CBSS

BANGALORE UNVERSITY

DEPARTMENT OF BOTANY

SYLLABUS

B. Sc., BOTANY

I – VI SEMESTER

2014

PROCEEDINGS OF THE MEETING OF THE BOARD OF STUDIES (UG) IN BOTANY, BANGALORE UNIVERSITY HELD ON 11 JUNE 2014 IN THE DEPARTMENT OF BOTANY, BANGALORE UNIVERSITY, BANGALORE – 560 056, AT 11-00 A.M.

Venue: Department of Botany, Bangalore University, Jnana Bharathi, Campus,Bangalore 560 056

Date: 11-06-2014

Time: 11-00 am

Agenda: To finalize the Scheme of study, Syllabus and Examination pattern for Undergraduate Credit Based Semester Scheme.

Members Present:

1	Prof. D.H.Tejavathi	Chairperson	Sd/
2	Sri. A. Karthikeyan	Member	Sd/
3	Sri. N.S.Shivashankaraiah	Member	Sd/
4	Dr. N.Venugopal	Member	Sd/
5	Smt. K. Pushpa	Member	Sd/
6	Sri. Mohamad Ataulla	Member	Sd/
7	Dr. Abdul Khayum	Member	Sd/
8	Smt. C. Shathakumari	Member	Sd/
9	Sri. K. G. Annappaswamy	Member	Sd/
10	Smt. K. S. Shylaja	Member	Sd/
11	Dr. Sabiha Sulthana	Member	Sd/
12	Prof. G. Krishnakumar	External member	Sd/
13	Prof. M.S.Sudarshana	External member	Sd/

Member Absent:

1.	Dr.Leelavathi	Member

MINUTES OF THE BOS (UG) MEETING:

Chairperson welcomed the members to the meeting and thereafter the agenda was taken up for discussion

1. Discussed and finalized syllabus for Theory and Practicals from I to VI semesters, Question Paper pattern, and Scheme of Valuation for B.Sc., Credit Based Semester system.

2. Chairperson is authorized to change or modify the syllabus based on the requirement.

The meeting ended with a vote of thanks by the Chairperson.

CHAIRPERSON.

PROFESSOR & CHAIRPERSON
Department of Botany
Bangalore University
Bangalore-560 056.

PROFORMA FOR THE SCHEME OF STUDY AND EXAMINATION OF CREIDIT BASED SEMESTER SCHEME, BACHELLOR'S DEGREE IN SCIENCE

Semester	Paper	Title of the Paper	Instruction hrs/week		Total No.Hrs.		Duration of Exam (hrs)		Max. Marks for Examination							Credits		
									IA		Exam		Total		Grand Total			
			Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical		Theory	Practical	Total
1	I	Diversity of Non- Vascular plants Part-1 Introduction to Microbiology, Viruses, Bacteria, Cyanobacteria and Phycology	4 hrs	3 hrs	52	52	3 hrs	3 hrs	30	15	70	35	100	50	150	02	01	03
2	II	Diversity of Non- Vascular plants Part-2 Mycology, Plant Pathology, Bryophytes and Plant Anatomy	4 hrs	3 hrs	52	52	3 hrs	3 hrs	30	15	70	35	100	50	150	02	01	03
3	III	Pteridophytes, Palaeobotany, Environmental Biology and Phytogeography.	4 hrs	3 hrs	52	52	3 hrs	3 hrs	30	15	70	35	100	50	150	02	01	03
4	IV	Gymnosperms and Embryology of Angiosperms	4 hrs	3 hrs	52	52	3 hrs	3 hrs	30	15	70	35	100	50	150	02	01	03
5	V	Taxonomy and Economic Botany	3 hrs	3 hrs	39	39	3 hrs	3 hrs	30	15	70	35	100	50	150	02	01	03
	VI	Molecular Biology, Genetic Engineering, Biotechnology and Plant Physiology	3 hrs	3 hrs	39	39	3 hrs	3 hrs	30	15	70	35	100	50	150	02	01	03
6	VII	Cytology, Genetics, Evolution and Plant Breeding	3 hrs	3 hrs	39	39	3 hrs	3 hrs	30	15	70	35	100	50	150	02	01	03
	VIII	Plant Physiology.	3 hrs	3 hrs	39	39	3 hrs	3 hrs	30	15	70	35	100	50	150	02	01	03

Chairperson

PROFESSOR & CHAIRPERSON
Department of Botany
Bangalore University
Bangalore - 560 056

QUESTION PAPER FORMAT
THEORY EXAMINATION

Masks for each question	Number of question to be		Total Marks
	Answered	Out of	
A. 2	10	12	20
B. 5	4	6	20
C. 10	3	5	30
		Total	70

BANGALORE UNIVERSITY

B.Sc., Degree Examination December / January 20
(Undergraduate Credit Based Semester Scheme)
BOTANY

Paper:

Time: 3 hours Max. Marks : 70

A. Explain / Define any ten of the following in **two** or **three** sentences: (10x2=20)

B. Write critical notes on any **four** of the following (4x5=20)

C. Give a comprehensive account on any **three** of the following (3x10=30)

INTERNAL ASSESSMENT

1. **THEORY** 30 MARKS – Attendance = 5, Assignment=5, Test =2 (ten marks each)
2. **PRACTICAL** 15 MARKS – Continues Assessment = 10, Test = 5

Frame Work

Semester I – Paper I	Dr. Venugopal.N, Govt. Science College, Nrupathunga Road, Bangalore – 560 001.
Semester II – Paper II	Prof.Karthikeyan.A. K. G. F. First Grade College, Ooragaum, KGF – 563 120
Semester III – Paper III	Ms.Pushpa.K., MES Degree College Arts, Commerce & Science, Malleshwaram, Bangalore 560 003.
Semester IV – Paper IV	Smt.Shylaja. K. S. Vijaya College, R. V. Road, Bangalore-560 004.
Semester V – Paper V	Dr.Abdul Khayum, Govt. College for Women, Chinthamani 563 125, Kolar District.
Semester V – Paper VI	Sri.Shivashankaraiah, Govt. First Grade College, RPC Layout, Vijayanagar, Bangalore – 560 040.
Semester VI– Paper VII	Sri.Annappa Swamy, H. K. E. Society, Sadashivanagar, Bangalore- 560 080..
Semester VI – Paper VIII	Sri.Mohammed Atha Ulla, Govt. Science College, Nrupathunga Road, Bangalore – 560 001.

I SEMESTER

PAPER – I: DIVERSITY OF NON VASCULAR PLANTS - PART-I

INTRODUCTION TO MICROBIOLOGY, VIRUSES, BACTERIA, CYANOBACTERIA AND PHYCOLOGY

52 hrs

UNIT I: INTRODUCTION TO MICROBIOLOGY AND VIRUSES **13 hrs**

Introduction, aim, objectives, scope of microbiology and significance.

Branches of microbiology- Industrial, Medical, Agricultural and Environmental microbiology, Contributions of scientists to the field of microbiology (Anton von Leeuwenhock, Louis Pasteur, Robert Koch, Alexander Flemming)

Isolation of microbes from soil – brief account of culture media, serial dilution, pour plate method and colony characteristics of bacteria.

Applied Microbiology- A brief account of Biofertilizers, Biopesticides, Biogas production, Bioremediation, and Bioconversion of waste products.

A brief history of Virology – (Adolf Mayer, Iwanowsky, Beijerinks, W. M. Stanley, F. W. Twort), General composition and properties of viruses, Architecture of TMV & Bacteriophages, Multiplication & transmission. A brief account of Prions and Viroids

Common plant diseases – ~~Little leaf of Tomato and *Vinca rosea*~~, Yellow Mosaic of Beans, and Papaya leaf curl

UNIT II: STUDY OF BACTERIA **13hrs**

Introduction, Brief account of Bergey's system of bacterial classification. Occurrence, size and shape, arrangement of flagella and structure of Bacterial cell.

Reproduction – Binary fission and genetic recombination. A brief history of plasmids – definition, properties and types, structure and importance of Ti plasmid, bacterial nutrition, phototrophs and chemotrophs.

Economic importance – Role of bacteria in agriculture, medicine and industry.

Bacterial disease - Citrus canker.

General account of Mycoplasma – Sandal spike disease., Little leaf of Tomato & Vinca rosea

Immunology – Brief account of immune systems, application of immune techniques in agriculture and industry, monoclonal anti bodies (ELISA, Hybridoma techniques).

UNIT III: STUDY OF CYANOBACTERIA AND PHYCOLOGY – PART-I **13hrs**

Cyanobacteria: Introduction, general characteristics, outlines of classification, thallus structure, ultra structure of cell, photosynthesis, reproduction, economic importance of Cyanobacteria, SCP, Biofertilizers, role in water pollution and treatment.

Type study: *Anabaena, Spirulina, Scytonema*

Phycology-Part-I: Introduction, general characteristics, outlines of classification (Fritsch – 1947), thallus structure, pigmentation, reproduction.Economic importance of algae in industry, agriculture and medicine. Toxic algae – Algal blooms, fish poisoning.

UNIT IV: PHYCOLOGY- PART –II **13hrs**

Occurrence, structure, reproduction and life cycle: *Chlamydomanas, Hydrodictyon, Oedogonium, Chara, Sargassum, and Polysiphonia*

PRACTICAL PAPER – I

DIVERSITY OF NON VASCULAR PLANTS

INTRODUCTION TO MICROBIOLOGY, VIRUSES, BACTERIA, CYANOBACTERIA AND PHYCOLOGY

Total Units - 13

1. Study of instruments: autoclave, inoculation chamber, hot air oven, incubator and inoculation loop. **2 units**
   Sterilization of glass ware and media preparation (Nutrient Agar, Martin Rose Bengal Agar).
   Isolation of Bacteria from soil by pour plate method.
2. Colony characteristics of Bacteria to identify colonies obtained. **2 units**
   Bacterial diseases - Tomato Leaf curl disease, citrus canker, Mycoplasma-sandal spike
3. Plant viral diseases- Little leaf of Tomato and *Vinca rosea*, Yellow Mosaic of Beans, and Papaya leaf curl **2 units**
   Gram staining: a) Rhizobium from root nodules b) Lactobacillus from curds.
4. Measurement of cell concentration – yeast cells / fungal spores using Haemocytometer. Type study of Cyanobacteria: *Anabaena, Spirulina, Scytonema* **2 units**
5. Type study of algae: *Chlamydomanas, Hydrodictyon, Oedogonium, Chara, Sargassum* and *Polysiphonia* **5 units**

PRACTICAL QUESTION PAPER-I

DIVERSITY OF NON VASCULAR PLANTS

INTRODUCTION TO MICROBIOLOGY, VIRUSES, BACTERIA, CYANOBACTERIA AND PHYCOLOGY

Max Marks – 35

1. Identify Given specimens **A, B, C & D** with labeled diagrams and reasons — **4x3=12**
2. Describe colony characteristics of given colony **E** and tabulate your observations. — **2**
3. Prepare temporary slide of **F,** sketch, label and identify with reasons. Leave preparation for evaluation. — **5**
4. Stain given material **G** by gram staining write the procedure and identify with reasons. Leave preparation for evaluation — **3**

   Or

   Calculate the population of fungal spores / yeast cells **G** using haemocytometer
5. Identify Slide **H** and **I** with labeled diagrams with reason — **2 x 2 ½ = 5**
6. Record and Submission (3 algae / Cyanobacteria) — **5+3= 8**

SCHEME OF VALUATION

1. Four specimens **A, B, C, D**- two from algae, one from Cyanobacteria and one specimen of diseases / Herbarium. (Identification – **1** mark, labeled diagram with reasons **2** marks)
2. Colony characters of the given colony **E** – **2** marks,
3. Specimen **F** from algae - mounting – **2** marks. Identification – **1** mark, sketch with reasons **2** marks)
4. Specimen **G** – Gram staining (Staining, Procedure and result – each **1** mark).

   OR

   Calculation of fungal spores / yeast cells using haemocytometer (Procedure **1** mark, calculation – **2** marks)
5. Two permanent slides **H** & **I** - from algae / Cyanobacteria (Identification – **1** mark, sketch with reasons **1 ½** marks)
6. a) Record – **5** marks

   b) Submission of 3 algae / Cyanobacteria materials – **3** marks

REFERENCES

1. Aggarwal, S. K. 2009. **Foundation Course in Biology,** A one books Pvt. Ltd., New Delhi.
2. Aneja, K. R. 1993. **Experiments in Microbiology, Pathology and Tissue Culture,** Vishwa Prakashan, New Delhi.
3. Annie Ragland, 2012. **Algae and Bryophytes**, Saras Publication, Kanyakumari, India.
4. Basu, A. N. 1993. **Essentials of Plant Viruses, Vectors and Plant diseases,** New Age International, New Delhi.
5. Chopra. G. L. 1984. **A text book of Algae**, Rastogi publications,Meerut,India.
6. Desikachari, T. V. 1959. **Cyanophyta**, ICAR, New Delhi.
7. Dubey, R. C. and Maheshwari. D.K. 2012. **Practical Microbiology,** S. Chand & Company, Pvt. Ltd., New Delhi.
8. Fritsch, R. E. 1977. **Structure and Reproduction of Algae**, Cambridge University Press,Londan.
9. Kodo,C.I.and Agarwal, H.O.1972. **Principles and techniques in Plant Virology**, Van Nostrand, Reinhold Company, New York.
10. Madhavee Latha, P. 2012, **A Textbook of Immunology**, S. Chand & Company Pvt. Ltd., New Delhi.
11. Pandey B.P. 2001. **College Botany Volume 1**, S Chand & Company Pvt.Ltd, New Delhi.
12. Pandey. B.P. 2014 **Modern Practical Botany**, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
13. Pelzar, 1963. **Microbiology**, Tata Mc Graw Hill, New Delhi
14. Rangaswamy, G. 2009, **Disease of Crop Plants in India**, Prientice Hall of India, New Delhi.
15. Sambamurty. A.V.S.S. 2006, **A Text book of Algae**, I. K. International Publishing House, Pvt. Ltd., New Delhi.
16. Sharma, P. D. 2012, **Microbiology and Plant Pathology**, Rastogi Publication Pvt Ltd., Meerut, India.
17. Singh, R. P. 2007. **Microbial Taxonomy and Culture Techniques**, Kalyani Publication, New Delhi.
18. Smith .G. M. 1996. **Cryptogamic Botany Volume I,** Tata Mc Graw Hill, New Delhi.
19. Sundar Rajan. S. 2010.**College Botany Volume I** ,Himalaya Publications, Mumbai.
20. Vashishta, B.R. Sinha, A.K. and Singh, V. P. 1991. **Algae,** S. Chand and Company,Pvt. Ltd., New Delhi.

Web Sites

- http://www.phycology.net/
- http://www.algaebase.org/

II SEMESTER

PAPER II: DIVERSITY OF NON-VASCULAR PLANTS – PART - II
MYCOLOGY, PLANT PATHOLOGY, BRYOPHYTES AND PLANT ANATOMY

52 hrs

UNIT I: MYCOLOGY **13hrs**

Introduction: General characters, occurrence, thallus organisation, reproduction and classification.

Structure, reproduction and life history of *Albugo, Peziza, Puccinia* and *Cercospora.*

Economic importance: Role of fungi in Medicine, Agriculture and Industry

Lichens: General account, Structure and reproduction. Ecological and Economic importance.

Mycorrhiza: General account

Saccharomyces - A model genetic organism.

UNIT II: PLANT PATHOLOGY **13 hrs**

General account of symptoms, pathogen etiology, mode of Infection.

Management of fungal diseases: Koleroga, Coffee rust, Grain smut of Sorghum, Blast disease of Rice, Red rot of Sugarcane.

A brief account of Biopesticides: Neem, *Trichoderma and Bacillus thuerngiensis*

UNIT III: BRYOPHYTA **13 hrs**

General characters. Study of distribution, structure, reproduction, classification and alternation of generation in *Marchantia, Anthoceros* and *Funaria*

UNIT IV: PLANT ANATOMY **13 hrs**

Meristematic Tissues : Structure, function, classification, Organisation of Apical Meristems:Tunica-carpus theory and Histogen theory.

Secretary Cells and Tissues: Structure, Classification and significance. Simple and permanent tissues

Vascular tissues: A brief account

Secondary growth: Dicot stem.

Anomalous Secondary growth: A general account (*Dracaena and Boerhaavia*)

PRACTICAL PAPER – II

DIVERSITY OF NON-VASCULAR PLANTS MYCOLOGY, PLANT PATHOLOGY, BRYOPHYTES AND PLANT ANATOMY

Total units - 13 Units

I.	Identification and classification of fungi members included in the theory	**3 Units**
II.	Demonstration of mushroom cultivation Study of lichens, Study of Mycorrhiza	**2 Units**
III.	Study of plant diseases included in the theory	**2 Units**
IV.	Study of forms of Bryophytes included in the theory	**3 units**
V.	Normal and Anomalous secondary growth in Stem ex. *Tridax*, *Dracaena* stem and *Boerhaavia* stem.	**2 Units**
VI.	Field visit to study pathogen and host interaction	**1 Units**
VII.	Report of Field visit: Project report of mushroom cultivation / Application of Bio fertilizers	

PRACTICAL QUESTION PAPER - II

DIVERSITY OF NON-VASCULAR PLANTS MYCOLOGY, PLANT PATHOLOGY, BRYOPHYTES AND PLANT ANATOMY

Time: 3 hours **Max. Marks: 35**

1.	Identify the specimens **A, B & C** with labelled diagrams and reasons	**3x3=9**
2.	Prepare a temporary Safranin stained T.S of the material **D** Sketch, label and Identify with reasons, leave the preparation for evaluation	**4**
3.	Write critical notes on **E**	**2**
4.	Identify the Slides **F,G,H & I** with labelled diagrams and reasons	**4x3=12**
5.	Record and submission.	**5+3=8**

SCHEME OF VALUATION

1. Two specimens from Fungi and one from Bryophyta (Identification -**1** mark, Labelled diagram with reasons **2** marks)

2. Any one of the following may be given-stem of *Tridax, Dracaena* or *Boerhaavia* (Staining and mounting- **2** marks, sketch and labelling- **1** mark, Identification with reasons- **1** mark)

1 copy

3. One diseased plant/Lichens/Mycorrhiza (Identification-**1** mark & critical points**1** mark)

4. Two from Bryophytes, One from Fungi and One from Anatomy (Identification & Classification -**1** mark, labelled diagrams with reasons-**2** marks)

5. Record & Submission: 3 Herbarium sheets from Plant pathology (marks **5+3**)

REFERENCES

1. Alexopoulos, C. J. 1992. **An introduction to Mycology**, New Age International, New Delhi.
2. Alexopoulos, C. J and Mims, C. W. 1990. **Introductory Mycology, 5 ed.** Wiley Eastern Ltd.,,New Delhi.
3. Cutter, D.G.1971.Plant **Anatomy-Part I & II**, Edward Arnold, London.
4. Fahn, A.1985. **Plant Anatomy**,Pergaon Press, Headington Hill Hall,Oxford.
5. Jim Deacon, 2007, **Fungal Biology 4 ed.**, First Indian reprint, Blackwell publishing Ltd., India.
6. Katherine Easu, 1993. **Anatomy** 2 ed., Wiley Eastern Pvt., Ltd., New Delhi.
7. Pandey, B. P. 2001. **College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta.** S. Chand and Company Pvt.Ltd., New Delhi.
8. Parihar, N. S. 1970. **An Introduction to Embryophyta, Vol. I Bryophyta** Central Book Depot, Allahabad.
9. Rashid, A.1998. **An Introduction to Bryophyta**. Vikas Publishing House Pvt. Ltd., New Delhi.
10. Sambamurthy, A. V. S. S. 2006. **A text book of Plant Pathology,** I. K. International Pvt. Ltd., New Delhi.
11. Sharma, O. P. 1992. **Textbook of Thallophyta**, Mc Graw Hill Publishing Co., New Delhi.
12. Singh, R. S 1978. **Plant Diseases 4 ed.**, Oxford and IBH, New Delhi.
13. Smith, G. M. 1994. **Cryptogamic Botany Vol II, 2 ed.**, Tata Mc Graw Hill, New Delhi.
14. Sporne, K. R. 1966. **Bryophytes**, 4 ed., B. I. Publishing Pvt., Ltd., India.
15. Thakur, A. K. and S. K. Bassi, 2008. **A Textbook of Botany: Diversity of Microbes and Cryptogams**. S Chand and Company Ltd., New Delhi.
16. Vashishta, B. R 1990. **Botany for degree students: Fungi.** S Chand and Company Ltd., New Delhi.
17. Vashishta. B. R. Sinha, A.K. and Adarsha Kumar. 2009. **Botany for Degree Students: Bryophyta**. S Chand and Company Ltd., New Delhi.
18. Watson, E. V. 1974. **The Structure and life of Bryophytes**, B. I Publication, New Delhi.

III SEMESTER

PAPER - III: PTERIDOPHYTES,PALEOBOTANY,ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY

52 hrs

UNIT I: PTERIDOPHYTES **13 hrs**

Introduction and general character with classification (As per Sporne). Study of diversity in morphology,anatomy and reproduction of the following groups in representative forms

1. Psilotopsida – Eg: *Psilotum.*
2. Lycopsida – Eg: *Lycopodium ,Selaginella.*
3. Filicopsida – Eg: *Marsilea.*

(Developmental stages not required)

Brief account of Stelar evolution,heterospory and seed habit.

UNIT II: PALEOBOTANY **13 hrs**

Contribution of Paleobotanist-Birbal Sahni.

Outline of geological time scale with emphasis on Paleozoic and Mesozoic Era. Process of fossilization– Compression,Impression and Petrifaction.

Type Study: *Rhynia,Cycadeoidea* and *Pentaxylon.*

UNIT III: ENVIRONMENTAL BIOLOGY **13 hrs**

Introduction and scope of Environmental Biology

Ecological Factors: Climatic – Light,Temperature, Rainfall,Wind and Atmospheric humidity.

Edaphic factors: Soil Formation, Soil Profile, Soil air, Soil Microorganisms

Soil Erosion:Water and Wind.

Soil Conservation:

Biological – Contour farming,Mulching,Strip cropping,Terracing and Crop rotation.

Mechanical – Basin Listing,Construction of dams

Soil reclamations

Biotic Factors – Positive and negative interactions.

Ecosystem – Concept,Components,Study of marine,Grass land and Crop land Ecosystems.

Ecological Succession – Hydrosere and Xerosere.

Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.

UNIT IV: ECOSYSTEM MANAGEMENT **13 hrs**

Water Shed Management.

Conservation of natural resources:

- Over Exploitation of Natural resources – eg:Forest
- Afforestation,Social Forestry and Agroforestry.

Conservation of plant diversity:
In-situ and *Ex-situ* Conservation – National park,Sancturies and Bioreserves. Role of Seed Bank and Gene Bank.

PHYTOGEOGRAPHY
Phytogeographical regions of India, Vegetational types of Karnataka.

PRACTICAL PAPER– III

PTERIDOPHYTES, PALEOBOTANY, ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY

Total Units – 13

1. Identification and Classification of Pteridophytes (examples studied in theory) **4 units**
2. Paleobotany – Study of specimens and slides (fossil material/slide) **1 unit**
3. Ecological Adaptations – Study of one example for each adaptation **2 units**
4. Estimation of chloride and dissolved oxygen content in the given sample **2 units**
5. Study of Quadrat method in Ecology and studying soil sample and analysis of soil sample for structure(texture) p^H etc. **3 units**
6. Marking of vegetation types of Karnataka on Karnataka map and Phytogeographical areas of India **1 unit**
7. Record & submissions: Submission of 3 slides of free hand sections (Pteridophytes / Ecological Specimens)

PRACTICAL QUESTION PAPER–III

PTERIDOPHYTES, PALEOBOTANY, ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY

Time : 3 hours **Max Marks : 35**

1. Identify and classify specimen **A** & **B** giving reasons. **2 x 3= 6**
2. Identify the slides **C, D, E** with reasons and diagrams. **3 x 3 = 9**
3. Comment on slide/specimen/photocopy/photograph of **F**, **3**
4. Identify and comment on Ecological adaptation of **G**. and **H** (vegetation pattern of Karnataka). **2x2 ½ = 5**

5. Estimate the Oxygen / Chloride content of the given sample **I**. 4
6. Record and Submission. (3 Slides) **5+3 = 8**

SCHEME OF VALUATION

1. Pteridophytes - (Identification & classification – **1** mark, Reasons – **2** marks).
2. Pteridophytes - (Identification – **1**mark, Reasons – **1** mark, Diagram – **1** mark).
3. Fossil Material - (Identification – **1** mark,comment – **2** marks)
4. Specimen/Slide / Map - (Identification – **1** mark,comment – **1.5** marks)
5. Estimation – (Conducting experiment – **2** marks ,principle, procedure & result– **2** marks)
6. Record and Submission : 3 permanent slides of free hand sections of Pteridophytes and ecological specimens (**5+3 = 8** marks).

(for Q.No-4 – "H" – Karnataka maps to be provided by College)

REFERENCES

1. Agarwal, K.C. 2001.**Environmental Biology**,Nidi Publications Ltd., Bikaner, London.
2. Agashe, S.N. 1995. **Paleobotany, Plants of the past, their evolution, paleoenvironment and application in exploration of fossil fuels.** Oxford & IBH Publishing Co., Pvt.Ltd. New Delhi.
3. Andrews, H.N. 1961. **Studies in Paleobotany, John** Wiley, New York.
4. Asthana, D.K. and Meera Asthana 2013 **A Text book of Environmental Studies**, S. Chand and Company Pvt Ltd., New Delhi.
5. Cain, S.A. 1944. **Foundations of Geography**, Harper and Bros. New York.
6. Good, R.D. 1974. **The Geography of Flowering Plants. 3 edition.** Long Mans, London.
7. Odum, E. P. 1971.**Fundamentals of Plant Ecology**. W. B. Snderson Co., Philadelphia
8. Parihar N. S. 1977. **The Morphology of Pteridophytes**. Central Book Depot, Allahabad
9. Polumine, N. 1950. **Introduction to Plant Geography**. Longmans Publishers, London.
10. Rashid. A 1998. **An Introduction to Pteridophyta. 2 edition.,** Vikas Pub. House Pvt., Ltd., New Delhi
11. Sharma. P. D. 1993. **Ecology and Environment**, Rastogi Pub., New Delhi
12. Sporne, K. R. 1966. **The Morphology of Pteridophytes. The structure of ferns and allied plants.** Hutchinson University Library, London.
13. Trivedi, R.K. 1995. **Advances in Environmental Sciences and Technology**, Ashish Publishing House, New Delhi.
14. Valentine,D.H. 1972. **Taxonomy, Phytogeography and Evolution**, Academic Press, London
15. Vasishta, B. R., Sinha,A.K. and Anil Kumar. 2005. **Botany for Degree Students-Pteridophyta**. Multicolour Illustrative edition, S .Chand and Co., Pvt. Ltd., New Delhi.
16. Wagnaer, K.D.1998. **Environmental Management**,W.B. Saundars Co., Philadelphia.

IV SEMESTER

PAPER–IV: GYMNOSPERMS AND EMBRYOLOGY OF ANGIOSPERMS

52 hrs

UNIT I **GYMNOSPERMS** **13hrs**

General characters and classification.
Economic importance of Gymnosperms with reference to wood, essential oils, resins and drugs.
Morphology and Anatomy of vegetative structures- Root, stem and leaf (primary and secondary growth), Reproductive structures (Developmental Stages not required) and life cycles of *Cycas* , *Pinus* and *Gnetum* (Evolutionary significance of *Gnetum*)

UNIT II **EMBRYOLOGY OF ANGIOSPERMS – I** **13 hrs**

Indian botanists and their contributions to Embryology– P.Maheshwari, BGL Swamy
Structure – Typical Angiosperm flower, Androecium and Gynoecium
Microsporangium-Development & structure of mature anther, Anther wall layers, Tapetum-types, structure& functions.Sporogenous tissue.
Microsporogenesis - Microspore mother cells (mmc) , cytokinesis, microspore tetrads
Abnormalities-Pollinia,compound pollengrains.
Microgametogenesis – Formation of vegetative and generative cells, structure of male gametophyte.
Abnormalities – Nemec phenomenon

UNIT III **EMBRYOLOGY OF ANGIOSPERMS – II** **13 hrs**

Structure of Pistil – Placentation-definition and types.
Megasporangium – Structure of ovule - Integuments(endothelium), Micropyle (Obturator),Nucellus (crassinucellate and tenuinucellate conditions). Types of ovule- Anatropous, Orthotropous, Amphitropous, Circinotropous. Megasporogenesis.
Megagametogenesis – Types of development of Female gametophyte/embryosac- monosporic- *Polygonum* type, bisporic-*Allium* type, tetrasporic- *Fritillaria* type.Structure of mature embryosac-Structure and functions of synergids, egg, central cell and antipodals.
Double fertilization – pollen germination, growth of pollen tube through style (solid and hollow styles), entry of pollen tube into ovule (porogamy, mesogamy, chalazogamy), entry of pollen tube into the embryosac, pollen tube discharge,syngamy, triple fusion. Significance of double fertilization, post fertilization changes.
Endosperm – Types and its biological importance. Free nuclear (*Areca catechu* ,*Cocos nucifera*), cellular (*Cucumis),* helobial types. Ruminate endosperm.

UNIT IV EMBRYOLOGY OF ANGIOSPERMS–III

13 hrs

Embryogenesis – Dicot (*Capsella bursa-pastoris)* and Monocot(*Najas).* Parthenocarpy. Polyembryony- definition and types.

Seed – Structure of Dicot and Monocot seed.

PALYNOLOGY- pollen morphology – pollen wall, aperture, shape, size and architecture, NPC system, pollen wall stratification. Applied Palynology – Aeropalynology, Mellissopalynology

EXPERIMENTAL EMBRYOLOGY - Definition, Totipotency, basic steps in plant tissue culture technique. Nutrient media- basic components , composition of MS & White's media.

Tissue culture techniques and their practical applications - Anther culture, Embryo culture, protoplast culture.

Embryology in relation to Taxonomy- egs. *Trapa, Exocarpus*

PRACTICAL - IV
GYMNOSPERMS AND EMBRYOLOGY OF ANGIOSPERMS

Total Untis – 13

1) Study of materials and permanent slides of Gymnosperms included in Theory — **5 units**
2) Permanent slides of microsporogenesis and male gametophyte — **1 unit**
3) Mounting of Pollen grains –*Grass, Mimosa,* Pollinia of *Calotropis* and Pollen germination (hanging drop method) — **1 unit**
4) Permanent slides of types of ovules,Megasporogenesis&embryosac development — **1 unit**
5) Permanent slides of types of placentation—Axile, Marginal, Parietal, basal types . Sectioning of ovary , for any two types of placentation. — **1 unit**
6) Mounting of embryo- *Tridax* and *Cyamopsis.* — **1 unit**
7) Mounting of endosperm - *Cucumis.* — **1 unit**
8) Mini project work in groups of 3-5 students, from the following list. — **2 units**
   a) Study of pollen morphology of different flowers with respect to shape, colour,
   b) pores etc.
   c) Pollen germination of different pollen grains andcalculate percentage of germination.
   d) Calculating percentage of germination of one particular type of pollen grain collected from different localities/ under different conditions.
   e) Study of placentation ofdifferent flowers.
   f) Any other relevant study related to Gymnosperms / Embryology.

Mini project work may be carried out in groups of 3-5 students, supervised by the batch in charge . The mini project report, about 5-6 pages (type written), to be prepared in following format and certified by the teacher in charge and HOD tobesubmitted in practical examination.

1.Introduction
2.Aim of study
3.Materials& methodology
4.Observation
5.Conclusion,
Copies to be submitted separately by individual members of the group..

PRACTICAL QUESTION PAPER–IV

GYMNOSPERMS AND EMBRYOLOGY OF ANGIOSPERMS

Time: 3 hours. **Max Marks: 35**

1. Identify and classify specimens **A,B** and **C** giving reasons -	**3X3= 9**
2. Identify the slides **D, E** & **F** with reasons and labeled diagrams	**3X3=9**
3. Mount the embryo/Endosperm of specimen **G** & comment.	**5**
4. Mount the pollinia/perform pollen germination of specimen **H** & comment	**4**
5. Record & submission	**5+3=8**

SCHEME OF VALUATION

1. Gymnospem materials- . *Cycas, .Pinus,.Gnetum* (Identification & classification- **1** mark, reasons-**2** marks).
2. One Gymnospem slide, one from T.S.of young anther/ mature anther, one from megasporogenesis/ stages of embryosac development, /placentation/ types of ovules included in theory.(Identification – **1** mark, Diagram-**1** mark, reasons- **1** mark).
3. Endosperm /Embryo mounting (preparation- **3** marks, comment with diagram- **2** marks).
4. Pollinia / pollen germination (preparation-**2** marks,comment with diagram- **2** marks)
5. Record & submission of mini project report (**5 + 3** marks)

REFERENCES

1. Bhatnagar, S.P. and Moitra, A. **Gymnosperms**, New Age Publications, New Delhi
2. Bhojuwani, S. S. and Bhatnagar, S. P 1979. **The Embryology of Angiosperms**, Vikas Pub, New Delhi.
3. Chopra,G.L. and Verma,V.1988.**Gymnosperms.** Pradeep Publications, Jalandar, India.

4. Coulter and Chamberline, 1964. **Morphology of Gymnosperms**, Central Book Depot. New Delhi.

5. Davis, G.L.1966. **Systemic Embryology of Angiosperms**. John Wiley & Sons Inc, New York.

6. Johansen,D.A.1950. **Plant Embryogeny** , Chronica Botanica Co., Waitham, Mass.

7. Johri, B. M 1984. **Embryology of Angiosperms**. Springer – ver lag,Berlin.

8. Maheshwari, P. 1950. **An Introduction to Embryology of Angiosperms**. Tata Mc Graw Hill, New York.

9. Maheshwari, P.1963. **Recent Advances in Embryology**, Intl.Soc.Pl. Morphol.,New York.

10. Pullaiah, T., Lakshminarayana, K. and Hanumantha Rao, K. 2001. **Text Book of Embryology of Angiosperms**, Regency Publications, New Delhi.

11. Raghavan, V.1979. **Experimental Embryogenesis of Vascular Plants**, Cambridge University Press, Cambridge, U.K.

12. Sinnott, E.W. 1960. **Plant Morphogenesis**. McGraw Hill Book Company,INC,NEW York.

13. Sporne, K. R 1974. **The Morphology of Gymnosperms**. Hutchinson & Co., London

14. Swamy B.G.L. and Krishnamurthy K. V, 1980. **From flower to fruit: embryology of flowering plants.** Tata Mc Grew- Hill Pub Co. New York.

15. Vashista, B. R. 1990 . **Gymnosperms**. S Chand & Co., Pvt. Ltd., New Delhi

V SEMESTER

PAPER-V: TAXONOMY AND ECONOMIC BOTANY

39hrs

UNIT: I CLASICAL TAXONOMY — 13 hrs

Aim and Scope of taxonomy, Brief History, Broad outline of classification proposed by Bentham & Hooker, Engler & Prantl and their relative merits and demerits. Species concept: Taxonomic hierarchy, species, genus and family.

Biosystematics: Plant nomenclature, Binomial system, ICBN- rules for nomenclature. Taxonomic Tools, Herbarium and its techniques, Floras and their importance, Botanical gardens and their importance (one state level, one national level & one international level). (Examples: State: Lalbagh, National: Indian Botanical garden Sibpur, Calcutta, International: Royal Botanical garden, Kew, England). Chemotaxonomy, Cytotaxonomy, Numerical taxonomy & application of computer.

UNIT: II TAXONOMY – I — 13hrs

Taxonomic studies of following families, according to Engler & Prantl system of classification and their economic importance

Monocotyledoneae Families: Poaceae, Arecaceae Musaceae, and rchidaceae

Dicotyledoneae Families:
Archichlamydeae- Magnoliaceae, Annonaceae, Brassicaceae, Rutaceae, Leguminosae (Subfamilies: Papilionatae, Caesalpinioideae and Mimosoideae) Rosaceae & Euphorbiaceae.

UNIT: III TAXONOMY – II AND ECONOMIC BOTANY — 13hrs

Metachlamydeae - Cucurbitaceae, Apiaceae Rubiaceae, Asteraceae, Asclepiadaceae, Acanthaceae & Lamiaceae.

Ethnobotany: A general account.

ECONOMIC BOTANY: Study of the following plants with Botanical names, Family, part used, and economic uses.

Edible oils:	Groundnut, Coconut & Sesamum
Sugar and Starch:	Sugarcane, Beetroot, Potato & Tapioca
Fibers:	Cotton, Jute & Coir
Paper & Pulp:	Bamboo & Eucalyptus
Beverages:	Coffee, Tea &Cocoa

Spices:	Ginger, Cardamom, Clove, Cinnamon, Asafoetida, Turmeric Saffron & Nutmeg
Timber:	Teak & Rose wood
Medicinal & Aromatic:	Ashwagandha, Aloe *vera,* Indian Pennywort, Holy Basil, Amla, Periwinkle, Margosa tree, *Patchouli*, Mint, & Lavender

PRACTICAL PAPER – V

TAXONOMY AND ECONOMIC BOTANY

Total Units: 13

1.	Morphology of Angiosperms – Vegetative Structure and modifications of root, & leaf.	**1 Unit**
2.	Morphology of Angiosperms – Inflorescence and flower	**1 Unit**
3.	Morphology of Angiosperms– Fruits (Simple, aggregate & multiple)	**1 Unit**
4.	Methods of identification of plants with Technical terms.	**1 Unit**
5.	Study of taxonomic characters of families included in theory (Minimum one genus from each family)	**6 Units**
6.	Study of economically important plants covered in theory to identify with Botanical names, families, parts used and Economic uses.	**2Units**
7.	Herbarium techniques.	**1 Unit**
8.	Study of local flora by arranging local collection trips.	
9.	Record & Submission of 6 Herbaria with field notes of plants included in theory.	

PRACTICAL QUESTION PAPER- V

TAXONOMY AND ECONOMIC BOTANY

Time: 3 hrs **Max marks: 35**

1.	Assign the specimens **A, B** & **C** to their respective families giving diagnostic features.	**3×3= 9**
2.	Describe **D** in technical terms; draw the floral diagram with floral formula.	**6**
3.	Identify the specimen **E, F, G, H, I &J** with their morphological, Biological & Economic importance.	**6x2=12**
4.	Record and Submission. (Herbaria with field notes)	**5+3=8**

SCHEME OF VALUATION

1. One Archichlamydeae, one Metachlamydeae, one Monocot (Identification ½ mark, Classification 1 mark, Diagnostic features 1½ mark)
2. Dicot plant (Technical detail 2 marks, floral diagram 2 marks, floral formula 2 marks)
3. Root/ Stem/ Leaf modification/ Inflorescence/ Fruit and/ Economic Importance. (Identification ½ mark, diagram½ mark, description **1** mark, for economic importance, identification with family **1** mark, part use ½ mark economic uses ½ mark)
4. Record- **5** marks.
5. Submission of **Six** herbaria with field notes of family's studies, ½ marks each-**3** marks

REFERENCES

1. Bierhorst, D .W. 1971. **Morphology of vascular Plants**. Macmillan, New York.
2. Chandel, K.P.S, Shukla,G and Sharma,N. 1996. **Biodiversity in Medicinal and Aromatic plants in India: Conservation and Utilization**, NBPGR, New Delhi.
3. Cronquist A. 1981. **An Integrated System of Classification of Flowering Plants**. Columbia University Press, New York.
4. Cronquist, A. 1988. **The Evolution and Classification of Flowering Plants**. Second Edn.,New York Botanical Garden, New York.
5. Dutta. S.C.1988. **Systematic Botany** Wiley Easter, New Delhi.
6. Ernest M. Gifford, A S. Foster.1989. **Morphology and evolution of vascular plants,** W.H. Freeman and Co., New York
7. Gamble. J.S. 1986. **Flora of Presidency of Madras**. Reprint - Bishen Singh and Mahendra Pal Singh, Deharadoon
8. Heywood,V.H.and Moore,D.M. 1984. **Current concepts in Plant Taxonomy**, Academic press, London
9. Hutchinson. J.1973.**The Families of Flowering Plants 3 edition.** Oxford University Press, Oxford.
10. Kocchar, S.L.1998. **Economic Botany of the Tropics.2 edition.** Mac millan IndiaLtd., Deihi.
11. Lawerence G.H.M,1951. **Taxonomy of Vascular plants**, Oxford & IBH publication, New Delhi.
12. Naik ,V.K.1984. **Principles and trends in the taxonomy of angiosperms**. Tata McGraw-Hill Co. Ltd., New Delhi.
13. Pandey, B.P.2014.**Economic Botany**,S.Chand and Company Pvt.ltd., New Delhi.
14. Pandey and Misra 2008. **Taxonomy of Angiosperms**: Ane Books Pvt Ltd,New Delhi
15. Pullaiah, T. 1998. **Taxonomy of Angiosperms**. Regency Publications, New Delhi.
16. Radford,A.E.,Dickinson W.C., Massey,J.R. and Ben.C.R. 1974. **Vascular Plant Systematics,** Harper and Row, New York.
17. Sambamurthy. A.V.S.S.2005.**Taxonomy of Angiosperms**, IK International publishers, New Delhi

18. Sharma. O.P.1996. **Hill's Economic Botany** (Late Dr. A.F.Hill adapted by P O Sharma). Tata McGraw Hill Co., Ltd., New Delhi.
19. Singh, S.K and Seema Srivastava, 2009. **Taxonomy of Angiosperms**: For B.Sc. and M.Sc. Students of Indian Universities. Campus Books International Publishers, New Delhi.
20. Stebbins, 1974. **Flowering plants – Evolution above the species level**, Arnold press. London.

V SEMESTER

PAPER VI: MOLECULAR BIOLOGY, GENETIC ENGINEERING, BIOTECHNOLOGY AND PLANT PHYSIOLOGY

39 hrs

UNIT I **MOLECULAR BIOLOGY** **13 hrs**

Introduction, Discovery, Chemical nature& replication of genetic material, genetic code, non genetic RNA, Biosynthesis of proteins, Regulation of gene action in prokaryotes (Lac operon concept only).

GENETIC ENGINEERING & BIOTECHNOLOGY: Steps in Recombinant DNA technology, Genomic libraries, application of genetic engineering technology in agriculture.A brief account on hazards & safe guards of genetic engineering technology with special reference to Bt Cotton. A brief account of Bioinformatics and its uses.

UNIT II **MICROBIAL BIOTECHNOLOGY** **13 hrs**

Uses of microbes in industry and agriculture fermentation – production of ethanol, production of antibiotics – Penicillin.

PLANT PHYSIOLOGY- I – Water Relations: Importance of water, Diffusion, Osmosis, water potential, Osmotic Potential, Membrane and their Permeability.Absorption Of Water- Mechanisms of water absorptions, factors affecting rate of waterabsorption.

Stress Physiology: Water stress, heat stress, salt stress and mechanisms of Plant response to water and related stress.

UNIT III **PLANT PHYSIOLOGY – II** **13 hrs**

Mechanism of ascent of Sap – Vital and physical force theories.

Transpiration – Loss of water, Types, Mechanisms, Stomatal Dynamics. Stomatal mechanism, Significance, Factors affecting transpiration, anti - transpirants, Guttation.

Mineral Nutrition In Plants - Major& Minor elements, their deficiency symptoms in plants.

Phloem Transport- Transport of organic solutes.Path of transport, vein loading and unloading.Transcellular or streaming hypothesis, contractive protein hypothesis, mass flow hypothesis,Source – Sink concept.

PRACTICAL PAPER–VI

MOLECULAR BIOLOGY, GENETIC ENGINEERING, BIOTECHNOLOGY AND PLANT PHYSIOLOGY

Total Units – 13

1.	Qualitative Test for Starch, Protein, Reducing Sugars and Lipids.	**2 Units**
2.	Determination of Osmotic potential of the cell sap by Plasmolytic method.	**1 Unit**
3.	Determination of Stomatal Index.	**1 Unit**
4.	Structures of Stomata in Hydrophytes, Mesophytes and Xerophytes.	**2 Units**
5.	Streaming of Protoplasm to show Cyclosis.	**1 Unit**
6.	Determination of pH of Plant Samples by using Indicators.	**1 Unit**
7.	Study of Osmosis & Transpiration Experiments.	**3 Units**
8.	Study of Phloem Transport by Ringing Experiment.	**2 Units**

PRACTICAL QUESTION PAPER–VI

MOLECULAR BIOLOGY, GENETIC ENGINEERING, BIOTECHNOLOGY AND PLANT PHYSIOLOGY

Time 3 hours **Max. Marks 35**

1.	Conduct the biochemical test of sample **A** and **B**.	**3+3= 6**
2.	Determine the osmotic potential of the cell sap by plasmolytic method / stomatal index of material **C**	**8**
3.	Determine the pH of the given sample **D**.	**2**
4.	Set up and comment on the experiment **E**.	**6**
5.	Comment on experiment **F** and **G**.	**4+4 = 8**
6.	Record.	**5**

SCHEME OF VALUATION

1. Samples – Starch, Protein, Reducing Sugar and Lipids (Positive Test - **1** mark, Negative Test – **2** marks).
2. Conducting the Experiment – **3** marks; Principle – **2** marks; Procedure – **1** mark; Result – **2** marks.
3. Extract from Root, Stem, Leaves of a Plant to be given (Determination of pH – **1** mark, Comment – **1** mark).
4. Experiments of E: a. Potato Osmoscope
   b. Thistle Funnel experiment.
   c. Farmer's Potometer.
   d. Ganongs Potometer.

(Requirements – **1** mark, Principle – **1** mark, Procedure & Conducting Experiment –**3** marks, Result – **1** mark)

5. Experiments of **F** & **G**: a. Streaming of Protoplasm (Cyclosis).
   b. Balsam Plant experiment.
   c. Bell Jar experiment.
   d. Transpiration Pull.
   e. Mass Flow Hypothesis.
   f. Ringing Experiment.
   (Identification – **1** mark, Comment – **3**)
6. Record **5** marks.

REFERENCES

1. Buchanan, B. B, Gruissem, W. and Jones, R. I 2004. **Biochemistry and Molecular Biology of Plants**. I. K. International Pvt. Ltd., New Delhi.
2. Dey and Harborne, J. B. (eds.) 1977. **Plant Biochemistry**. Academic Press, New York.
3. Dubey, R. C. 2014. **Advanced Biotechnology**, S. Chand & Company Pvt. Ltd., New Delhi.
4. Hall, D. O. and Rao, K. K. 1999. **Photosynthesis. 6 edition**, published in association with the Institute of Biology. Cambridge University Press. Cambridge, U.K.
5. Harborne, T. C 1981. **Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis**. Chapman and Hall, London.
6. Lodish, Berk, Matsudaira, Kaiser, Kriega, Scott. Zipursky Darnell, 2004. **Molecular cell Biology Fifth Edition**, W. H. Freeman and company, New York.
7. Moore, T. C. 1989. **Biochemistry and Physiology of Plant Hormones. 2 edition**. Springer – Verlag, New York.
8. Moore, T. C. 1974. **Research Experiences in Plant Physiology**: A Laboratory Manual, Springer. Verlag, Berin.
9. Peter Snustad, D and Michael. J. Simmons 2006. **Principles of Genetics. 4 edition.** Waley and Sons – INC.,New York.
10. Plummer, D. T. 1988. **An Introduction to Practical Biochemistry**. Tata Mc Graw – Hill Pub. Co., Ltd., New Delhi.
11. Ramawat, K. G and Shaily Goyal, 2010. **Molecular Biology and Biotechnology**, S. Chand and Company Pvt. Ltd., New Delhi
12. Singhal, G. S. Renger. G. Sporty S. K., Irrang, K. D and Govindjee. 1999 **Concepts in Photobiology, Photosynthesis and Photo morphogenesis.** Narosa Publishing House, New Delhi.

13. Stumpf, P. K. and Conn, E. E. (eds). 1988. **The Biochemistry of Plants – A Comprehensive treatise**. Academic Press. New York.
14. Taiz L & Zeiger E. 1998. **Plant Physiology**. **2 edition**. Sinauer Associates, Inc., Publishers, Massabhusetts, USA.
15. Taiz, I., & Zeiger, E 2003. **Plant Physiology, 3 Edition**. Panima Publishing Corporation, New Delhi/ Bangalore
16. Thomas, B. and Vince – Prue, D. 1997. **Photoperiodism in Plants**. **2 edition**. Academic Press, San Diego, USA.
17. Wilkins M. B (eds.) 1989. **Advanced Plant Physiology**. Pitman publishing Ltd., London
18. Wilson, K and Goulding, K. H. (eds.). 1986. **A Biologists Guide to Principles and Techniques of Practical Biochemistry**. Edward Arnold, London, UK.

VI SEMESTER

PAPER–VII: CYTOLOGY, GENETICS, EVOLUTION AND PLANT BREEDING

39 hrs

UNIT 1 CELL & CHROMOSOME BIOLOGY **13 hrs**

Cell as a fundamental unit of life and organism. Structure of eukaryotic chromosome;centromere,kinetochore and telomere. Nucleosome and its importance in the organisation of eukaryotic chromosome. Types of Chromosomes; biarmed and holocentrictypes.

Cell Division - Phases, mitotic apparatus, cytokinesis, mitotic inhibitors, significance of mitosis; Meiosis- phases of meiotic cycle cytological proof of crossing over, synaptonemal complex. Brief study on Apoptosis (PCD).

UNIT II MENDELIAN GENETICS **13 hrs**

Biography of Mendel in brief: Mendel's experiments:Monohybrid cross – law of dominance, law of segregation, purity of gametes .Homozygous, heterozygous, phenotype, genotype, monohybrid test cross, Dihybridcross-law of independent assortment, dihybrid test cross, incomplete dominance(*Mirabilis jalapa*, Snapdragon).

Modification of Mendelian ratios:(With reference to plant examples). Interaction of genes epistasis (dominant & recessive); supplementary factors, complementary factors: Polygenic inheritance in Maize (Self Sterility in*Nicotiana*), Linkage & Crossing over (in Maize).

SEX DETERMINATION: Chromosomal mechanism of sex determination methods. XX –XY, ZZ – ZW & XX – XO (Sex determination in *Melandrium*) and genetic problems related to topics.

UNIT III EVOLUTION **13 hrs**

Origin of life, theories of evolution, modern concepts of evolution, role of mutations in evolution, Gene duplication (2R hypothesis), Big Bang theory Numerical changes in chromosome number, polypioidy and aneuploidy - trisomics and monosomics and Chromosomal aberrations.

PLANT BREEDING

Historical account and objectives of plant breeding.Vegetative propagation methods (underground plant parts and isolated plant parts - cutting, grafting, layering, gootee, clones) Hybridization (intergeneric and interspecific), maintenance of germplasm, pollen banks, quarantine methods.

2 copies

PRACTICAL PAPER – VII

CYTOLOGY, GENETICS, EVOLUTION AND PLANT BREEDING

Total Units - 13

1.	Preparation of cytological stains - Aceto carmine &Aceto orcein.	**1 Unit**
2.	Mitosis from *Allium* root tips—Aceto orcein.	**3Units**
3.	Meiosis from *Allium* flower buds- Aceto carmine.	**3Units**
4.	Karyotype and Idiogram : Camera Lucida drawing.	**1 Unit**
5.	Permanent slides of Mitosis.	**1Unit**
6.	Permanent slides of Meiosis.	**1 Unit**
7.	Emasculation and bagging of the flower buds of available species.	**1 Unit**
8.	Genetic problems.	**2Units**
9.	Record and Submission- 6 Slides (3 Mitosis and 3 Meiosis.)	

PRACTICAL QUESTION PAPER- VII

CYTOLOGY, GENETICS, EVOLUTION AND PLANT BREEDING

Time: 3 hours **Max Marks: 35**

1.	Prepare a temporary mitotic, slide from material **A** identify the stage with diagram.	**6**
2.	Prepare a temporary meiotic slide from material **B** identify the stage with diagram	**6**
3.	Identify and comment on **C** along with a sketch (only Karyotype).	**4**
4.	Identify and comment on slides **D** and **E** with suitable sketches	**3+3=6**
5.	Solve the Genetic Problem **F**	**5**
6.	Record and Submission	**5+3=8**

Scheme of Valuation

1. Preparation- **4** marks, identification of stage - **1** mark and labelled diagram **1** mark
2. Preparation - **4** marks, identification of stage - **1** mark and diagram **1** mark
3. Karyotype - slide or sketch, identification-**1** mark, diagram- **1** mark, comment- **2** marks

4. Slides from meiosis and mitosis identification **0.5** mark, sketch **0.5** mark and comment **2** marks.
5. Genetic problems from
    i. Dihybrid cross and test cross
    ii. Incomplete dominance
    iii. Complementary factors
    iv. Supplementary factors
    v. Epistasis - **5** marks

6. i. Record - **5** marks
    ii. 3 Mitotic and 3 Meiotic permanent slides ½ mark each - **3** marks

REFERENCES

1. Benjamine A. 2012, **Genetics- conceptual approach 4 edition.**W.H.Freeman and company, New york.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter 2007, **Molecular Biology of the Cell**: **5 edition**. Garland Science, 1526 illustrations. Package with Media DVD.
3. Chaudhari, H.K.1983. **Elementary Principles of Plant Breeding,** TMH publishers Co., New Delhi
4. De Robertis E.D.P. and De Robertis, E.M.FJr, 2002. **Cell and Molecular Biology**, USA cippoctt,
5. Gardener E.J.and Sanstad D.P.1984. **Principles of Genetics** ,John wiley Publishing Co., New Delhi
6. Goodenough, U.1990.Genetics,3 **edn**., Saunders College Publishers, New York.
7. Gupta.p.k.1994, **Genetics,** Rastogi publications,New Delhi.
8. Jain J, Sanjayjain, I and Nitin jain,2005. **Fundamentals of Biochemistry**, S.Chand & company Pvt Ltd.,New Delhi.
9. Jha,A. P. 1993, **Genes and Evolution**. Mac Millan India Ltd., New Delhi.
10. John Ringo, 2004. **Fundamental genetics,** India Cambridge univ.,New Delhi
11. Mahesh.S.2008. **Plant Molecular Biotechnology,** New age Int.Publ, NewDelhi,
12. Nelson D,I and Cox, M. M.1996. **Principles of Biochemistry.** Macmillan worth Publications,New Delhi
13. Sadhu M.K.1996. **Plant propagation,** New age international publishers,New Delhi.
14. Sharma, J.R. 1994. **Principles and Practice of Plant Breeding**, Tata McGraw-Hill Publishers, New Delhi
15. Shukla R.S.and P.S.Chandel,2004.**Cytogenetics, Evolution and Plant Breeding** S.Chand and company Pvt Ltd., New Delhi

16. Shukla.R.S. and P.S.Chandel,2005,**Cytogenetics, Evolution& Plant Breeding** S.Chand & co, New Delhi
17. Sinnot, E.W., Dunn,.L.C. &Dobzonsky,T.1958. **Principles of Genetics**. Tata Mc Graw Hill, NewYork.
18. Strickberger, M.W.2002.**Evolution**.Jones and Barlett Publishers,Sudbury.

- http/www/desica/de/plantbreeding/
- http/www/bilogyariozona.edu/mendeliangenetics/htm/

VI SEMESTER
PAPER –VIII: PLANT PHYSIOLOGY – III

39 hrs

UNIT I **ENZYMES** **13 hrs**

Nomenclature, classification, chemical composition, prosthetic groups coenzymes, cofactors , vitamins properties of enzymes , mechanism of enzymes action, enzyme kinetics, factors affecting enzyme activity, Inhibition of enzyme action (Competitive, Non Competitive, feedback), Allosteric enzyme.

Nitrogen Metabolism:

Sources of nitrogen, Nitrogen fixation, *nif* genes in relation to symbiotic fixation in *Rhizobim.* Synthesis of amino acids and Nitrogen cycle.

UNITII **BIOENERGETICS** **13hrs**

Photosynthesis – Introduction, ultra structure of the chloroplast, photosynthetic apparatus, principle of light absorption, Emerson's enhancement effect, photosystems I & II, Light reaction – Hill reaction, photophosphorylation (cyclic, non-cyclic), carbon reactions (Calvin Cycle, C_4 – Pathway, CAM), Factors affecting the process.

Photorespiration – Organelles involved, mechanisms and significance.

Respiration- Introduction, mechanism of aerobic respiration – glycolysis,TCA cycle, ETS and oxidative phosphorylation, mechanism of anaerobic respiration(alcoholic fermentation and lactic acid fermentation), Respiratory Quotient and its significance, factors affecting respiration.

UNIT III **PLANT GROWTH AND GROWTH REGULATORS** **13hrs**

Definitions of growth, Kinetics, Factors affecting growth, Phytohormones, Metabolism, Physiological effects, mode of action of auxins, gibberellins, cytokinins, ethylene and ABA. Applications of these hormones in agriculture and horticulture.

Plant movements – A brief account on the classification and types of movements.

Photobiology – A brief account of dormancy, Photoperiodism, phytochrome and its role, Florigen concept, Vernalization,

Defence mechanisms – A brief account of Secondary metabolites (Phenolics, Flavonoids and alkaloids) and their role in plant defence.

PRACTICAL PAPER – VIII
PLANT PHYSIOLOGY – III

Total Units : 13

1. Separation of Photosynthetic pigments by paper chromatography and measurement of Rf Values. **1 unit**
2. Determination of rate of photosynthesis at different wavelengths of light. **1 unit**
3. Determination of rate of photosynthesis at different concentrations of CO_2 **1 unit**
4. Estimation of Ascorbic acid content in a plant sample. **1 unit**
5. Determination of RQ of carbohydrates, fats and proteins. **1 unit**
6. Study of geotropism, phototropism and hydrotropism. **2 unit**
7. Evolution of O_2 during photosynthesis. **1 unit**
8. Evolution of CO_2 during respiration. **1 unit**
9. Kuhne's fermentation vessel. **1 unit**
10. Moll's half leaf Experiment. **1 unit**
11. Evolution of heat during respiration **1 unit**
12. Determination of the rate of growth using Arc Auxanometer **1 unit**
13. An industrial visit to study the manufacture of alcohol / antibiotics / enzymes. Bioinformatics/ Molecular biological lab.

PRACTICAL QUESTION PAPER – VIII
PLANT PHYSIOLOGY-III

Time: 3hours **Max Marks: 35**

1. Separate the photosynthetic pigments from sample **A** by paper chromatography and measure their Rf values. **8 marks**
2. Estimate the ascorbic acid content in the sample **B.** **8 marks**
3. Set up and comment on experiment **C**. **6 marks**
4. Identify and comment on physiological set up **D&E.** **2x 2 ½ 5 marks**
5. Record and submission **5+3 = 8 marks**

SCHEME OF VALUATION

1. A. Requirement-**1** mark, principle- **2** marks, procedure and conducting the experiment- **3** marks, Rf values- **2** marks.
2. B. Requirements- **1** mark, principle- **2** marks, procedure and conducting the experiment- **3** marks, Result- **2** marks.
3. C. Identification-**1** mark, set up- **2** marks, comments-**2** marks, labelled Diagram-**1** mark
4. D. Identification-½ mark, comments-**1** mark, labelled diagram- **1** mark.

E. Identification- ½ mark, comments-**1** mark, labelled diagram- **1** mark.

5. Record and Submission of field report (hand written field report only) **5+3** marks

LIST OF EXPERIMENTS FOR C.

	B1	B2
i. Evolution of O_2 during photosynthesis.	2	2
ii. Evolution of CO_2 during respiration.	1	1
iii. Moll's half leaf Experiment.	2	2
iv. Evolution of heat during respiration (Thermos flask Experiment)	(2)	1

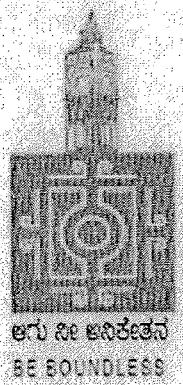
LIST OF EXPERIMENTS FOR D&E.

i. Photosynthesis at different wavelengths of light
ii. Photosynthesis at different concentrations of CO_2
iii. Respirometer experiment for RQ
iv. Kuhne's fermentation vessel
v. Hydrotropism
vi. Phototropism
vii. Geotropism
viii. Arc Auxanometer

REFERENCES

1. Buchanan, B.B, Gruissem, W. and Jones, R.L.2004. **Biochemistry and Molecular Biology of plants**. I.K.International Pvt. Ltd., New Delhi,
2. Dey and Harborne, J.B. (eds.) 1997. **Plant Biochemistry**. Academic press, New York.
3. Hall (1980), **Photosynthesis. 4 edition** Atlas publishers, New Delhi
4. Hall, D.O. and Rao, K.K. 1999 **Photosynthesis. 6 edition**, published in association with the Institute of Biology, Cambridge University Press. Cambridge, U.K.
5. Harborne, T.C 1981 **Phytochemical Methods**: A guide to Modern Techniques of **Plant Analysis**. Chapman and Hall, London.
6. Hopkins, W.G. 1995. **Introduction to Plant Physiology**, John Wiely and Sons, New York.
7. Moore, T.C. 1989. **Biochemistry and Physiology of Plant Hormones. 2 edition** Springer-Verlag, New York, USA.
8. Moore, T.C.1974. **Research Experiences in Plant Physiology: A laboratory Manual**. Springer. Verlag, Berlin.

9. Muheyi, S and Ghosh, A.K. 2005 **Plant Physiology** New Central Book Agency (p) Ltd. 8/1 Chintamonu Das Lane, Kolkata 2009. India.
10. Plummer, D.T.1998. An Introduction to Practical **Biochemistry**. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
11. Purohit, S.S.2009 **Biochemistry-Fundamentals and Applications**. Gobies (India)
12. Salisbury and Ross. 2005. **Plant Physiology**, Thomson Wads Worth.
13. Singhal G.S., Renger G., Sopory S.K., Irrang K.D. &Govindjee 1999. Concepts in **Photobiology: Photosynthesis & Photomorphogenesis**. Narosa Pub. House, New Delhi.
14. Stumpf, P.K. and Conn, E.E. (eds.) 1988. **The Biochemistry of Plants-** A Comprehensive treatise. Academic Press, New York.
15. Sunderajan, S. 1997. **College Botany Vol.III**, Himalaya Publications.
16. Taiz and Zeiger 2004. **Plant Physiology 3 edition**. Panima Publishing Corporation, New Delhi/Bangalore.
17. Taiz C and Zeiger E .1998 **Plant Physiology. 2 edition** Sinauer Associates, Inc, Publishers, Massachusetts, USA
18. Taiz. L. and Zeiger, E. 2003. **Plant Physiology. 3 edition**. Panima Publishing Corporation, New Delhi.
19. Thomas B. & Vince-Prue D. 1997. **Photoperiodism in plants. 2 edition**. Academic press, San Diego, USA.
20. Wilkins, M.B. (eds). 1989. **Advanced plant physiology**. Pitman Publishing Ltd., London
21. Wilkins,M .B. 1998. **Advanced physiology**, ELBS, Longman
22. Wilson, K and Goulding, K.H. (eds.) 1986. **A Biologist Guide to Principles and Techniques of Practical Biochemistry**. Edward Arnold, London, UK.



BENGALURU CITY UNIVERSITY

SYLLABUS For B.Sc BOTANY
(I & II Semester)

CHOICE BASED CREDIT SYSTEM

2020-2021

PROCEEDINGS OF THE MEETING OF THE BOARD OF STUDIES (UG) IN BOTANY BANGALORE CENTRAL UNIVERSITY HELD ON 28-06-2018 IN THE DEPARTMENT OF BOTANY, BANGALORE UNIVERSITY, BANGALORE

Venue: Department of Botany, J. B. Campus, Bangalore University, Bangalore — 560 056.

Date : 28-06-2018

Time : 11.00 AM

Agenda:

1. To finalize the draft syllabus for Choice Based Credit System for B.Sc., Botany, for approval
2. Any other academic matter with the permission of the Chair.

Members Present:

1.	**Smt. Shailaja. K. S**	**Member**	**Sd/-**
2.	**Dr. Dhaneshwari.**	**Member**	**Sd/-**
3.	**Dr.Sabiha Sultana.M**	**Member**	**Sd/-**
4.	**Dr. Lt. Ramakrishnaiah**	**Member**	**Sd/-**
5.	**Dr. Manjula. B. L**	**Member**	**Sd/-**
6.	**Prof. G. R. Janaradhan**	**External Member**	**Sd/-**
7.	**Prof. L. Rajanna**	**Chairman**	**Sd/-**

Members Absent

1.	Dr. Anitha. P	Member
2.	Dr. B. S. Jyothsna	Member
3.	Dr. N. Rajeshwari	External Member

MINUTES OF THE BoS (UG) MEETING:

Chairman welcomed the members to the meeting and thereafter the agenda were taken up for discussion

a) The draft scheme of study, Examination and Syllabus for Choice Based Credit System for I and II Semester B. Sc., Botany, were scrutinized, discussed and approved after minor changes.

b) The Chairperson BoS was authorized to make necessary modifications wherever it is required.

The meeting ended with a vote of thanks by the Chairman.

Chairman
Professor & Chairman
Department of Botany
Bangalore University
Bangalore - 560 056.

MINUTES OF THE BOS (UG) MEETING:

Chairman welcomed the members of the UG Board to the meeting and agenda was placed for discussion

a. Discussed and finalized the syllabus and scheme of examination for I and II Semester B.Sc., Botany (Theory and Practicals) question paper pattern, and scheme of valuation for the introduction of choice based credit system (CBCS).

b. The panel of Examiners was approved and recommended for UG Examinations for the academic year 2018-19

c. Names were recommended for the constitution of a BoE for the academic year 2018 – 19

d. Names were recommended by the BoS (UG) to be nominated by Vice Chancellor for BOAE.

e. The Chairperson was authorized to finalize the BoE (UG) for the year 2018-19 after looking into the number of years of service and date of entry in to the service of the teachers for consideration.

The meeting ended with a vote of thanks by the Chairman.

Chairman
Professor & Chairman
Department of Botany
Bangalore University
Bangalore - 560 056.

Name of the Board of Members (UG)	Signature
1. Prof. G.R. Ganeshan	
2. Dr. Sabiha Sultana	
3. Prof. Dhananjaya D	
4. Dr. H. Ramakrishnaiah	
5. Dr. B.L. Manjula	
6. Dr. S. Shailaja	
7. Dr. L. RAJANNA	

Professor & Chairman
Department of Botany
Bangalore University
Bangalore - 560 056.

I SEMESTER

PAPER – I: MICROBIAL DIVERSITY AND PHYCOLOGY

52 Hours

UNIT I: INTRODUCTION TO MICROBIOLOGY AND VIRUSES **13 Hrs**

Introduction and Scope of Microbiology.

Branches of microbiology - Industrial, Medical, Agricultural and Environmental Microbiology. Contributions of scientists to the field of Microbiology: Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Iwanowsky and W M Stanley.

Isolation of microbes from soil – A brief account of culture media, serial dilution, pour plate method and colony characteristics of Bacteria.

Applied Microbiology- A brief account of Bio-fertilizers, Biogas production and Bioremediation.

Introduction and properties of Viruses - Architecture of TMV & T4 Bacteriophage Multiplication (lytic and lysogenic cycle) & Transmission of viruses. Tomato leaf curl disease. Brief account of Prions and Viroids

UNIT II: STUDY OF BACTERIA **13 Hrs**

Introduction, classification of Bacteria based on shape and flagella.

Ultra structure of bacterial cell with special reference to Gram positive and Gram negative cell wall composition. Endospore – a brief account.

Reproduction – Binary fission and genetic recombination (Transformation, Transduction and Conjugation).

A brief account of plasmids – definition and properties. Structure and importance of Ti plasmid.

Bacterial nutrition. Citrus canker disease

Economic importance – Role of bacteria in Agriculture, Medicine and Industry.

General account of Phytoplasma and Sandal spike disease.

UNIT III: STUDY OF CYANOBACTERIA AND PHYCOLOGY: PART-I **13 Hrs**

Cyanobacteria: Introduction, general characteristics, thallus structure, Ultra structure of the cell, reproduction, economic importance.

SCP and Biofertilizer. Role in water pollution and treatment.

Type study: *Anabaena, Spirulina* and *Scytonema.*

Phycology-Part-I: Introduction, general characteristics, outlines of Fritsch's (1947) classification, thallus structure, pigmentation and reproduction.

Occurrence, structure, reproduction and life cycle: *Chlamydomonas* and *Volvox*

UNIT IV: PHYCOLOGY- PART –II **13 Hrs**

Occurrence, structure, reproduction and life cycle: *Hydrodictyon, Oedogonium, Chara, Sargassum,* and *Polysiphonia.*

Economic importance of Algae in Industry, Agriculture and Medicine.

PRACTICAL PAPER – I

MICROBIAL DIVERSITY AND PHYOLOGY

Total Units: 13

1. Study of instruments: autoclave, inoculation chamber/LAF, hot air oven, incubator and inoculation loop. **1 unit**
2. Sterilization of glassware and media preparation nutrient media (Nutrient Agar) Isolation of Bacteria from soil by pour plate method **1 unit**
3. Colony characteristics of Bacteria to identify colonies **1 unit**
4. Diseases: Tomato Leaf curl, Citrus Canker and Sandal spike **1 Unit**
5. Gram staining: Rhizobium from root nodules and Lactobacillus from curd **1 Unit**
6. Measurement of cell concentration – yeast cells / fungal spores using Haemocytometer **1 Unit**
7. Type study of Cyanobacteria: *Anabaena, Spirulina and Scytonema* **1 Unit**
8. Type study of Algae: *Chlamydomanas, Volvox, Hydrodictyon, Oedogonium, Chara, Sargassum* and *Polysiphonia* **6 Units**

PRACTICAL QUESTION PAPER-I

MICROBIAL DIVERSITY AND PHYOLOGY

Max Marks: 35

1. Identify & classify specimen **A, B, & C** with labelled diagrams and reasons — **3 X 3 = 9**
2. Describe colony characteristics of **D** — **1 X 2 = 2**
3. Identify and Comment on the instrument / Disease **E** — **1 X 3 = 3**
4. Prepare a temporary slide of **F,** sketch, label and identify with reasons. Leave the preparation for evaluation — **1 X 5 = 5**
5. Stain given material **G** by Gram staining. Write the procedure and identify with reasons. Leave the preparation for evaluation

   OR

   Calculate the population of fungal spores / yeast cells in **G** using haemocytometer — **1 X 4 = 4**

6. Identify Slide **H** and **I** with labelled diagrams with reason — **2 X 2 = 4**
7. Record and Submission — **5 + 3 = 8**

SCHEME OF VALUATION

1. Four specimens **A, B and C,** - one from Cyanobacteria, two from algae, (Identification – **1** mark, labelled diagram with reasons **2** marks)
2. Colony characters of the given colony **D** – **2** marks,
3. Instrument; (Identification **1** mark, working principle **1** Mark, Labelled diagram **1** mark) / Diseases (Identification **1** mark, Comment and Labelled diagram **2** marks)
4. Specimen **F** from Cyanobacteria / algae - mounting – **2** marks. Identification – **1** mark, sketch with reasons **2** marks)
5. Specimen **G** – Gram staining (Staining – **2** marks, Procedure and result – each **1** mark).

   OR

   Calculation of fungal spores / yeast cells using haemocytometer (Procedure - **2** marks, calculation – **2** marks)
6. Two permanent slides **H & I** - from Cyanobacteria / algae (Identification – **1** mark, sketch with reasons - **1** mark)
7. a) Record – **5** marks

   b) Submission of 3 algae / Cyanobacteria materials – **3** marks

REFERENCES

1. Aggarwal, S. K. 2009. **Foundation Course in Biology,** A one books Pvt. Ltd., New Delhi.
2. Aneja, K. R. 1993. **Experiments in Microbiology, Pathology and Tissue Culture,** VishwaPrakashan, New Delhi.
3. Annie Ragland, 2012. **Algae and Bryophytes,** Saras Publication, Kanyakumari, India.
4. Basu, A. N. 1993. **Essentials of Plant Viruses, Vectors and Plant diseases,** New Age International, New Delhi.
5. Chopra. G. L. 1984. **A text book of Algae,** Rastogi publications,Meerut,India.
6. Desikachari, T. V. 1959. **Cyanophyta,** ICAR, New Delhi.
7. Dubey, R. C. and Maheshwari. D.K. 2012. **Practical Microbiology,** S. Chand & Company, Pvt. Ltd., New Delhi.
8. Fritsch, R. E. 1977. **Structure and Reproduction of Algae,** Cambridge University Press,London.
9. Kodo,C.I.and Agarwal, H.O.1972. **Principles and techniques in Plant Virology,** Van Nostrand, Reinhold Company, New York.
10. Madhavee Latha, P. 2012. A Text of Immunology, S. Chand & Co., Pvt., Ltd., New Delhi.
11. Pandey B.P. 2001. **College Botany Volume 1,** S Chand & Company Pvt.Ltd, New Delhi.
12. Pandey. B.P. 2014 **Modern Practical Botany,** (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
13. Pelzar, Kreig and Chan 1963. **Microbiology,** Tata Mc Graw Hill, New Delhi
14. Rangaswamy, G. 2009, **Disease of Crop Plants in India,** Prentice Hall of India, New Delhi.
15. Sambamurty. A.V.S.S. 2006, **A Text book of Algae,** I. K. International Publishing House, Pvt. Ltd., New Delhi.
16. Sharma, P. D. 2012, **Microbiology and Plant Pathology,** Rastogi Publication Pvt Ltd., Meerut, India.
17. Singh, R. P. 2007. **Microbial Taxonomy and Culture Techniques,** Kalyani Publication, New Delhi.
18. Smith ,G. M. 1996. **Cryptogamic Botany Volume I,** Tata Mc Graw Hill, New Delhi.
19. SundarRajan. S. 2010.**College Botany Semester I** ,Himalaya Publications, Mumbai.
20. Vashishta, B.R. Sinha, A.K. and Singh, V. P. 1991. **Algae,** S. Chand and Company,Pvt. Ltd., New Delhi.

Web Sites

http://www.phycology.net/

http://www.algaebase.org/

II SEMESTER

PAPER II: MYCOLOGY, BRYOLOGY AND PLANT ANATOMY

52 Hrs

UNIT I: MYCOLOGY **13hrs**

Introduction: General characters, thallus organisation, reproduction and outlines of Ainsworth classification

Structure, reproduction and life history of *Albugo, Peziza, Puccinia* and *Cercospora.*

Economic importance: Role of fungi in Medicine, Agriculture and Industry

UNIT II: LICHENS, MYCORRHIZAE AND FUNGAL DISEASES **13 hrs**

Lichens: General account, Structure and reproduction. Ecological and Economic importance.

Mycorrhizae: General account

Fungal Diseases: General account of symptoms, pathogen etiology, mode of infection. Management of fungal diseases: Koleroga, Coffee rust, Grain smut of Sorghum, Blast disease of Rice, Red rot of Sugarcane.

A brief account of Biopesticides: Neem, *Trichoderma* and *Bacillus thuringiensis*

UNIT III: BRYOPHYTA **13 hrs**

General characters, Study of distribution, structure, reproduction, Classification and alternation of generation in *Marchantia, Anthoceros* and *Funaria*

UNIT IV: PLANT ANATOMY **13 hrs**

Meristematic Tissues: Structure, function and classification.

Organisation of Apical Meristems: Tunica-corpus theory and Histogen theory.

Histology: Structure, Classification and significance of simple, complex and secretory tissues. Types of vascular bundles

Secondary growth: Dicot stem. Example: *Tridax*

Anomalous Secondary growth: *Boerhaavia and Dracaena.*

PRACTICAL PAPER – II

PAPER II: MYCOLOGY, BRYOLOGY AND PLANT ANATOMY

Total units - 13 Units

1. Identification and study of fungal members included in the theory — **3 Units**
2. Study of lichens — **1 Unit**
3. Study of Mycorrhiza — **1 Unit**
4. Study of plant diseases included in the theory — **2 Units**
5. Study of forms of Bryophytes included in the theory — **3 Units**
6. Anatomy-sectioning: Dicot stem Ex. : *Tridax*
   Anomalous secondary growth in *Boerhaavia* and *Dracaena* — **3 Units**
7. Project report of :
   1 Mushroom cultivation
   2 Application of Biofertilizers
   3 Isolation of Fungi from spoiled fruits & vegetables
   4 Study of Mycorrhizae

PRACTICAL QUESTION PAPER - II

PAPER II: MYCOLOGY, BRYOLOGY AND PLANT ANATOMY

Time: 3 hours **Max. Marks: 35**

Identify and classify specimens **A, B & C** with labelled diagrams and reasons — **3 X 3 = 9**

2. Prepare a temporary stained T.S of the material **D.** Sketch, label and identify with reasons. Leave the preparation for evaluation — **4**
3. Write critical note on **E** — **2**
4. Identify the Slides **F,G,H & I** with labelled diagrams and reasons — **4 X 3 = 12**
5. Record and submission. — **5 + 3 = 8**

SCHEME OF VALUATION

1. Two specimens from Fungi and one from Bryophytes (Identification -1 mark, Labelled diagram with reasons 2 marks)
2. Any one of the following may be given-stem of *Tridax, Boerhaavia* or *Dracaena* (Staining and mounting- 2 marks, sketch and labelling- 1 mark, Identification with reasons- 1 mark)
3. One diseased plant/Lichens/ (Identification-1 mark & critical points1 mark)
4. Two from Bryophytes, One from Fungi and One from Anatomy (Identification & Classification -2 mark, labelled diagrams with reasons-2 marks)
5. Record & Project submission: (marks 5+3)

REFERENCES

1. Alexopoulos, C. J 1992. **An Introduction to Mycology**, New Age International, New Delhi.
2. Alexopoulos, C. J and Mims, C. W. 1990. Introductory Mycology, 5 edn. Wiley Estern Ltd., New Delhi.
3. Cutter, D.G.1971.Plant **Anatomy-Part I & II**, Edward Arnold, London.
4. Fahn, A.1985. **Plant Anatomy**,Pergaon Press, Headington Hill Hall,Oxford.
5. Jim Deacon, 2007, **Fungal Biology 4 edn.** First Indian reprint, Blackwell publishing Ltd., India.
6. Katherine Easu, 1993. **Anatomy** 2 edn. Wiley Eastern Pvt., Ltd., New Delhi.
7. Pandey, B. P. 2001. **College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses,Plant Pathology, Industrial Microbiology and Bryophyta.** S. Chand and CompanyPvt.Ltd., New Delhi.
8. Parihar, N. S. 1970. **An Introduction to Embryophyta, Vol. I Bryophyta** Central Book Depot, Allahabad.
9. Rashid, A.1998. **An Introduction to Bryophyta**. Vikas Publishing House Pvt. Ltd., New Delhi.
10. Sambamurthy, A. V. S. S. 2006. **A text book of Plant Pathology,** I. K. International Pvt. Ltd., New Delhi.
11. Sharma, O. P. 1992. **Textbook of Thallophyta**, Mc Graw Hill Publishing Co., New Delhi.
12. Singh, R. S 1978. **Plant Diseases 4 edn**. Oxford and IBH, New Delhi.
13. Smith, G. M. 1994. **Cryptogamic Botany Vol II, 2 edn.** Tata Mc Graw Hill, New Delhi.
14. Sporne, K. R. 1966. **Bryophytes**, 4 edn. B. I. Publishing Pvt., Ltd., India.
15. Thakur, A. K. and S. K. Bassi, 2008. **A Textbook of Botany: Diversity of Microbes and Cryptogams**. S Chand and Company Ltd., New Delhi.
16. Vashishta, B. R 1990. **Botany for degree students: Fungi.** S Chand and Company Ltd., New Delhi.
17. Vashishta. B. R. Sinha, A.K. and Adarsha Kumar. 2009. **Botany for Degree Students:Bryophyta**. S Chand and Company Ltd., New Delhi.
18. Watson, E. V. 1974. **The Structure and life of Bryophytes**, B. I Publication, New Delhi.

III SEMESTER

PAPER - III: PTERIDOPHYTES, PALEOBOTANY, ECOLOGY AND PHYTOGEOGRAPHY

52 hrs

UNIT I: PTERIDOPHYTES **13 hrs**

Introduction and general character with classification (Sporne).
Study of diversity in morphology,anatomy and reproduction of the following groups in representative forms

1. Psilotopsida – Eg: *Psilotum.*
2. Lycopsida – Eg: *Lycopodium, Selaginella.*
3. Filicopsida – Eg: *Marsilea.*

(Developmental stages not required)

Brief account of Telome theory, Stelar evolution, heterospory and seed habit.

UNIT II: PALEOBOTANY **13 hrs**

Contribution of Paleobotanist-Birbal Sahni.
Outline of geological time scale with special emphasis on Paleozoic and Mesozoic Era. Process of fossilization– Compression, Impression and Petrifaction.
Type Study: *Rhynia, Cycadeoidea* and *Pentaxylon.*

UNIT III: PLANT ECOLOGY Part - I **13 hrs**

Introduction and scope of Plant Ecology
Ecological Factors: Climatic – Light, Temperature, Rainfall, Wind and Atmospheric humidity.
Edaphic factors: Soil Formation, Soil Profile, Soil air and Soil Microorganisms
Soil Erosion: Water and Wind.
Soil Conservation:
Biological – Contour farming, Mulching, Strip cropping, Terracing and Crop Rotation.
Mechanical – Basin Listing and Construction of dams
Soil reclamations
Biotic Factors – Positive and negative interactions.
Ecosystem – Concept, Components, Study of marine, Grassland and Cropland Ecosystems.
Ecological Succession – Hydrosere and Xerosere.
Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.

UNIT IV: PLANT ECOLOGY Part - II **13 hrs**

Water Shed Management with reference to Rain water harvesting
Conservation of natural resources:

- Conservation of plant resources (Value added products/Botanicals), Conservation of Germplasm (Quarantine)
- Bio energy, Biofuels and Phyto remediation
- Afforestation, Social Forestry and Agroforestry.

Conservation of plant diversity:

In-situ and *Ex-situ* Conservation – National park, Sancturies and Bioreserves. Role of Seed Bank and Gene Bank.

PHYTOGEOGRAPHY

Phyto-geographical regions of India. Vegetational types of Karnataka.

PRACTICAL PAPER– III

PTERIDOPHYTES, PALEOBOTANY, ECOLOGY AND PHYTOGEOGRAPHY

Total Units – 13

1.	Identification and Classification of Pteridophytes (examples studied in theory)	**3 units**
2.	Paleobotany – Study of specimens and slides (fossil material/slide)	**1 unit**
3.	Ecological Adaptations – Study of one example for each adaptation	**2 units**
4.	Estimation of chloride and dissolved oxygen content in the given sample	**2 units**
5.	Water potability test – Bacteriological test for different samples of drinking water, Calculation of most probable number	**2 units**
6.	Study of Quadrat method in Ecology and studying soil sample and analysis of soil sample for structure(texture) pH etc.	**2 units**
7.	Marking of vegetation types of Karnataka on Karnataka map and Phytogeographical areas of India	**1 unit**
8.	Record & submissions: Submission of 3 slides of free hand sections (Pteridophytes / Ecological Specimens)	

PRACTICAL QUESTION PAPER–III

PTERIDOPHYTES, PALEOBOTANY, ECOLOGY AND PHYTOGEOGRAPHY

Time: 3 Hrs **Max. Marks: 35**

1. Identify and classify specimen A & B giving reasons.	**2X3=6**
2. Identify the slides C, D & E with reasons and diagrams.	**3X3=9**
3. Comment on slide/specimen/photocopy/photograph of F.	**1X3=3**
4. Identify and comment on the Ecological adaptations of G & H (Vegetation patterns of Karnataka).	**2X2½=5**
5. Estimate the Oxygen/Chloride content of the given sample/ Water potability test.	**1X4=4**
6. Record and Submission	**5+3=8**

SCHEME OF VALUATION

1. Pteridophytes - (Identification & classification – **1** mark, Reasons – **2** marks).
2. Pteridophytes - (Identification – **1**mark, Reasons – **1** mark, Diagram – **1** mark).
3. Fossil Material - (Identification – **1** mark,comment – **2** marks)
4. Specimen/Slide / Map - (Identification – **1** mark,comment – **1.5** marks)
5. Estimation (Conducting experiment – **2** marks ,principle, procedure & result **2** marks)
6. Record and Submission: 3 permanent slides of free hand sections of Pteridophytes and ecological specimens (**5+3 = 8** marks).

REFERENCES

1. Agarwal, K.C. 2001.**Environmental Biology**,Nidi Publications Ltd., Bikaner, London.
2. Agashe, S.N. 1995. **Paleobotany, Plants of the past, their evolution, paleoenvironment and application in exploration of fossil fuels.** Oxford & IBH Publishing Co., Pvt.Ltd. New Delhi.
3. Andrews, H.N. 1961. **Studies in Paleobotany, John** Wiley, New York.
4. Asthana, D.K. and Meera Asthana 2013 **A Text book of Environmental Studies**, S. Chand and Company Pvt Ltd., New Delhi.
5. Cain, S.A. 1944. **Foundations of Geography**, Harper and Bros. New York.
6. Good, R.D. 1974. **The Geography of Flowering Plants. 3 edition.** Long Mans. London.
7. Odum, E. P. 1971.**Fundamentals of Plant Ecology**. W. B. Snderson Co., Philadelphia
8. Parihar N. S. 1977. **The Morphology of Pteridophytes**. Central Book Depot. Allahabad
9. Polumine, N. 1950. **Introduction to Plant Geography**. Longmans Publishers, London.
10. Rashid. A 1998. **An Introduction to Pteridophyta. 2 edition.,** Vikas Pub. House Pvt., Ltd., New Delhi
11. Sharma. P. D. 1993. **Ecology and Environment**, Rastogi Pub., New Delhi
12. Sporne, K. R. 1966. **The Morphology of Pteridophytes. The structure of ferns and allied plants.** Hutchinson University Library, London.
13. Trivedi, R.K. 1995. **Advances in Environmental Sciences and Technology**, Ashish Publishing House, New Delhi.
14. Valentine,D.H. 1972. **Taxonomy, Phytogeography and Evolution**, Academic Press. London
15. Vasishta, B. R., Sinha,A.K. and Anil Kumar. 2005. **Botany for Degree Students-Pteridophyta**. Multicolour Illustrative edition. S .Chand and Co., Pvt. Ltd., New Delhi.
16. Wagnaer, K.D.1998. **Environmental Management**,W.B. Saundars Co., Philadelphia.

IV SEMESTER

PAPER–IV: GYMNOSPERMS, EMBRYOLOGY OF ANGIOSPERMS, PALYNOLOGY AND TISSUE CULTURE

NIT – I GYMNOSPERMS

13 Hrs

General characters and classification. Economic importance of Gymnosperms with special mention of Taxus, Pinus, Ephedra and Gingko. Morphology and Anatomy of vegetative structures - Root, stem and leaf (primary and secondary growth), Reproductive structures (Developmental Stages not required) and life cycles of *Cycas* and *Gnetum* (Evolutionary significance of *Gnetum*)

NIT – II EMBRYOLOGY OF ANGIOSPERMS - I

13 Hrs

Microsporangium - Development & structure of mature anther. Anther wall layers. Tapetum - types, structure & functions. Sporogenous tissue.
Microsporogenesis - Microspore mother cells, microspore tetrads, Pollinia.
Microgametogenesis – Formation of vegetative and generative cells, structure of male gametophyte. Pollen embryosac (Nemec phenomenon).
Megasporangium – Structure of typical Angiosperm ovule.
Types of ovule- Anatropous, Orthotropous, Amphitropous, Circinotropous.
Megagametogenesis – Types of development of Female gametophyte/embryosac- (According to BGL Swamy) - monosporic- *Polygonum* type, bisporic – *Allium* type, tetrasporic - *Fritillaria* type. Structure of mature embryosac.

NIT – III EMBRYOLOGY OF ANGIOSPERMS – II

13 Hrs

Double fertilization – pollen germination, growth of pollen tube through style, entry of pollen tube into ovule (porogamy, mesogamy and chalazogamy), entry of pollen tube into the embryosac, pollen tube discharge, syngamy, triple fusion. Significance of double fertilization, post fertilization changes.
Endosperm – Types and its biological importance. Free nuclear (*Cocos nucifera*) cellular (*Cucumis*), helobial types. Ruminate endosperm.
Embryogenesis – Dicot (*Capsella bursa-pastoris*) and Monocot (*Najas*).
Parthenocarpy. Polyembryony- definition and types.
Contribution of Indian Botanists – BGL Swamy and P Maheswari.

NIT – IV PALYNOLOGY AND TISSUE CULTURE

13 Hrs

PALYNOLOGY- pollen morphology – pollen wall, aperture, shape, size and architecture, NPC system, pollen wall stratification. Applied Palynology – Aeropalynology, Mellissopalynology.
PLANT TISSUE CULTURE TECHNIQUE - Definition, Totipotency, basic steps in plant tissue culture technique. Nutrient media - basic components, composition of MS & White's media.
Tissue culture techniques and their practical applications - Biotransformation, synthetic seed technology. Anther culture, Embryo culture, protoplast culture and Somatic Embryogenesis. Plant tissue culture industry in India – Scope, products - (Micropropagation of Horticulture plants/plant extracts-) export potential, Indigenous market.

PRACTICAL – IV

GYMNOSPERMS, EMBRYOLOGY OF ANGIOSPERMS, PALYNOLOGY AND TISSUE CULTURE

13 Hrs

1) Study of materials and permanent slides of Gymnosperms included in Theory **5 units**
2) Permanent slides of microsporogenesis and male gametophyte **1 unit**
3) Mounting of Pollen grains – *Grass, Hibiscus,* Pollinia of *Calotropis* and Pollen Germination (hanging drop method) **1 unit**
4) Permanent slides: Types of ovules, Megasporogenesis & embryosac Development **1 unit**
5) Permanent slides: Types of placentation — Axile, Marginal, Parietal, basal types. Sectioning of ovary, for any two types of placentation. **1 unit**
6) Mounting of embryo - *Tridax* and *Cyamopsis*. **1 unit**
7) Mounting of endosperm - *Cucumis*. **1 unit**
8) Mini project work in groups of 3-5 students, from the following list. **2 units**

a) Study of pollen morphology of different flowers with respect to shape, colour, Pores etc.
b) Pollen germination of different pollen grains and calculate percentage of germination.
c) Calculating percentage of germination of one particular type of pollen grain collected from different localities/ under different conditions.
d) Study of placentation of different flowers.
e) Tissue culture – Synthetic seeds, Seed culture and stem culture etc.
f) Any other relevant study related to Gymnosperms / Embryology.

Mini project work may be carried out in groups of 3-5 students, supervised by the batch in charge. The mini project report, about 5-6 pages (type written), to be prepared in following format and certified by the teacher in charge and HOD to be submitted in practical examination. 1. Introduction 2. Aim of study 3. Materials & Methodology 4. Observation 5. Conclusion, Copies to be submitted separately by individual members of the group.

PRACTICAL QUESTION PAPER–IV

GYMNOSPERMS, EMBRYOLOGY OF ANGIOSPERMS, PALYNOLOGY AND TISSUE CULTURE

Time: 3 hours. **Max Marks: 35**

1. Identify and classify specimens A and B giving reasons	**2X3= 6**
2. Identify the slides C, **D, E & F** with reasons and labelled diagrams	**4X3=12**
3. Mount the embryo/Endosperm of specimen **G** & comment.	**1X5=5**
4. Mount the pollinia/perform pollen germination of specimen **H** & comment	**1X4=4**
5. Record & submission	**5+3=8**

SCHEME OF VALUATION

1. Gymnospem materials - *Cycas* and *Gnetum* (Identification & classification-**1** mark, reasons-**2** marks).
2. One Gymnospem slide, one from T.S. of young anther/ mature anther, one from megasporogenesis/ stages of embryosac development. /placentation (Permanent slides or fresh free hand sections)/ types of ovules included in theory. (Identification – **1** mark. Diagram-**1** mark, reasons- **1** mark).
3. Endosperm /Embryo mounting (preparation- **3** marks, comment with diagram-**2** marks).
4. Hibiscus pollen/ Pollinia / pollen germination (preparation-**2** marks, comment with diagram- 2 marks)
5. Record & submission of mini project report (**5 + 3** marks)

REFERENCES

1. Bhatnagar, S.P. and Moitra, A. **Gymnosperms**, New Age Publications, New Delhi
2. Bhojuwani, S. S. and Bhatnagar, S. P 1979. **The Embryology of Angiosperms**, Vikas Pub, New Delhi.
3. Chopra,G.L. and Verma,V.1988.**Gymnosperms.** Pradeep Publications, Jalandar, India.

V SEMESTER

PAPER-V: TAXONOMY AND ECONOMIC BOTANY

39 Hrs

UNIT: I CLASSICAL TAXONOMY — 13 Hrs

Aim and Scope of taxonomy. Brief History. Broad outline of classification proposed by Bentham & Hooker, Engler & Prantl and their relative merits and demerits. Species concept: Taxonomic hierarchy, species, genus and family.

Biosystematics: Plant nomenclature, Binomial system, ICBN - rules for nomenclature. Taxonomic Tools, Herbarium and its techniques, Floras and their importance. Botanical gardens and their importance (one state level, one national level & one international level). (Examples: State: Lalbagh, National: Indian Botanical garden Sibpur. Calcutta. International: Royal Botanical garden, Kew, England). Chemotaxonomy. Cytotaxonomy. Numerical taxonomy & application of computer.

UNIT: II TAXONOMICAL STUDIES OF FAMILIES — 13hrs

Taxonomic studies of following families, according to Bentham & Hooker system of classification and their economic importance.

Dicotyledoneae Families: Polypetalae - Magnoliaceae, Cucurbitaceae, Brassicaceae, Rosaceae and Apiaceae.

Gamopetalae – Asteraceae, Asclepediaceae and Lamiaceae.

Monochlamydae – Euphorbiceae

Monocotyledoneae Families: Poaceae (Special reference to importance of Cereals and millets) and orchidaceae.

UNIT: III ECONOMIC BOTANY — 13 Hrs

A brief account of pulses.

Study of the following plants with Botanical names, Family, part used, and economic uses.

Edible oils: Groundnut, Coconut and Sesamum; Fibres: Cooton, Jute and Coir;

Beverages: Coffee, tea and cocoa; Timber: Teak and Rosewood; Natural dyes: Indigo;

Spices: Cardamom, clove, cinnamon, saffron and Nutmeg.

Ethnobotany: Ethnopharmacology/Ethnomedicobotany – Definition, Botanicals and application methods of Aloe, Brahmi, Holy basil, Neem, Mint, Turmeric & Nelanelli.

Pomology: Importance of fruits as food and medicine and commercial values – Mango, pomegranate and grape.

Horticulture techniques: Vegetation propagation – Gootee, Grafting and Cutting.

Green house/polyhouse, organic farming, terrace gardening, Hydroponics, Compost and microgreens.

PRACTICAL PAPER V

TAXONOMY AND ECONOMIC BOTANY

Total Units: 13

1. Morphology of Angiosperms – Vegetative Structure and modifications of root/stem and inflorescence. **1 Unit**
2. Morphology of Angiosperms – flower and fruit **1 Unit**
3. Methods of identification of plants with Technical terms. **1 Unit**
4. Study of taxonomic characters of families included in theory (Minimum one genus from each family) **5 Units**
5. Study of economically important plants covered in theory to identify with Botanical names, families, parts used and Economic uses. **2 Units**
6. Herbarium techniques. **1 Unit**
7. Horticulture techniques **2 Units**
8. Study of local flora by arranging local collection trips.
9. Record & Submission of 6 Herbaria with field notes of plants included in theory. (It can be reduced to 3/replaced with tour report on Botanical trip/any of the horticulture techniques carried out).

PRACTICAL QUESTION PAPER- V

TAXONOMY AND ECONOMIC BOTANY

Time: 3 hrs **Max marks: 35**

1. Assign the specimens **A & B** to their respective families giving diagnostic features. 2×3=6
2. Describe **C** in technical terms; draw the floral diagram with floral formula. 1X6=6
3. Comment on Horticulture technique **D** 1X3=3
3. Identify the specimen **E, F, G, H, I &J** with their morphological, Biological & Economic importance. 6x2=12
4. Record and Submission. (Herbaria with field notes) 5+3=8

SCHEME OF VALUATION

1. One Polypetalae, one Gamopetalae/Monocot (Identification ½ mark, Classification 1 mark, Diagnostic features 1½ mark)
2. Dicot plant (Technical detail 2 marks, floral diagram 2 marks, floral formula 2 marks)
3. Horticulture technique- Vegetative propagation/hydroponics/mangroves – Comment- 3marks
4. Root/ Stem/ Leaf modification/ Inflorescence/ Fruit and/ Economic Importance (Any two). (Identification ½ mark, diagram½ mark, description 1 mark, for economic importance, identification with family 1 mark, part use ½ mark economic uses ½ mark)
5. Record- 5 marks.
6. Submission of Six herbaria with field notes of family's studies, ½ marks each-3 marks

REFERENCES

1. Bierhorst, D .W. 1971. **Morphology of vascular Plants**. Macmillan, New York.
2. Chandel, K.P.S, Shukla,G and Sharma,N. 1996. **Biodiversity in Medicinal and Aromatic plants in India: Conservation and Utilization**, NBPGR, New Delhi.
3. Cronquist A. 1981. **An Integrated System of Classification of Flowering Plants**. Columbia University Press, New York.
4. Cronquist, A. 1988. **The Evolution and Classification of Flowering Plants**. Second Edn.,New York Botanical Garden, New York.
5. Dutta. S.C.1988. **Systematic Botany** Wiley Easter, New Delhi.
6. Ernest M. Gifford, A S. Foster.1989. **Morphology and evolution of vascular plants,** W.H. Freeman and Co., New York
7. Gamble. J.S. 1986. **Flora of Presidency of Madras**. Reprint - Bishen Singh and Mahendra Pal Singh, Deharadoon
8. Heywood,V.H.and Moo+re,D.M. 1984. **Current concepts in Plant Taxonomy**. Academic press, London
9. Hutchinson. J.1973.**The Families of Flowering Plants 3 edition.** Oxford University Press, Oxford.
10. Kocchar. S.L.1998. **Economic Botany of the Tropics.2 edition.** Mac millan IndiaLtd., Deihi.
11. Lawerence G.H.M,1951. **Taxonomy of Vascular plants**, Oxford & IBH publication, New Delhi.
12. Naik ,V.K.1984. **Principles and trends in the taxonomy of angiosperms**. Tata McGraw-Hill Co. Ltd., New Delhi.
13. Pandey, B.P.2014.**Economic Botany**,S.Chand and Company Pvt.ltd., New Delhi.
14. Pandey and Misra 2008. **Taxonomy of Angiosperms**: Ane Books Pvt Ltd,New Delhi
15. Pullaiah, T. 1998. **Taxonomy of Angiosperms**. Regency Publications, New Delhi.
16. Radford,A.E.,Dickinson W.C., Massey,J.R. and Ben.C.R. 1974. **Vascular Plant Systematics,** Harper and Row, New York.
17. Sambamurthy. A.V.S.S.2005.**Taxonomy of Angiosperms**. IK International publishers, New Delhi

V SEMESTER

PAPER VI: MOLECULAR BIOLOGY, GENETIC ENGINEERING, BIOTECHNOLOGY AND PLANT PHYSIOLOGY

39 hrs

UNIT I MOLECULAR BIOLOGY — 13 hrs

Introduction, Discovery, Chemical nature& replication of genetic material, genetic code, non genetic RNA, Biosynthesis of proteins, Regulation of gene action in prokaryotes (Lac operon concept only).

GENETIC ENGINEERING & BIOTECHNOLOGY: Steps in Recombinant DNA technology, Genomic libraries, application of genetic engineering technology in agriculture.A brief account on hazards & safe guards of genetic engineering technology with special reference to Bt Cotton. A brief account of Bioinformatics and its uses.

UNIT II MICROBIAL BIOTECHNOLOGY — 13 hrs

Uses of microbes in industry and agriculture fermentation – production of ethanol, production of antibiotics – Penicillin.

PLANT PHYSIOLOGY- I – Water Relations: Importance of water, Diffusion, Osmosis, water potential, Osmotic Potential, Membrane and their Permeability.Absorption Of Water- Mechanisms of water absorptions, factors affecting rate of waterabsorption.

Stress Physiology: Water stress, heat stress, salt stress and mechanisms of Plant response to water and related stress.

UNIT III PLANT PHYSIOLOGY – II — 13 hrs

Mechanism of ascent of Sap – Vital and physical force theories.

Transpiration – Loss of water, Types, Mechanisms, Stomatal Dynamics, Stomatal mechanism, Significance, Factors affecting transpiration, anti - transpirants, Guttation.

Mineral Nutrition In Plants - Major& Minor elements, their deficiency symptoms in plants.

Phloem Transport- Transport of organic solutes.Path of transport, vein loading and unloading.Transcellular or streaming hypothesis, contractive protein hypothesis, mass flow hypothesis.Source – Sink concept.

PRACTICAL PAPER–VI

MOLECULAR BIOLOGY, GENETIC ENGINEERING, BIOTECHNOLOGY AND PLANT PHYSIOLOGY

Total Units – 13

1. Qualitative Test for Starch, Protein, Reducing Sugars and Lipids.	2 Units
2. Determination of Osmotic potential of the cell sap by Plasmolytic method.	1 Unit
3. Determination of Stomatal Index.	1 Unit
4. Structures of Stomata in Hydrophytes, Mesophytes and Xerophytes.	2 Units
5. Streaming of Protoplasm to show Cyclosis.	1 Unit
6. Determination of pH of Plant Samples by using Indicators.	1 Unit
7. Study of Osmosis & Transpiration Experiments.	3 Units
8. Study of Phloem Transport by Ringing Experiment.	2 Units

PRACTICAL QUESTION PAPER–VI
MOLECULAR BIOLOGY, GENETIC ENGINEERING, BIOTECHNOLOGY AND PLANT PHYSIOLOGY

Time 3 hours **Max. Marks 35**

1. Conduct the biochemical test of sample **A** and **B**.	3 x 3= 6
2. Determine the osmotic potential of the cell sap by plasmolytic method / stomatal index of material **C**	1X4=4
3. Determine the pH of the given sample **D**.	1X2=2
4. Set up and comment on the experiment **E**.	1X6=6
5. Comment on experiment **F** and **G**.	4+4 = 8
6. Record.	05

SCHEME OF VALUATION

1. Samples – Starch, Protein, Reducing Sugar and Lipids (Positive Test - **1** mark, Negative Test – **2** marks).
2. Conducting the Experiment – **3** marks; Principle – **2** marks; Procedure **1** mark; Result – **2** marks.
3. Extract from Root, Stem, Leaves of a Plant to be given (Determination of pH - **1** mark, Comment – **1** mark).
4. Experiments of E: a. Potato Osmoscope.
   b. Thistle Funnel experiment.
   c. Farmer's Potometer.
   d. Ganongs Potometer.

(Requirements – **1** mark, Principle – **1** mark, Procedure & Conducting Experiment – **3** marks, Result – **1** mark)

5. Experiments of **F & G**: a. Streaming of Protoplasm (Cyclosis).
   b. Balsam Plant experiment.
   c. Bell Jar experiment.
   d. Transpiration Pull.
   e. Mass Flow Hypothesis.
   f. Ringing Experiment.
   (Identification – **1** mark, Comment – **3**)
6. Record **5** marks.

REFERENCES

1. Buchanan, B. B, Gruissem, W. and Jones, R. I 2004. **Biochemistry and Molecular Biology of Plants**. I. K. International Pvt. Ltd., New Delhi.
2. Dey and Harborne, J. B. (eds.) 1977. **Plant Biochemistry**. Academic Press. New York.
3. Dubey, R. C. 2014. **Advanced Biotechnology**, S. Chand & Company Pvt. Ltd.. New Delhi.
4. Hall, D. O. and Rao, K. K. 1999. **Photosynthesis. 6 edition**. published in association with the Institute of Biology. Cambridge University Press. Cambridge. U.K.
5. Harborne. T. C 1981. **Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis**. Chapman and Hall, London.
6. Lodish, Berk, Matsudaira, Kaiser, Kriega, Scott. Zipursky Darnell, 2004. **Molecular cell Biology Fifth Edition**, W. H. Freeman and company, New York.
7. Moore, T. C. 1989. **Biochemistry and Physiology of Plant Hormones. 2 edition**. Springer – Verlag, New York.
8. Moore, T. C. 1974. **Research Experiences in Plant Physiology**: A Laboratory Manual, Springer. Verlag, Berin.
9. Peter Snustad, D and Michael. J. Simmons 2006. **Principles of Genetics. 4 edition.** Waley and Sons – INC.,New York.
10. Plummer. D. T. 1988. **An Introduction to Practical Biochemistry**. Tata Mc Graw – Hill Pub. Co., Ltd., New Delhi.
11. Ramawat. K. G and Shaily Goyal, 2010. **Molecular Biology and Biotechnology**. S. Chand and Company Pvt. Ltd., New Delhi
12. Singhal, G. S. Renger. G. Sporty S. K., Irrang. K. D and Govindjee. 1999 **Concepts in Photobiology, Photosynthesis and Photo morphogenesis.** Narosa Publishing House. New Delhi.

VI SEMESTER

PAPER–VII: CYTOLOGY, GENETICS, EVOLUTION AND PLANT BREEDING

NIT 1 **CELL & CHROMOSOME BIOLOGY 13 hrs** Cell as a fundamental unit of life and organism. Structure of eukaryotic chromosome;centromere,kinetochore and telomere. Nucleosome and its importance in the organisation of eukaryotic chromosome. Types of Chromosomes: biarmed and holocentrictypes. **39 hrs**

Cell Division - Phases, mitotic apparatus, cytokinesis, mitotic inhibitors, significance of mitosis; Meiosis- phases of meiotic cycle cytological proof of crossing over, synaptonemal complex. Brief study on Apoptosis (PCD).

T II **MENDELIAN GENETICS** **13 hrs**

Biography of Mendel in brief: Mendel's experiments:Monohybrid cross – law of dominance, law of segregation, purity of gametes .Homozygous, heterozygous, phenotype, genotype, monohybrid test cross, Dihybridcross-law of independent assortment, dihybrid test cross, incomplete dominance(*Mirabilis jalapa*, Snapdragon).

Modification of Mendelian ratios:(With reference to plant examples). Interaction of genes epistasis (dominant & recessive); supplementary factors, complementary factors: Polygenic inheritance in Maize (Self Sterility in*Nicotiana*), Linkage & Crossing over (in Maize).

SEX DETERMINATION: Chromosomal mechanism of sex determination methods. XX –XY, ZZ – ZW & XX – XO (Sex determination in *Melandrium*) and genetic problems related to topics.

T III **EVOLUTION** **13 hrs**

Origin of life, theories of evolution, modern concepts of evolution, role of mutations in evolution, Gene duplication (2R hypothesis), Big Bang theory.Numerical changes in chromosome number, polypioidy and aneuploidy - trisomics and monosomics and Chromosomal aberrations.

PLANT BREEDING

Historical account and objectives of plant breeding.Vegetative propagation methods (underground plant parts and isolated plant parts - cutting, grafting, layering, gootee, clones) Hybridization (intergeneric and interspecific), maintenance of germplasm, pollen banks, quarantine methods.

PRACTICAL PAPER – VII

CYTOLOGY, GENETICS, EVOLUTION AND PLANT BREEDING

Total Units - 13

1. Preparation of cytological stains - Aceto carmine &Aceto orcein.	**1 Unit**
2. Mitosis from *Allium* root tips—Aceto orcein.	**3Units**
3. Meiosis from *Allium* flower buds- Aceto carmine.	**3Units**
4. Karyotype and Idiogram: Camera Lucida drawing.	**1 Unit**
5. Permanent slides of Mitosis.	**1Unit**
6. Permanent slides of Meiosis.	**1 Unit**
7. Emasculation and bagging of the flower buds of available species.	**1 Unit**
8. Genetic problems.	**2Units**
9. Record and Submission- 6 Slides (3 Mitosis and 3 Meiosis.)	

PRACTICAL QUESTION PAPER- VII

CYTOLOGY, GENETICS, EVOLUTION AND PLANT BREEDING

Time: 3 hours **Max Marks: 35**

1. Prepare a temporary mitotic, slide from material **A** identify the stage with diagrams	**1X6=6**
2. Prepare a temporary meiotic slide from material **B** identify the stage with diagram.	**1X6=6**
3. Identify and comment on **C** along with a sketch (only Karyotype).	**1X4=4**
4. Identify and comment on slides **D** and **E** with suitable sketches.	**3+3=6**
5. Solve the Genetic Problem **F**	**1X5=5**
6. Record and Submission.	**5+3=8**

Scheme of Valuation

1. Preparation- **4** marks, identification of stage - **1** mark and diagram **1** mark
2. Preparation - **4** marks, identification of stage - **1** mark and diagram **1** mark
3. Karyotype - slide or sketch, identification-**1** mark, diagram- **1** mark, comment- **2** marks

4. Slides from meiosis and mitosis identification **0.5** mark, sketch **0.5** mark and comment **2** marks.
5. Genetic problems from
    i. Dihybrid cross and test cross
    ii. Incomplete dominance
    iii. Complementary factors
    iv. Supplementary factors
    v. Epistasis - **5** marks

6. i. Record - **5** marks
    ii. 3 Mitotic and 3 Meiotic permanent slides ½ mark each - **3** marks

REFERENCES

1. Benjamine A. 2012, **Genetics- conceptual approach 4 edition.** W.H.Freeman and company, New york.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter 2007, **Molecular Biology of the Cell: 5 edition**. Garland Science. 1526 illustrations. Package with Media DVD.
3. Chaudhari, H.K.1983. **Elementary Principles of Plant Breeding,** TMH publishers Co., New Delhi
4. De Robertis E.D.P. and De Robertis, E.M.FJr, 2002. **Cell and Molecular Biology**, USA cippoctt,
5. Gardener E.J.and Sanstad D.P.1984. **Principles of Genetics** .John wiley Publishing Co., New Delhi
6. Goodenough, U.1990.Genetics,3 **edn.**, Saunders College Publishers, New York.
7. Gupta.p.k.1994, **Genetics,** Rastogi publications,New Delhi.
8. Jain J, Sanjayjain, I and Nitin jain,2005. **Fundamentals of Biochemistry**, S.Chand & company Pvt Ltd.,New Delhi.
9. Jha,A. P. 1993, **Genes and Evolution**. Mac Millan India Ltd., New Delhi.
10. John Ringo, 2004. **Fundamental genetics,** India Cambridge univ.,New Delhi
11. Mahesh.S.2008. **Plant Molecular Biotechnology,** New age Int.Publ, NewDelhi.
12. Nelson D,I and Cox, M. M.1996. **Principles of Biochemistry.** Macmillan worth Publications,New Delhi
13. Sadhu M.K.1996. **Plant propagation,** New age international publishers,New Delhi.
14. Sharma, J.R. 1994. **Principles and Practice of Plant Breeding**, Tata McGraw-Hill Publishers, New Delhi
15. Shukla R.S.and P.S.Chandel,2004.**Cytogenetics, Evolution and Plant Breeding** S.Chand and company Pvt Ltd., New Delhi

VI SEMESTER
PAPER –VIII: PLANT PHYSIOLOGY – III

39 hrs

UNIT I ENZYMES **13 hrs**

Nomenclature, classification, chemical composition, prosthetic groups coenzymes, cofactors , vitamins properties of enzymes , mechanism of enzymes action, enzyme kinetics, factors affecting enzyme activity, Inhibition of enzyme action (Competitive, Non Competitive, feedback), Allosteric enzyme.

Nitrogen Metabolism:

Sources of nitrogen, Nitrogen fixation, *nif* genes in relation to symbiotic fixation in *Rhizobim*. Synthesis of amino acids and Nitrogen cycle.

UNITII **BIOENERGETICS** **13hrs**

Photosynthesis – Introduction, ultra structure of the chloroplast, photosynthetic apparatus, principle of light absorption, Emerson's enhancement effect, photosystems I & II, Light reaction – Hill reaction, photophosphorylation (cyclic, non-cyclic), carbon reactions (Calvin Cycle, C_4 – Pathway, CAM), Factors affecting the process.

Photorespiration – Organelles involved, mechanisms and significance.

Respiration- Introduction, mechanism of aerobic respiration – glycolysis,TCA cycle, ETS and oxidative phosphorylation, mechanism of anaerobic respiration(alcoholic fermentation and lactic acid fermentation), Respiratory Quotient and its significance, factors affecting respiration.

UNIT III **PLANT GROWTH AND GROWTH REGULATORS** **13hrs**

Definitions of growth, Kinetics, Factors affecting growth, Phytohormones, Metabolism, Physiological effects, mode of action of auxins, gibberellins, cytokinins, ethylene and ABA. Applications of these hormones in agriculture and horticulture.

Plant movements – A brief account on the classification and types of movements.

Photobiology – A brief account of dormancy, Photoperiodism, phytochrome and its role, Florigen concept, Vernalization,

Defence mechanisms – A brief account of Secondary metabolites (Phenolics, Flavonoids and alkaloids) and their role in plant defence.

PRACTICAL PAPER – VIII
PLANT PHYSIOLOGY – III

Total Units : 13

1. Separation of Photosynthetic pigments by paper chromatography and measurement of Rf Values.	**1 unit**
2. Determination of rate of photosynthesis at different wavelengths of light.	**1 unit**
3. Determination of rate of photosynthesis at different concentrations of CO_2	**1 unit**
4. Estimation of Ascorbic acid content in a plant sample.	**1 unit**
5. Determination of RQ of carbohydrates, fats and proteins.	**1 unit**
6. Study of geotropism, phototropism and hydrotropism.	**2 unit**
7. Evolution of O_2 during photosynthesis.	**1 unit**
8. Evolution of CO_2 during respiration.	**1 unit**
9. Kuhne`s fermentation vessel.	**1 unit**
10. Moll's half leaf Experiment.	**1 unit**
11. Evolution of heat during respiration	**1 unit**
12. Determination of the rate of growth using Arc Auxanometer	**1 unit**
13. An industrial visit to study the manufacture of alcohol / antibiotics / enzymes. Bioinformatics/ Molecular biological lab.	

PRACTICAL QUESTION PAPER – VIII
PLANT PHYSIOLOGY-III

Time: 3hours **Max Marks: 35**

1. Separate the photosynthetic pigments from sample A by paper chromatography and measure their Rf values.	**8 marks**
2. Estimate the ascorbic acid content in the sample **B.**	**8 marks**
3. Set up and comment on experiment **C.**	**6 marks**
4. Identify and comment on physiological set up **D&E.**	**2x 2 ½ 5 marks**
5. Record and submission	**5+3 = 8 marks**

SCHEME OF VALUATION

1. A. Requirement-**1** mark, principle- **2** marks, procedure and conducting the experiment- **3** marks, Rf values- **2** marks.
2. B. Requirements- **1** mark, principle- **2** marks, procedure and conducting the experiment- **3** marks, Result- **2** marks.
3. C. Identification-**1** mark, set up- **2** marks, comments-**2** marks, labelled Diagram-**1** mark
4. D. Identification-½ mark, comments-**1** mark, labelled diagram- 1 mark.

E. Identification- ½ mark, comments-1 mark, labelled diagram- 1 mark.

5. Record and Submission of field report (hand written field report only) 5+3 marks

LIST OF EXPERIMENTS FOR C.

i. Evolution of O_2 during photosynthesis.
ii. Evolution of CO_2 during respiration.
iii. Moll's half leaf Experiment.
iv. Evolution of heat during respiration (Thermos flask Experiment)

LIST OF EXPERIMENTS FOR D&E.

i. Photosynthesis at different wavelengths of light
ii. Photosynthesis at different concentrations of CO_2
iii. Respirometer experiment for RQ
iv. Kuhne's fermentation vessel
v. Hydrotropism
vi. Phototropism
vii. Geotropism
viii. Arc Auxanometer

REFERENCES

1. Buchanan, B.B, Gruissem, W. and Jones, R.L.2004. **Biochemistry and Molecular Biology of plants**. I.K.International Pvt. Ltd., New Delhi,
2. Dey and Harborne, J.B. (eds.) 1997. **Plant Biochemistry**. Academic press, New York.
3. Hall (1980). **Photosynthesis. 4 edition** Atlas publishers, New Delhi
4. Hall, D.O. and Rao, K.K. 1999 **Photosynthesis. 6 edition**, published in association with the Institute of Biology, Cambridge University Press, Cambridge, U.K.
5. Harborne, T.C 1981 **Phytochemical Methods**: A guide to Modern Techniques of **Plant Analysis**. Chapman and Hall, London.
6. Hopkins, W.G. 1995. **Introduction to Plant Physiology**, John Wiely and Sons, New York.
7. Moore, T.C. 1989. **Biochemistry and Physiology of Plant Hormones. 2 edition** Springer-Verlag, New York, USA.
8. Moore, T.C.1974. **Research Experiences in Plant Physiology: A laboratory Manual**. Springer. Verlag, Berlin.

9. Muheyi, S and Ghosh, A.K. 2005 **Plant Physiology** New Central Book Agency (p) Ltd. 8/1 Chintamonu Das Lane, Kolkata 2009, India.
10. Plummer, D.T.1998. An Introduction to Practical **Biochemistry**. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
11. Purohit, S.S.2009 **Biochemistry-Fundamentals and Applications**. Gobies (India)
12. Salisbury and Ross. 2005. **Plant Physiology**, Thomson Wads Worth.
13. Singhal G.S., Renger G., Sopory S.K., Irrang K.D. &Govindjee 1999. Concepts in **Photobiology: Photosynthesis & Photomorphogenesis**. Narosa Pub. House, New Delhi.
14. Stumpf, P.K. and Conn, E.E. (eds.) 1988. **The Biochemistry of Plants**- A Comprehensive treatise. Academic Press, New York.
15. Sunderajan, S. 1997. **College Botany Vol.III**, Himalaya Publications.
16. Taiz and Zeiger 2004. **Plant Physiology 3 edition**. Panima Publishing Corporation, New Delhi/Bangalore.
17. Taiz C and Zeiger E .1998 **Plant Physiology. 2 edition** Sinauer Associates. Inc. Publishers. Massachusetts, USA
18. Taiz. L. and Zeiger, E. 2003. **Plant Physiology. 3 edition**. Panima Publishing Corporation, New Delhi.
19. Thomas B. & Vince-Prue D. 1997. **Photoperiodism in plants. 2 edition.** Academic press, San Diego, USA.
20. Wilkins, M.B. (eds). 1989. **Advanced plant physiology**. Pitman Publishing Ltd., London
21. Wilkins,M .B. 1998. **Advanced physiology**, ELBS, Longman
22. Wilson, K and Goulding, K.H. (eds.) 1986. **A Biologist Guide to Principles and Techniques of Practical Biochemistry**. Edward Arnold, London, UK.

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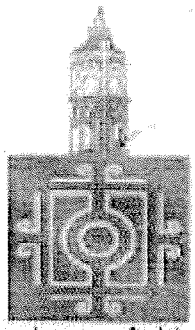

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BE BOUNDLESS

BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM

(Semester Scheme with Multiple Entry and Exit Options for Under Graduate Course)

Syllabus for Botany
(I & II Semester)

2021-22 onwards

Proceedings of the meeting of BOS (UG) in Botany held on 30th September 2021 at Senate hall,Department of Commerce, Bangalore City University, Bengaluru – 560 001

Reference:

1. G.O. ED: 260/USE/2019 (part-1), Bangalore
2. Email from HEC, GOK dated
3. University order dated

Adverting to above, the drafted syllabus prepared by Higher Educational Council (HEC), Government of Karnataka (GOK) pertaining to B.Sc. Botany was circulated by online mode (mailed on 24.09.2021) to all the members of BOS.

Agenda: Approval of syllabus for B.Sc. in Botany theory and practical and scheme of examination for I and II semesters of Bangalore City University, Bangalore.

Resolution: The proposed syllabus for B.Sc. in Botany and practical, Open Elective and Scheme of Examination for I and II semesters were scrutinized thoroughly, finalized with appropriate inclusions and deletions and finally approved.

Members Present		**Signature**
1. **Zaiba Nishanth Banu**	**Member**	
2. **Dr. Mallikarjuna P.B.**	**Member**	
3. **Dr. B.L. Manjula**	**Member**	
4. **Smt. K.R. Kavitha**	**Member**	K.R. Kavitha
5. **Smt. N. Sarvamangala**	**Co-opted Member**	
6. **Smt. K.S. Shailaja**	**Co-opted Member (ONLINE)**	
7. **Dr. L. Rajanna**	**Chairman**	30/9/21

Members Absent	
1. **Dr. Deepak Bhat**	**Member**
2. **Dr. Jenifer lolitha**	**Member**
3. **Smt. Chandrakala S**	**Member**

MINUTES OF THE MEETING OF BOS (UG) IN BOTANY

Chairman welcomed the members of the BoS (UG) Board to the meeting and the agenda was placed for discussion

a. Discussed and finalized the syllabus and Scheme of examination for B.Sc. Botany (CBCS) III, IV, V and VI Semester (theory and practical) Question paper pattern, and scheme of valuation

b. The panel of Examiners was approved and recommended for UG Examinations for the academic year 2021-22.

c. Recommendations were made to constitute BoE for the academic year 2021-22.

d. Discussed and finalized the syllabus for theory and practical of I and II Semester B.Sc. Botany, question paper pattern, blue print of question Paper, formative assessment and Scheme of valuation for NEP programme to be implemented from the academic year 2021-22.

e. The Chairman was authorized to change/ incorporate the corrections as per the directions of the University.

The meeting ended with a vote of thanks by the Chairman

1. Dr. B.L. Manjula
2. Dr. P.B. Mallikarjuna, Associate Professor, GFGC Yelahanka
3. Zaiba Nishath Bano
4. Dr. K.R. KAVITHA K.R. Kavitha 30/9/2021
5. N. SARVAMANGALA N. Sarvamangala 30.9.21

30/9/21

& Chairman BoS(UG)
B.C.U.

Karnataka State Higher Education Council
BOTANY Syllabus Framing Committee

Sl No	Name	Designation	Signature
1.	Prof. G R Naik, Vice Chancellor, Garden City University, Bengaluru	Chairperson	
2.	Dr. A.H . Rajasab, Pro Vice Chancellor, KNB University, Kalaburagi	Member	
3.	Dr. G.R. Janardhana, Professor, University of Mysore, Mysuru	Member	
4.	Dr. H. Niranjanamurthy, Professor, Karnataka University, Dharwad	Member	
5.	Dr. L. Rajanna, Professor, Bangalore University, Bengaluru	Member	
6.	Dr. Krishna Kumar G, Professor, Mangalore University, Konaje	Member	
7.	Dr. M.B. Shivanna, Professor, Kuvempu University, Shivamogga	Member	
8.	Dr. Govindappa M, Professor, Davangere University, Davangare	Member	
9.	Dr H.Ramakrishnaiah, Registrar and Associate Professor, Maharani Cluster University, Bengaluru	Member	
10.	Shri. M. N. Mallikarjunaiah, Associate Professor, Mandya University, Mandya	Member	
11.	Shri. Rangaswamy R.K. Government Science College, Chitradurga	Member	
12.	Dr. Abdul Khayum, Associate Professor, Government Women's College, Kolar	Member	
13.	Dr. Mamtha, Associate Professor, Government First Grade College,Bengaluru	Member	
14.	Dr. Jayakara Bhandary, Associate Proessor, Government First Grade College, Mangalore	Member	

15.	Dr. R.J. Katti, Associate Professor, Kittel College Dharwad	Member	
16.	Shri L.S. Ramesh, Special Officer, Karnataka State Higher Education Council	Member Convener	

Preface

Greetings, from NEP 2020 Botany syllabus framing committee.

The committee members are thankful to the Government of Karnataka for initiating the process of implementation of NEP-2020 in our state. It is our privilege to be part of this process through a committee constituted to frame the syllabus for the UG 4 year (Honors) course in Botany.

The committee members conducted online meeting on 23.08.2021, 27.08.2021, 02.09.2021 04.09.2021 and 05.09.2021 for discussion and finalizing the course titles as per pattern given in Table II A. These deliberations also helped in preparing the syllabus for Semester I and Semester II and the programme and subject outcomes. The model draft curriculum structure and the syllabus for first 2 semesters was presented in the faculty committee on 9th September and the inputs are considered during further revision .The model draft document is ready for submitting to Karnataka State Higher Education Council for further action.

The committee will be working further to complete the remaining part of the syllabus for other papers and any academic inputs required to implement the syllabus in the spirit and philosophy of NEP 2020.

Prof. G. R. Naik
Vice Chancellor,
Garden City University and

Chairperson, Botany Syllabus Curriculum Committee NEP-2020

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Preamble

The objective of a B.Sc. (Honors) programme in Higher Education system is to prepare its students for the society. The current pattern is designed to provide a focused learning outcome-based syllabus at the Honors level providing structured teaching-learning experiences catering to the needs of the students. The honors courses will prepare the students both academically and in terms of employability. The programme also inculcates various attributes at the Honors level. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and various skills required for employability, thus preparing students for continuous learning and sustainability. The new curriculum based on learning outcomes of BSc (Honours) Botany offers knowledge of areas including Plant Systematics, Plant Biotechnology, Resource Botany, Genetics, Ecology, Conservation biology, Physiology and Bioinformatics, Medicinal plants, Plant diseases management etc. The courses define clearly the objectives and the learning outcomes, enabling students to choose the elective subjects broadening their skills in the field of Botany. The course also offers skills to pursue research and teaching in the field of Botany and thus would produce best minds to meet the demands of society This curriculum framework for the bachelor-level program in Botany is developed keeping in view of the student-centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. To avoid a rote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on the pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works.

Aims of Bachelor's degree programme in Botany:

The broad aims of the bachelor's degree programme in Botany are:

1. To provide an environment that ensures the cognitive development of students in a holistic manner. A dialogue about plants and their significance is fostered in this framework, rather than didactic monologues on mere theoretical aspects
2. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
3. To mould a responsible citizen who is aware of the most basic domain-independent knowledge, including critical thinking and communication.
4. To enable the graduate to prepare for national as well as international competitive examinations, especially UGC-CSIR NET, and UPSC Civil Services Examination.

Program Learning Outcomes:

The students graduating with the Degree B.Sc. Three years and B. Sc. (Honors) Botany should be able to acquire.

Core competency: Students will acquire core competency in the subject Botany, and allied subject areas.

1. The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae and fungi) and higher (angiosperms and gymnosperms) plants.
2. Students will be able to use the evidence-based comparative botany approach to explain the evolution of organisms and understand the genetic diversity on the earth. The students will be able to explain various plant processes and functions, metabolism, concepts of

gene, genome, and how organism's function is influenced at the cell, tissue, and organ level.

3. Students will be able to understand the adaptation, development, and behavior of different forms of life.
4. The understanding of networked life on earth and tracing the energy pyramids through nutrient flow is expected from the students.
5. Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Botany.

Analytical ability:

The students will be able to demonstrate the knowledge in understanding research and addressing practical problems.

1. Application of various scientific methods to address different questions by formulating the hypothesis, data collection, and critically analyze the data to decipher the degree to which their scientific work supports their hypothesis.

Critical Thinking and problem-solving ability:

An increased understanding of fundamental concepts and their applications of scientific principles is expected at the end of this course. Students will become critical thinkers and acquire problem-solving capabilities.

Digitally equipped:

Students will acquire digital skills and integrate the fundamental concepts with modern tools.

Ethical and Psychological strengthening: Students will also strengthen their ethical and moral values and shall be able to deal with psychological weaknesses.

Team Player: Students will learn team workmanship in order to serve efficiently institutions, industry, and society.

Independent Learner: Apart from the subject-specific skills, generic skills, especially in botany, the program outcome would lead to gain knowledge and skills for further higher studies, competitive examinations, and employment. Learning outcomes-based curriculum would ensure equal academic standards across the country and a broader picture of their competencies. The Bachelor's program in Botany and Botany honors may be mono-disciplinary or multidisciplinary with following broad objectives.

1. Critically evaluation of ideas and arguments by collecting relevant information about the plants, to recognize the position of the plant in the broad classification and phylogenetic level.
2. Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and a depth and breadth of knowledge/expertise in the field of Plant Identification.
3. Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of the plant in taxonomy.
4. Students will be able to apply the scientific method to questions in botany by formulating testable hypotheses, collecting data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses.
5. Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists.
6. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works.
7. Students will be able to apply fundamental mathematical tools (statistics, calculus) and physical principles (physics, chemistry) to the analysis of relevant biological situations.
8. Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be

able to compare and contrast the characteristics of plants, algae, and fungi that differentiate them from each other and other forms of life.

9. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.
10. Students will be able to explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems
11. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

B. Sc. Botany Course outcomes as per NEP 2020

The framework of curriculum for the Bachelor's program in Botany aims to transform the course content and pedagogy to provide a multidisciplinary, student-centric, and outcome-based, holistic education to the next generation of students.

Aside from structuring the curriculum to be more in-depth, focused, and comprehensive with significant skill-set for all exit levels; keeping in mind the job prospects; the emphasis has been to maintain academic coherence and continuum throughout the program of study and help build a strong footing in the subject, thereby ensuring a seamless transition into their careers.

Special attention is given to eliminate redundancy, discourage rote learning, and espouse a problem-solving, critical thinking, and inquisitive mindset among learners.

The curriculum embraces the philosophy that science is best learned through experiential learning, not limited to the confines of a classroom but rather through hands-on training, projects, field studies, industrial visits, and internships.

This updated syllabus, with modern technology, helps students stay informed on the leading- edge developments in plant sciences and promotes curiosity, innovation, and a passion for research, that will serve them well in their journey into scientific adventure and discovery beyond graduation.

The goal is to equip students with holistic knowledge, competencies, professional skills, and a strong positive mindset that they can leverage while navigating the current stiff challenges of the job market.

B. Sc. Botany Programme outcomes as per NEP 2020

Name of the Degree Program: B.Sc. Discipline Core: Botany

Total Credits for the Program: 176 **Starting year of implementation: 2021-22**

Program Outcomes:

By the end of the program the students will be able to:

(Refer to literature on outcome based education (OBE) for details on Program Outcomes)

PO1: Skill development for the proper description using botanical terms, identification, naming and classification of life forms especially plants and microbes.

PO2: Acquisition of knowledge on structure, life cycle and life processes that exist among plant and microbial diversity through certain model organism studies.

PO3: Understanding of various interactions that exist among plants and microbes; to develop the curiosity on the dynamicity of nature.

PO4: Understanding of the major elements of variation that exist in the living world through comparative morphological and anatomical study.

PO5: Ability to explain the diversity and evolution based on the empirical evidences in morphology, anatomy, embryology, physiology, biochemistry, molecular biology and life history.

PO6: Skill development for the collection, preservation and recording of information after observation and analysis- from simple illustration to molecular database development.

PO7: Making aware of the scientific and technological advancements- Information and Communication, Biotechnology and Molecular Biology for further learning and research in all branches of Botany.

PO8: Internalization of the concept of conservation and evolution through the channel of spirit of inquiry.

PO 9: To enable the graduates to prepare for national as well as international level competitive examinations like UGC-CSIR, UPSC, and KPSC etc.

PO10: To enable the students for practicing the best teaching pedagogy as a biology teacher including the latest digital modules.

PO 11: The graduates should be knowledgeable and competent enough to appropriately deliver on aspects of global importance like climate change, SDGs, green technologies etc at the right opportunity.

PO 12: The graduate should be able to demonstrate sufficient proficiency in the hands-on experimental techniques for their area of specialization within biology during research and in the professional career.

Assessment: (Teaching, Learning and Evaluation)

Weightage for assessments (in percentage):

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	**40**	**60**
Practical	**25**	**25**
Projects	**40**	**60**
Experiential Learning (Internships etc.)	**80**	**20**

SUGGESTED METHODOLOGY FOR TEACHING, LEARNING AND EVALUATION TEACHING-LEARNING

The whole programme is an Outcome Based Education. Different methods are to be used for teaching learning evaluation; in order to attain the fixed outcomes.

Theory:

Student: Review of Literature, Assignment, Presentation, e-learning, Discussion and Debate with peer group, teachers and experts.

Teacher: Lecture, Demonstration, Presentation, Discussion and Debate.

Practical:

Student: Identification, Comparison, Differentiation and Categorization of different plants and their parts by observing Permanent Slides, Hand sectioning etc., Demonstration, Experimentation, Field visit, Report Writing and Keeping records

Teacher: Demonstration, Experimentation, Field visit, Certification.

Project: The finalization of the topic should be done at the beginning of the fourth semester and the list should be kept with the HOD for the perusal of the University Examination authorities. There should be at least three projects from a department. The selection of the topic and group should be student centered as far as possible. A project log book/register is to be maintained by each student and submitted along with the project report during the final submission.

Student: Suggestion of Topic, Discussion with the Project guide and Peer group, Review of Literature, Project planning and Designing, Experimentation, Data Analysis and Project Report Preparation and Presentation.

Teacher: Confirmation of Topic, Demonstration, Planning of Experimentation, Guidance and Correction and Certification.

Experiential Learning (Internships etc.):

Student should choose one of the topics for self-study from the beginning of the seventh semester. A report should be submitted by the end of Eighth Semester.

Suggested topics include: Studies on mangroves / Sacred groves / Campus flora; Cultivation of RET / Fruit / Vegetable / Medicinal plants / Mushroom; Topics related to Social responsibility-River restoration, PBR (People Biodiversity Register) preparation, Herbarium arrangement, VFC (Village Forest Committee), VNRC (Village Natural Resource Committee) formation, Landscaping and Green Auditing.

Field Study / Study Tour:

The plant diversity studies should be carried out with the support of Field Study / Study Tour. During each year there should be a field study of 1-5 days duration, with a minimum of 5 days for the completion of the programme.

EVALUATION

External Evaluation:

External assessment by the University level examinations on specified times announced by the University for all the courses, theory, practical and Project/Viva Voce. Each student should go through the evaluation process according to the University Regulations 2021-2022

End Semester Evaluation-Theory:

The components of external evaluation and their unit wise and each theory and practical course and the time of examination will be in accordance with the calendar prepared by the University for each academic year. At the end of each semester, there will be an examination for theory courses. The duration of examinations for all theory and practical courses in Botany will be three hours, except for the Generic Elective Course papers.

External –Practical:

Practical Courses have external examination for all semester. There will be an external practical examiner and an internal examiner / skilled assistant for every practical examination of three hour duration. The external evaluation should be carried out by the team of examiners.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Attendance**	**10**
2	**RECORD:**	
	Scientific Accuracy	**30**
	Completeness	**20**
	Neatness and Legibility	**10**
3	**Field Study Report/ Slide / Herbarium submitting**	**30**

EXTERNAL – PROJECT / FIELD STUDY / VIVA VOCE

The Project/Field Study/General Viva Voce will be conducted in I/II/III/IV/V/VI/VII/ VIII Semester Practical Examination.

Viva should be based on:

Project work

Experiential Learning (Internships etc)

Field Study

General Learning Activity of four years:

For the external evaluation the components and weightage of Project/Field Study/ Viva Voce can be discussed and determined finally by the Board of Examiners; the suggested components and their weightage is given below. The project viva should be based on the Project and importance should be given to the Scientific method undertaken in that project. The general viva should be on based the changes in the outlook of the student after the learning activity of the 4 year programme, field study and Experiential Learning (Internships etc.). Time taken for each practical batch should be 3 hrs, by giving nearly 10-15 minutes for each student. The project/field study/viva voce evaluation should be conducted by external examiners and internal examiner.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Attendance**	**10**
2	**PROJECT REPORT:**	
	Report With All General Parts – Relevance, Objective, Methodology, Data Analysis, Discussion, Conclusion And Reference etc.	**10**
	Presentation Skill	**30**
	Viva	**30**
3	Field Study Report	**10**
4	Viva	**10**

ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION

1. 80% Attendance (All Sem.)
2. Certified Bona-fide Record (All Sem.)
3. Herbarium and Field Book (Respective Sem.)
4. Field Study Reports (Respective Sem.)
5. Certified Bona-fide Project Report (Eighth Sem.)
6. Report on Experiential Learning (Internships etc.) (Eighth Sem.)

CONTINUOUS INTERNAL EVALUATION

Internal evaluation is a continuous evaluation in all types of courses- theory/ practical / Project / Field study. The teacher has flexibility in deciding the components and their weightage in accordance with the University Regulations, 2021-22. Internal evaluation should be very Transparent to the students and the components and relative weightage should be announced at the beginning of each learning activity by the concerned teacher. Internal evaluation should be published in the notice board, one week before the closure of each semester.

INTERNAL –THEORY

The percentile system can be adopted for calculating the internal component, test paper.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Attendance**	10
	Test Papers	40
2	**Assignment**	20
	Seminar	20
	Viva	10

INTERNAL – PRACTICAL

The internal evaluation may be regular internal assessment on hourly basis or unit wise, whichever is communicated with the student.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Regularity**	25
2	**Practical Skill-** (Sectioning, Drawing, Labeling, Record Keeping Etc)	50
3	Regular Viva/Model Examination	25

INTERNAL - PROJECT/FIELD STUDY/VIVA VOCE

Internal evaluation of the project should start with the beginning of the project and can be finalized by the project viva.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Participation**	50
2	**Viva**	25
3	**Field Study and other Assignment Reports**	25

B1. Model Programme Structure for Bachelor of Science (Basic/Hons.) Programme with Botany as Major and Zoology as Minor (bothy subjects with practical).

Sem.	Discipline Core (DSC) (Credits) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)		
I	Botany C1(4+2) Zoology C1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: Digital Fluency (2) (1+0+2)	Yoga (1) (0+0+2)	Health &Wellness (1) (0+0+2)	25
II	Botany C2(4+2) Zoology C2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1)(0+0+2)	25
Exit option with Certificate (with a minimum of 48 credits)								
III	Botany C3(4+2) Zoology C3(4+2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs. each)		SEC-2: AI or some other SEC (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
IV	Botany C4(4+2) Zoology C4(4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs. each)	Constitution of India (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
Exit option with Diploma in Science (with a minimum of 96 credits) OR Choose any one of the core subjects as Major and the other as Minor								
V	Botany C5(3+2) Botany C6(3+2) Zoology C5(3+2)	Vocational-1 (3)			SEC-3: Cyber Security or some other SEC (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	22
VI	Botany C7(3+2) Botany C8(3+2) Zoology C6(3+2)	Vocational-2 (3) Internship (2)			SEC-4: Professional Communication (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	24
Exit option with Bachelor of Science, B. Sc. Degree (with a minimum of 144 credits) or continue studies with the Major in the 4th year								
VII	Botany C9(3+2) Botany C10(3+2) Botany e C11(3)	Botany E-1 (3) Botany E-2 (3) Res. Methodology (3)						22
VIII	Botany C12(3) Botany C13(3) Botany C14(3)	Botany E-3 (3) Botany E-4 (3) Research Project (6)*						21
Award of Bachelor of Science Degree withy Honours, B.Sc. (Hons.) Degree in Botany (with a minimum of 186 credits)								

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

B2. Model Programme Structure for Bachelor of Science (Basic/Hons.) Programme with both Botany & Zoology as Majors (subjects with practical) in the 3rd year.

Sem.	Discipline Core (DSC) (Credits)	Discipline Elective(DSE) / Open Elective (OE) (Credits)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)		
I	Botany C1(4+2) Zoology C1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: Digital Fluency (2) (1+0+2)	Yoga (1)(0+0+2)	Health &Wellness (1) (0+0+2)	25
II	Botany C2(4+2) Zoology C2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1)(0+0+2)	25
Exit option with Certificate (with a minimum of 48 credits)								
III	Botany C3(4+2) Zoology C3(4+2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs. each)		SEC-2: AI or some other SEC (2)(1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
IV	Botany C4(4+2) Zoology C4(4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs. each)	Constitution of India (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
Exit option with Diploma in Science (with a minimum of 96 credits) OR Choose both the core subjects as Majors and continue the study								
V	Botany C5(3+2) Botany C6(3+2) Zoology C5(3+2) Zoology C6(3+2)				SEC-3: Cyber Security or some other SEC (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	24
VI	Botany C7(3+2) Botany C8(3+2) Zoology C7(3+2) Zoology C8(3+2)				SEC-4: Professional Communication (2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	24
Exit option with Bachelor of Science, B. Sc. Degree (with a minimum of 144 credits) or continue studies with one of the Majors in the 4th year								
VII	Zoology C9(3+2) Zoology C10(3+2) Zoology e C11(3)	Zoology E-1 (3) Zoology E-2 (3) Res. Methodology (3)						22
VIII	Zoology C12(3) Zoology C13(3) Zoology C14(3)	Zoology E-3 (3) Zoology E-4 (3) Research Project (6)*						21
Award of Bachelor of Science Degree with Honours, B.Sc. (Hons.) Degree in Zoology (with a minimum of 186 credits)								

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

Curriculum Structure for the Undergraduate Degree Program

B.Sc. BOTANY

Total Credits for the Program: 176 **Starting year of implementation:**

2021-22 Name of the Degree Program: B.Sc. **Discipline/Subject: BOTANY**

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internships etc. Elective courses may be listed separately.

Semester	Title / Name Of the course	Program outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy##	Assessment$
1	BOT A1 Microbial Diversity and Technology	PO1	---	Ex. MOOC Desk Work Problem solving,	Quiz Debate
2	BOT A2 Diversity of Nonflowering Plants	PO2, PO3	BOT A1		
3	BOT A3 Plant Anatomy and	PO4, PO5	BOT A1 and A2		

	Developmental Biology			Book Chapter Seminar, Project based learning, Term paper Assignment, Group Discussion Research Project Instrumentation	Class work Class work Seminar Project writing Articles writing, Interpretation of results
4.	BOT A4 Ecology and Conservation Biology	PO4, PO5	BOT A1 A2 A3		
5.	BOT A5 Plant Taxonomy and Resource Botany	PO6, PO7	BOT A1 A2 A3		
	BOT A6 Cell Biology and Genetics	PO6, PO7	BOT A6 A1 A2 A3 A4 A5		
6.	BOT A7 Plant Physiology and Biochemistry	PO6, PO7, PO9	BOT A5		
	BOT A8 Plant Biotechnology	PO8. PO9	BOT A5		
7.	BOT A9 Molecular Biology	PO8, PO9	BOT A6 A8		
	BOT A10 Seed Biology and Seed Technology	PO9, PO10	BOT A5 A8 A9		
	BOT A11 Plant Health Technology	PO9, PO10	BOT A5 A4 A8		

8.	BOT A12 Medicinal Plants and Phytochemistry	PO9, PO10	BOT A4 A5 A7 A8		
	BOT A13 Bioinformatics and Computational Biology	PO9, PO10	BOT A5 A8 A9		
	BOT A14 Research Methodology	PO9, PO10	BOT A13		

Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. The list includes active learning/ course projects/ problem or project based learning/ case studies/self-study like seminar, term paper or MOOC.

$ Every course needs to include assessment for higher order thinking skills (Applying/ Analyzing/ Evaluating/ Creating). However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for learning).

Semester I and II

Course Title: **B.Sc. BOTANY**	
Total Contact Hours: 56	Course Credits:06
Formative Assessment Marks: 40	Duration of ESA/Exam: 3hrs
Model Syllabus Authors: Dr. G.R.NAIK AND TEAM	Summative Assessment Marks: 60

Course Pre-requisite(s): Mention only course titles from the curriculum that are needed to be taken by the students before registering for this course.

DISCIPLINE CORE PAPERS (DSC)

Sl. No.	Semester Details	Subject	Paper No
1	Semester I	Microbial Diversity and Technology	**A-1**
2	Semester II	Diversity and Conservation of Non Flowering Plants	**A-2**
3	Semester III	Plant Anatomy and Development Biology	**A-3**
4	Semester IV	Ecology and Conservation Biology	**A-4**
5	Semester V	Plant taxonomy and Resource Botany	**A-5**
		Genetics and Cell Biology	**A-6**
6	Semester VI	Plant Physiology and Biochemistry	**A-7**
		Plant Biotechnology	**A-8**
7	Semester VII	Molecular Biology	**A-9**
		Seed Biology and Seed Technology	**A-10**
		Plant Health Technology	**A-11**
8	Semester VIII	Medicinal Plants and Phytochemistry	**A-12**
		Bioinformatics and Computational Biology	**A-13**
		Research Methodology	**A-14**

CORESPECIFIC ELECTIVE PAPERS (DSE)

Sl No.	Semester Details	Subject: Botany	Credits	Paper No
1	Semester V	**DSE 1:** Algal and Fungal Biotechnology	03	E-1
2	Semester VI	**DSE 2:** Herbal Technology	03	E-2
3	Semester VII	**DSE 3:** Plant Propagation and Tissue Culture	03	E-3
4	Semester VIII	**DSE 4:** Landscaping, Gardening and Green House Technology	03	E-4

BOTANY COURSE OUTCOMES (COs):

At the end of the course the student should be able to:

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

Semester I (A-1): Microbial Diversity and Technology

1. Understand the fascinating diversity, evolution, and significance of microorganisms.
2. Comprehend the systematic position, structure, physiology and life cycles of microbes and their impact on humans and environment.
3. Gain laboratory skills such as microscopy, microbial cultures, staining, identification, preservation of microbes for their applications in research and industry.

Semester II (A-2): Diversity of Non- Flowering Plants

1. Understand the diversity and affinities among Algae, Bryophytes, Pteridophytes and Gymnosperms.
2. Understand the morphology, anatomy, reproduction and life cycle across Algae, Bryophytes, Pteridophytes and Gymnosperms, and their ecological and evolutionary significance.
3. Obtain laboratory skills/explore non-flowering plants for their commercial applications.

Semester III (A-3): Plant Anatomy and Developmental Biology

1. Observation of variations that exist in internal structure of various parts of a plant and as well as among different plant groups in support for the evolutionary concept.

2. Skill development for the proper description of internal structure using botanical terms, their identification and further classification.
3. Understanding the basic concepts in plant morphogenesis, embryology and organ development.

Semester IV (A-4): Ecology & Conservation Biology

1. Understanding the fundamental concepts in ecology, environmental science and phytogeography.
2. Concept development in conservation, global ecological crisis, Sustainable development and pros and cons of human intervention.
3. Enable the student to appreciate bio diversity and the importance of various conservation strategies, laws and regulatory authorities and global issues related to climate change and sustainable development.

Semester V (A-5): Plant Taxonomy &Resource Botany

1. Ability to identify, classify and describe the plants in scientific terms. Identification of plants using dichotomous keys.
2. Recognition, processing and utilization of economically important plants.
3. Skill development in processing of biomass and plant products as source of food, healthcare, energy and natural products.

Semester V (A-6): Cell Biology & Genetics

1. Identify the basic principles and current trends in classical genetics and Cell biology.
2. Recognize the historical process of the evolution of molecular genetics from classical genetics.

3. Develop theoretical background on molecular genetics to provide a strong support for the student for future research and employability.

Semester VI (A-7): Plant Physiology & Biochemistry

1. Preliminary understanding of the basic functions and intermediary metabolism in a plant body.
2. Awareness on the interdisciplinary nature of botany, chemistry and physics by studying the principles of plant life, growth and reproduction.
3. Recognizing the wonderful mechanism of transport and the Interrelationships existing between metabolic pathways thereby gaining and idea about the importance of plants in the dynamicity of nature.

Semester VI (A-8): Plant Biotechnology

1. Learning of knowledge & skill in plant tissue culture, plant molecular biology and transgenic.
2. Application of plant biotechnology in plant genomics, phylogenetic studies and metabolic engineering.
3. Understanding of new molecular techniques in cell and metabolic manipulations.

Semester VII (A-9): Molecular Biology

1. Understanding the mechanism and concepts of life process at molecular level through central dogma concept.
2. Skill acquiring in the basic molecular biology techniques & characterization of micro-molecules.
3. Acquiring the emerging technology skills in plant genetic engineering & proteomics.

Semester VII (A-10): Seed Biology & Seed Technology

1. Understanding the seed structure and related functions, seed health and productivity.
2. Technology for assessing the seed pathology, purity, and preservation.
3. Learning the field and laboratory protocols of seed production, certification and quality.

Semester VII (A-11): Plant Health Technology

1. Understanding & learning common diseases & control measures of plant diseases.
2. Acquiring skills in plant disease diagnosis, control & management through IPM.
3. Learning of new skills in health clinic through biological methods.

Semester VIII (A-13): Medicinal Plants & Phytochemistry

1. Knowledge of Indian system of medicine with regard to medicinal plants.
2. Acquiring skills in identification, cultivation and preservation of medicinal plants.
3. Isolation, identification, characteristics of active principles in medicinal plants & drug formulations.

Semester VIII (A-14): Bioinformatics & Computational Biology

1. Learning of basic principles of application, ICT Technology in biological studies & research.
2. Acquiring skill to utilize the computational apps, active data basis and tools in analysis in genetics & proteomics.
3. Learning skills and software used for biological research & process understanding.

Semester VIII (A-15): Research Methodology

1. Understanding the working of science for further application in free, independent, individual needs and in designing scientific experimentation.
2. Acquire knowledge on the principles, components and applications of various scientific equipment in biology.
3. Foundation knowledge in the basic concepts, components and functions of informatics and the importance of statistical principles in biological research.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

SEMENAR	Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8		9	10	11	12
1.	A-1	X	X	X			X				X			X
2.	A-2	X	X	X			X		X		X			X
3.	A-3		X	X	X	X		X			X			X
4.	A-4			X		X	X	X	X		X	X	X	X
5.	A-5, A-6	X	X	X	X	X		X	X		X	X	X	X
6.	A-7, A-8					X		X			X		X	X
7.	A-9, A-10, A-11					X	X	X			X	X	X	X
8.	A-12A-13, A-14,					X	X	X	X		X	X	X	X

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

COURSE PATTERN AND SCHEME OF EXAMINATION FOR B.SC. / B.SC. (HONS.) AS PER NEP (2021-22 ONWARDS)																
SUBJECT : BOTANY																
Sl. No	Semester	Title Of The Paper	Teaching Hours	Hours/Week		Examination pattern Max. and Min. Marks/Paper						Duration of exam (hours)		Total marks/ paper	Credits	
						Theory			Practical							
				Theory	Practical	Max.	Min.	IA	Max.	Min.	IA	Theory	Practical		Theory	Practical
1	I	CORE SUBJECT	56	4	4	60	22	40	25	10	25	3	4	150	4	2
		OPEN ELECTIVE	42	3	-	60	22	40	-	-	-	3	-	100	3	-
		SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	II	CORE SUBJECT	56	4	4	60	22	40	25	10	25	3	4	150	4	2
		OPEN ELECTIVE	42	3		60	22	40				3	-	100	3	-
		SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-

IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka Bachelor of Science (Basic/ Hons.) (Botany as Major)

Sem.	Discipline Core (DSC) (L+T+P)	Discipline Elective (DSE) / Open Elective (OE)	Ability Enhancement Compulsory Courses (AECC), Languages (L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (L+T+P)	Value based (L+T+P)	
I	Discipline A 1(6) **Microbial Diversity and Technology** Discipline B 1(5)	OE-1 (3)	L1-1 (3), L2-1(3) (3+1+0 each)		SEC-1: Digital Fluency (2) (1+0+2)	Health and Wellness/ Social & Emotional Learning (2) (1+0+2)	24
II	Discipline A 2(5) **Diversity of nonflowering plants** Discipline B 2(6)	OE-2 (3)	L1-2(3), L2-2 (3) (3+1+0 each)	Environmental Studies (2)		Sports/NCC/NSS etc. (2) (1+0+2)	24
Exit option with Certificate (48 credits)							
III	Discipline A 3(6) **Plant Anatomy and Developmental Biology** Discipline B 3(5)	OE-3 (3)	L1-3 (3), L2-3(3) (3+1+0 each)	Constitution of India (2)	SEC-2: Artificial Intelligence (2)(1+0+2)		24
IV	Discipline A 4(5) **Ecology and conservation biology** Discipline B 4(6)	OE-4 (3)	L1-4 (3), L2-4(3) (3+1+0 each)		SEC-3: Cyber Security (2) (1+0+2)	Sports/NCC/NSS etc. (2) (1+0+2)	24
Exit option with Diploma (96 credits)							
Choose any one Discipline as Major, the other as the Minor							
V	Discipline A 5(5) **Plant Taxonomy and resource botany** Discipline A 6(5) **Cell biology and Genetics** Discipline B 5(5)	DSE A-1 (3) **Algal and Fungal Biotechnology**			SEC-3: (2) (2+0+2)	Ethics & Self Awareness (2) (1+0+2)	20
VI	Discipline A 7(5) **Plant Physiology and biochemistry** Discipline A 8(5) **Plant Biotechnology** Discipline B 6(5)	DSE A-2 (3) **Herbal Technology**			SEC-4: Professional/ Societal Communication (2)		20
[illegible] Degree (132 credits)							
VII	Discipline A-9(5) **Molecular Biology** Discipline A-10(5) **Seed biology and seed Technology** Discipline A-11(4) **Plant Health Technology.**	DSE A-3 (3) **Plant Propagation and Tissue Culture (3)**					20
VIII	Discipline A-12(4) **Medicinal Plants and Phytochemistry** Discipline A-13(4) **Bioinformatics and Computational Biology** Discipline A-14(3) **Research Methodology**	DSE A-4 (3) **Landscaping, Gardening and Green House Technology**					20
Award of Bachelor of Bachelor of Science Honours, B.Sc. (Hons) degree in a discipline etc. (176 credits)							

Semester – 1

Title of the Paper: Microbial Diversity and Technology

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
4	56	2	56

Content of Theory Course 1	56 Hrs
Unit –1	15
Chapter No. 1: Microbial diversity-Introduction to microbial diversity; Methods of estimation; Hierarchical organization and positions of microbes in the living world. Whittaker's five-kingdom system and Carl Richard Woese's three-domain system. Distribution of microbes in soil, air, food and water. Significance of microbial diversity in nature.	5
Chapter No. 2 History and developments of microbiology-Microbiologists and their contributions (Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Dmitri Iwanowski, Sergius Winogradsky and M W Beijerinck and Paul Ehrlich).	5
Chapter No. 3 Microscopy-Working principle and applications of light, dark field, phase contrast and electron microscopes (SEM and TEM). Microbiological stains (acidic, basic and special) and Principles of staining. Simple, Gram's and differential staining.	5

Unit – 2	15
Chapter No. 4. Culture media for Microbes-Natural and synthetic media, Routine media -basal media, enriched media, selective media, indicator media, transport media, and storage media.	5
Chapter No. 5. Sterilization methods -Principle of disinfection, antiseptic, tyndallisation and Pasteurization, **Sterilization**-Sterilization by dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods of sterilization-phenolic compounds, anionic and cationic detergents.	5
Chapter No. 6. Microbial Growth-Microbial growth and measurement. Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs and chemotrophs; lithotrophs and organotrophs.	5
Unit – 3	11
Chapter No. 7 Microbial cultures and preservation-Microbial cultures. Pure culture and axenic cultures, subculturing, Preservation methods-overlaying cultures with mineral oils, lyophilisation. Microbial culture collections and their importance. A brief account on ITCC, MTCC and ATCC.	5
Chapter No. 8. Viruses- General structure and classification of Viruses; ICTV system of classification. Structure and multiplication of TMV, SARS-COV-2, and Bacteriophage (T2). Cultivation of viruses. A brief account of Vaccines.	4
Chapter No. 9. Viroids- general characteristics and structure of Potato Spindle	2

Tuber Viroid (PSTVd); Prions - general characters and Prion diseases. Economic Importance of viruses.	
Unit – 4	15
Chapter No. 10. Bacteria- General characteristics and classification. Archaebacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of *Rhizobium* and its applications. A brief account of Actinomycetes. Mycoplasmas and Phytoplasmas. Economic importance of Bacteria.	5
Chapter No. 11. Fungi-General characteristics and classification. Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study of *Albugo, Neurospora, Puccinia, and Penicillium.*	5
Chapter No. 12. Lichens – Structure and reproduction. **VAM Fungi** and their significance. **Plant diseases**- Downy Mildew of Bajra, Grain smut of Sorghum, Sandal Spike and Citrus Canker. Economic importance of Fungi.	5

Text Books

1. Ananthnarayan R and Panikar JCK. 1986. Text book of Microbiology. Orient Longman ltd. New Delhi.
2. Arora DR. 2004. Textbook of Microbiology, CBS, NewDelhi.

3. William CG. 1989. Understanding microbes. A laboratory text book for Microbiology. W.H. Freeman and Company. New York.
4. Dubey RC and Maheshwari DK. 2007. A textbook of Microbiology, S. Chand and Company, NewDelhi.
5. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, S.C.Chand and Company, Ltd. Ramnagar, New Delhi.
6. Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp.
7. Sharma PD. 1999. Microbiology and Plant Pathology. Rastogi publications. Meerut, India.
8. Vasanthkumari R. 2007. A textbook of Microbiology, BI Publications Pvt. Ltd., New Delhi.

References:

1. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., NewDelhi.
2. Allas RM. 1988. Microbiology: Fundamentals and Applications, Macmillan publishing co. New York.
3. Brook TD, Smith DW and Madigan MT. 1984. Biology of Microorganisms, 4th ed. Eaglewood Cliffts. N.J.Prentice- Hall. New Delhi.
4. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge UniversityPress. Cambridge.
5. Jayaraman J. 1985. Laboratory Manual of Biochemistry, Wiley Eastern Limited. New Delhi.
6. Ketchum PA. 1988. Microbiology, concepts and applications. John Wiley and Sons. New York.
7. Michel J, Pelczar Jr.EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, New

Delhi.

8. Powar CB and Daginawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishing house,Bombay.
9. Reddy S and Ram. 2007. Microbial Physiology. Scientific Publishers, Jodhpur, 385pp.
10. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co.Pvt.Ltd. New Delhi.
11. Schlegel HG. 1986. General Microbiology. Cambridge. University Press. London, 587pp.
12. Roger S, Ingrahan Y, Wheelis JL, Mark L and Page PR. 1990. Microbial World 5th edition. Prentice-Hall India, Pvt. Ltd. New Delhi.
13. Sullia SB. and Shantharam S. 2005. General Microbiology, Oxford and IBH, NewDelhi.

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
I TEST	15
II TEST	15
ASSIGNMENT	10
Total	40

Date **Course Co-ordinator** **Subject Committee Chairperson**

Contents of Practical Paper 1: Microbial Diversity and Technology
List of Experiments to be conducted

Practical 1: Safety measures in microbiology laboratory and study of equipment/appliances used for microbiological studies (Microscopes, Hot air oven, Autoclave/Pressure Cooker, Inoculation needles/loop, Petri plates, Incubator, Laminar flow hood, Colony counter, Haemocytomer, Micrometer etc.).

Practical 2: Enumeration of soil/food /seed microorganisms by serial dilution technique.

Practical 3: Preparation of culture media (NA/PDA) sterilization, inoculation, incubation of *E coli / B. subtilis/* Fungi and study of cultural characteristics.

Practical 4: Determination of cell count by using Haemocytometer and determination of microbial cell dimension by using Micrometer.

Practical 6: Simple staining of bacteria (Crystal violet /Nigrosine blue) / Gram's staining of bacteria.

Practical 7: Isolation and study of morphology of *Rhizobium* from root nodules of legumes

Practical 8: Preparation of spawn and cultivation of paddy straw (Oyster) mushroom.

Practical 9: Study of vegetative structures and reproductive structures - *Albugo, Neurospora, Puccinia, Agaricus, Lycoperdon, Penicillium.* (Depending on local availability)

Practical 10: Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying.

Practical 11: Study of Downy mildew of Bajra, Citrus canker, Tobacco mosaic disease, Sandal spike disease.

Practical 12: Study of well-known microbiologists and their contributions through charts and photographs.

Practical-13: Visit to water purification units/Composting/microbiology labs/dairy and farms to understand role of microbes in day today life.

(Note: Submission of Practical record on the date of practical examination is compulsory)

(Note: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory).

Practical Question Paper I

Microbial Diversity and Technology

Time – 3 hrs **Max. marks - 25**

1. Conduct the Experiment 'A' Gram staining of the given sample (Root nodule/curd) **03 marks**

2. Perform the Experiment 'B' (Haemocytometer/Micrometry) **03 marks**

3. Identify the given sample 'C' & 'D' with reason **(2X2)** **05 marks**

4. Comment on the given slides 'E' & 'F' with labelled diagrams and reasons **(2X2)** **05 marks**

5. Identify and comment on 'G' & 'H' **(2X2)** **04 marks**

6. Record and submission **(2½ +2½)** **05 marks**

Scheme of Evaluation

1. A. – (root nodule / curd sample)
   Preparation & Identification = 2 marks, Procedure = 1 mark, **Total = 3 marks**
2. B. – Haemocytometer
   Preparation = **1½** marks, calculation= **1½** marks, **Total = 3 marks**
3. C & D – Specimens (Fungi)
   Identification & Classification = 1½ marks, Reasons = 1 mark (2X2½) Total = 5 marks
4. E & F – Fungal Slides
   Identification = 1 mark, Diagram & Reasons = 1½ mark **(2X2½)** **Total = 5 marks**
5. G & H – Mushroom Cultivation / instruments / Diseases/ colony characteristics / Scientists Photos Identification = 1 mark, Reasons = 1 **(2X2)** **Total = 4 marks**
6. Record – **2½** marks, Submission – **2½** marks (tour report) **Total = 5 marks**

I Semester

Open Elective Course (OE-1)

Title: Plants and Human Welfare

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with economic importance of diverse plants that offer resources to human life.

2. To make the students known about the plants used as-food, medicinal value and also plant source of different economic value.

3. To generate interest amongst the students on plants importance in day today life, conservation, ecosystem and sustainability.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	42	0	00

Content of Theory	42 Hrs
Unit – I	14 Hrs
Chapter – 1: Origin of Cultivated Plants. Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions. Crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant bio- diversity and conservation.	04 Hrs
Chapter – 2: Cereals: Wheat and Rice (origin, evolution, morphology, post-harvest Processing & uses).Green revolution. Brief account of millets and their nutritional Importance.	04 Hrs
Chapter – 3: Legumes: General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem.	03 Hrs
Chapter – 4: Fruits: Mango, grapes and Citrus (Origin, morphology, cultivation, processing and uses).	03 Hrs

Unit – II	14 Hrs
Chapter – 5: Cash crops: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Natural Rubber –cultivation, tapping and processing. **Chapter – 6: Spices:** Listing of important spices, their family and parts used, economic importance with special reference to Karnataka. Study of fennel, clove, black pepper and cardamom. **Chapter – 7: Beverages:** Tea, Coffee (morphology, processing & uses) **Chapter – 8: Oils and fats:** General description, classification, extraction, their uses and health implications; groundnut, coconut, sunflower and mustered (Botanical name, family & uses). Non edible oil yielding trees and importance as biofuel. Neem oil and applications.	04 Hrs 03 Hrs 03 Hrs 04 Hrs
Unit – III	**14 Hrs**
Chapter – 9: Essential Oils: General account. Extraction methods of sandal wood oil, rosa oil and eucalyptus oil. Economic importance as medicine, perfumes and insect repellents. **Chapter – 10: Drug-yielding plants:** Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Aloe vera and Cannabis. **Chapter – 11: Fibers:** Classification based on the origin of fibers; Cotton and jute (origin morphology, processing and uses). **Chapter – 12: Forests:** Forest and forest products. Community forestry. Concepts of reserve forests, sanctuaries and national parks with reference to India. Endangered species and red data book.	04 Hrs 03 Hrs 03 Hrs 04 Hrs

Text Books and References

1. Kochhar, S.L. (2012). Economic Botany in Tropics. New Delhi, India: MacMillan & Co.
2. Wickens, G.E. (2001). Economic Botany: Principles &Practices.The Netherlands: Kluwer Academic Publishers.
3. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture.Jones& Bartlett - Publishers.

gy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
I TEST	15
II TEST	15
ASSIGNMENT	10
Total	40

Date **Course Co-ordinator** **Subject Committee Chairperson**

Semester – 2

Title: Diversity of Non- Flowering Plants

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	56	2	56

Content of Theory	56Hrs
Unit –1	15
Chapter No. 1 Algae –Introduction and historical development in algology. General characteristics and classification of algae, Diversity- habitat, thallus organization, pigments, reserve food, flagella types, life-cycle and alternation of generation in Algae. Distribution of Algae.	5
Chapter No. 2 General characteristics of Cyanobacteria. Morphology and reproduction and life-cycles of *Nostoc, Oedogonium, Chara, Sargassum and polysiphonia*. Diatoms and their importance. Blue-green algae-A general account. Algal blooms and toxins.	5
Chapter No. 3 Algal cultivation- Cultivation of microalgae-*Spirulina* and *Dunaliella;* Algal cultivation methods in India. Algal products- Food and Nutraceuticals, Feed stocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae and uses.	5
Unit – 2	15

Chapter No. 4. Bryophytes – General characteristics and classification of Bryophytes, Diversity-habitat, Gametophytes and sporophytes.	5
Chapter No. 5 Distribution, morphology, anatomy, reproduction and life-cycles of *Riccia, Anthoceros*, and *Funaria*. Ecological and economic importance of Bryophytes.	5
Chapter No. 6. . Pteridophytes- General characteristics and classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in *Selaginella*, *Equisetum* and *Pteris*.	5
Unit – 3	15
Chapter No. 7 A brief account of heterospory and seed habit. Stelar evolution in Pterodophytes. Evolutionary significance of Pteridophytes. Ecological and economic importance.	5
Chapter No. 8. Gymnosperms- General characteristics. Distribution and classification of Gymnosperms. Study of the habitat, distribution, habit, anatomy, reproduction and life-cycles in *Cycas, Pinus* and *Gnetum*.	5
Chapter No. 9. Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines.	5
Unit – 4	11

Chapter No. 10. Origin and evolution of Plants: Origin and evolution of plants through Geological Time scale.	2
Chapter No. 11. Paleobotany- Paleobotanical records, plant fossils, Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts.	5
Chapter No. 12. Fossil taxa- *Rhynia, Lepidodendron, and Cycadeoidea*. Exploration of fossil fuels. Birbal Sahni Institute of Paleosciences.	4

Text Books

1) Chopra, G.L. A text book of Algae. Rastogi & Co., Meerut, Co., New Delhi, Depot. Allahabad.
2) Johri, Lata and Tyagi, 2012, A Text Book of, Vedam e Books, New Delhi.
3) Sharma, O.P. 1990. Text Book of Pteridophyta. McMillan India Ltd. New Delhi.
4) Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co. New Delhi.
5) Sharma, O.P., 2017, Algae Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut.

References

1. Sambamurty, A.V. S. S. A Text Book of Algae. I.K. International Private Ltd., New Delhi.
2. Agashe, S. N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Allied plants. Hutchinson & Co., Ltd., London.
3. Anderson R.A. 2005, Algal cultural Techniques, Elsievier, London.
4. Publication, Application in exploration of fossil fuels. Oxford & IBH., New Delhi.

5. Eams, A.J., (1974) Morphology of vascular plants - Lower groups. Tata Mc Grew- Hill Publishing Co. New Delhi, Freeman & Co., New York.

6. Fritze, R.E. 1977. Structure and reproduction of Algae. Cambridge University Press.

7. Goffinet B and Shaw A.J. 2009, Bryophyte Biology, 2nd ed. Cambridge Unversity Press, Cambridge.Gymnosperms.

8. Srivastava, H N, 2003. Algae Pradeep Publication, Jalandhar, India.

9. Kakkar, R.K. and B.R.Kakkar (1995). The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.

10. Kumar H. D., 1999, Introductory Phycology, Affiliated East-West Press, Delhi.

11. Lee, R.E., 2008, Phycology, Cambridge Unversity Press, Cambridge. 4th edition.McGraw Hill Publishing Co., New Delhi.

12. Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allhabad.

13. Parihar, N.S. (1976) An Introduction to Pteridophytes, Central Book Depot, Allhabad.

14. Parihar, N.S. 1977. The Morphology of Pteridophytes. Central Book Depot., Allahabad.Press, Cambridge.

15. Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New Delhi.

16. Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata Tata McGraw Hill Publishing, New Delhi.

17. Smith, G.M. 1971. Cryptogamic Botny. Vol.I Algae & Fungi. Tata McGraw Hill Publishing. New Delhi.

18. Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd., London.

19. Stewart, W. M. 1983. Paleobotany and the Evolution of Plants, Cambridge University Cambridge.

20. Sundarajan, S. 1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.

21. Vanderpoorten, A. and Goffinet, B. 2009, Introduction to Bryophytes, Cambridge Unversity Press, Cambridge.

22. Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

Pedagogy: Lectures, Practicals, Field and laboratory visits, participatory learning, seminars, assignments, MOOCs and specimen preparation and submission.

Formative Assessment	
Assessment Occasion / type	**Weightage in Marks**
I TEST	15
II TEST	15
ASSIGNMENT	10
Total	40

Date **Course Co-ordinator** **Subject Committee Chairperson**

Content of Practical Course 2: List of Experiments to be conducted

Practical-1: Study of morphology, classification, reproduction and lifecycle of *Nostoc.*

Practical-2: Study of morphology, classification, reproduction and life-cycle of *Oedogonium & Chara,* Sargassum and *Polysiphonia.*

Practical-3: Study of morphology, classification, reproduction and life-cycle of *Anthoceros & Funaria.*

Practical-4: Study of morphology, classification, anatomy, reproduction and life-cycle of *Selaginella and Equisetum.*

Practical -5: Study of morphology, classification, anatomy, reproduction and life-cycle of *Pteris.*

Practical -6: Study of morphology, classification & anatomy, reproduction in *Pinus.*

Practical -7: Study of morphology, classification & anatomy, reproduction in *Gnetum.*

Practical -8: Study of important blue green algae causing water blooms in the lakes.

Practical -9: Study of different methods of cultivation of ferns in a nursery.

Practical -10: Media preparation and cultivation of *Spirulina.*

Practical -11: Study different algal products and fossils impressions and slides.

Practical-12: Visit to algal cultivation units/lakes with algal blooms/Fern house/ Nurseries/Geology museum/lab to study plant fossils.

(Note: Submission of Practical record on the date of practical examination is compulsory)

(Note: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)

Visit or cultivation of 1 fern (Visit 01 mark / Submission of 01 potted fern 01 mark).

Practical question paper – II
Diversity of Non- Flowering Plants

Time- 3 hrs **Max. marks - 25**

1. Identify and classify the specimens 'A', 'B' & 'C' with reasons **(3X $2^1/_2$)** **$7^1/_2$ marks**
2. Comment on the permanent slides 'D', 'E' & 'F' with labelled diagrams and reasons **(3X $2^1/_2$)** **$7^1/_2$ marks**
3. Mounting/Temporary slide preparation 'G' (Algae) **02 marks**
4. Comment on 'H' & 'I' (Mounting pollen/Sporangia & Fossil) **(2X2)** **04 marks**
5. Record and submission **(2 X 2)** **04 marks**

Scheme of Evaluation

1. A, B & C. (A - Bryophyte, B – Pteridophytes, C - Gymnosperms) **(3X $2^1/_2$)**
   Identification & Classification = **$1^1/_2$** marks, reasons = 1 mark, **Total = $7^1/_2$ marks**
2. D, E & F. (D – Algae / Bryophyte, E – Pteridophyte, F – Gymnosperms) **(3X $2^1/_2$)**
   Identification = 1 mark, Diagram & Reasons = **$1^1/_2$** marks, **Total = $7^1/_2$ marks**
3. G – (Mounting of Algal specimen)
   Mounting = 1 marks, Identification + Reasons = 1 marks, **Total = 2 marks**
4. H &I – (Pinus pollen grain / Fern sporangia & Fossil slides / photograph) **(2X2)**
   H - Mounting = 1 mark, Reasons = 1mark,
   I – Identification = 1 mark, Reasons = 1 mark **Total = 4 marks**
5. Record and submission
   Record = 2 marks, Tour report = 1 mark, 1 algal submission **or**
   1 potted fern plant grown by the student = 1 mark (student must be able to identify the fern with salient features) **Total = 4 marks**

II Semester

Open Elective (OE-2)

Title: Plant Propagation, Nursery management and Gardening

Paper Outcome:

On completion of this course, the students will be able to

1. To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants.
2. To get knowledge of new and modern techniques of plant propagation.
3. To develop interest in nature and plant life.
4.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	42	0	00

Content of Theory Course 1	42 Hrs
Unit 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 pots and nursery.	08
Unit II	
Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy. Seed storage: Types of storage, Seed banks, factors affecting seed viability, seed germination and seed production technology. Seed testing and certification.	08

Unit III	
Vegetative propagation: Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings. Hardening of plants .Green house, mist chamber, shed root, shade house and glass house.	08
Unit IV	
Gardening: Definition, objectives and scope. Different types of gardening - landscape and home/terrace gardening, parks and its components. Plant materials and design. Computer applications in landscaping, Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	10
Unit V	
Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables and flowering plants: cabbage, brinjal, lady's finger, tomatoes, carrots, bougainvillea, roses, geranium, ferns, petunia, orchids etc. Storage and marketing procedures. Developing and maintenance of different types of lawns. Bonsai technique.	08

Text Books and References

1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd.
2. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH Publishing Co.
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.

Additional Resources:

1. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co.
2. Sandhu, M.K. (1989). Plant Propagation. Madras, Bangalore: Wile Eastern Ltd.

Pedagogy:

Lectures, Practical, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc.

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
I TEST	15
II TEST	15
ASSIGNMENT	10
Total	40

Date **Course Co-ordinator** **Subject Committee Chairperson**

MODEL QUESTION PAPER

B.Sc. BOTANY (UG) SEMESTER I & II Examination

TIME: 3 Hrs **Max. Marks: 60**

Instructions: 1. Answer all questions

2. Draw diagrams wherever necessary

SECTION – A

Answer any FIVE of the following **5 X2=10**

SECTION – B

Answer any FOUR of the following **4X5=20**

SECTION – C

Answer any THREE of the following **3X10=30**

Blue print of the question paper

	No. of questions from each units		
Unit	**2 marks**	**5 marks**	**10 marks**
I	2	1 + 1	1
II	2	1 + 1	1
III	2	1	1 + ½
IV	2	1	1 + ½
Total No. of questions	**8**	**6**	**5**

Note: Equal importance and weightage is to be given to each units. **Section – C. Question No. 19**. a). and b). Which carries 5 marks each to be selected from the units III & IV.

Job opportunities in Botany

Exit after ONE Year: Certificate Course

I Sem. - **A1: Microbial Diversity and Technology**

II Sem. – **A2: Diversity and Conservation of Non- Flowering plants**

Job opportunities in Botany
• Preparation of algal, fungal microbial, bryophyte, pteridophyte, and gymnosperm slides for educational institutions and other line departments (Entrepreneurship). • Providing algal, fungal microbial, bryophyte, pteridophyte, and gymnosperm materials for educational institutions and other line departments (Entrepreneurship). • Developing Nursery (Entrepreneurship). • Nursery supervisor/manager • Mushroom cultivation (Entrepreneurship). • Cyanobaterial, algal and microbial culture (Entrepreneurship). • Fermentation industries. Dairy farming industries. Dairy products industries. Spice Industries (Lichens) • Quarantine dept., Quality control/analyst, packaging, Lab. assistant

Job opportunities in Botany

Exit After **TWO** Year: **Diploma Course**

III Semester: A3: Plant Anatomy and Developmental Biology

IV Semester: A4: Ecology and Conservation Biology

Job opportunities in Botany
In Addition to one year certificate • Preparation of Anatomy embryology and Ecological slides for educational institutions and other line departments (Entrepreneurship). • Providing Anatomy embryology and Ecological materials for educational institutions and other line departments (Entrepreneurship). • Lab technician • Garden / nursery supervisor • Developing his/her own nursery (Entrepreneurship). • Forest guard, Wild life watch guard.

Job opportunities in Botany

Exit After **THREE** Year: **Degree Course**

V Semester- A5: Plant Taxonomy and Resource

Botany V Semester- A6: Genetics and Cell Biology

VI Semester- A7: Plant Physiology and Biochemistry

VI Semester- A8: Plant Biotechnology

Job opportunities in Botany
In Addition to two year diploma • Supplying the angiosperm plants and cytological slides to the educational institutions and other line departments (Entrepreneurship). • Advisor for Health department • Marketing NTFPs species (Entrepreneurship). • RFO/ forest officers • Biochemical Laboratory (Soil, Water, Air testing etc). (Entrepreneurship). • Adviser to grow advanced crop (Biotech crop). • Farmer friendly liaison officer.

Job opportunities in Botany

Exit After FOUR Year: Degree Course (Honors)

VII Semester-	**A9: Molecular Biology**
VII Semester-	**A10: Seed Biology and Seed Technology**
VII Semester-	**A11: Plant Health Technology**
VIII Semester-	**A12: Medicinal Plants and Phytochemistry**
VIII Semester-	**A13: Bioinformatics & Computational Biology**
VIII Semester-	**A14: Research Methodology**

Jobs opportunities in Botany

In Addition to three year degree

- Assisting for Ayurvedic doctors.
- Medicinal plants Marketing (Entrepreneurship).
- R & D Botany, Biotechnology, Ayurvedic and Pharmaceutical Lab.
- Laboratory on checking food adulteration (Entrepreneurship).
- Soil and water assessment laboratory (Entrepreneurship).
- Biological material analysis Laboratory (Entrepreneurship).
- Teacher in primary and High Schools.
- Prepare for joining Research institution for Ph.D. programmes.
- Wild life photographer
- Separation and Analyzing phytochemical compounds.
- Seed technician.
- Plant health manager

Practical Question Paper I

Microbial Diversity and Technology

Time – 3 hrs

Max. marks - 25

1. Conduct the Experiment 'A' Gram staining of the given sample (Root nodule/curd) **03 marks**

2. Perform the Experiment 'B' (Haemocytometer/Micrometry) **03 marks**

3. Identify the given sample 'C' & 'D' with reason **(2X2)** **05 marks**

4. Comment on the given slides 'E' & 'F' with labelled diagrams and reasons **(2X2)** **05 marks**

5. Identify and comment on 'G' & 'H' **(2X2)** **04 marks**

6. Record and submission **(2½ +2½)** **05 marks**

Scheme of Evaluation

1. A. – (root nodule / curd sample)
   Preparation & Identification = 2 marks, Procedure = 1 mark, **Total = 3 marks**
2. B. – Haemocytometer
   Preparation = **1½** marks, calculation= **1½** marks, **Total = 3 marks**
3. C & D – Specimens (Fungi)
   Identification & Classification = 1½ marks, Reasons = 1 mark (2X2½) Total = 5 marks
4. E & F – Fungal Slides
   Identification = 1 mark, Diagram & Reasons = 1½ mark **(2X2½)** **Total = 5 marks**
5. G & H – Mushroom Cultivation / instruments / Diseases/ colony characteristics / Scientists Photos Identification = 1 mark, Reasons = 1 **(2X2)** **Total = 4 marks**
6. Record – **2½** marks, Submission – **2½** marks (tour report) **Total = 5 marks**