

**B.Sc. V Semester**  
**Discipline Specific Course**  
**CORE COURSE BOTANY PAPER**  
**Course Title: Plant Morphology and Taxonomy**  
**Course Code: NDSCBOT-C09-T**  
**Credit: Theory-04, Practical-02**

**THEORY**

| Type of Course and number | Theory/ Practical | Title of the Course           | Credit | Teaching hours per week | Total number of lecture hours/ semester | Duration of Exam | Formative assessment marks | Summative assessment marks | Total Marks |
|---------------------------|-------------------|-------------------------------|--------|-------------------------|-----------------------------------------|------------------|----------------------------|----------------------------|-------------|
| NDSC BOT-C09-T            | Theory            | Plant Morphology and Taxonomy | 04     | 04                      | 60                                      | 03               | 20                         | 80                         | 100         |

**Course Outcomes (COs): At the end of the course students will able to**

- CO1.** Understanding the main features in Angiosperm evolution.  
**CO2.** Ability to identify, classify and describe a plant in scientific terms, thereby, Identification of plants using dichotomous keys. Skill development in identification and classification of flowering plants.  
**CO3.** Interpret the rules of ICN in botanical nomenclature.  
**CO4.** Classify Plant Systematic and recognize the importance of herbarium and Virtual herbarium, and evaluate the Important herbaria and botanical gardens.  
**CO5.** Recognition of locally available angiosperm families and plants and economically important plants. Appreciation of human activities in conservation of useful plants from the past to the present.

| Unit   | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 60 Hrs |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Unit-1 | Morphology: Root, stem, leaf and its modifications for various functions. Inflorescence and its types, flowers and its variations, fruits and its types. Floral formula and floral diagram. Taxonomy: Introduction, objectives and scope. Systems of Classification- natural (Linnaeus), artificial (Bentham and Hooker) and phylogenetic (Engler and Prantl) and APG IV System (2016). Merits and demerits of classification. Taxonomic literature: Floras, Monographs, Journals and Revisions. Botanical Gardens and Herbaria: Role of Botanical Gardens, Botanical gardens of India and world. Techniques of herbarium preparation and its importance. Virtual Herbarium: E-flora Documentation  | 15     |
| Unit-2 | Plant identification: Taxonomic dichotomous keys, intended (yolked) and bracketed keys.<br>Plant identification: Common terminologies used for description of vegetative and reproductive parts of the following families (descriptive features of any 15 families);<br>Annonaceae, Anacardiaceae, Asteraceae, Apocynaceae, Acanthaceae, Amaranthaceae, Apiaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae (with sub families), Lamiaceae, Meliaceae, Myrtaceae, Rubiaceae, Rutaceae, Solanaceae, Orchidaceae, Arecaceae, Cyperaceae, Commelinaceae, Liliaceae, Poaceae, Zingiberaceae, Plant Taxonomic Evidences: palynology, embryology, cytology, phytochemistry, molecular data, field inventory. | 15     |



|        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |    |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Unit-3 | Taxonomic hierarchy: Concept of taxa (family, genus and species) Categories and taxonomic hierarchy, Species concepts (biological, morphological and evolutionary). Modes of species problems with species concept, Rankless system of Phylogenetic systematics. Botanical Nomenclature: Principles and rules (ICN), brief account on Latest code, ranks of Taxa, Type concept (Typification), Rule of priority, author citation, valid publication, rejection of names, principles of priority and its limitations. Names of hybrid or cultivated species.                                                                                                                                              | 15 |
| Unit-4 | Biometrics, Numerical Taxonomy: Phenetics and Cladistics: Characters, Variations, OTUs, Character weighting and coding, cluster analysis, Phenograms, cladograms. Phylogenetic systematics: terms and concepts, primitive and advanced, Homology and analogy, parallelism and convergence, Monophyly, paraphyly, polyphyly, clades, Synapomorphy, symplesiomorphy, apomorphy, lineage sorting, serial homology. Origin and evolution of angiosperms: Co-evolution, of angiosperms and animals, Methods of illustrating evolutionary relationship (Phylogenetic and cladogram) Molecular taxonomy: DNA sequence of chloroplast genes (atp B, rbcL, ITS) and one nuclear gene (nuclear ribosomal 18s DNA). | 15 |

#### Recommended Books:

1. Baker. H.G. 1970. Plant and Civilization, Wadsworth Publishing Company.
- 2 Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –Chichester
- 3 Cotton, C.M. 1996. Ethnobotany – Principles and Applications. Wiley and Sons
- 4 Datta S C, *Systematic Botany*, 4th Ed, Wiley Eastern Ltd., New Delhi, 1988.
- 5 Eames A. J. - *Morphology of Angiosperms* - Mc Graw Hill, New York.
- 6 Hall, B.G.2011. *Phylogenetic Trees Made Easy: A How-To Manual*. Sinauer Associates, Inc. USA
- 7 Heywood - *Plant taxonomy* - Edward Arnold London.
- 8 Jeffrey C.J. and A. Churchil - *An introduction to taxonomy* – London.
- 9 Jeffrey, C.1982. *An Introduction to Plant Taxonomy*. Cambridge University Press, Cambridge
- 10 Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F., Donogue, M.J., 2002. *Plant Systematics: A Phylogenetic approach*, 2nd edition. Sinauer Associates, Inc., USA.
- 11 Lawrence - *Taxonomy of Vascular Plants* - Oxford & I B H, New Delhi.
- 12 Manilal, K.S. and M.S. Muktesh Kumar 1998. *A Handbook on Taxonomy Training*. DST, New Delhi.
- 13 Manilal, K.S. and A.K. Pandey, 1996. *Taxonomy and Plant Conservation*. C.B.S. Publishers & Distributors, New Delhi.
- 14 Manilal, K.S. 2003. *Van Rhee de's Hortus Malabaricus. English Edition*, with Annotations and Modern Botanical Nomenclature. (12 Vols.) University of Kerala, Trivandrum.
- 15 Naik V.N., *Taxonomy of Angiosperms*, 1991. Tata Mcgraw-Hill Pub. Co. Ltd., New Delhi.
- 16 Pandey, S. N, and S.P. Misra. 2008. -*Taxonomy of Angiosperms*- Ane Books India, New Delhi.
- 17 Radford A B, W C Dickison, J M Massey & C R Bell, *Vascular Plant Systematics*, 1974, Harper & Row Publishers, New York.
- 18 Singh G.2012. *Plant systematics: Theory and Practice*. Oxford and IBH, Pvt. Ltd., New Delhi.
- 19 Singh V. & Jain - *Taxonomy of Angiosperms* - Rastogi Publications, Meerut.
- 20 Sivarajan V. V - *Introduction to Principles of taxonomy* - Oxford & I B H New Delhi.
- 21 Any local/state/regional flora published by BSI or any other agency.

| <b>Formative Assessment for theory</b>     |                 |
|--------------------------------------------|-----------------|
| <b>Assessment Types</b>                    | <b>Marks</b>    |
| Internal Assessment Test-1                 | 05              |
| Internal assessment Test-2                 | 05              |
| Seminar/Group Discussion                   | 05              |
| Assignment/Field visit/Minor Project       | 05              |
| <b>Total</b>                               | <b>20 marks</b> |
| Formative Assessment as per the guidelines |                 |



**B.Sc. V Semester**  
**Discipline Specific Course**  
**CORE COURSE BOTANY PAPER**  
**Course Title: Genetics and Plant Breeding**  
**Course Code: NDSCBOT-C11-T**  
**Credit: theory-04, Practical-02**  
**THEORY**

| Type of Course and number | Theory/ Practical | Title of the Course         | Credit | Teaching hours per week | Total number of lecture hours/semester | Duration of Exam | Formative assessment marks | Summative assessment marks | Total Marks |
|---------------------------|-------------------|-----------------------------|--------|-------------------------|----------------------------------------|------------------|----------------------------|----------------------------|-------------|
| NDSC BOT-C11-T            | Theory            | Genetics and Plant Breeding | 04     | 04                      | 60                                     | 03               | 20                         | 80                         | 100         |

**Course Outcomes (COs): At the end of the course students will able to**

**CO1:** Understanding the basics of Genetics and Plant breeding

**CO2:** Ability to identify, calculate and describe crossing over, allelic generations and frequencies of recombination.

**CO3:** Interpret the results of mating and pollinations.

**CO4:** Classify Plant pollination methods.

**CO5:** Recognition of modes of inheritance of traits/phenotypes and Phenotype-genotype correlation.

| Unit   | Title                                                                                                                                                                                                                                                                                                                                                                                                                       | 60Hrs/Sem |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Unit-1 | Mendelian genetics and its extension, History, Principles of inheritance, Chromosome theory of inheritance, Autosomes and Sex Chromosomes, Probability and pedigree analysis, Incomplete dominance, Recessive and dominant traits, penetrance and expressivity, Numerical, Polygenic inheritance, Extrachromosomal Inheritance: Chloroplast mutation; Variegation in Four 'O' Clock plant. Mitochondrial mutation in Yeast. | 15        |
| Unit-2 | Linkage, Crossing over and Chromosome mapping, Recombination frequency, two factor and three factor crosses, Sex linkage, Variation in chromosome number and structure. Gene mutation, types of mutation, Molecular basis of mutation, Physical and chemical basis of mutation. Detection of mutations: CIB method, Role of transposons in mutation, DNA Repair mechanism. Hardy-Weinberg law.                              | 15        |
| Unit-3 | Plant breeding: Introduction, objectives and scope. Mode of reproduction in plants (self-pollination, cross pollination and vegetative), important achievements and undesirable consequences of plant breeding, methods of crop improvement. Centre of origin and domestication of crop plants, plant genetic resources, Methods, advantages and disadvantages of hybridization.                                            | 15        |
| Unit-4 | Quantitative inheritance: Inheritance of Kernal colour in Wheat, mutagen and polygene inheritance. Inbreeding depression: Genetic basis of inbreeding depression, advantages. Heterosis and its applications. Role of mutation, polyploidy, Distant hybridization and biotechnology in crop improvement.                                                                                                                    | 15        |

**Recommended Books:**

1. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. New Jersey, U.S.: Blackwell Publishing.
2. Singh, B.D. (2005). Plant Breeding: Principles and Methods, 7th edition. New Delhi, Delhi: Kalyani Publishers.
3. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding, 2nd edition. New Delhi, Delhi: Oxford –IBH.
4. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi,

Delhi: John Wiley & sons

5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, 10th edition. New York, NY: W.H. Freeman and Co.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics, 10th edition. San Francisco, California: Benjamin Cummings
7. Raven, F.H., Evert, R.F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Co.
8. Welsh, J.R. (1981). Fundamentals of Plant Genetics and Breeding. John Wiley and Sons, New York.
9. Poehlman, J.M. (1987). Breeding Field Crops, 3rd Ed. AVI Publishing Co. Inc., West port, Connecticut
10. Chopra, V.L. (2000). Plant Breeding: Theory and Practice 2nd Ed. Oxford & IBH, New Delhi.

| Formative Assessment for theory            |         |
|--------------------------------------------|---------|
| Assessment Types                           | Marks   |
| Internal Assessment Test 1                 | 05      |
| Internal assessment Test 2                 | 05      |
| Seminar/Group Discussion                   | 05      |
| Assignment/Field visit/Minor Project       | 05      |
| Total                                      | 20marks |
| Formative Assessment as per the guidelines |         |

**B.Sc. V Semester**

**Practical**

**Course Title: Plant Morphology and Taxonomy & Genetics and Plant Breeding**

**Practical: List of the experiments each will have four hours per week (Minimum 11 Experiment).**

| Sl.No | Experiments                                                                                                                                                       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Study of root, stem, leaf and its modifications..                                                                                                                 |
| 2     | Study of inflorescence and its types.                                                                                                                             |
| 3     | Study of flowers and its parts.                                                                                                                                   |
| 4     | Study of fruits and its types                                                                                                                                     |
| 5     | Illustrate floral formula and floral diagram. Study of families (mentioned in theory)                                                                             |
| 6     | Selecting one example from each family and describe Botanically and identify up to species                                                                        |
| 7     | Reproductive Biology: Self and Cross-Pollinated plants and vegetative reproduction.                                                                               |
| 8     | Hybridization: Emasculation, bagging, pollination, and production hybrids and pollen fertility.                                                                   |
| 9     | Origin, distribution, and centres of diversity of crop plants: Jawar, Wheat, Rice, Chilly, Soyabean, Cotton, Sugarcane, Potato, Coffee, Sunflower, and Ground nut |
| 10    | Mendelian laws through seed ratio: Laboratory exercise in probability and Chi-square.                                                                             |
| 11    | Chromosome mapping using point, test, and cross data                                                                                                              |
| 12    | Calculation of recombinant frequency and state the order of genes from the available data.                                                                        |



**B.Sc. V Semester**  
**OPEN ELECTIVE COURSE**  
**BOTANY**

**Course Title: Medicinal plants and Herbal medicine**

**Course Code: NBOT-OEC-05**

**Credit: 03**

**THEORY**

| Type of Course and number | Theory/ Practical | Title of the Course                  | Credit | Teaching hours per week | Total number of lecture hours/semester | Duration of Exam | Formative assessment marks | Summative assessment marks | Total Marks |
|---------------------------|-------------------|--------------------------------------|--------|-------------------------|----------------------------------------|------------------|----------------------------|----------------------------|-------------|
| NBOT-OEC-05               | Theory            | Medicinal plants and Herbal medicine | 2      | 2                       | 32                                     | 2                | 10                         | 40                         | 50          |

**Course outcome:** At the end of the course students will able to

**CO1:** Understand the fundamentals, classification, and importance of medicinal plants.

**CO2:** Explain phytochemical extraction, analysis, and standardization techniques.

**CO3:** Analyze pharmacological activities and therapeutic potential of medicinal plants.

**CO4:** Evaluate herbal formulations, quality control, and regulatory aspects.

**CO5:** Understand modern approaches such as plant biotechnology, nano-herbal medicine, and *In-silico* studies.

| Unit    | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 32 Hours |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Unit I  | Fundamentals of medicinal plants: History and scope of medicinal plant research; traditional and modern systems; role in primary healthcare and drug discovery; classification based on active constituents (alkaloids, glycosides, terpenoids, phenolics); taxonomical and chemotaxonomical approaches; secondary metabolites and their biosynthetic pathways (shikimate, mevalonate, acetate); ecological and physiological roles; conservation strategies ( <i>in situ</i> , <i>ex situ</i> ); sustainable harvesting; biodiversity laws. | 16       |
| Unit II | Phytochemistry and analytical techniques: Extraction and isolation techniques (Soxhlet, maceration, steam distillation, supercritical fluid extraction); phytochemical screening (qualitative and quantitative); chromatographic techniques (TLC, HPLC, GC-MS, LC-MS/MS); spectroscopic methods (UV-Vis, FTIR, NMR, mass spectrometry); standardization of herbal drugs: WHO guidelines; marker compounds; fingerprinting.                                                                                                                   | 16       |

**Recommended Books:**

1. Rastogi, R. P., & Mehrotra, B. N. (2001-2009). *Indian medicinal plants* (Vols. I-VI). Central Institute of Medicinal and Aromatic Plants (CIMAP).
2. Kirtikar, K. R., & Basu, B. D. (1999). *Indian medicinal plants* (Vols. I-IV). International Book Distributors.
3. Nadkarni, K. M. (2007). *Indian materia medica* (Vols. I-II). Popular Prakashan.
4. Varier, P. S. (1994-1996). *Indian medicinal plants: A compendium of 500 species* (Vols. I-V). Orient Longman.
5. Kokate, C. K. (2010). *Pharmacognosy*. Nirali Prakashan.
6. Sharangi, A. B., & Peter, K. V. (Eds.). (2016). *Medicinal plants: Bioprospecting and pharmacognosy*. CRC Press.
7. Evans, W. C. (2009). *Trease and Evans pharmacognosy* (16th ed.). Saunders Elsevier.
8. Tyler, V. E., Brady, L. R., & Robbers, J. E. (1988). *Pharmacognosy* (9th ed.). Lea & Febiger.
9. Bone, K., & Mills, S. (2013). *Principles and practice of phytotherapy: Modern herbal medicine* (2nd ed.). Churchill Livingstone Elsevier.

| Formative Assessment for theory            |                |
|--------------------------------------------|----------------|
| Assessment Types                           | Marks          |
| Internal Assessment Test 1                 | 05             |
| Internal assessment Test 2                 | 05             |
| Seminar/Group Discussion                   | 05             |
| Assignment                                 | 05             |
| <b>Total</b>                               | <b>20marks</b> |
| Formative Assessment as per the guidelines |                |

**GENERAL PATTERN OF THEORY QUESTION PAPER**

(80 Marks for semester end examination with 3 hours duration)

1. Question number 1-12 carries 2 marks each. Answer any 10 questions.
2. Question number 13-18 carries 5 marks each. Answer any 04 questions.
3. Question number 19-24 carries 10 marks each. Answer any 04 questions.