

## Department of Botany

### Discipline Specific Core Course: Botany

Sem	Theory/ Practical	Course Title	Teaching/ Practical Instruction hour/week	Total Hours /Sem	Duratio n of Exam in hours	Assessment Marks			Credits
						Summative	Formative	Total	
V	Theory	Plant Morphology and Taxonomy	4	60	3	80	20	100	4
	Practical	Lab	4	60	3	40	10	50	2
	OR								
	Theory	Genetics and Plant Breeding	4	60	3	80	20	100	4
	Practical	Lab	4	60	3	40	10	50	2
	Elective	Medicinal Plants and Herbal Medicine	4	60	3	80	20	100	3

**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. Plant identification: Common terminologies used for description of vegetative and reproductive parts of the following families (descriptive features of any 15 families); 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 Rheede'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: Plant Morphology and Taxonomy**  
**Course Code: NDSCBOT-C10-P**

**Practical**

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-C10-P	Practical	Plant Morphology and Taxonomy	02	04	60	03	10	40	50

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

**CO1:** Understanding the basics of Plant morphology and Systematic Botany.

**CO2:** Ability to identify, Classify and describe the plants up to species level.

**CO3:** Interpret the results by using biometrics.

**CO4:** Know the terminologies of plant morphology.

**CO5:** Understand the phylogeny of the family they studied.

**CO6:** Know how to construct the taxonomic key with different methods.

**CO7:** Know the economic importance of the family they studied.

**CO8:** Field visit to help the student to learn the nature and understand the methods of herbarium preparations.

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

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.

6. Study of families (mentioned in theory). Selecting one example from each family and describe Botanically and identify up to species.

7. Study of classification of individual species of a family as per Bentham and Hooker system of classification and write floral formula and floral diagram.

8. Construction of plant phylogenetic trees using various loci atpB, rbcL, ITS.

9. Identify, classify and part used of plants namely Jawar, Rice, Wheat, Bajra, Green gram, Redgram, Black gram, Horse gram, Bengal gram, Brinjal, Mango, Coffee, Sunflower, Ground nut, Coriander, Black pepper, Ginger, Chilly, Turmeric, Coir, Arecanut, Sugarcane, Sarpagandha, Ashwagandha, Adathoda.

10. Local or outside visit to the Botanical Garden or Tribal settlement area and prepare a report.

11. Study of collection of plants and preparation of herbaria.

<b>Formative Assessment for Practical</b>	
<b>Assessment Types</b>	<b>Marks</b>
Internal Assessment Test	06
Practical Record	02
Assignment/Tour Report/Field studies	02
<b>Total</b>	<b>10marks</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.

### **GENERAL PATTERN OF PRACTICAL QUESTION PAPER**

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

1. Identify, classify and describe the specimen 'A' & 'B' taxonomically. 10 Marks
2. Identify the specimen 'C' up to family, genus and species using flora. 05 Marks
3. Write the floral formula and floral diagram of specimen 'D'. 04Marks
4. Identify and comment on specimen 'E', 'F', 'G'. 06 Marks
5. Viva voce. 05 marks
6. Submissions (Record and study tour report). 10 marks

**Note:** Same scheme may be used for IA (Formative Assessment) Examination

#### **General Instructions:**

1. Specimen 'A' given from Dicotyledonous and 'B' from Monocotyledonous family.
2. Specimen 'C' given from the studied family.
3. Specimen 'D' given from the studied family.
4. Specimens/Slide/material 'E' (Leaf/Stem/Leaf/Inflorescence) 'F' (Flower/Fruit), 'G' (Economic importance).
5. Viva Voce based on syllabus or field visit.
6. Submission of certified Records and Tour Report.

**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.

<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>20marks</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-C12-P**

**Practical**

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-C12-P	Practical	Genetics and Plant Breeding	02	04	60	03	10	40	50

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

**CO1:** Students will learn how genes are involved in evolution.

**CO2:** Evolution through mutations.

**CO3:** Understand the plant pollination methods.

**CO4:** Students get opportunity through plant breeding practices to make their own kitchen gardens/fields.

**CO5:** They will understand various methods of plant breeding.

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

- 1.Reproductive Biology: Self and Cross-Pollinated plants and vegetative reproduction.
- 2.Hybridization: Emasculation, bagging, pollination and production hybrids and pollen fertility.
- 3.Origin, distribution and centres of diversity of crop plants. Jawar, Wheat, Rice, Chilly, Soyabean, Cotton, Sugarcane, Potato, Coffee, Sunflower and Ground nut.
- 4.Mendelian laws through seed ratio. Laboratory exercise in probability and Chi-square.
- 5.Chromosome mapping using point, test and cross data.
- 6.Calculation of recombinant frequency and state the order of genes from the available data.
- 7.Problems on Complete dominance through seed ratio (3:1, 9:3:3:1)
- 8.Study of aneuploidy: Down's, Klinefelter's and Turner's syndrome.
- 9.Phtographs/permanent slides showing Translocation Ring, Laggards and Inversion bridge.
- 10.Problems on incomplete dominance and gene interaction through seed ratio (9:7, 9:6:1, 13:3, 15:1,12:3:1)
- 11.Visit to any plant breeding centre/Research institute.

<b>Formative Assessment for Practical</b>	
<b>Assessment Types</b>	<b>Marks</b>
Internal Assessment Test	06
Practical Record	02
Assignment/Tour Report/Field studies	02
<b>Total</b>	<b>10marks</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.

**GENERAL PATTERN OF PRACTICAL QUESTION PAPER**  
(40 Marks for semester end examination with 3 hours duration)

1. Perform emasculation/ pollen viability/fertility of the given sample 'A' 10Marks
2. Calculate the recombinant frequency and find out the state of order from the given Data 'B'. 10 Marks
3. Genetic Problem "C". 04Marks
4. Identification of specimen/ slides/ photographs D and E. 06 Marks
5. Viva voce. 05 Marks
6. Record submission. 05Marks

**Note:** Same scheme may be used for IA (Formative Assessment) Examination

**General Instruction:**

1. Specimen 'A' given any bisexual flower and for pollen viability use hanging drop method.
2. Data 'B' followed any recombinant frequency data.
3. Problem 'C' based on Monohybrid cross or Dihybrid cross or Dihybrid gene interaction.
4. Specimens/Slide/material/Photographs 'E' & 'F' (Syndromes), 'G' (Chromosomal aberration)
5. Viva Voce based on syllabus or field visit.
6. Submission of certified Records and tour report.

**B.Sc. V Semester**  
**Discipline Specific Course**  
**CORE COURSE BOTANY PAPER**  
**Course Title: Project work/Practical/Internship**  
**Course Code: NBOTSEC09**  
**Credit: -02**  
**THEORY**

Type of Course and number	Theory/ Practical	Credit	Project/ Practical work hours per week	Total number of Contact hours/ semester	Duration of Exam	Formative assessment marks	Summative assessment marks (Project Dissertation and presentation and viva voce=30+ 10)	Total Marks
Project work/ Practical/ Internship NBOTSEC09	Practical	02	04	32	02	10	40	50

**Note:** Skill evaluation in specified subject like Botany often involves independent research and analysis and it allows the students to explore specific area of interest, developing research skills and apply theoretical knowledge to the real-world issues.

Skill should contain: 1) A well-structured report.

- 2) Clear explanation of problem, methodology, results and conclusions.
- 3) Proper citation and academic writing.
- 4) Oral presentation and or demonstration.

**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	Durati on of Exam	Formative assessment marks	Summative assessment marks	Total Marks
NBOT-OEC-05	Theory	Medicinal plants and Herbal medicine	03	04	60	03	20	80	100

**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	60Hrs/Sem
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.	15
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.	15
Unit III	Pharmacological and therapeutic aspects: Mechanism of action of plant-derived compounds; study of medicinal plants ( <i>Withania somnifera</i> , <i>Azadirachta indica</i> , <i>Ocimum sanctum</i> , <i>Curcuma longa</i> ); pharmacological activities (antioxidant, antimicrobial, anti-inflammatory, anticancer, neuroprotective); toxicity studies (acute, sub-acute, chronic); herb-drug interactions.	15
Unit IV	Herbal drug technology and emerging approaches: Herbal formulations (Ayurvedic, Siddha, Unani, modern dosage forms); quality control and quality assurance; regulatory guidelines (AYUSH, WHO, FDA); plant tissue culture; genetic engineering; nano-herbal medicine; phyto-nanotechnology; <i>in-silico</i> pharmacology.	15

**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>20 marks</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.
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