery. Hardening of plants. Green house, mist chamber, shed root, shade house and glass house. Bonsai technique. Culture of bonsai, art of making bonsai. Land scape designs, Urban land scaping, Land scaping for specific situations - institutions, industries, residents, hospitals, road sides, establishment and maintenance	12hrs
II	Gardening: Definition, objectives, and scope. Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden. Different types of gardening-vertical gardens, roof gardens, parks and public gardens, indoor gardening, therapeutic gardening. Special types of gardens, parks and its components. Plant materials and design. Walk-paths, bridges, constructed features; their design, values in land scaping. Planting trees, shrubs and herbaceous perennials. Climbers and creepers, palms, ferns, grasses and succulents. Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. Transplanting of seedlings - Study of cultivation of different vegetables and flowering plants, Developing and maintenance of different types of lawns.	12hrs
	Total	24 Hours

Text Books and References

1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture andCooperation, National Seed Corporation Ltd.
2. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH Publishing.
3. Jules, J. (1979). Horticultural Science, 3rd Edition. San Francisco, California: W.H. Freeman and Co.
4. Kumar, N. (1997). Introduction to Horticulture. Nagercoil, Tamil Nadu: Rajalakshmi Publications.
5. Musser E. Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: Mc Graw Hill Book Co.

B.Sc. BOTANY – IV Semester
Skill Paper 1
Floriculture

Objectives:

- To have a basic idea about floriculture.
- To learn the commercial aspects of floriculture.
- To learn certain arts related to floriculture.
- To learn methods involved in the cultivation of commercially important plants for cut flowers.

Learning outcome:

After completing this course, the learner will be able to;

- Distinguish among the various Ornamental and indoor plants.
- Understand various commercial aspects of floriculture.
- Diagnose the various diseases and pests of ornamental plants.

Unit I

12 Hrs

Introduction: Importance and scope of floriculture.

Ornamental Plants: Flowering annuals; perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and fern allies; Cultivation of plants in pots; Indoor gardening.

Floriculture and greenhouse technology. Commercial aspects and exporting of flowers and ornamental plants. Quarantine and testing requirements.

Unit II

12 Hrs

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements, Ikebana in brief. Methods to prolong vase life.

Cultivation of Important cut flowers (Carnation, Jasmine, Anthurium, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Liliun, Orchids). Diseases and Pests of Ornamental Plants.

Reference

1. Randhawa, G.S. and Mukhopadhyay, A. (1986). Floriculture in India. Allied Publishers.
2. Adams, C., M. Early and J. Brrok (2011). Principles of Horticulture. Routledge, U.K

SEMESTER –V; Paper-V

Ecology and Conservation Biology – Theory

Course objectives:

- To make the students understand the interactions between environment and organisms
- To increase the awareness among students about global environmental concerns.
- To make the students appreciate the concepts of ecological issues and conservation methods.

Course outcome:

After the successful completion of the course, the student will be able to:

- Understand the role of various factors in developing the ecology of an area.
- Understand the stability of an ecosystem.
- Learn the conservation measures

Unit	Topics	Teaching Hours (36)
I	Introduction to Ecology and Ecosystem Ecology Definitions, Principles and scope of Ecology. Ecological factors: Climatic factors: light, temperature, precipitation and humidity. Edaphic factors: Soil and its types, soil texture, soil profile, physico-chemical properties of soil-mineral particle, soil pH, soil aeration, organic matter, soil humus and soil microorganisms. Ecological groups of plants and their adaptations: Morphological and anatomical adaptations of hydrophytes, xerophytes, epiphytes and halophytes. Ecosystem Ecology: Types of ecosystems with examples – terrestrial and aquatic Ecosystem functions and processes. Ecological succession: Definition, types - primary and secondary. General stages of succession. Community Ecology: Community and its characteristics, Concept of Ecotone and Ecotypes.	12
II	Unit-II: Phytogeography and Environmental issues Phyto geographical regions - concept, phyto geographical regions of India. Vegetation types of Karnataka – Composition and distribution of evergreen, semi-evergreen, deciduous, scrub, mangroves, shoal forests. Ecological methods and techniques: Methods of sampling plant communities – transects and quadrates. Remote sensing as a tool for vegetation analysis, land use land cover mapping. Water pollution: Causes, effects and control of water pollution. Air pollution: Causes, effects and control measures. Soil pollution: Causes, effects and control measures.	12

III	<p>Unit-III: Biodiversity and Conservation</p> <p>Biodiversity: Definition, types of biodiversity - habitat diversity, species diversity and genetic diversity, Global and Indian species diversity in brief. NTFP, Values of Biodiversity, Threats to biodiversity.</p> <p>Concept of Biodiversity Hotspots, Biodiversity hotspots of India. Concept of endemism and endemic species. ICUN plant categories with special reference to Karnataka/Western Ghats. Biodiversity Conservation-Indian Forest conservation act, Biodiversity bill (2002). Conservation methods. <i>In-situ</i> and <i>ex-situ</i> methods. <i>In-situ</i> methods – Biosphere reserves, National parks, Sanctuaries, Sacred grooves. <i>Ex-situ methods</i>-Botanical gardens, Seed bank, Gene banks, Pollen banks, Culture collections, Cryopreservation.</p> <p>Soil and Water conservation practices: Soil management, Rain water harvesting and watershed management.</p>	12
	Total	36 hrs

REFERENCES:

- Bendre A. M. & Pande P. C. 2006. Introductory Botany, Rastogi Publications.
- Chapman, J.L&M.J. Reiss 1992. Ecology (Principles & Applications). Cambridge University Press, U.K.
- Kaushik A. & Kaushik C.P. 1990. Perspectives in Environmental Studies. New Age International Publishers
- Kochhar, P.L. 1975. Plant Ecology. (9th Edn.,) New Delhi, Bombay.
- Kumar, H.D. 1992. Modern Concepts of Ecology (7th Edn.) Vikas Publishing Co., New Delhi.
- Mohan P. Arora. 2002. Ecology, Himalaya Publishing House.
- Odum E.P. 1975. Ecology by Holt, Rinert & Winston.
- Sharma, P.D. 2018. Fundamentals of Ecology. Rastogi Publications, New Delhi.
- Shukla, R.S. and Chandel, P.S. 2005. A Textbook of Plant Ecology: Ethnobotany and Soil Science. 10th edition. S Chand publication, New Delhi.
- Verma P.S. & Agarwal V.K. 2010. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Pvt. Ltd.
- Weaver J. E. & Clements F. E.: Plant Ecology, Tata McGraw-Hill Publishing Company Ltd. New Delhi.

SEMESTER –V; Paper-VI

Genetics, Cell and Molecular Biology -Theory

Course objectives:

- To study the structure and functions of a cell and its organelles.
- To understand cell division and plant growth
- To know the inheritance in plants
- To study the plant at its molecular level

Course outcome:

After the successful completion of the course, the student will be able to:

- Understand the significance of a cell and its organelles
- Distinguish the two types of cell division and its role in plants growth and development.
- Understand the plants at molecular level

Unit	Topics	Teaching Hrs. (36)
I	<p>Cytology: Structure of plant cell, Ultra-structure and functions of cell wall, plasma membrane- fluid-mosaic model, endoplasmic reticulum, chloroplast, ribosomes, golgi complex, mitochondria, peroxisome, plastids and vacuole. Ultra structure of nucleus - nuclear membrane, nuclear pore complex and nucleolus. Ergastic substances in plant cells.</p> <p>Cell Division and Chromosomes: Types of chromosomes based on centromere position, Autosomes and Allosomes, structure of metaphase chromosome, Ultra structure of Chromosomes- Nucleosome model. Cell cycle, Mitosis in plant cells– karyokinesis and cytokinesis, Meiosis in plant cells, significance of mitosis and meiosis.</p>	12
II	<p>Structure, Chemistry and Expression of Gene: Experiments to prove DNA as genetic material – Griffith experiment, Avery. McCarty and MacLeod experiments, Hershey - Chase experiment. DNA: Chemical composition, types -A, B and Z-DNA, structure-Watson & Crick model, Semiconservative replication of DNA. RNA: Structure and functions of m RNA, t RNA and r RNA. Structure of Gene: Cistron, recon and muton concept. Prokaryotic and eukaryotic genes. Genetic code and its properties. Regulation of gene expression in prokaryotes- Lac operon model. Gene regulation in eukaryotes- Transcription and Translation, process of Gene splicing, post transcriptional changes.</p>	12

III	<p>Genetics:</p> <p>Introduction to genetics, Brief history of Mendel and his experiments on pea plants.</p> <p>Monohybrid cross and law of segregation, dihybrid cross and law of independent assortment. Test cross and back cross-monohybrid and dihybrid.</p> <p>Incomplete dominance- flower color in <i>Mirabilis</i>. Multiple alleles – self sterility in tobacco.</p> <p>Gene Interactions with plant examples: Complementary - 9:7, Supplementary - 9:3:4 and Dominant Epistasis –, 12:3:1 ratio. Polygenic inheritance - kernel color in wheat.</p> <p>Linkage and its types – cis and trans, complete and incomplete. Linkage in Maize. Mechanisms of sex determination in Plants – <i>Melandrium</i> and <i>Coccinia indica</i>, Gene mutations: Spontaneous mutations, Induced mutations -Physical and chemical mutations. Molecular basis of mutations- base substitutions and frameshift mutations.</p>	12
	Total	36 hrs

REFERENCE BOOKS:

1. S Sundara Rajan, 2004, Genetics, Anmol Publications Ltd.
2. Gupta P.K 1999. A text book of Cell and Molecular Biology. Rastogi Publication Meerut
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. 2008. Principles of Genetics. 8th Edition Wiley India.
6. Griffiths, A.J.F. Wessler, S.R., Lewontin, R.C. and Carroll, S.B. 2012. Introduction to Genetic Analysis. IX Edition W.H. Freeman and Co.
7. Burns G.W. 1983. The Science of Genetics - An Introduction to Heredity. 5th edition Mac Mill. Publ.
8. David Freifelder 1996. Essentials of Molecular biology Panima Publishing company New Delhi.
9. Gardner E.J., M.J. Simmons & D.P. Snustad. 1991. Principles to Genetics 8th edition. John Wiley
10. Gupta P.K. 2000 Genetics and Cytogenetics. Rastogi Publishers.
11. lug W.S. & M.R. Gummings. 2003. Concepts of Genetics 7th Edition. Pearson Edition
12. Kumar H.D. 2000. Molecular Biology. Vikas Publishers.
13. Malacinski G.M. & D. Freifelder. 1998. Essentials of Molecular Biology. Jones & Bartlatt Publishing Boston. 3rd Edition.
14. Powar C.B. 2005, Cell Biology 3 edition Himalaya Publishing New Delhi.
15. Sambamurty A.V.S.S. 1999. Genetics, Narosa Publishing House.

SEMESTER –V

Ecology, Genetics, Cell and Molecular Biology– Practical

Practical No.	Experiments
1	Hydrophytes: Morphological adaptations in <i>Pistia</i> , <i>Eichhornia</i> , <i>Hydrilla</i> , <i>Nymphaea</i> and Anatomical adaptations of Hydrophytes - <i>Hydrilla</i> and <i>Nymphaea</i> .
2	Xerophytes: Morphological adaptations in <i>Asparagus</i> , <i>Casuarina</i> , <i>Acacia</i> , <i>Aloe vera</i> , <i>Euphorbia tirucalli</i> and Anatomical adaptations of <i>Casuarina phylloclade/ Acacia phylloclade</i> .
3	Epiphytes: Morphological adaptations in <i>Acampe</i> , <i>Bulbophyllum</i> , <i>Drynaria</i> and Anatomical adaptations of epiphytic root of <i>Acampe/ Vanda</i> . Halophytes: Vivipary and Pneumatophores
4	Demonstration of different types of vegetation sampling methods – transects and quadrats. Field visits to study different types of local vegetations/ecosystems and the report to be written in practical record book
5	Project work Ecology
6	Project work
7	Study of ergastic substances - starch (potato), aleurone (wheat grain), calcium oxalate (<i>Pistia</i>), calcium carbonate (<i>Ficus</i> leaf), oil globules (castor seed) and Raphides (<i>Colocasia</i> petiole). Observation of permanent slides of mitosis and meiosis
8	Study of different stages of mitosis by squash technique using Onion root tip
9	Study of different stages of meiosis using permanent slides.
10	Measurement of length and breadth of cells by micrometry technique (Using Onion or <i>Rhoeo</i> leaf cells)
11	Genetic problems related to Mendel's law and incomplete dominance (any Four)
12	Genetic problems related to interaction of genes (any Four)

Mangalore University
III B. Sc. Semester - V, Practical Examination
Ecology, Genetics, Cell and Molecular Biology
Question paper and Scheme of evaluation

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

1. Prepare a stained temporary mount of the T.S. of material **A**. Draw a neat labeled diagram.
 Leave the slide for inspection. 05
2. Prepare a squash of **B** for the study of mitosis. Leave the slide for inspection. 06
3. Identify the ecological group of **C** and **D**. Comment on their ecological adaptation. 04
4. Identify the slides **E & F** and Comment on it. 06
5. Solve the genetic problem **G** 04
6. Practical Record with field visit report 10
7. Project work report 05

1	A		Prep. 02 Sk 01 Features <u>02</u> 05	Reg. No. of Candidates Assigned: <u>Reg. No. of</u> <u>absentees:</u> <u>Total examined:</u> <u>Examiners:</u> 1.External 2.Internal
2	B		Prep. & Stage 03 Sk 01 Comments <u>02</u> 06	
3	C		Ecol.Group 01 Ecol.Features <u>01</u>	
	D		02 each	
4	E		Identification 01 Sk 01	
	F		Comment <u>01</u> 03 each	
5	G		Problem solve 03 Conclusion <u>01</u>	
6		Practical Record with field visit report	10	
7		Project report	05	

Instruction to Examiners:

A from Hydrophyte/Xerophyte/ Epiphyte

B Mitosis squash

C and **D** Specimen from Hydrophyte/Xerophyte/ Epiphyte/Halophyte

E- Stages of Meiosis and **F**-Ergastic substance

G -Any one genetic problem mentioned in the practical syllabus

B.Sc. BOTANY – V Semester
SKILL PAPER -II
Mushroom Cultivation Technology

Learning outcomes:

After completion of the course, the students will be able to;

- Understand the various aspects of mushroom cultivation the diversity of microbes in nature.
- Understand the storage of methods of cultivated mushrooms
- Know the nutritional benefits of edible mushrooms

Unit	Topics	Teaching Hours
I	Introduction – Edible and non-edible mushrooms. Edible mushrooms commercially cultivated in India – <i>Volvariella volvacea</i> , <i>Pleurotus citrinopileatus</i> and <i>Agaricus bisporus</i> . Cultivation Technology: History. Infrastructure- substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, stove, sieves, culture rack, mushroom unit (Thatched house), water sprayer, tray. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, banana leaves, areca sheath and coconut leaves. Composting technology in mushroom production.	12
II	Storage and nutrition: Short-term storage (Refrigeration – up to 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions. Chemical composition and their nutritional values: Proteins - amino acids, minerals, carbohydrates, vitamins and crude fiber. Food Preparation: Types of foods prepared from mushrooms. Research Centers - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.	12
	Total	24 hrs

References:

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

SEMESTER – VI; Paper-VII
PLANT PHYSIOLOGY – Theory

Course objectives: To understand the various physiological life processes in plants
 To study the importance of the physiological processes and their mechanism
 To study the role of various metabolites and their importance

Course outcome: After the successful completion of the course, the student will be able to:

- Compare the various metabolic activities taking place in plants.
- Evaluate the various factors affecting the plant activities.

Unit	Topics	Teaching Hrs (36)
I	Plant water relations: Mechanism of water absorption, Factors affecting water absorption. Mechanism of ascent of sap: Vital and physical force theories. Transpiration. Types and process. Mechanism of guard cell movement. K ⁺ ion exchange mechanism. Antitranspirants. Guttation. Translocation of organic solutes: Transport of organic solutes. path of transport, vein loading and unloading. Transcellular hypothesis, mass flow hypothesis. Mineral nutrition: Essential elements: Classification - Macro and Micronutrients. Functions and deficiency symptoms of macro elements- N, P, K and Mg. Functions and deficiency symptoms of Micronutrients-Zn, Mn and B. Hydroponics and its applications. Mechanism of mineral salt absorption: Passive absorption – diffusion, ion exchange. Active absorption- Cytochrome pump theory, Protein Lecithin theory. Enzymes - classification, kinetics and mechanism of action. Bioenergetics: Definition, examples for major bioenergetic processes.	12
II	Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C ₃ , C ₄ and CAM pathways of carbon fixation; Photorespiration (C ₂ pathway). Respiration: Glycolysis, TCA cycle; Oxidative phosphorylation, Glyoxylate cycle, Oxidative Pentose Phosphate Pathway. Anaerobic respiration – alcoholic and lactic acid fermentation. ATP yield during aerobic and anaerobic respirations. Respiratory quotient.	12

III	<p>Carbohydrate metabolism–General account of carbohydrates. Metabolism of sucrose and starch.</p> <p>Nitrogen metabolism - physical and biological nitrogen fixation and mechanism of biological nitrogen fixation- asymbiotic and symbiotic, Nitrate reduction and amino acid synthesis.</p> <p>Fat metabolism - General account of fats, synthesis of glycerol, synthesis of fatty acids, and condensation of fatty acid and glycerol, fat degradation, β (Beta) - oxidation, glyoxylate cycle and its significance, plant waxes.</p> <p>Plant growth regulators: Definition and classification, Role of Auxins, Gibberlins, cytokinins, ABA and ethylene on plant growth and development. Practical utility in agriculture and horticulture, Synthetic growth regulators.</p> <p>Plant movements: Nastic movements – nyctinasty, chemo nasty and seismonasty. Tropic movements –phototropic, hydrotropic, geotropic and thigmotropic.</p> <p>Brief account of seed dormancy: Causes and breaking of seed dormancy</p>	12
Total		36 Hours

References:

1. Wilson, K. and Walker, J. 1994. Fundamentals of Biochemistry 2nd Ed, John Wiley and Sons Inc.
2. Jain V K, 2008. Fundamentals of Plant Physiology. S Chand and Co.
3. Kochhar P L, Krishnamoorthy H N. Plant Physiology. Atmaram and sons, Delhi.
4. Kumar and Purohit. Plant Physiology: Fundamentals and Applications. Agrobotanical Publishers.
5. Malik CP, 2002. Plant Physiology. Kalyani publishers.
6. Mukherjee S, Ghosh AK, 2005. Plant Physiology. New Central Book Agency, Calcutta.
7. Noggle GR, Fritz GJ, Introductory Plant Physiology. Prentice Hall of India.
8. Pandey SN, Sinha BK, 2006. Plant Physiology. Vikas Publishing House, New Delhi.
9. Salisbury F B, Ross C W, 1992. Plant Physiology. CBS publishers and Distributers, New Delhi.
10. Verma V, 2007. Text book of plant physiology, Ane books India.

SEMESTER – VI; Paper-VIII

Plant Breeding and Biotechnology

Course outcome: After the successful completion of the course, the student will be able to:

Understand the plant breeding methods and importance

Understand the methods of plant tissue culture and plant biotechnology

Unit	Topics	Teaching Hrs. (36)
I	<p>Plant Breeding: History of plant breeding, Objectives, and major contributions of plant breeding. Centres of origin and evolution of crop plants. Genetic basis of breeding self- and cross-pollinated crops. Role of plant genetic resources in plant breeding. Methods of Plant breeding: Introduction, Selection- Pure line, Clonal and Mass line. Polyploidy breeding, Mutation Breeding, Hybrid breeding – concept of heterosis and inbreeding, types and techniques of hybridisation. Self-incompatibility and Male sterility in crop plants -types, production, and significance in plant breeding. Cultivar development, Plant Breeders rights and Farmers rights</p>	12
II	<p>Plant Tissue Culture: History and Scope, concept of cellular totipotency. Tissue culture laboratory and Equipments Basic aspects of plant tissue culture- Sterilization, Culture media and its preparation. Role of growth hormones in plant tissue culture. Types of cultures-Callus culture and Organogenesis. Pollen culture and haploid plant production. Embryo culture. Somatic embryogenesis and synthetic seeds. Protoplast culture and somatic hybridization techniques. Application of plant tissue culture in Agriculture, Forestry, Industries and plant conservation.</p>	12
III	<p>Plant Biotechnology: Introduction to Plant Genetic Engineering. Tools used in genetic engineering: Enzymes- Restriction endonucleases, DNA ligase, Vectors -pBR 322, Ti and Ri plasmid vectors, artificial chromosomes, difference between cloning and expression vectors. General steps of recombinant DNA technology using plasmid vectors and bacterial host cell. Gene transfer methods to plant cells: Agrobacterium based gene transfer technique, Direct gene transfer – microinjection, electroporation, microprojectile techniques. Plant regeneration from transformed cells. Transgenic plants: Definition and examples, Steps involved in the production of golden rice and Bt cotton. Applications and threats from transgenic plants.</p>	12
	Total	36 hrs

SUGGESTED REFERENCE BOOKS:

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

SEMESTER –VI

Plant Physiology and Plant Breeding & Biotechnology

Practical No	Experiments
	Major experiments
1	Experiment to measure the solute potential of a cell sap by plasmolytic method.
2	Demonstration of transpiration pull/Suction force due to transpiration.
3	Separation of plant pigments by paper chromatography method.
4	Demonstration of CO ₂ liberation during respiration using Ganong's respiroscope
	Minor Experiments
5	Potato osmoscope /Thistle funnel experiment to demonstrate osmosis Demonstration of imbibition pressure using germinating seeds
6	Demonstration of O ₂ liberation during photosynthesis by bubbling method Demonstration of fermentation using Kuhne's Fermentation vessel
7	Demonstration of plant movements – Heliotropism, Geotropism, Hydrotropism Measurement of growth using arc auxanometer
8	Qualitative test for carbohydrates, Protein, fat, and oil
9	Study of plant propagation methods-Cutting, Layering and Grafting
10	Techniques of emasculation, artificial pollination, and bagging
11(a)	Study of Biotechnology lab equipment's – Autoclave, Laminar air flow cabinet, Hot air oven, Incubator, Colony counter, Hemocytometer
11 (b)	Preparation of Synthetic seeds by alginate encapsulation
12	Visits to local nurseries and institutions involved in plant breeding to study the various methods and techniques employed/ Biotechnology Lab or institutions/biofertilizer and biopesticide production sites and submit a report

Mangalore University

B. Sc – VI Semester, Botany Practical Examination

PLANT PHYSIOLOGY AND BIOTECHNOLOGY

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

- | | |
|---|----------|
| 1. Conduct Major Experiment A | 12 marks |
| 2. Comment on minor experiments B and C | 08 marks |
| 3. Perform the Biochemical test D | 04 marks |
| 4. Identify and comment on E and F | 06 marks |
| 5. Practical Record and Field report | 10 marks |

Mangalore University
B. Sc – VI Semester, Botany Practical Examination
PLANT PHYSIOLOGY AND BIOTECHNOLOGY
Question paper and Scheme of evaluation

1	A		Requirements - 02 Principle -01 Sketch-01 Procedure-02 Setting-04 Results and Inference-02 = 12	Register No. Assigned:
2	B		Procedure -02 Sketch -01	Absentees:
	C		Results and Inference <u>01</u> 04 each	
3	D		Procedure-02 Prep -01 Results and Inference-01	Examiners
4	E		Identification 01 Sk 01	1. 2.
	F		Comment <u>01</u> 03 each	
5		Practical Record with field visit report	7+3=10	

Instruction to Examiners:

A Physiology Major Experiment by picking lots

B and **C** Physiology minor experiments

D- Biochemical test

E-Plant propagation methods/techniques; **F** -Any one biotechnological instrument

B.Sc. BOTANY – VI Semester

SKILL PAPER -III

Seed Technology

Course Outcome:

- Understanding the fundamentals of seed germination, viability and vigour
- Learning about seed production, processing, and quality control.
- Exploring the role of seed technology in agricultural productivity.

Unit 1: Introduction to Seed Technology

- **Introduction to Seed Technology:** Definition, scope, and importance. Historical perspective of seed technology in agriculture.
- **Seed Development and Germination:** Structure and development of seeds. Factors affecting seed germination and dormancy.
- **Seed Viability and Vigor:** Concepts of seed viability and vigor. Methods of testing seed viability and vigor.

Unit 2: Seed Production and Processing

- **Principles of Seed Production:** Genetic and agronomic principles. Seed production techniques for self-pollinated and cross-pollinated crops.
- **Seed Certification and Quality Control:** Objectives and procedures of seed certification. Seed standards and quality control measures.
- **Seed Processing and Storage:** Principles and techniques of seed processing. Seed storage and its importance in maintaining seed quality.

Unit 3: Advances in Seed Technology

- **Biotechnological Approaches in Seed Technology:** Role of biotechnology in seed improvement. Genetic engineering and molecular markers in seed technology.
- **Seed Health:** Importance of seed health in agriculture. Methods of seed treatment and protection.
- **Seed Industry and Trade:** Overview of the seed industry in India. National and international seed trade regulations and policies.

Assessment:

- Internal Assessment Test: 10%
- Assignments/Projects: 10%
- End-Semester Examination: 80%

Recommended Readings:

1. Agarwal, R.L., Seed Technology, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Bewley, J.D., and Black, M., Seeds: Physiology of Development and Germination, Springer.
3. McDonald, M.B., and Copeland, L.O., Seed Production: Principles and Practices, Chapman & Hall.
4. Basra, A.S., Seed Quality: Basic Mechanisms and Agricultural Implications.