



KARNATAK UNIVERSITY, DHARWAD  
ACADEMIC (S&T) SECTION  
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ  
ವಿದ್ಯಾಮಂಡಲ (ಎಸ್&ಟಿ) ವಿಭಾಗ



Tele: 0836-2215224  
e-mail: academic.st@kud.ac.in  
Pavate Nagar, Dharwad-580003  
ಪಾವಟೆ ನಗರ, ಧಾರವಾಡ - 580003

NAAC Accredited  
'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/SVB-05/BOS /Botany (UG) /20-21 ಆ ೩೫

Date: 16 OCT 2020

**NOTIFICATION**

Sub: Regarding introduction of the syllabus of Botany UG under C.B.C.S. w.e.f. the academic year 2020-21 & onwards.

- Ref: 1. UGC Letter DO No. 1-1/2016(SECY), dt. 10.08.2016.  
2. Special BOS Res. No. 01, dt. 10.07.2020.  
3. Special Faculty Res. No. 01, dt. 11.08.2020.  
4. Special Academic Council Res. No. 38, dt. 21.08.2020.  
5. Vice-Chancellor's order dated - 07-10-2020

Adverting to the above, it is hereby notified to the Principals of all constituent and affiliated degree colleges coming under the jurisdiction of Karnatak University, Dharwad that the Botany UG syllabus for I to VI Semester which is annexed herewith in Annexure-A is introduced under C.B.C.S. from the academic year 2020-21 & onwards.

Hence, the contents of this notification may please be brought to the notice of the students and all the concerned. The prescribed C.B.C.S. syllabus may also be obtained through K.U. website ([www.kud.ac.in](http://www.kud.ac.in)).

*Hanumanthappa K.T.*  
(Dr. Hanumanthappa K.T.)  
REGISTRAR

To,

1. The Chairman, BOS Botany (UG), Dept. of Botany, K.U.Dharwad.
2. The Chairman, Dept. of Botany, K.U.Dharwad.
3. The Principals of all the constituted and affiliated degree colleges under the jurisdiction of Karnatak University, Dharwad. (The same may be sent through e-mail)
4. The Registrar (Evaluation), K.U.Dharwad.

**Copy fws to:**

1. Dr. Ch.Ramesh, Dean, Faculty of Science & Tech., Dept. of Botany, K.U.Dharwad.
2. The Director, IT Section, Examination Section, K.U.Dharwad for information and to upload on K.U.Website ([www.kud.ac.in](http://www.kud.ac.in)).

**Copy to:**

1. PS to Vice-Chancellor, K.U.Dharwad.
2. S.A. to Registrar, K.U.Dharwad.
3. O.S., Exam UG / Confl / QP / GAD Section, K.U.Dharwad.
4. The System Analyst, Computer Unit Exam Section, K.U.Dharwad.



**KARNATAK UNIVERSITY, DHARWAD**

**Syllabus and Structure**

**For**

**B. Sc. Botany**

**(I-VI SEMESTER)**

**Under**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**w.e.f. 2020 - 2021 onwards**

# SEMESTER I

## CORE COURSE: BOTANY PAPER - I

### BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

(Credits: Theory-4, Practicals-2)

#### THEORY

Lectures: 60

#### Unit 1: Microbes

(10 Lectures)

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

#### Unit 2: Algae

(12 Lectures)

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Sargassum*, *Batrachospermum*. Economic importance of algae

#### Unit 3: Fungi

(12 Lectures)

Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

#### Unit 4: Introduction to Archegoniate

(2 Lectures)

Unifying features of archegoniate, Transition to land habit, Alternation of generations.

#### Unit 5: Bryophytes

(10 Lectures)

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of Bryophytes with special mention of *Sphagnum*.

#### Unit 6: Pteridophytes

(8 Lectures)

General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.

## Unit 7: Gymnosperms

(6 Lectures)

General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

### Practical

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (Electron micrographs), *Oedogonium*, *Vaucheria*, *Fucus\** and *Polysiphonia* through temporary preparations and permanent slides. (\* *Fucus* - Specimen and permanent slides)
5. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. *Alternaria*: Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. *Funaria*- Morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s. rhizome (permanent slide).
15. *Pteris*- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

## SUGGESTED READINGS

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2<sup>nd</sup> edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10<sup>th</sup> edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4<sup>th</sup> edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
9. Smith, G.M. 1971. Cryptogamic Botny. Vol.I Algae & Fungi. Tata McGraw Hill Publishing Co., New Delhi.
10. Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co.
11. Sharma, P.D. 1991. The Fungi. Rastogi & Co., Meerut.
12. Dube, H.C. 1990. An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., Delhi.
13. Clifton, A. 1958. Introduction to the Bacteria. McGraw Hill & Co., New York.
14. Aneja, K.R. 1993. Experiments in Microbiology, Pathology and Tissue Culture. Vishwa Prakashan, New Delhi.
15. Vashista, B.R. 1978. Algae. S Chand & Co. Ltd., New Delhi.
16. Basu A.N. 1993. Essentials of plant viruses, vectors and plant diseases. New Age International, New Delhi.
17. Chopra, G.L. A text book of algae. Rastogi & Co., Meerut.
18. Fritze, R.E. 1977. Structure and reproduction of Algae. Cambridge University Press.
19. Rangaswamy, G. 1988. Diseases of crop plants in India. Prentice Hall of India, New Delhi.
20. Sundarajan, S. 1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.
21. Alexopoulos, 1992. An Introduction to Mycology. New Age International, New Delhi.
22. Vashista, B.R. 1978. Fungi. S Chand & Co. Ltd., New Delhi.
23. H.N.Srivastava , 2003. Algae Pradeep Publication, Jalandhar, India
24. Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut
25. Anil K.Thakur & Susheel K.Bassi. Diversity of Microbes and Cryptogams. Chand Publication.

26. A.V.S.S.Sambamurty. A Text Book of Algae. I.K. International Private Ltd.
27. Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi.
28. Sharma, O.P. 1990. Text Book of Pteridophyta. McMillan India Ltd.
30. Puri, P. 1980. Bryophyta. Atma Ram & Sons, Delhi.
31. Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot. Allahabad.
32. Sporne, K.R. 1966. Bryophytes.
33. Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.
34. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms. New Age International Ltd., New Delhi.
35. Gifford, E.M. and Foster, A.S. 1988. Morphology and Evolution of Vascular Plants. W.H. Freeman & Co., New York.
36. Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd., London.
37. Stewart, W.M. 1983. Paleobotany and the Evolution of Plants. Cambridge University Press, Cambridge.
38. Agashe, S.N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Application in exploration of fossil fuels. Oxford & IBH., New Delhi.
39. Parihar, N.S. 1977. The morphology of Pteridophytes. Central Book Depot., Allahabad.
40. Rashid, A. 1998. An Introduction to Pteriophyta. II Ed., Vikas Publishing House, New Delhi.
41. Sporne, K.R. 1966. The morphology of Pteridophytes. The structure of ferns and Allied plants. Hutchinson & Co., Ltd., London.
42. Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut
43. Pandey, Sihna and Trivedi. Text Book of Botany Vol-I. Bikas publishers.

# SEMESTER I

## CORE COURSE: BOTANY PAPER - I

### BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

#### THEORY

Time : 3 Hours

Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

- From Unit – 1 : Two Sub questions
- From Unit – 2 : Two Sub questions
- From Unit – 3 : Two Sub question
- From Unit – 4 : One Sub questions
- From Unit – 5 : Two Sub questions
- From Unit – 6 : One Sub question
- From Unit – 7 : Two Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

- From Unit – 1 : One Sub question
- From Unit – 2 : Two Sub question
- From Unit – 3 : Two Sub question
- From Unit – 5 : One Sub questions
- From Unit – 6 : One Sub question
- From Unit – 7 : One Sub question

Q. III. Answer any **THREE** of the following: 3 x 10 = 30 Marks

- From Unit – 1 : One Sub question
- From Unit – 2 : One Sub question
- From Unit – 3 : One Sub question
- From Unit – 5 : One Sub questions
- From Unit – 6 : One Sub question

# SEMESTER I

## CORE COURSE: BOTANY PAPER - I

### BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

#### THEORY

Time : 3 Hours

Max. Marks: 80

#### BLUE PRINT OF THE QUESTION PAPER

| Sl. No. | Unit | Title                        | Teaching Hours | Total Questions Allotted |         |          | Total Marks |
|---------|------|------------------------------|----------------|--------------------------|---------|----------|-------------|
|         |      |                              |                | 2 marks                  | 5 Marks | 10 Marks |             |
| 1.      | 1    | Microbes                     | 10             | 02                       | 01      | 01       | 19          |
| 2.      | 2    | Algae                        | 12             | 02                       | 02      | 01       | 24          |
| 3.      | 3    | Fungi                        | 12             | 02                       | 02      | 01       | 24          |
| 4.      | 4    | Introduction to Archegoniate | 02             | 01                       | 00      | 00       | 02          |
| 5.      | 5    | Bryophytes                   | 10             | 02                       | 01      | 01       | 19          |
| 6.      | 6    | Pteridophytes                | 08             | 01                       | 01      | 01       | 17          |
| 7.      | 7    | Gymnosperms                  | 06             | 02                       | 01      | 00       | 09          |
| Total   |      |                              | 60             | 12                       | 08      | 05       | 114         |



# SEMESTER I

## CORE COURSE: BOTANY PRACTICAL - I

### BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

Time : 03 Hours

Max. Marks: 40

- |       |  |          |
|-------|--|----------|
| Q. 1. | Identify and classify the given specimen A, B, C, D, E and F giving reasons.   | 12 marks |
| Q. 2. | Make Simple/ Differential staining of the given specimen H and show the preparation to the examiner (No written answer is expected). | 03 marks |
| Q. 3. | Identify the given specimen / slide I, J, K, L, M and N giving reasons.  | 09 marks |
| Q. 4. | Identify the given specimen / Photograph O giving reasons.   | 02 marks |
|       | Practical Record (Journal)   | 05 Marks |
|       | Botanical Study-Tour Report  | 05 marks |
|       | Viva-voce  | 04 Marks |

-----

### Instructions to the Examiner

- Q. 1. One Specimen each from Algae, Fungi, Bryophyte, Pteridophyte and Gymnosperm.
- Q.2. Simple/ Differential staining of Bacteria
- Q. 3. One specimen / slide each from Algae, Fungi, Bryophyte, Pteridophyte and Gymnosperm.
- Q. 5. One specimen / slide / Electron Micrograph of Viruses or Bacteria.

# SEMESTER II

## CORE COURSE BOTANY –PAPER II PLANT ECOLOGY AND TAXONOMY (Credits: Theory-4, Practicals-2)

### THEORY

Lectures: 60

**Unit 1: Introduction** (02 Hours)

**Unit 2: Ecological factors** (10 Hours)

Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

**Unit 3: Plant communities** (06 Hours)

Characters; Ecotone and edge effect; Succession; Processes and types.

**Unit 4: Ecosystem** (08 Hours)

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

**Unit 5: Phyto geography** (04 Hours)

Principle Biogeographical zones, Endemism

**Unit 6 : Introduction to Taxonomy** (02 Hours)

Identification, Classification, Nomenclature

**Unit 7 : Identification** (04 Hours)

Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

**Unit 8 : Taxonomic Evidences** ( 06 Hours)

From Palynology, Cytology, Phytochemistry and Molecular data.

**Unit 9 : Taxonomic Hierarchy** Ranks, categories and taxonomic groups (02 Hours)

**Unit 10 : Botanical Nomenclature** ( 06 Hours)

Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

**Unit 11 Classification** (06 Hours)

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).

**Unit 12 Biometrics, numerical taxonomy and cladistics** (04 Hours)

Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

## PRACTICALS

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).  
(b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (Orobanchae), Epiphytes, Predation (Insectivorous plants)
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): **Brassicaceae** - *Brassica*, *Alyssum* / *Iberis*; **Asteraceae** - *Sonchus*/*Launaea*, *Vernonia*/*Ageratum*, *Eclipta*/*Tridax*; **Solanaceae** - *Solanum nigrum*, *Withania*; **Lamiaceae** - *Salvia*, *Ocimum*; **Liliaceae** - *Asphodelus* / *Lilium* / *Allium*.
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

-0-0-0-

## SUGGESTED READINGS

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4<sup>th</sup> edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8<sup>th</sup> edition.
3. Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford & IBH Pvt. Ltd., New Delhi. 3<sup>rd</sup> edition.
5. Bharati Bhattacharyya, 2005. Systematic Botany. Narosa Publishing House, New Delhi.
6. Daniel, M. 2009. Taxonomy; Evolution at work, Narosa Publishing House, New Delhi.
7. Dutta, S.C. 1988. Systematic Botany. Wiley Eastern, New Delhi.
8. Davis, P.H. and Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
9. Heywood, V.H. and Moore, D.M. (eds) 1984. Current concepts in Plant Taxonomy Academic Press, London.
10. Jaques, H.E. 1999. Plant families – How to know them. IBS, New Delhi.
11. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge, London.
12. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw Hill Book Co., New York.
13. Lawrence, G.H.M. 1951. Taxonomy of vascular plants. MacMillan, New York.
14. Mondal, A.K. 2009. Advanced Plant Taxonomy, New central public agency (P) Ltd. New Delhi.

15. Naik V. N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
16. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row, New York.
17. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
18. Singh, V. & D.K. Jain 1996. Taxonomy of Angiosperms, Rastogi Publications, Meerut.
19. Sivarajan, V.V., 1984. Introduction to the Principles of Plant Taxonomy. Oxford & IBH Publishing. Co. Pvt. Ltd. New Delhi.
20. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold, London.
21. Stewart, W.M. 1983. Paleobotany and the Evolution of Plants. Cambridge University Press, Cambridge.
22. Odum, E.P. 1983. Basic Ecology, Saunders, Philadelphia.
23. Kormondy, E.J. 1996. Concepts of Ecology. Prentice-Hall of India Pvt. Ltd. Delhi.
24. Mackenzie, A et al. 1999. Instant Notes in Ecology. Viva Books Pvt. New Delhi.
25. Kocchar, S.L. 1998. Economic Botany in Tropics. 2<sup>nd</sup> edition, Macmillian India Ltd., New Delhi.
26. Sambamurthy, A.V.S.S. and Subramanyam, N.S. 1989. A Text Book of Economic Botany, Wiley Eastern Ltd. New Delhi.
27. Sharma, O.P. 1996. Hill's Economic Botany. Tata McGraw Hill Co., Ltd., New Delhi.
28. Simpson, B.B. and Conner-Ogorzaly, M. 1986. Economic Botany-Plants in our world. McGraw Hill, New York.
29. Hill, A.F. 1989. Economic Botany. Tata McGraw-Hill, New York.
30. Sharma, P.D. 1993. Ecology and Environment. Rastogi Publications, New Delhi.

**For laboratory exercises**

31. Krebs, C.J. 1989. Ecological Methodology. Harper and Row, New York.
32. Ludwig, J.A. and Reynolds, J.F. 1988. Statistical Ecology. Wiley, New York.
33. Moore, P.W. and Chapman, S.B. 1986. Methods in Plant Ecology. Blackwell Scientific Publications.
34. Misra, R. 1968. Ecology Work Book. Oxford & IBH, New Delhi.

**SEMESTER II**  
**CORE COURSE BOTANY –PAPER II**  
**PLANT ECOLOGY AND TAXONOMY**  
(Credits: Theory-4, Practicals-2)

**THEORY**

Time : 3 Hours

Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

- From Unit – 2 : Two Sub questions
- From Unit – 3 : One Sub questions
- From Unit – 4 : Two Sub questions
- From Unit – 5 : One Sub questions
- From Unit – 7 : One Sub questions
- From Unit – 8 : One Sub questions
- From Unit – 9 : One Sub questions
- From Unit – 10 : One Sub questions
- From Unit – 11 : One Sub questions
- From Unit – 12 : One Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

- From Unit – 2 : Two Sub questions
- From Unit – 3 : One Sub questions
- From Unit – 4 : One Sub questions
- From Unit – 5 : One Sub questions
- From Unit – 7 : One Sub questions
- From Unit – 10 : One Sub questions
- From Unit – 11 : One Sub questions

Q. III. Answer any **THREE** of the following: 3 x 10 = 30 Marks

- From Unit – 2 : One Sub questions
- From Unit – 3 : One Sub questions
- From Unit – 4 : One Sub questions
- From Unit – 8 : One Sub questions
- From Unit – 11 : One Sub questions

**SEMESTER II**  
**CORE COURSE BOTANY –PAPER II**  
**PLANT ECOLOGY AND TAXONOMY**  
(Credits: Theory-4, Practicals-2)

**THEORY**

**Time : 3 Hours**

**Max. Marks: 80**

**BLUE PRINT OF THE QUESTION PAPER**

| Sl. No.      | Unit | Title   | Teaching Hours | Total Questions Allotted |           |           | Total Marks |
|--------------|------|---|----------------|--------------------------|-----------|-----------|-------------|
|              |      |   |                | 2 marks                  | 5 Marks   | 10 Marks  |             |
| 1.           | 1.   | Introduction                                  | 02             | 00                       | 00        | 00        | 00          |
| 2.           | 2.   | Ecological Factors                            | 10             | 02                       | 02        | 01        | 24          |
| 3.           | 3.   | Plant communities                             | 06             | 01                       | 01        | 01        | 17          |
| 4.           | 4.   | Ecosystem                                     | 08             | 02                       | 01        | 01        | 19          |
| 5.           | 5.   | Phytogeography                                | 04             | 01                       | 01        | 00        | 07          |
| 6.           | 6.   | Introduction to Taxonomy                      | 02             | 00                       | 00        | 00        | 00          |
| 7.           | 7.   | Identification                                | 04             | 01                       | 01        | 00        | 07          |
| 8.           | 8.   | Taxonomic Evidences                           | 06             | 01                       | 00        | 01        | 12          |
| 9.           | 9.   | Taxonomic Hierarchy                           | 02             | 01                       | 00        | 00        | 02          |
| 10.          | 10.  | Botanical Nomenclature                        | 06             | 01                       | 01        | 00        | 07          |
| 11.          | 11.  | Classification                                | 06             | 01                       | 01        | 01        | 17          |
| 12.          | 12   | Biometrics, Numerical Taxonomy and Cladistics | 04             | 01                       | 00        | 00        | 02          |
| <b>Total</b> |      |   | <b>60</b>      | <b>12</b>                | <b>08</b> | <b>05</b> | <b>114</b>  |

**SEMESTER II**  
**CORE COURSE BOTANY – PRACTICAL - II**  
**PLANT ECOLOGY AND TAXONOMY**  
(Credits: Theory-4, Practicals-2)

**PRACTICAL**

Time : 3 Hours

Max. Marks: 40

- |       |  |           |
|-------|--|-----------|
| Q. 1. | Give an account of external and internal features of ecological adaptations of specimen A and mention the habitat to which it belongs. | 05 marks  |
| Q. 2. | Assign the specimens B, C and D to the respective families giving diagnostic features and their classifications ( up to family).       | 09 marks. |
| Q. 3. | Estimate the salinity / P <sup>H</sup> of given water sample E. Write the procedure and inference                                      | 04 marks  |
| Q. 4. | Draw the floral diagram and write floral formula of specimen F.  | 03 marks. |
| Q. 5. | Identify the slides / specimens G, H, I, giving reasons.   | 06 marks  |
|       | Practical Record (Journal)   | 05 Marks  |
|       | Submission of Herbaria of weeds ( Any Five)  | 04 marks  |
|       | Viva-voce (On Ecology / Vegetation types)  | 04 Marks  |
- 

**Instructions to the Examiner**

- Q. 1. One ecological specimen (External adaptation – 1 mark, Internal adaptation – 2 marks, diagram (T.S.) – 2 marks, mentioning habitat – 1 mark)
- Q. 2. Three families done in the practical class.  
(Identification – 1 mark, Classification – 1 mark, Features – 2 marks)
- Q. 3. For P<sup>H</sup> (Setting instrument – 2 marks, record of reading – 2 marks, conclusion & result – 1 mark)  
For salinity of water ( conducting the test – 2 marks, tabulation of readings – 1 mark, calculation and result – 2 marks)
- Q. 4. A twig with flower buds (Floral diagram – 2 marks, Floral formula – 1 mark)
- Q. 5. 3 Slides / specimens of ecological interest (Identification – 1 mark, description – 1 mark)
-

**SEMESTER III**  
**CORE COURSE BOTANY –PAPER III**  
**PLANT ANATOMY AND EMBRYOLOGY**  
**(Credits: Theory-4, Practicals-2)**  
**THEORY**

**Lectures: 60**

- Unit 1: Meristematic and permanent tissues** (8 Hours)  
Root and shoot apical meristems; Simple and complex tissues.
- Unit 2: Organs** (4 Hours)  
Structure of dicot and monocot root stem and leaf.
- Unit 3: Secondary Growth** (8 Hours)  
Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).
- Unit 4: Adaptive and protective systems** (8 Hours)  
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.
- Unit 5: Structural organization of flower** (8 Hours)  
Structure and development of anther and pollen; Structure and development of ovule, types of ovules; Types of embryo sacs, organization and ultra structure of mature embryo sac.
- Unit 6: Pollination and fertilization** (8 Hours)  
Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.
- Unit 7: Embryo and endosperm** (8 Hours)  
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship.
- Unit 8: Apomixis and polyembryony** (8 Hours)  
Definition, types and practical applications.

-0-0-0-



## PRACTICALS

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.
14. Demonstration of Microtomy.

## SUGGESTED READINGS

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5<sup>th</sup> edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
3. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms. 4<sup>th</sup> revised and Enlarged edition. Vikas Publishing House, Delhi.
4. Cutter, E.G. 1969. Part I. Cells and tissues. Edward Arnold, London.
5. Cutter, E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part II. Organs. Edward Arnold, London.
6. Easu, K. 1977. Anatomy of seed plants. 2<sup>nd</sup> edition. John Wiley & Sons, New York.
7. Fahn, A. 1974. Plant Anatomy. 2<sup>nd</sup> edition. Pergamon Press, Oxford.
8. Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Co., Inc., Menlo Park, California, USA.
9. Raven, P.H. , Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants. 5<sup>th</sup> edition. W.H. Freeman and Co., Worth Publishers, New York.
10. Johri, B.M. 1984. Embryology of Angiosperms. Springer-Verlag, Berlin.
11. Maheshwari, P. 1950. An Introduction to Embryology of Angiosperms. Tata McGraw Hill, New York.
12. Shukla, A.K. 1999. Biology of Pollen. Atlas Books & Periodicals.
13. Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York.
14. B.P.Pandey. Plant Anatomy
15. M.S.Tayal. Plant Anatomy
16. Singh, Pandey and Jain. Embryology of angiosperms.
17. V.K.Gupta. Embryology of angiosperms.
18. K.R.Shivanna. Pollen Biotechnology.

**SEMESTER III**  
**CORE COURSE BOTANY –PAPER III**  
**PLANT ANATOMY AND EMBRYOLOGY**

Time : 3 Hours

Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

- From Unit – 1 : One Sub questions
- From Unit – 2 : Two Sub questions
- From Unit – 3 : Two Sub questions
- From Unit – 4 : Two Sub questions
- From Unit – 5 : One Sub questions
- From Unit – 6 : One Sub questions
- From Unit – 7 : One Sub questions
- From Unit – 8 : Two Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

- From Unit – 1 : One Sub questions
- From Unit – 3 : One Sub questions
- From Unit – 4 : One Sub questions
- From Unit – 5 : One Sub questions
- From Unit – 6 : One Sub questions
- From Unit – 7 : One Sub questions
- From Unit – 8 : Two Sub questions

Q. III. Answer any **THREE** of the following: 3 x 10 = 30 Marks

- From Unit – 1 : One Sub questions
- From Unit – 3 : One Sub questions
- From Unit – 5 : One Sub questions
- From Unit – 6 : One Sub questions
- From Unit – 7 : One Sub questions

**SEMESTER III**  
**CORE COURSE BOTANY –PAPER III**  
**PLANT ANATOMY AND EMBRYOLOGY**

THEORY

Time : 3 Hours

Max. Marks: 80

BLUE PRINT OF THE QUESTION PAPER

| Sl. No.      | Unit | Title                                 | Teaching Hours | Total Questions Allotted |           |           | Total Marks |
|--------------|------|---------------------------------------|----------------|--------------------------|-----------|-----------|-------------|
|              |      |                                       |                | 2 marks                  | 5 Marks   | 10 Marks  |             |
| 1.           | 1.   | Meristematic and Permanent Tissues    | 08             | 01                       | 01        | 01        | 17          |
| 2.           | 2.   | Organs                                | 04             | 02                       | 00        | 00        | 04          |
| 3.           | 3.   | Secondary Growth                      | 08             | 02                       | 01        | 01        | 19          |
| 4.           | 4.   | Adaptive and Protective System        | 08             | 02                       | 01        | 00        | 09          |
| 5.           | 5.   | Structural and Organization of flower | 08             | 01                       | 01        | 01        | 17          |
| 6.           | 6.   | Pollination and Fertilization         | 08             | 01                       | 01        | 01        | 17          |
| 7.           | 7.   | Embryo and Endosperm                  | 08             | 01                       | 01        | 01        | 17          |
| 8.           | 8.   | Apomixis and Polyembryony             | 08             | 02                       | 02        | 00        | 14          |
| <b>Total</b> |      |                                       | <b>60</b>      | <b>12</b>                | <b>08</b> | <b>05</b> | <b>114</b>  |

**SEMESTER III**  
**CORE COURSE BOTANY –PRACTICAL- III**  
**PLANT ANATOMY AND EMBRYOLOGY**

**PRACTICAL**

Time : 3 Hours

Max. Marks: 40

- Q. 1. Prepare a double stained temporary micropreparation of T.S. of specimen A. Draw a labelled diagram and mention the features of anatomical interest. 07 marks  
Show the preparation to the examiner.
- Q. 2. Make a temporary micropreparation of specimen B so as to expose \_\_\_\_\_.  
Show the preparation to the examiner (No written answer is expected). 03 marks
- Q. 3. Make a temporary micropreparation of specimen C so as to expose \_\_\_\_\_.  
Draw a neat labelled diagram Show the preparation to the examiners. 03 marks
- Q. 4. Identify and describe the salient features observed in the specimen / slide  
D, E, F, G, H and I. 18 marks
- Q. 5. Estimate the percentage of pollen viability in the given flower A by  
Hanging drop method 04 marks
- Practical Record (Journal) 05 Marks
- 

**Instructions to the Examiner**

- Q. 1. Any one stem showing anomalous secondary growth.
- Q. 2. One specimen from anatomy.
- Q. 3. Mounting – Embryo / endosperm.
- Q. 4. Two slides from anatomy, One specimen / Photograph from Pollination and Microtomy each,  
two slides from embryology.
- Q. 5. Unopened flowers with intact anthers  
(Preparation – 2 marks, procedure – 3 marks, Inference – 2 marks)
-

**SEMESTER IV**  
**CORE COURSE BOTANY –PAPER IV**  
**PLANT PHYSIOLOGY, METABOLISM AND PHYTOCHEMISTRY**  
(Credits: Theory-4, Practicals-2)  
**THEORY**

**Lectures: 60**

**Unit 1: Plant-water relations** **(8 Hours)**

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

**Unit 2: Mineral nutrition** **(6 Hours)**

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

**Unit 3: Translocation in phloem** **(6 Hours)**

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

**Unit 4: Photosynthesis** **(12 Hours)**

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C<sub>3</sub>, C<sub>4</sub> and CAM pathways of carbon fixation; Photorespiration.

**Unit 5: Respiration** **(6 Hours)**

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

**Unit 6: Enzymes** **(4 Hours)**

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

**Unit 7: Plant growth regulators** **(6 Hours)**

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

**Unit 8: Plant response to light and temperature** **(6 Hours)**

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

**Unit 9: Phytochemistry** **(6 Hours)**

**1. General account:** Plants as source of medicine. Phytochemistry and its importance in modern medicine. Classification of plant drugs. Chemical and pharmacological drug evaluation – microscopic, physical, chemical and biological.

**2. Secondary Metabolites:** Definition of secondary metabolites and difference with primary metabolites. Major types – Terpenoids, phenolics, alkaloids and their protective action against pathogenic microbes and herbivores.

## PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O<sub>2</sub> evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.
9. Biochemical tests for proteins, carbohydrates and fats.
10. Microscopic features of some common powder drugs
11. Test for secondary metabolites - Terpenoids, phenolics, alkaloids.

### Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

-0-0-0-

## SUGGESTED READINGS

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5<sup>th</sup> Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4<sup>th</sup> Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell (eds). 1997. Plant Metabolism (2<sup>nd</sup> edition). Longman, Essex, England.
5. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
6. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc. New York.
7. Lea, P.J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology. John Wiley Sons, Chichester, England.
8. Mohr, H. and Schopfer, P. 1995. Plant Physiology. Springer-Verlag, Berlin.
9. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4<sup>th</sup> edition). Wadsworth Publishin Co., California.
10. Taiz, L. and Zeiger, E. 2002 . Plant Physiology (3<sup>rd</sup> edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
11. Devi P 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
12. Moore, T.C. 1974. Research Experiences in Plant Physiology: A Laboratory Manual. Springer-Verlag, Berlin.
13. Ninfa, A.J. and Ballou, D.P. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology., Fitzgerald Science Press, Ind., Maryland, USA.
14. Roberts, J. and Tucker, G.A. (Eds.) 2000 Plant Hormone Protocols. Humana Press, New Jersey, USA.
15. Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.
16. Wilson, K. and Goulding, K.H. (eds.) 1986. A Biologists Guide to principles and Techniques of Practical Biochemistry. Edward Arnold, London.
17. V. Verma. Plant Physiology
18. S.N.Pandey and B.K.Sinha. Plant Physiology. IV Edition. Vikas Publication.
19. S.K.Verma. Plant Physiology. S. Chand Publications, Meerut.

-0-0-0-

**SEMESTER IV**  
**CORE COURSE BOTANY –PAPER IV**  
**PLANT PHYSIOLOGY, METABOLISM AND PHYTOCHEMISTRY**

Time : 3 Hours

Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

- From Unit – 1 : One Sub questions
- From Unit – 2 : One Sub questions
- From Unit – 3 : One Sub questions
- From Unit – 4 : Three Sub questions
- From Unit – 5 : One Sub questions
- From Unit – 6 : One Sub questions
- From Unit – 7 : One Sub questions
- From Unit – 8 : Two Sub questions
- From Unit – 9 : One Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

- From Unit – 1 : One Sub questions
- From Unit – 2 : One Sub questions
- From Unit – 3 : One Sub questions
- From Unit – 4 : One Sub questions
- From Unit – 6 : One Sub questions
- From Unit – 7 : One Sub questions
- From Unit – 8 : One Sub questions
- From Unit – 9 : One Sub questions

Q. III. Answer any **THREE** of the following: 3 x 10 = 30 Marks

- From Unit – 1 : One Sub questions
- From Unit – 4 : One Sub questions
- From Unit – 5 : One Sub questions
- From Unit – 7 : One Sub questions
- From Unit – 9 : One Sub questions

**SEMESTER IV**  
**CORE COURSE BOTANY –PAPER IV**  
**PLANT PHYSIOLOGY, METABOLISM AND PHYTOCHEMISTRY**

**THEORY**

**Time : 3 Hours**

**Max. Marks: 80**

**BLUE PRINT OF THE QUESTION PAPER**

| Sl. No.      | Unit | Title                                   | Teaching Hours | Total Questions Allotted |           |           | Total Marks |
|--------------|------|---|----------------|--------------------------|-----------|-----------|-------------|
|              |      |   |                | 2 marks                  | 5 Marks   | 10 Marks  |             |
| 1.           | 1    | Plant water Relations                   | 08             | 01                       | 01        | 01        | 17          |
| 2.           | 2    | Mineral Nutrition                       | 06             | 01                       | 01        | 00        | 07          |
| 3.           | 3    | Translocation in Phloem                 | 06             | 01                       | 01        | 00        | 07          |
| 4.           | 4    | Photosynthesis                          | 12             | 03                       | 01        | 01        | 21          |
| 5.           | 5    | Respiration                             | 06             | 01                       | 00        | 01        | 12          |
| 6.           | 6    | Enzymes                                 | 04             | 01                       | 01        | 00        | 07          |
| 7.           | 7    | Plant Growth Regulators                 | 06             | 01                       | 01        | 01        | 17          |
| 8.           | 8    | Plant response to Light and Temperature | 06             | 02                       | 01        | 00        | 09          |
| 9.           | 9    | Phytochemistry                          | 06             | 01                       | 01        | 01        | 17          |
| <b>Total</b> |      |   | <b>60</b>      | <b>12</b>                | <b>08</b> | <b>05</b> | <b>114</b>  |



**SEMESTER IV**  
**CORE COURSE BOTANY –PRACTICAL - IV**  
**PLANT PHYSIOLOGY, METABOLISM AND PHYTOCHEMISTRY**

**PRACTICAL**

Time : 3 Hours

Max. Marks: 40

- Q. 1. Set up an experiment as per slip A. Write requirements, principle involved, procedure and conclusion. (Show the set up of the experiment to the examiners). 12 marks.
- Q. 2. Perform and write the Biochemical test of the given sample B for \_\_\_\_\_ (Show the result to the examiners). 04 marks.
- Q. 3. Identify and comment on the physiological phenomenon involved in the experiments C, D, E. 12 marks.
- Q. 5. Identify, mention the parts used and describe microscopic features of the given powdered drug G. 03 marks
- Q. 6. Perform the phyto-chemical test for the given sample H. 04 Marks
- Practical Record (Journal) 05 Marks.

-0-0-0-

**Instructions to the Examiner**

- Q. 1. One experiment as per the slip. (Requirements – 2 marks, setting – 4 marks, procedure – 4 marks, conclusion – 2 marks)
- Q. 2. Perform the test for Carbohydrates or Proteins or Fats. (Procedure – 2 marks, result – 2 marks)
- Q. 3. Any three physiology experiments as per the practical syllabus. (Identification – 1 mark, procedure – 1 mark and Inference – 2 marks)
- Q. 5. Identification and parts used – 1 Mark and description – 2 Mark.
- Q. 6. Procedure – 2 Marks, Result – 2 Mark.
-

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)**

**SEMESTER V**

(Student shall choose either paper- I or Paper-II or paper –III)

**PAPER-I: CELL AND MOLECULAR BIOLOGY**

(Credits: Theory-4, Practicals-2)

**THEORY**

**Lectures: 60**

**Unit 1: Techniques in Biology**

**(8 Lectures)**

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

**Unit 2: Cell as a unit of Life**

**(2 Lectures)**

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

**Unit 3: Cell Organelles**

**(20 Lectures)**

Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants, ribosome structure and biogenesis.

Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus (brief).

**Unit 4: Cell Membrane and Cell Wall**

**(6 Lectures)**

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall-structure and functions.

**Unit 5: Cell Cycle**

**(6 Lectures)**

Overview of Cell cycle, Mitosis and Meiosis; Molecular controls

**Unit 6: Genetic material**

**(6 Lectures)**

DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi-conservative, mode of replication, replication of linear, ds-DNA, replicating the 5' end of linear chromosome including replication enzymes.

**Unit 7: Transcription and Translation (Prokaryotes and Eukaryotes)**

**(6 Lectures)**

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code.

**Unit 8: Regulation of gene expression**

**(6 Lectures)**

Prokaryotes: Lac operon and Tryptophan operon ; and in Eukaryotes.

**PRACTICAL**

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
5. Study the effect of temperature, organic solvent on semi permeable membrane.
6. Demonstration of dialysis of starch and simple sugar.
7. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.
9. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
10. Study DNA packaging by micrographs.
11. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

**SUGGESTED READINGS**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

# Karnatak University, Dharwad

DISCIPLINE SPECIFIC ELECTIVE (DSE)

## SEMESTER V

CELL AND MOLECULAR BIOLOGY

### Practical

Time : 04 Hours

Max. Marks: 40

- Q. 1. Make a temporary micropreparation of the squash/ smear of the material A. Draw labeled diagram of any two stages of cell division seen in your preparation and show to the examiners 08 marks.
- Q. 2. Determine the length and breadth of the given material B by micrometric method. 05 marks.
- Q. 3. Conduct the experiment as per the direction given. 08 marks.
- Q. 4. Identify and describe the cytological stage in the slides F, G and H 09 marks.
- Practical Record (Journal) 05 marks.
- Submission of slides (2 meiosis slides and 3 mitosis slides) 05 marks.

-0-0-0-

### Instructions to the Examiner

- Q. 1. Squash - *Allium* root tips.  
Smear - *Allium*, *Tradescantia*, *Aloe vera* – flower buds may be given.  
(preparation - 5 mark, drawing – 3 marks)
- Q. 2. Onion peels  
( calibration – 2 marks, drawing – 1 mark, measurement – 2 marks)
- Q. 3. Any one experiment given in the practical list ( Sl. No. 05 to 07 )  
(Requirements – 2 marks, setting – 2 marks, procedure – 2 marks, conclusion – 2 marks)
- Q. 4. One slide from mitosis and two slides from meiosis  
( identification – 1 mark, description – 1 mark, labelled diagram – 1 mark)
-

# Karnatak University, Dharwad

## DISCIPLINE SPECIFIC ELECTIVE (DSE)

### SEMESTER V

#### CELL AND MOLECULAR BIOLOGY

Time : 3 Hours

Max. Marks: 80

Q. I. Answer any **TEN** of the following:

10 x 2 = 20 Marks

|               |   |                   |
|---------------|---|-------------------|
| From Unit – 1 | : | One Sub question  |
| From Unit – 2 | : | One Sub question  |
| From Unit – 3 | : | Two Sub question  |
| From Unit – 4 | : | One Sub questions |
| From Unit – 5 | : | Two Sub questions |
| From Unit – 6 | : | Two Sub questions |
| From Unit – 7 | : | Two Sub questions |
| From Unit – 8 | : | One Sub questions |

Q. II. Answer any **SIX** of the following:

6 x 05 = 30 Marks

|               |   |                   |
|---------------|---|-------------------|
| From Unit – 1 | : | One Sub question  |
| From Unit – 3 | : | Two Sub questions |
| From Unit – 4 | : | One Sub questions |
| From Unit – 5 | : | One Sub question  |
| From Unit – 6 | : | One Sub question  |
| From Unit – 7 | : | One Sub question  |
| From Unit – 8 | : | One Sub question  |

Q. III. Descriptive answers:

10 Marks

One questions from Unit – 1

OR

One questions from Unit – 3

Q. IV. Descriptive answers:

10 Marks

One questions from Unit – 3

OR

One questions from Unit – 4 or 5

Q. V. Descriptive answers:

10 Marks

One questions from Unit – 6

OR

One questions from Unit – 7 or 8

---0---0---

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)**

**SEMESTER V**

(Student shall choose either paper- I or Paper-II or paper –III)

**PAPER-II: ECONOMIC BOTANY AND BIOTECHNOLOGY**

(Credits: Theory-4, Practicals-2)

**THEORY**

**Lectures: 60**

**Unit 1: Origin of Cultivated Plants**

**(4 Lectures)**

Concept of centres of origin, their importance with reference to Vavilov's work

**Unit 2: Cereals**

**(2 Lectures)**

Wheat -Origin, morphology, uses

**Unit 3: Legumes**

**(4 Lectures)**

General account with special reference to Gram and soybean

**Unit 4: Spices**

**(4 Lectures)**

General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

**Unit 5: Beverages**

**(2 Lectures)**

Tea (morphology, processing, uses)

**Unit 6: Oils and Fats**

**(2 Lectures)**

General description with special reference to groundnut

**Unit 7: Fibre Yielding Plants**

**(4 Lectures)**

General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

**Unit 8: Introduction to biotechnology**

**(2 Lectures)**

Historical account, branches of biotechnology.

**Unit 9: Plant tissue culture**

**(16 Lectures)**

Introduction, steps involved in plant tissue culture, Micropropagation: haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

**Unit 10: Recombinant DNA Technology**

**(20 Lectures)**

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

## **PRACTICAL**

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.
5. Preparation of synthetic seeds.

## **SUGGESTED READINGS**

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4<sup>th</sup> edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)**

**SEMESTER V**

(Student shall choose either paper- I or Paper-II or paper –III)

**PAPER-III: BIOINFORMATICS**

(Credits: Theory-4, Practicals-2)

**THEORY**

**Lectures: 60**

**Unit 1: Introduction to Bioinformatics**

**(5 Lectures)**

Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

**Unit 2: Databases in Bioinformatics**

**(5 Lectures)**

Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

**Unit 3 : Biological Sequence Databases**

**(25 Lectures)**

National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.

**Unit 4: Sequence Alignments**

**(10 Lectures)**

Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

**Unit 5: Molecular Phylogeny**

**(8 Lectures)**

Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

**Unit 6: Applications of Bioinformatics**

**(7 Lectures)**

Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

**Practical**

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

**Suggested Readings**

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.



**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: SKILL ENHANCE COURSES (SEC-I)**  
(Student shall choose either paper- IA or Paper-IB for SEC-I)

## SEMESTER V

### PAPER-IA: HERBAL TECHNOLOGY

(Credits: 2)

#### THEORY

**Lectures: 30**

**Unit 1:** Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants. **(6 Lectures)**

**Unit 2:** Pharmacognosy - systematic position and medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. **(6 Lectures)**

**Unit 3:** Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster). **(8 Lectures)**

**Unit 4:** Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds) **(8 Lectures)**

**Unit 5:** Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy) **(2 Lectures)**

#### SUGGESTED READINGS

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

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: SKILL ENHANCE COURSES (SEC-I)**  
(Student shall choose either paper- IA or Paper-IIB for SEC-I)

## SEMESTER V

### PAPER-IB: NURSERY AND GARDENING

(Credits: 2)

#### THEORY

Lectures: 30

**Unit 1:** Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. (4 Lectures)

**Unit 2:** Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification. (6 Lectures)

**Unit 3:** 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. (6 Lectures)

**Unit 4:** Gardening: definition, objectives and scope - different types of gardening - landscape and home 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. (8 Lectures)

**Unit 5:** Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures. (6 Lectures)

#### SUGGESTED READINGS

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National \_Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: SKILL ENHANCE COURSES (SEC-II)**  
(Student shall choose either paper- IIA or Paper-IIB for SEC-II)

**SEMESTER V**  
**PAPER-IIA: FLORICULTURE**  
(Credits: 2)

**THEORY**

**Lectures: 30**

**Unit 1:** Introduction: History of gardening; Importance and scope of floriculture and landscape gardening. **(2 Lectures)**

**Unit 2:** Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators. **(8 Lectures)**

**Unit 3:** Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai. **(5 Lectures)**

**Unit 4:** Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India. **(5 Lectures)**

**Unit 5:** Landscaping Places of Public Importance: Landscaping highways and Educational institutions. **(2 Lectures)**

**Unit 6:** Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Liliium, Orchids). **(6 Lectures)**

**Unit 7:** Diseases and Pests of Ornamental Plants. **(2 Lectures)**

**SUGGESTED READINGS**

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: SKILL ENHANCE COURSES (SEC-II)**  
(Student shall choose either paper- IIA or Paper-IIB for SEC-II)

**SEMESTER V**  
**MEDICINAL BOTANY**  
(Credits: 2)

**THEORY**

**Lectures: 30**

**Unit 1:** History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations. **(10 Lectures)**

**Unit 2:** Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding. **(10 Lectures)**

**Unit 3:** Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. **(10 Lectures)**

**SUGGESTED READINGS**

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2<sup>nd</sup> edn. Agrobios, India.

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)**

**SEMESTER VI**

(Student shall choose either paper- I or Paper-II or paper –III)

**PAPER-I: GENETICS AND PLANT BREEDING**

(Credits: Theory-4, Practical-2)

**THEORY**

**Lectures: 60**

**Unit 1: Heredity**

**(20 Lectures)**

Brief life history of Mendel, Terminologies, Laws of Inheritance, Modified Mendelian Ratios: 2:1- lethal Genes; 1:2:1- Co- dominance, incomplete dominance; 9:7; 9:4:3; 13:3; 12:3:1., Chi- Square, Pedigree Analysis, Cytoplasmic Inheritance: Shell Coiling in Snail, Kappa particles in Paramecium, leaf variegation in *Mirabilis jalapa*, Male sterility, Multiple allelism in *Nicotiana tobaccum*, Pleiotropism, Chromosome theory of Inheritance.

**Unit 2: Sex-determination and Sex-linked Inheritance**

**(4 Lectures)**

Sex-determination in *Drosophila sp.* and Sex-linked Inheritance in *Melandrium album*.

**Unit 3: Linkage and Crossing over**

**(8 Lectures)**

Linkage: concept & history, complete & incomplete linkage, bridges experiment, coupling & repulsion, recombination frequency, linkage maps based on two and three factor crosses. Crossing over: concept and significance, cytological proof of crossing over.

**Unit 4: Mutations and Chromosomal Aberrations**

**(4 Lectures)**

Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy ; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

**Unit 5: Plant Breeding**

**(4 lectures)**

Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

**Unit 6: Methods of crop improvement**

**(8 lectures)**

Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.

**Unit 7: Quantitative inheritance**

**(4 lectures)**

Concept, mechanism, examples. Monogenic vs polygenic Inheritance.

**Unit 8: Inbreeding depression and heterosis**

**(4 lectures)**

History, Genetic basis of inbreeding depression and heterosis; Applications.

**Unit 9: Crop improvement and breeding**

**(4 lectures)**

Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

## PRACTICAL

1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
2. Chromosome mapping using point test cross data.
3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
5. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs.
6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
7. Hybridization techniques - Emasculation, Bagging (For demonstration only).
8. Induction of polyploidy conditions in plants (For demonstration only).
9. In-vitro germination of pollens and estimation of percentage of pollen viability by hanging drop method.

## SUGGESTED READINGS

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5<sup>th</sup> edition.
3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10<sup>th</sup> edition.
5. Pierce BA (2011) Genetics: A Conceptual Approach, 4<sup>th</sup> Ed., Macmillan Higher Education Learning.
6. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7<sup>th</sup> edition.
7. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2<sup>nd</sup> edition.
8. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

# Karnatak University, Dharwad

## DISCIPLINE SPECIFIC ELECTIVE (DSE)

### SEMESTER VI

#### GENETICS AND PLANT BREEDING

(Credits: Theory-4, Practical-2)

#### THEORY

Time : 3 Hours

Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

- From Unit – 1 : Two Sub questions
- From Unit – 2 : One Sub question
- From Unit – 3 : Two Sub questions
- From Unit – 4 : One Sub question
- From Unit – 5 : One Sub question
- From Unit – 6 : Two Sub questions
- From Unit – 7 : One Sub question
- From Unit – 8 : One Sub question
- From Unit – 9 : One Sub question

Q. I. Answer any **SIX** of the following: 6 x 05 = 30 Marks

- From Unit – 1 : Three Sub questions
- From Unit – 2 & 3 : One Sub question
- From Unit – 4 & 5 : One Sub question
- From Unit – 6 : One Sub question
- From Unit – 7 & 8 : One Sub question
- From Unit – 9 : One Sub question

Q. III. Descriptive answers: 10 Marks

One questions from Unit – 1

OR

One questions from Unit – 2 & 3

Q. IV. Descriptive answers: 10 Marks

One questions from Unit – 1

OR

One questions from Unit – 4 or 5

Q. V. Descriptive answers: 10 Marks

One questions from Unit – 6

OR

One questions from Unit – 7 or 8

# Karnatak University, Dharwad

**DISCIPLINE SPECIFIC ELECTIVE (DSE)**

**SEMESTER VI**

**GENETICS AND PLANT BREEDING**

**Practical**

Time : 04 Hours

Max. Marks: 40

- |       |   |           |
|-------|---|-----------|
| Q. 1. | Estimate the percentage of pollen viability in the given flower A by Hanging drop method  | 07 marks  |
| Q. 2. | Demonstrate the emasculation technique in the given plant twig B Show the preparation to the examiners and write the procedure. | 05 marks. |
| Q. 3. | Solve the genetic problem C and D.  | 08 marks. |
| Q. 4. | Identify and comment on the specimens / photographs D, E, F, G & H.   | 15 marks. |
|       | Practical Record (Journal)  | 05 Marks. |

-0-0-0-

## **Instructions to the Examiners**

- Q. 1. Unopened flowers with intact anthers (Preparation – 2 marks, procedure – 3 marks, Inference – 2 marks)
  - Q. 2. One plant propagation or hybridization technique  
(Preparation – 2 marks, Procedure – 2 marks, inference – 2 marks)
  - Q. 3. Genetic Problems – 02 ( 04 Marks each )
  - Q. 4. One material from Practical 1, 2, 3, 4, 5, 6 & 8 (Any five)
-



**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)**

**SEMESTER VI**

(Student shall choose either paper- I or Paper-II or paper –III)  
**PAPER-II: ANALYTICAL TECHNIQUES IN PLANT SCIENCES**

(Credits: Theory-4, Practicals-2)

**THEORY**

**Lectures: 60**

**Unit 1: Imaging and related techniques** **(15 Lectures)**

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

**Unit 2: Cell fractionation** **(8 Lectures)**

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl<sub>2</sub> gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

**Unit 3: Radioisotopes** **(4 Lectures)**

Use in biological research, auto-radiography, pulse chase experiment.

**Unit 4: Spectrophotometry** **(4 Lectures)**

Principle and its application in biological research.

**Unit 5: Chromatography** **(8 Lectures)**

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

**Unit 6: Characterization of proteins and nucleic acids** **(6 Lectures)**

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

**Unit 7: Biostatistics** **(15 Lectures)**

Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

## **Practicals**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

## **Suggested Readings**

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3<sup>rd</sup> edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3<sup>rd</sup> edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4<sup>th</sup> edition.

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)**  
**SEMESTER VI**

(Student shall choose either paper- I or Paper-II or paper -III)

**PAPER-III: RESEARCH METHODOLOGY**

(Credits: Theory-4, Practicals-2)

**THEORY**

**Lectures: 60**

**Unit 1: Basic concepts of research** **(10 Lectures)**

Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

**Unit 2: General laboratory practices** **(12 Lectures)**

Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

**Unit 3: Data collection and documentation of observations** **(6 Lectures)**

Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissuespecimens and application of scale bars. The art of field photography.

**Unit 4: Overview of Biological Problems** **(6 Lectures)**

History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics-Transcriptional regulatory network.

**Unit 5: Methods to study plant cell/tissue structure** **(6 Lectures)**

Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections.

**Unit 6: Plant microtechniques** **(12 Lectures)**

Staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed plant materials.

**Unit 7: The art of scientific writing and its presentation** **(8 Lectures)**

Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

## **Practical**

1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.

## **Suggested Readings**

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: SKILL ENHANCE COURSES (SEC-I)**

**SEMESTER VI**

(Student shall choose either paper- IA or Paper-IB)

**PAPER-IA: PLANT DIVERSITY AND HUMAN WELFARE**

(Credits: 2)

**THEORY**

**Lectures: 30**

**Unit 1:** Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes. **(8 Lectures)**

**Unit 2: Loss of Biodiversity:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss,

**Management of Plant Biodiversity:** Organizations associated with biodiversity management- Methodology for execution- IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication. **(10 Lectures)**

**Unit 3: Conservation of Biodiversity:** Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. **(6 Lectures)**

**Unit 4: Role of plants in relation to Human Welfare;** a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses. **(6 Lectures)**

**SUGGESTED READINGS**

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity – Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: SKILL ENHANCE COURSES (SEC-I)**

**SEMESTER VI**

(Student shall choose either paper- IA or Paper-IB)

**PAPER-IB: ETHNOBOTANY**

(Credits: 2)

**THEORY**

**Lectures: 30**

**Unit 1: Ethnobotany**

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science.

The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. **(8 Lectures)**

**Unit 2: Methodology of Ethnobotanical studies**

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places. **(4 Lectures)**

**Unit 3: Role of ethnobotany in modern Medicine**

Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) a) *Azadirachta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauwolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*.

Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). **(12 Lectures)**

**Unit 4: Ethnobotany and legal aspects**

Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge. **(6 Lectures)**

**SUGGESTED READINGS**

- 1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 2) S.K. Jain (ed.) Glimpses of Indian Ethnobotany, Oxford and I B H, New Delhi – 1981
- 3) Lone et al., Palaeoethnobotany
- 4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- 5) S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
- 6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
- 7) Rama Rao, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah. 8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur-1996-9)

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: SKILL ENHANCE COURSES (SEC-II)**

**SEMESTER VI**

(Student shall choose either paper- IIA or Paper-IIB)

**PAPER- IIA: MUSHROOM CULTURE TECHNOLOGY**

(Credits: 2)

**THEORY**

**Lectures: 30**

**Unit 1:** Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*. **(5 Lectures)**

**Unit 2:** Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production. **(12 Lectures)**

**Unit 3:** Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins. **(8 Lectures)**

**Unit 4:** Food Preparation\_: Types of foods prepared from mushroom. Research Centres - National level and Regional level.\_Cost benefit ratio - Marketing in India and abroad, Export Value. **(5 Lectures)**

**SUGGESTED READINGS**

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

**KARNATAKA UNIVERSITY, DHARWAD**  
**BOTANY: SKILL ENHANCE COURSES (SEC-II)**

**SEMESTER VI**

(Student shall choose either paper- IIA or Paper-IIB)

**PAPER- IIB: INTELLECTUAL PROPERTY RIGHTS**

(Credits: 2)

**THEORY**

**Lectures: 30**

**Unit 1: Introduction to intellectual property right (IPR)**

**(2 lectures)**

Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

**Unit 2 : Patents**

**(2 Lectures)**

Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

**Unit 3: Copyrights**

**(2 Lectures)**

Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.

**Unit 4: Trademarks**

**(2 Lectures)**

Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.

**Unit 5: Geographical Indications**

**(2 Lectures)**

Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position.

**Unit 6: Protection of Traditional Knowledge**

**(6 Lectures)**

Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

**Unit 7: Industrial Designs**

**(2 Lectures)**

Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

**Unit 8: Protection of Plant Varieties**

**(4 Lectures)**

Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers. National gene bank, Benefit sharing. Protection of Plant Varieties and Farmers' Rights Act, 2001.

**Unit 9: Information Technology Related Intellectual Property Rights**

**(4 Lectures)**

Computer Software and Intellectual Property, Database and Data Protection, Protection of Semiconductor chips, Domain Name Protection

**Unit 10: Biotechnology and Intellectual Property Rights.**

**(4 Lectures)**

Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

**SUGGESTED READINGS**

1. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
2. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
3. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
4. Arthur Raphael Miller, Micheal H. Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
5. Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.