GONDWANA UNIVERSITY, GADCHIROLI

FACULTY OF SCIENCE & TECHNOLOGY

SYLLABUS

FOR

B.Sc.

BOTANY

S e m e s t e r - V

As per National Education Policy – 2020

(w.e.f.: 2026 – 27)

Gondwana University, Gadchiroli
NEP 2020 U.G. PROGRAMME SESSION 2026-27
Faculty of Science and Technology
Programme Name - B.Sc. Botany SemesterV (Level-5.5)

Sr. No.	Course Category	Subject name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
							Theory					Practical				
				Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	Major Subject (Core Subject)	Paper V 2 credits Theory + 2 credits Practical **Plant Biochemistry and Physiology**	04	02	04	06	40	10	50	20	03	30	20	50	25	100
		Paper VI 2 credits Theory + 2 credits Practical **Cell Biology, Genetics and Plant Breeding**	04	02	04	06	40	10	50	20	03	30	20	50	25	100
2	Major Subject (Discipline Specific Elective)	Paper DSE I 2 credits Theory + 2 credit Practical Any one from Major Elective Subject Basket	04	02	04	06	40	10	50	20	03	30	20	50	25	100
3	Minor Subject (Core Subject)	Paper III 4 credits theory + 2 credit Practical **Economic Botany**	06	04	04	08	80	20	100	40	03	30	20	50	25	150
4	VSC	Based on Major subject. Any one from VSC Basket	02	--	04	04						30	20	50	25	50
6	FP/CEP	Based on Major Subjects (30 hrs/credit)	02	--	04	04	--	--	--	--	--	30	20	50	25	50
Total			22	10	24	34	200	50	250	100	12	180	120	300	150	550

Annexure – I

NEP2020 B. Sc. Botany Major

B. Sc. Semester V

Basket for Discipline Specific Elective – I

Options	DSE – I Subjects
I	Molecular Biology and Plant Biotechnology - I
II	Ethnobotany, Ethnomedicine and Phytochemistry - I
III	Mycology and Plant Pathology – I
IV	Paleobotany – I
V	Biodiversity Conservation - I

Annexure – II

NEP2020 B. Sc. Botany Major

B. Sc. Semester V

Basket for Vocational Skill Course (VSC)

Options	Vocational Skill Courses
I	Plant Growth Medium
II	Modern Farming Techniques

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Paper – V (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 501

Plant Biochemistry and Physiology

Credits: 02 **Hours: 30 Hours**

UNIT I: Fundamentals of Plant Biochemistry (08 Hours)

Structures, types and functions of Biomolecules: Carbohydrates (*Sugars (Monosaccharides, Disaccharides) and non-sugars (Homo and Hetero-Polysaccharides), α and β glycosidic bonds; Functions: Energy source, Energy storage, Structural Components*), Proteins (*Primary, Secondary, Tertiary and Quaternary; Functions: Structural, Enzymes, Hormones, Transport)*, Lipids (*Saturated and Unsaturated Fatty Acids, Triglycerides (Fats and Oil), Phospholipids, Steriods, Waxes; Functions: Energy Storage, Structural components, Insulation and Protection, Hormones and Signaling, Waterproofing, Vitamins storage and transport)*, Nucleic Acids (*Pentose sugars, Phosphoric Acid, Nitrogen Bases, Nucleoside, Nucleotide, Glycosidic bond, Phosphodiester linkage)*, Enzymes (*Globular Proteins, Active site, C and N-terminals of polypeptide chains; Oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases, Ligases; Functions: Catalysis, Digestion, DNA replication, Cellular processes, Building and Repair*).

UNIT II: Plant secondary metabolites (07 Hours)

Structures, types and functions: Alkaloids (*Nitrogen containing Cyclic or Heterocyclic compounds; True alkaloids, Protoalkaloids, Pseudoalkaloids; Defense, Physiological effects, Medicinal uses, Metabolic role, Antioxidants*), Phenolics (*Aromatic Ring compounds; Simple Phenols, Phenolic Acids, Flavonoids, Tannins, Lignans, Stilbenes*), Terpenoids (*Isoprene unit; Monoterpenoids, Sesquiterpenoids, Diterpenoids, Sesterterpenoids, Triterpenoids, Tetraterpenoids, Polyterpenoids; Defens, Aromatics, Colours, Flavours, Medicinal properties*), Polyketides (*Repeating Units of Acetyl-CoA or Malonyl-CoA; Type I, II and III Polyketides; Antimicrobial, Anticancer, Immunosuppressant, Ecological role*), specialised Amino Acids and Peptides (*Proline, Hydroxyproline, Glutamic Acid, Arginine, Glycine, Alanine, Serine, Lysine, Threonine, Plant Elicitor Peptides, Systemin, Glucosinolates*).

Biosynthesis Pathways: Shikimate pathway, Phenylpropanoid pathway.

Recent Advancements: Advances in plant metabolomics using Mass Spectrometry and NMR.

UNIT III: Principles of Plant Physiology (08 Hours)

Plant-Water relations: Absorption (*Mechanism of Active and Passive water absorption, Apoplast and Symplast pathways of water movement, Role of root hair, Factors affecting water absorption*), Transport (*Structure of Xylem, Root pressure theory, Capillary theory, Cohesion-Tension theory*), Transpiration (*Transpiration Pull Theory*).

Mineral Nutrition: Types and role of Macronutrients (*Primary: Nitrogen, Phosphorus, Potassium; Secondary: Calcium, Magnesium, Sulphur*) and Micronutrients (*Boron, Chlorine, Copper, Iron, Manganese, Molybdenum, Zinc*); deficiency symptoms (*Chlorosis, Mottling, Scorching, Necrosis, Curling, Twisting, Stunted growth*) and diseases.

UNIT IV: Physiological Processes (07 Hours)

Photosynthesis: Light Dependent Reactions (*Light Absorption and Energy Transfer*), Electron Transport Chain (*Photosytem I and II*), Photolysis of Water. Light Independent Reactions (*C3, C4 and CAM pathways, Regulation of the Calvin Cycle*), Efficiency of Photosynthesis (*Quantum Yield, Factors affecting*).

Respiration and Photorespiration: Glycolysis, Kreb's (*TCA/Citric Acid*) cycle, Electron Transport Chain (*Oxidative Phosphorylation*), Stoichiometry, Factors affecting Respiration in plants, Respiratory ratio, Photorespiration (*Mechanism and Role*).

Suggested Laboratory Exercises:

1. Qualitative and quantitative analysis of Carbohydrates in local crops.
2. Qualitative and quantitative analysis of Proteins in local crops.

3. Enzyme assays (Amylase/Catalase/Acid Phosphatase/Phenylalanine Lyase/Gulcanase/Chitinase) using extracts from regional plant species.
4. Extraction and profiling (Qualitative or Quantitative) of secondary metabolites (Alkaloids/ Phenolics/Tanins/Falvonoids) from indigenous medicinal plants.
5. Measurement of transpiration and water potential in local plants.
6. Demonstration of differential Transpiration rates on Upper and Lower surfaces of plants using Bell Jar and Cobalt Chloride Method.
7. Demonstration of root pressure in plant.
8. Demonstration of Ascent of sap.
9. Demonstration of amount of water absorbed and the amount of water transpired by plant are approximately equal.
10. Determination of the osmotic potential/pressure of vacuolar sap by plasmolytic method.
11. Demonstration of photosynthetic pigments in native crops using chromatography.
12. Demonstration of effect of abiotic stress on Photosynthetic rate in *Hydrilla*.
13. Demonstration of necessity of Light for Photosynthesis.
14. Demonstration of necessity of light, chlorophyll, water and CO_2 for Photosynthesis.
15. Demonstration of cellular respiration in local plant species.
16. Demonstration of Anaerobic Respiration.
17. Demonstration of evolution of CO_2 during respiration.
18. Demonstration of release of energy in the form of heat during respiration.
19. Assessment of physiological responses to abiotic stress (e.g., local varieties under drought).
20. Study effects of local environmental stresses (drought, salinity) on plant physiology.
21. Case studies on physiological adaptations of regional flora.

References:

Textbooks

- Plant Physiology, Development and Metabolism by Satish C Bhatla & Manju A. Lal. Springer Nature, 2018.
- A Textbook of Plant Physiology, Biochemistry and Biotechnology by Mohit Verma & S K Verma. S Chand Publishing.
- Plant Biochemistry, 6th Edition by Birgit Piechulla, Hans-Walter Heldt, et al. Elsevier, 2025.
- Plant Biochemistry and Molecular Biology, 2nd Edition edited by Peter J. Lea & Richard C. Leegood. Wiley, 1998.
- BOTANY (PLANT PHYSIOLOGY & BIOCHEMISTRY) Sem-VI. EbookseLibrary.
- Plant Physiology and Biochemistry. Uttarakhand Open University, MSCBOT 601, 2022.
- Plant Biology by Linda E. Graham, James M. Graham, and Lee Warren Wilcox. Prentice Hall, 2003.
- Botany: An Introduction to Plant Biology by James D. Mauseth. Jones and Bartlett, 2003.

Reference Books & Manuals

- Practicals in Plant Physiology and Biochemistry. Scientific Publishers, 2013.
- Methods in Plant Biochemistry and Molecular Biology by William V. Dashek, CRC Press, 1997 (also available as eBook).

Research Journals & Articles

- Plant Physiology and Biochemistry. Elsevier (peer-reviewed journal; see publisher's website for the latest research and review articles).
- 'Guide to Reference and Information Sources in Plant Biology' by Diane Schmidt et al., Libraries Unlimited, 2006—provides bibliographies, databases, and a curated list of journals and handbooks in plant sciences.

Digital Contents

- Plant Biochemistry and Physiology OpenCourseWare and lecture notes (e.g., materials from Uttarakhand Open University).

- Curated web resource lists for Plant Biology from University of Illinois—includes web-accessible bibliographies, databases, dictionaries, protocols, and major journals.
- eBook versions of classic and modern plant biochemistry textbooks (see publisher sites such as Springer, Elsevier, or CRC Press for digital access).
- https://www.sciencedirect.com/journal/plant-physiology-and-biochemistry/special-issue/10SGW8XDCT
- https://pmc.ncbi.nlm.nih.gov/articles/PMC3315222/
- https://plantbiologyconference.com/program/scientific-sessions/plant-physiology-and-biochemistry.
- https://www.pondiuni.edu.in/wpcontent/uploads/2021/01/Syllabus_Affiliated_ArtsScience_M.Sc_.-BotanyCBCS-2020-21.pdf
- https://ramjas.du.ac.in/adminramjas/web/syllabus_new/Botany_LOCF.pdf
- https://uou.ac.in/sites/default/files/slm/BSCBO-303.pdf

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Major Paper – VI (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 502

Cell Biology, Genetics and Plant Breeding

Credits: 02 **Hours: 30**

UNIT I: Cell Biology – Principles and Innovations(07 Hours)

Basic Principles: Structure and function of Prokaryotic and Eukaryotic cells, Ultrastructure of cell organelles and their functions (*Nucleus, Mitochondria, Chloroplasts, Endoplasmic Reticulum, Golgi Apparatus, Vacuole*), Membrane structure (*Fluid Mosaic model*) and transport mechanisms (*Diffusion, Osmosis, Active transport*), Cell cycle and regulation of Mitosis and Meiosis.

Recent Advancements: Live-cell imaging and Fluorescence Microscopy, Organelle Biogenesis and Targeted Protein Trafficking, Single-Cell Omics in Plant Research.

UNIT II: Genetics - Mendelian and Molecular Genetics(08 Hours)

Basic Principles: Mendelian laws of inheritance (*Monohybrid, Dihybrid crosses and ratios, Multiple alleles, Gene Interactions, Pleiotropy, Polygenic inheritance*), Chromosomal theory of inheritance (*Linkage and crossing over*), Chromosomal aberrations (*Numerical and Structural*), Cytoplasmic inheritance (*Leaf variegation, Cytoplasmic Male Sterility (CMS), Iojap in Maize*).

Recent Advancements: Molecular markers, Gene mapping in plants, Epigenetics and regulation of gene expression in plants, Advances in next-generation sequencing and genomic data analysis.

Unit III: Genetics - Biodiversity and Contemporary Issues(07 Hours)

Genetic Resources and Biodiversity: Concepts, values, conservation strategies of Germplasm (*collection, maintenance, and evaluation*), Principles and methods of Plant Biotechnology (*Micropropagation, Somaclonal variations, Somatic Hybridization*).

Recent Advancements: Use of genome-editing for conservation of endangered/endemic species, Field applications of gene-edited crops (local and global examples), Regulatory, ethical, and patent challenges in use of new plant breeding technologies.

Unit IV: Applied Plant Breeding(08 Hours)

Objectives and types of Plant Breeding: Selection, Hybridization, Mutation breeding, Heritability, Genetic variation, Selection indices, Breeding for disease resistance and stress tolerance.

Recent Advancements: CRISPR-Cas and genome editing techniques in crop improvement, AI- and data-driven breeding approaches—Predictive Analytics for trait selection, Speed breeding using controlled light and photobiological tools.

Suggested Laboratory Exercises:

1. Microscopic examination of local plant cell types (e.g., rice, pulses, millets etc.).
2. Isolation, Staining and counting of cell organelles in indigenous species.
3. Analysis of mitosis/meiosis in regionally important crops.
4. Mendelian ratio analysis using coloured beads.
5. DNA extraction from regional plants.
6. PCR demonstration for local cultivar identification.
7. Demonstration of Hybridization techniques on local crops.
8. Assessment of qualitative and quantitative traits in indigenous plant varieties.
9. Application of AI-based tools (demonstration or virtual toolkits) for local breeding challenges.

10. In vitro propagation of local medicinal or food crops.
11. Survey/design of mini germplasm banks for local varieties.
12. Case studies on regional biodiversity and conservation needs.

References:

Textbooks

- Cell Biology, Genetics and Plant Breeding by Dr. Harish Pal Bhati & Dinesh Kumar (Amiga Press).
- A Text Book of Botany: Cell Biology, Genetics & Plant Breeding by Dr. U.N. Bhale & Dr. A.B. Ade.
- Cell Biology, Genetics & Plant Breeding (Botany I Year), Neelkanth Publishers.
- Principles of Plant Genetics and Breeding, 3rd Edition by George Acquaah (Wiley).
- Covers both classical and molecular aspects, recent advances (CRISPR, genome editing), molecular markers, and practical breeding strategies.

Reference Books & Manuals

- Cell Biology, Genetics and Plant Breeding, KDPublications.
- Strong focus on cell structure, chromosome organization, Mendelian and post-Mendelian genetics, selection, hybridization, and mutation.

Research Papers & Review Articles

- Plant Cell, Elsevier: Leading journal for latest research in plant cell biology, genetics, and related biotechnological advances.
- Theoretical and Applied Genetics, Springer: Cutting-edge research in plant genetics and breeding methodologies.
- Critical reviews and original articles in journals such as:Plant Physiology (Elsevier), Genetics (Genetics Society of America), Frontiers in Plant Science.

Articles & Digital Content

- Cell Biology, Genetics and Plant Breeding PDF materials from Alagappa University MSc Botany Syllabus.
- Covers detailed units on cell structure, organelles, chromosomes, cell division, Mendelian genetics, mutation, population genetics, breeding methods, and biotechnological advances.
- Wiley companion website for Principles of Plant Genetics and Breeding.
- Includes artwork, instructor resources, topic summaries, and assessment questions.
- Online course materials and MOOC modules for Genetics and Plant Breeding from leading universities (check resources from MIT OCW, NPTEL).
- https://www.frontiersin.org/journals/genome editing/articles/10.3389/fgeed.2025.1623540/pdf
- https://www.isaaa.org/blog/entry/default.asp?BlogDate=1%2F22%2F2025
- https://middlemarketgrowth.org/agriculture-plant-genetics-innovation-m-a-partners/
- https://farmonaut.com/usa/ai-driven-crop-breeding-5-ways-it-transforms-nc-agriculture
- https://www.sciencedirect.com/science/article/pii/S2214514125001370
- https://www.sciencedirect.com/science/article/abs/pii/S0167779925001386
- https://www.tandfonline.com/doi/full/10.1080/21645698.2025.2524236

Gondwana University, Gadchiroli

Theory Question Paper Pattern

B. Sc. SEMESTER – V BOTANY (Major Papers V and VI)

Time: 03 Hours **Total Marks: 40**

Note: 1) All questions are compulsory and carry equal marks.
2) Draw well labelled diagram wherever necessary, but NOT necessary for Q. No. 5

Question 1. Write in detail **4 M x 2 = 08 M**

a) Unit – I
b) Unit – I

OR

c) Unit – II
d) Unit – II

Question 2. Write in detail **4 M x 2 = 08 M**

a) Unit – III
b) Unit – III

OR

c) Unit – IV
d) Unit – IV

Question 3. Write in short **2 M x 4 = 08M**

a) Unit – I
b) Unit – I
c) Unit – I
d) Unit –I

OR

e) Unit –II
f) Unit – II
g) Unit – II
h) Unit – II

Question 4. Write in short **2 M x 4 = 08 M**

a) Unit – III
b) Unit – III
c) Unit – III
d) Unit –III

OR

e) Unit –IV
f) Unit – IV
g) Unit – IV
h) Unit – IV

Question 5. Write answers to any ten questions in one or two lines only. **1 M x 8 = 08 M**

a) Unit – I
b) Unit – I
c) Unit – I
d) Unit – II
e) Unit – II
f) Unit – II
g) Unit – III
h) Unit – III
i) Unit – III
j) Unit – IV
k) Unit – IV
l) Unit – IV

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SEMESTER –V (Level – 05.5)
Practical Examination – Botany (Major - V)
Plant Biochemistry and Physiology
(Based on Theory Major Paper - V)
Course Code – USCBOT 503

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Any one Exercise [A] from Plant Biochemistry	05 M
Que. 2: Any one Exercise [B] from Plant Biochemistry	05 M
Que. 3: Any one Exercise [C] from Plant Physiology	05 M
Que. 4: Any one Exercise [D] from Plant Physiology	05 M
Que. 5: SPOTTINGS SPOT – E : Plant Biochemistry SPOT – F : Plant Biochemistry SPOT – G : Plant Biochemistry SPOT – H: Plant Physiology SPOT – I : Plant Physiology SPOT – J: Plant Physiology	06 M
Q 6: Submission of duly certified Practical Record	02 M
Q 7: Viva-Voce.	02 M

SEMESTER –V (Level – 05.5)
Practical Examination – Botany (Major - VI)
Cell Biology, Genetics and Plant Breeding
(Based on Theory Major Paper - VI)
Course Code – USCBOT 504

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Any one Exercise [A] from Cell Biology	04 M
Que. 2: Any one Exercise [B] from Cell Biology	04 M
Que. 3: Any one Exercise [C] from Genetics	06 M
Que. 4: Any one Exercise [D] from Plant Breeding	06 M
Que. 5: SPOTTINGS SPOT – E : Cell Biology SPOT – F : Cell Biology SPOT – G : Genetics SPOT – H: Genetics SPOT – I : Plant Breeding SPOT – J: Plant Breeding	06 M
Q 6: Submission of duly certified Practical Record	02 M
Q 7: Viva-Voce.	02 M

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Major Elective (DSE-I) Paper – I (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 505

Molecular Biology and Plant Biotechnology - I

Credits: 02 **Hours: 30**

UNIT I:Molecular Basis of Heredity(07 Hours)

Basic Principles: Historical development of Molecular Biology (*Definition and scope,Contribution of Friedrich Miescher, Richard Altmann, Phoebus Levene, Torbjorn Caspersson, Einar Hammerstein, Frederick Griffith, Oswald Avery, Colin MacLeod, and Maclyn McCarty, Erwin Chargaff, Alfred Hershey and Martha Chase, Fraenkel and Conrat, Rosalind Franklin, James Watson, Francis Crick, Jacob and Monod*), Chemical composition (*Deoxyribose and Ribose Sugars, Nitrogen Bases, Phosphate, Nucleosides, Nucleotides*), Structure (*Watson-Crick DNA double helix*), types (*B, A, & Z forms of DNA, rRNA, mRNA, tRNA (Clover Leaf Model), snRNA, snoRNA, miRNA, siRNA*) and properties (*Charge, Solubility, Stability, Directionality, Length*) of nucleic acids (*DNA & RNA*), Organization of viral (Single stranded linear and circular DNA (ssDNA), Double stranded linear and circular DNA (dsDNA), Single stranded liner and circular RNA (ssRNA), Double stranded liner RNA (dsRNA), prokaryotic (*Nucleoid, single, circular double stranded DNA, associated RNA and proteins (HU, H-NS, HIF, FIS, Dps and P) and their probable role, Plasmid*), eukaryotic genomes (*Primary structure-Nucleosome, Nucleosome fibre (Beaded string); Higher order structure- Solenoid fibre, Chromatin Fibre, Chromonema, Chromosome, Heterochromatin and Euchromatin*), Denaturation and Renaturation of DNA (*definition and processes*) , Cot curve (*interpretation and applications*).

UNIT II: DNA Replication(08 Hours)

DNA replication in prokaryotes and eukaryotes: Enzymes and Proteins associated with Prokaryotic DNA replication (*DNA Helicase (DnaB), DNA Primase (DnaG), DNA Polymerase III, DNA Polymerase I, DNA Gyrase (Topoisomerase II), Initiator protein (DnaA), SSB proteins, Sliding Clamp (β subunit of DNA Pol III), Tus protein*), Enzymes and Proteins associated with Eukaryotic DNA replication (*Origin Replication Complex (ORC), Cdc6 and Cdt1, Minichromosome maintenance (MCM) proteins, DNA Helicase, DNA Polymerase α (Pol α), DNA Polymerase δ (Pol δ), DNA Polymerase ε (Pol ε), CMG Helicase Complex (Cdc45-MCM-GINS), Replication Protein A, Proliferating Cell Nuclear Antigen (PCNA), Replication Factor C (RFC), DNA Ligase I, Flap Endonuclease 1 (FEN1), Dna2 and RNase H, Topoisomerases I and II, Telomerases*), Mechanism of DNA replication in Prokaryotes and Eukaryotes (*Initiation, Elongation and Termination*), Semiconservative replication, Theta (θ) replication and Rolling Circle model for circular DNA replication.

UNIT III: Transcription (07 Hours)

Structure and function of Prokaryotic (*Promoter, Coding sequence/Operons, Terminator region*) and Eukaryotic (*Promoter and Enhancer, Exons and Introns, Terminationregion*) genes, Enzymes and Proteins involved in Transcription of Prokaryotic (*RNA Polymerase (α, β, β', ω, σ subunits), Catabolite Activation Proteins (CAP), Rho (ρ) protein*) and Eukaryotic (*RNA polymerase I, II and III, General transcription factors (TFIID, TFIIB, TFIIE, TFIIF, and TFIIH), Specific Transcription factors (Activators and Repressors), TATA-Binding Protein (TBP)*) genes, The process of transcription in Prokaryotes (*Initiation (Closed, Open and Tertiary Complex), Elongation and Termination (Rho independent and dependent)*) and Eukaryotes (*Initiation, Elongation, Termination*), RNA polymerases and transcription factors in plants, Eukaryotic mRNA processing (*5' Methyl Capping, 3' Polyadenylation, Splicing*).

UNIT IV: Translation(08 Hours)

Genetic code (*Triplate nature, Characteristics, Wobble Hypothesis*), Ribosomes (*structure (small and large subunits) and types in Prokaryotes (70s) and Eukaryotes (80s), Plant specific features*), Enzymes and proteins involved in Prokaryotic (*Initiation Factors (IF1, IF2, IF3), Elongation Factors (EF-Tu, EF-Ts, EF-G), Peptidyl Transferase, Release Factors (RF1, RF2, RF3)*) and Eukaryotic (*Aminoacyl t-RNA synthetases, Eukaryotic Initiation factors (eIFs), Elongation*

Factors (EF1α, EF2), Release Factor (eRF1)) mRNA translations, Mechanism of Translation (protein synthesis) in Prokaryotes and Eukaryotes (*Activation of Amino acids, Formation of Aminoacyl-tRNA complex, Initiation, Elongation and Termination of Polypeptide chain formation*).

Suggested Laboratory Exercises:

1. To study structure of DNA double helix using model/chart/photograph/ppt/video.
2. To study structures of different types of DNA using models /charts / photographs /ppt /video.
3. To study structure of different types of RNA using models / charts / photographs /ppt /video.
4. Extraction and quantification of DNA/RNA from local plant species.
5. Agarose gel electrophoresis and assessment of nucleic acid quality.
6. To estimate isolated DNA content by Diphenyl amine reagent method.
7. To prepare LB medium for culturing Bacteria.
8. To study Bacterial culture methods (streak plate and pour plate methods).
9. To isolate and quantify Plasmid DNA.
10. To study organization of eukaryotic chromatin using model /chart /photograph /ppt / video.
11. To study DNA replication mechanisms (Rolling circle, Theta replication and semi-conservative replication) through models/charts/photographs/ppt/video.
12. Survey/report on local plant genome diversity.
13. Isolation and analysis of total RNA from indigenous plant tissues.
14. Protein extraction and quantification from local seeds/leaves.
15. To study table of Genetic Code and find amino acid sequence from mRNA codons.
16. To study mechanism of transcription in prokaryotes using model/charts/photographs/ppt/video.
17. To study mechanism of transcription in eukaryotes using model /charts/photographs/ppt/video.
18. To study mechanism of eukaryotic mRNA processing (5' capping, 3'tailing and splicing) using model/chart/photographs/ppt/video.
19. To study mechanism of translation in prokaryotes using model/charts/photographs/ppt/video.
20. To study mechanism of translation in eukaryotes using model /charts /photographs/ppt/video.
21. Demonstration of in vitro translation (virtual/simulation if facilities are limited).

References:

Textbooks

- Biochemistry & Molecular Biology of Plants (2nd edition) edited by Bob B. Buchanan, Wilhelm Gruissem, Russell L. Jones. American Society of Plant Biologists/Wiley-Blackwell, 2015.This is a highly acclaimed, comprehensive reference, meticulously organized with over 1,000 illustrations and covering cell structure, gene expression, signal transduction, and plant-environment interactions.
- Plant Biochemistry and Molecular Biology (2nd edition) edited by Peter J. Lea & Richard C. Leegood. Wiley, updated edition.Covers molecular biology in a plant context, with updated chapters on metabolic and regulatory pathways.
- The Molecular Life of Plants by Russell L. Jones, Helen Ougham, Howard Thomas, Susan Waaland. Wiley-Blackwell/ASPB.An accessible, integrated introduction to plant molecular biology, offering a "seed-to-seed" life cycle approach.
- Molecular Plant Biology: A Practical Approach, Vol. 1-2 edited by P.M. Gilmartin & C. Bowler. Oxford University Press, 2002.Focuses on laboratory techniques and protocols, including gene isolation, mutagenesis, and plant transformation.
- Molecular Biology of the Gene (5th edition, general molecular biology) by James D. Watson et al. Pearson/Addison Wesley. While not plant-specific, this classic provides essential molecular biology foundations with relevance to plants.
- Molecular Cell Biology (Lodish et al.), recent editions.Comprehensive molecular and cellular processes, including gene regulation and signaling applicable to plant systems.

Reference Books

- Plant Molecular Genetics by S. Chakraborty & P.K. Borua. Scientific Publishers Focused on genetic engineering, molecular markers, and crop improvement strategies.
- A Textbook of Biotechnology by R.C. Dubey. S. Chand Publishing.Includes sections on molecular biology techniques and plant genetic transformation.

Research Papers & Review Articles

- Plant Molecular Biology (Springer): International peer-reviewed journal dedicated to molecular aspects of plant biology.Includes research articles, reviews, and methodological advancements.
- Annual Review of Plant Biology: Publishes review articles summarizing recent advances in plant molecular and cellular biology.
- The Plant Cell (ASPB), Plant Physiology (ASPB), Trends in Plant Science (Elsevier): Leading journals featuring high-impact papers and reviews on gene expression, genome editing, regulatory networks, and molecular responses to environmental cues.

Articles & Digital Content

- Biochemistry & Molecular Biology of Plants Companion Website (by ASPB/Wiley): Includes digital illustrations, PowerPoint slides, and teaching resources corresponding to the textbook.
- MIT OpenCourseWare and NPTEL Modules: Offer video lectures and notes on plant molecular biology, including genomics, gene expression, and transgenic technology.
- Plant Science ebooks and digital databases from Elsevier and Springer platforms provide direct access to current plant molecular biology research and textbooks.
- Institutional repositories and open-access resources such as PubMed Central, Plant Molecular Biology Reporter (Springer), and preprint servers for up-to-date research.
- https://makautexam.net/aicte_details/Syllabus/BScMOLB/AllSem.pdf
- https://www.caluniv.ac.in/ccf-ug/files/MB-CSR-73.pdf
- https://makautwb.ac.in/syllabus/B.Sc(MolecularBiology)_Syllabus.pdf
- h t t p s:/ / w w w.a u j o d h p u r.a c.in / p u blic / p d f / S ylla b u s - D E P A R T M E N T O F M O L E C U L A R BIO L O G YA N D BIO T E C H N O L O G Y(U G , P G - a n d - P h D).p d f

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Major Elective (DSE-I) Paper – I (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 505

Ethnobotany, Ethnomedicine and Phytochemistry - I

Credits: 02 **Hours: 30**

UNIT I: Introduction to Ethnobotany and Ethnomedicine

Basic Principles: Definition, scope, and interdisciplinary nature of ethnobotany and ethnomedicine, Relationship between plants and indigenous/traditional cultures, Historical development and relevance in the modern context. Major ethnic groups and their lifestyles with respect to plant uses.**Categories of plant uses:** food, medicine, rituals, and miscellaneous.

Recent Advancements: Integration of ethnobotany with modern scientific approaches, Role of ethnobotanical research in bioprospecting and drug discovery, Intellectual Property Rights (IPR), biopiracy issues, and preservation of traditional knowledge.

UNIT II: Medicinal Plants and Their Ethnomedicinal Uses

Basic Principles: Introduction to medicinal plants (active phytochemicals and their therapeutic roles), Preparation and types of traditional medicines (decoctions, infusions, poultices), Categories of ethnomedicinal plants used for common ailments, Role of ethnomedicine in primary healthcare.

Recent Advancements: Phytochemical screening techniques and bioassays (antimicrobial, antioxidant activities), Ethnopharmacology and validation of traditional medicines using modern lab methods, Development of herbal drugs and commercial herbal products.

UNIT III: Ethnobotanical Research Methods and Conservation

Basic Principles: Methods of ethnobotanical research (field surveys, interviews, data recording), Classification and identification techniques for ethnobotanical specimens, Ethical considerations in ethnobotanical research, Importance of conservation of ethnobotanical and medicinal plant resources.

Recent Advancements: Use of GIS and digital tools in ethnobotanical documentation, Community-based conservation and participatory approaches, Role of ethnobotany in biodiversity conservation and sustainable use.

UNIT IV: Contemporary Issues and Applications in Ethnobotany and Ethnomedicine

Basic Principles: Role of ethnobotany and ethnomedicine in modern drug discovery and healthcare, Intellectual property rights (IPR), benefit sharing, and traditional knowledge protection, Impact of globalization and cultural changes on traditional knowledge systems, Sustainable utilization and ethical harvesting of ethnobotanical resources.

Recent Advancements: Advances in ethno-genomics and metabolomics in medicinal plant research, Patenting of herbal drugs and regulation of herbal products, Integration of traditional knowledge with modern medicine and biotechnology.

Suggested Laboratory Exercises:

22.Survey and documentation of local ethnobotanical plants.
23.Preparation of herbarium sheets from collected local medicinal plants.
24.Case studies on local ethnic groups' plant knowledge.
25.Extraction and qualitative phytochemical tests of local medicinal plants.
26.Testing antimicrobial or antioxidant activity of extracts from indigenous plants.

27.Documentation and analysis of traditional herbal formulations from local sources.

28.Field trips to local tribal settlements or forests for plant survey.

29.Data collection and preparation of Peoples' Biodiversity Registers (PBR).

30.Preparation of ethnobotanical reports focusing on local plant use and conservation.

31.Patent search exercises related to herbal and ethnomedicinal products.

32.Testing of biochemical parameters and effectiveness of local herbal extracts.

33.Socio-economic impact study of local ethnobotanical resources and products.

References:

Textbooks

- Martinez, J.L., Muñoz-Acevedo, A., & Rai, M. (2018). Ethnobotany: Application of Medicinal Plants. CRC Press. This comprehensive text incorporates case studies from various global regions, focusing on ethnomedicinal plants, traditional uses, and applications in healthcare.
- Trivedi, P.C., & Sharma, N. (2011). Text Book of Ethnobotany. Indian Books and Periodicals. A syllabus-aligned Indian textbook introducing ethnobotanical concepts, traditional plant use, and field methodologies.
- Sarkar, B. (Ed.). (2024). The Basic Handbook of Indian Ethnobotany and Traditional Medicine Vol. 1. Updated guide including both classical and regional ethnomedicinal practices.

Reference Books

- Pullaiah, T., Krishnamurthy, K.V., & Bahadur, B. (Eds.). Ethnobotany of India: Five-Volume Series. Routledge/CRC Press. This authoritative series explores human-plant relationships, medicinal plants, regional diversity, and ethnomedicine across India, providing in-depth regional and thematic studies.
- Harshberger, J.W. An International Textbook on Medicinal Plants of India: An Ethnobotanical Research. IIP Publications. Covers the evolution, scope, and modern application of ethnobotanical research, including databases and bioinformatics for ethnomedicine.
- Economic Botany, Ethnomedicine and Phytochemistry. (2023). Follows common university syllabi, integrating economic aspects, phytochemistry, and ethnomedicine with a focus on practical applications.

Research Papers, Articles, and Journals

- Hydrobiology and Medicinal Plants of the Indian Subcontinent. Eds. Srivastava, R.K. (2021). This collection contains over 150 peer-reviewed papers on ethnobotany, medicinal plants, and economic plants in the Indian subcontinent.
- Phytochemical and ethnomedicinal research articles are frequently published in journals such as Journal of Ethnopharmacology, Journal of Ethnobiology and Ethnomedicine, and Ethnobotany Research & Applications. Access recent reviews and specific case studies via databases like PubMed and Google Scholar.
- Regional studies, such as those focusing on Arunachal Pradesh, indigenous knowledge, and medicinal plants of tribal groups, are covered in recent chapters in edited volumes and open-access journals.

Digital and Open-access Resources

- Uttarakhand Open University, Ethnobotany - Syllabus-oriented course module (MSCBOT-608): Comprehensive, freely available PDF covering fundamentals, research methods, medico-ethnobotany, ethnomedicines, conservation, and regulatory aspects.
- TNAU Agritech Portal – Section on Medicinal Plants and Ethnobotany: Notes, practical exercises, ethnomedicinal uses and management protocols tailored for university courses.
- Online library guides, such as the Sacramento State University "Books - Ethnoecology, Ethnobotany & Medicinal Plants" page, curate eBooks and references on global ethnobotany, indigenous plant use, and pharmacological applications.

Recommended Syllabus-aligned Indian Resources

- Pandey, B.P. "Botany for Degree Students": Includes chapters on Ethnobotany and Ethnomedicine.
- Vardhman Mahaveer Open University, Kota: Open-source ethnobotany units and practical manuals for Indian undergraduate and postgraduate syllabi.
- Digital databases such as NAPRALERT, AYURBASE, and others referenced in recent ethnobotanical literature provide curated data on medicinal plant use, chemical constituents, and traditional applications.
- https://www.mangalkotegovtcollege.org/wp-content/uploads/2024/08/Botany-Ethnobotany-22-23.pdf
- https://uou.ac.in/sites/default/files/slm/MSCBOT-608.pdf
- https://www.keralauniversity.ac.in/downloads/MSc_Botany_with_specialization_in_Ethno_Botany_and_Ethno_Pharmacology1605678105.pdf

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Major Elective (DSE-I) Paper – I (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 505

Mycology and Plant Pathology - I

Unit- I:

1. Introduction, Definition, Objectives, Mycological institute in India (IARI and VINSTROM), progress and status of mycology in India.
2. General Characteristics and classification of fungi by G. C. Ainsworth, 1973 (outline only).
3. Characteristic of Mastigomycotina, Ascomycotina, Zygomycotina, Basidiomycotina and Deuteromycotina.

Unit- II:

1. Chemical composition of fungal cell wall and its functions.
2. Characteristics of fungi spores, types of spores based on spore production structure, function and motility.
3. General variations in fungi Heterokaryopsis, Parasexuality, Homothallism and Heterothallism.

Unit- III

1. Role of fungi in industrial Mycology, scope & their utility.
2. Industrial application of fungal enzymes – protease, cellulase & invertase.
3. Production of alcoholic beverages, antibiotics, organic acids, alkaloids & ergot by using fungi.

Unit – IV

1. Production of secondary metabolites by using fungi.
2. Role of fungi in agriculture and forestry & conservation of germplasm.
3. Cultivation of fungi for food – Mushrooms, mycoproteins & mycofoods & importance of medical mycology.

Laboratory Exercises: -

Make use of permanent micro-preparation, temporary mounts, transparencies, photographs, charts etc.

1. Principles & working of tools, Equipment's and other requirements in the Mycology & Plant Pathology laboratory
2. General Mycological laboratory procedures.
3. Sterilization Processes viz. Moist heat, Dry heat, Chemical and Radiation.
4. To study the Preparation of Potato Dextrose Agar (PDA).
5. Pouring of Nutrient Media into Petri dishes and Slant preparation.
6. Isolation of soil borne Fungi by dilution method.
7. Isolation of air borne Fungi on nutrient media.
8. Preparation of pure culture of Fungi and its identification.
9. Measurement of fungal growth by linear determination.
10. Study of locally available Mushrooms.
11. To study and demonstrate Mushroom culture technique.
12. To study the construction of Mushroom culture unit.
13. To test the sensitivity of microorganism against antibiotics.

Suggested Readings:

1. Introductory Mycology – C. J. Alexopolus & C. W. Mims
2. A text book of fungi – B. R. Vashishta

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Major Elective (DSE-I) Paper – I (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 505

Paleobotany - I

UNIT – I:

I. INTRODUCTION

Concepts of Palaeontology and Paleobotany; Baron Georges Cuvier (Father of Palaeontology), Professor Birbal Sahni (Father of Indian Paleobotany); The Birbal Sahni Institute of Paleobotany, Lucknow; Wadadham Fossil Park, Sironcha; Scope and Objectives of Paleobotany

UNIT – II:

II. FOSSILS AND FOSSILIZATION

Fossils; Process and conditions for Fossilization; Nature of the specimen undergoing Fossilization; Events Before, During and After Fossilization; Theories of Fossilization; Types of Fossils; Kinds of Fossils

UNIT – III:

III. TECHNIQUES FOR FOSSIL STUDY

1. Methods of Study Petrifications- Ground Thin Sections, Film or Peel Method, Microtomy, X-Ray Radiography Technique, µ-Computed Tomography.
2.Methods of Study Compressios- Maceration Techniques, Transfer Technique, Excavation Technique.

Form Genera; Nomenclature of Fossil Plants; Calculation of Age of Fossil

UNIT – IV:

IV. CLASSIFICATION OF FOSSIL PLANTS

Classification of Fossil Plants; Fossils of - Algae, Fungi, Bryophytes, Ptridophytes-*Rhynia*, Gymnosperms-*Cycadeoidea,* Angiosperms-*Enigmocarpon* Fruit *and Sahnianthus* Flower

Laboratory Exercises:

1. Study of different types of Fossils.
2. Study of different kinds of Fossils.
3. Study any Petrified fossil material by Peeling Technique.
4. Study Compression fossil material by MacerationTechnique.
5. Study of fossilAlgae material from permanent slides.
6. Study of fossilFungi material from permanent slides.
7. Study of fossilBryophytes material from permanent slides.
8. Study of fossilPteridophytes material from permanent slides.
9. Study of fossilGymnosperms material from and permanent slides.
10. Study of fossilAngiosperms material from permanent slides.
11. Study of Fossil Localities of Chandrapur District.
12. Study of Wadadham Fossil Parks, Sironcha
13. Visit to Palaeobotanical Institutes, Localities and Fossil Parks.

Suggested Readings:

1. Stewart, W.N. and Rothwell G.W. (1993): Palaeobotany and the Evolution ofPlants, Cambridge University Press.
2. Foster A.S. & Gifford F.M. (1967): Comparative morphology of vascular plants,Freeman Publishers, San Fransisco.
3. Eames, A.J. (1974): Morphology of Vascular Plants- lower groups, Tata Mc-Graw Hill publishing Co., New Delhi.
4. Arnold, C.A. (1947): Introduction to Palaeobotany, Mc-Graw Hill Book Co. Inc., New York and London.
5. Kubitzki K. (1990): The families and genera of vascular plants Pteridophytes and Gymnosperms, Springer Verlag, New York
6. Agashe, S.N. (1995): Palaeobotany, Oxford & IBH, New Delhi.
7. Biswas, C & Johri, B.N. (2004): The Gymnosperms, Narosa Publishing House, New Delhi.
8. Coulter J.M. & Chamberlain C.J. (1978): Morphology of Gymnosperms, Central Book Depot, Allahabad.
9. Kakkar, R.K. and Kakkar, B.R. (1995): The Gymnosperms (Fossils & Living), Central Publishing House, Allahabad.
10. Sharma O.P. (2002) Gymnosperms, Pragati Prakashan, Meerut.
11. Siddiqui, K.A. (2002): Elements of Palaeobotany, Kitab Mahal, Allahabad.
12. Bhatnagar, S.P. and Moitra A. (1996): Gymnosperms, New Age International Pvt. Ltd., New Delhi.
13. Singh, H. (1978): Embryology of Gymnosperms, Encyclopedia of Plant Anatomy X, Gebryder, Bortragear, Berlin.
14. Pant, D.D. (2003): *Cycas* and allied Cycadophytes, BSIP, Publications.
15. Bierhorst D.W. (1971): Morphology of vascular plants McMillan, New York.
16. Thomas, B.A. & Spicer R.A. (1987): The Evolution and Palaeobiology of land plants. Discordies Press, Fortland, USA.
17. Spicer, R.A. & Thomas, B.A. (1986): Systematic and taxonomic approaches in Palaeobotany.Systematic Association Special Volume.
18. Chamberlain C.J. (1986): Gymnosperms, structure and Evolution, CBS publishers and distributors, New Delhi. On line Journals available on UGC -VSAT

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Major Elective (DSE-I) Paper – I (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 505

Biodiversity Conservation - I

Unit 1: Introduction to Biodiversity Conservation

- Definition and concept of biodiversity.
- Levels of biodiversity: genetic, species, ecosystem.
- Importance and scope of biodiversity conservation.
- Threats to biodiversity: habitat loss, fragmentation, overexploitation, pollution.
- Biodiversity hotspots and global significance.

Unit 2: Principles and Strategies of Conservation

- In situ conservation: protected areas, biosphere reserves, wildlife sanctuaries, national parks.
- Ex situ conservation: botanical gardens, seed banks, cryopreservation, captive breeding.
- Conservation genetics: genetic diversity and its role in population survival.
- Role of keystone, indicator, and umbrella species in conservation.
- Conservation priorities and ethics.

Unit 3: Biodiversity Assessment and Monitoring Techniques

- Sampling methods and biodiversity indices (Simpson's, Shannon-Wiener).
- Remote sensing and GIS in biodiversity mapping and monitoring.
- Role of molecular tools (DNA barcoding, molecular markers).
- Community participation and citizen science in biodiversity monitoring.
- Case studies on biodiversity assessment

Unit 4: Recent Developments and Global Initiatives

- Biodiversity-related international conventions: CBD, CITES, Ramsar, IUCN.
- Ecological restoration and habitat management techniques.
- Role of biotechnology in conservation (genetic rescue, cloning).
- Sustainable use and conservation: agro-biodiversity, bioprospecting.
- Emerging challenges: climate change impacts on biodiversity

Suggested Laboratory Exercises:

1. Identification and documentation of local flora and fauna.
2. Quadrat and transect sampling for species diversity estimation.
3. Calculation of biodiversity indices from field data.
4. Use of GIS tools for mapping vegetation or habitat types.
5. Study of threatened species and their conservation status.
6. Simple DNA isolation and analysis (basic molecular techniques)

Suggested Readings:

- Primack, R. B. (2014). *Essentials of Conservation Biology*.
- Gaston, K. J., & Spicer, J. I. (2013). *Biodiversity: An Introduction*.
- Odum, E. P. (2004). *Fundamentals of Ecology*.
- Meffe, G. K., & Carroll, C. R. (1997). *Principles of Conservation Biology*.
- Heywood, V. H. (1995). *Global Biodiversity Assessment*.

Gondwana University, Gadchiroli

Theory Question Paper Pattern

B. Sc. SEMESTER – V BOTANY (Major Paper DSE - I)

Time: 03 Hours **Total Marks: 40**

Note: 1) All questions are compulsory and carry equal marks.
2) Draw well labelled diagram wherever necessary, but NOT necessary for Q. No. 5

Question 1. Write in detail **4 M x 2 = 08 M**

a) Unit – I
b) Unit – I

OR

c) Unit – II
d) Unit – II

Question 2. Write in detail **4 M x 2 = 08 M**

a) Unit – III
b) Unit – III

OR

c) Unit – IV
d) Unit – IV

Question 3. Write in short **2 M x 4 = 08M**

a) Unit – I
b) Unit – I
c) Unit – I
d) Unit –I

OR

e) Unit –II
f) Unit – II
g) Unit – II
h) Unit – II

Question 4. Write in short **2 M x 4 = 08 M**

a) Unit – III
b) Unit – III
c) Unit – III
d) Unit –III

OR

e) Unit –IV
f) Unit – IV
g) Unit – IV
h) Unit – IV

Question 5. Write answers to any ten questions in one or two lines only. **1 M x 8 = 08 M**

a) Unit – I
b) Unit – I
c) Unit – I
d) Unit – II
e) Unit – II
f) Unit – II
g) Unit – III
h) Unit – III
i) Unit – III
j) Unit – IV
k) Unit – IV
l) Unit – IV

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SEMESTER –V (Level – 05.5)
Practical Examination – Botany (Major DSE - I)

(Based on Theory Major DSE-I)
Course Code – USCBOT 506

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Any one Exercise [A] based on exercise from Unit I	05 M
Que. 2: Any one Exercise [B] based on exercise from Unit II	05 M
Que. 3: Any one Exercise [C] based on exercise from Unit III	05 M
Que. 4: Any one Exercise [D] based on exercise from Unit IV	05 M
Que. 5: SPOTTINGS SPOT – E :From Unit I SPOT – F :From Unit II SPOT – G :From Unit III SPOT – H: From Unit IV	04 M
Q 6: Submission of duly certified Practical Record	02 M
Q. 7 Submission of Institution Visit Report	02 M
Q 8: Viva-Voce.	02 M

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Minor Paper – III (4 Credits; 60 hours) (UA-80+CA-20)
Course Code – USCMEEB 05

Economic Botany

Credits: 04 **Hours: 60**

UNIT I: Origin, Scope & Principles of Economic Botany(15 Hours)

Basic Principles: Definition, scope, and historical development of Economic Botany. Classification of plants based on economic use (food, fiber, medicine, etc.). Domestication and centers of origin of cultivated plants. Major food crops: cereals (rice, wheat), millets, pulses.

Recent Advancements: Biotechnological improvement in staple food plants (e.g., transgenic rice, biofortified crops). Advances in crop productivity and resource-efficient varieties.

UNIT II: Commercial and Industrial Plants(15 Hours)

Basic Principles: Sources and uses of plant fibers (Cotton, Jute, Hemp). Edible oils (Mustard, Groundnut, Sesame), Beverages (Tea, Coffee, Palash, Senna), and Sugars. Timber, Rubber, Resins, and other industrial raw materials.

Recent Advancements: Advances in fiber technology (e.g., improved Cotton varieties, eco-friendly processing). New industrial applications: bio-based plastics, phyto-remediation.

UNIT III:Medicinal, Spices, Aromatic & Plantation Crops(15 Hours)

Basic Principles: Introduction to medicinal plants (active compounds, sources, uses, pharmacognosy basics), Spices and condiments (botany, cultivation, and uses), Plantation crops (Nilgiri, Teak).

Recent Advancements: Ethnobotanical approaches and plant-based drug discovery. Advances in cultivation and processing of high-value medicinal/spice crops.

UNIT IV:Contemporary Issues & Sustainable Utilization(15 Hours)

Basic Principles: Role of plants in environmental sustainability and rural development. Non-timber forest products, biofuels, and fodder plants. Conservation and sustainable management of plant resources.

Recent Advancements: Sustainable harvesting techniques and community-based resource management. Recent developments in bio-energy and plant-based green technologies.

Suggested Laboratory and Field Exercises:

1. Morphological and anatomical study of grains/pulses used locally.
2. Estimation of nutritional parameters (Carbohydrates, Proteins, Fats and Vitamins) in staple food crops though biochemical tests.
3. Survey/report on indigenous food crops and their socio-economic impact.
4. Identification and analysis of local fiber crops.
5. Demonstration/Extraction and qualitative analysis of oil/essential oil/biofuel from local crops.
6. Field visit or case study on local plant-product-based industry.
7. Morphological characteristics and microscopic analysis of local medicinal plants.
8. Morphological characteristics and microscopic analysis of local spice, condiments and beverage plants.
9. Extraction and phytochemical screening from regional medicinal plants.
10. Preparation of herbarium sheets or traditional knowledge documentation on Ethnobotany.
11. Survey and mapping of locally exploited wild/NTFP plants.

12. Socio-economic impact assessment of plant-based rural enterprises.

13. Case study/project on local agro-ecosystem or resource management practices.

REFERENCES

Textbooks

- Economic Botany, 5th Edition by S.L. Kochhar. Cambridge University Press, 2016. Widely regarded as a seminal text, covering plant domestication, crop origins and uses, ethnobotany, major economic plant groups (food, beverages, fibres, medicines, timber, etc.), and biodiversity conservation. Heavily illustrated; updated content for undergraduates and postgraduates.
- Economic Botany by B.P. Pandey. S. Chand Publishing, multiple editions. A popular Indian textbook, suitable for undergraduate and competitive examinations. Describes major economic plants, their cultivation, processing, and uses in detail.
- Economic Botany by Albert F. Hill. Surjeet Publications. Classic reference discussing useful plants and plant products globally, appropriate for advanced undergraduate courses.
- Economic Botany: Plant Resources & Economic Botany – A Comprehensive Textbook by Dr. Kalyan Das, Mahaveer Publications. Focuses on plant resources and their economic value, offering Indian and global perspectives.
- Economic Botany: An Introduction for Undergraduates (2024). Comprehensive and current, covering crop origins, global food and industrial uses, ethnobotany, biodiversity, and commercial applications. Useful for both science and applied courses.

Reference Books

- A Textbook of Economic Botany by S.L. Kochhar (multiple editions).
- Textbook of Economic Botany by R.W. Schery. Wiley Eastern, 1972.
- Plants for Man by R.W. Schery. Prentice-Hall, 1972.

Research Papers & Review Articles

- Economic Botany (journal, Springer): Peer-reviewed journal publishing research on the relationship between plants and people globally, including new uses, domestication, and ethnobotany.
- Journal of Ethnopharmacology (Elsevier): Valuable for research on medicinal plants and traditional knowledge in economic botany.
- Selected review articles in Annual Review of Plant Biology and Economic Botany (journal).

Articles & Digital Content

- Cambridge University Press – Supplementary references and reading lists included in "Economic Botany, A Comprehensive Study".
- Economic Botany course materials from major universities (e.g., MIT OpenCourseWare, lecture notes and video content on useful plants, plant resources, and ethnobotany).
- Digital Commons (Humboldt State University): General reference lists and open-access publications on economic botany.
- Online lectures and practical guides from institutions like NPTEL (India), focusing on economic plant species, their uses, and industrial applications.
- https://botany.uok.edu.in/Files/bdcfcf70-294a-4c43-95ed-70caf685f3b2/Alert/UG_Botany_5th_Semester_CBCS_70d1b6eb-ae04-48a0-9fea-f92857a69937.docx
- https://www.cbpbu.ac.in/userfiles/file/2023/Syllabus_NEP2023/Botany.pdf
- https://cottonuniversity.ac.in/storage/uploads/syllabus/54b5eee97e244ba50239831d90ef9573.pdf

Gondwana University, Gadchiroli

Theory Question Paper Pattern

B. Sc. SEMESTER – V BOTANY (Minor Paper III – Economic Botany)

Time: 03 Hours **Total Marks: 40**

Note: 1) All questions are compulsory and carry equal marks.
2) Draw well labelled diagram wherever necessary, but NOT necessary for Q. No. 5

Question 1. Write in detail **04 M x 02 = 08 M**

a) Unit – I

b) Unit – I

OR

c) Unit – II

d) Unit – II

Question 2. Write in detail **04 M x 02 = 08 M**

a) Unit – III

b) Unit – III

OR

c) Unit – IV

d) Unit – IV

Question 3. Write in short **02 M x 04 = 08M**

a) Unit – I

b) Unit – I

c) Unit – I

d) Unit –I

OR

e) Unit –II

f) Unit – II

g) Unit – II

h) Unit – II

Question 4. Write in short **02 M x 04 = 08M**

a) Unit – III

b) Unit – III

c) Unit – III

d) Unit –III

OR

e) Unit –IV

f) Unit – IV

g) Unit – IV

h) Unit – IV

Question 5. Write answers to any ten questions in one or two lines only. **1 M x 08 = 08 M**

a) Unit – I

b) Unit – I

c) Unit – I

d) Unit – II

e) Unit – II

f) Unit – II

g) Unit – III

h) Unit – III

i) Unit – III

j) Unit – IV

k) Unit – IV

l) Unit – IV

Practical Examination
B. Sc. SEMESTER – V (Level 05.5)
Subject – Botany (Minor)
Economic Botany
Course Code: USCMEEB 06

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Any one Exercise [A] based on Food crops 04 M

Que. 2: Any one Exercise [B] based on Oil crops 04 M

Que. 3: Any one Exercise [C] based on Fibre crops 04 M

Que. 4: Any one Exercise [D] based on Medicinal plants 04 M

Que. 5: SPOTTINGS 06 M

SPOT – E : Spices and Condiments
SPOT – F : Timber
SPOT – G : Transgenic Crop
SPOT – H: NTFP
SPOT – I : Gum/Resin
SPOT – J: Beverage

Q 6: Submission of duly certified Classical/Virtual Herbarium sheet on Ethnobotany 04 M

Q 7: Submission of duly certified Practical Record 02 M

Q 8: Viva-Voce. 02 M

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Vocational Skill Course (2 Credits; 60 hours) (UA-30+CA-20)
Course Code – VSC

Option I: Plant Growth Medium

Unit I:**Fundamentals of Plant Growth Medium**

Definition and importance of plant growth media in agriculture and horticulture.
Types of growth media: natural soil, soilless media (Compost, Peat –Peat Moss, Peat Humus, Cocopeat, Shredded Bark, Leaf Mould, Vermiculite, Perlite), andinert substrates (Sand).
Key physical and chemical properties: texture, porosity, water-holding capacity, aeration,nutrient availability, pH, electrical conductivity (EC).
Role of growth media in seed germination, root development, and overall plant growth.
Overview of local soils in eastern Vidarbha (black cotton soil, lateritic soil) and theirsuitability as growth media.
Challenges associated with local soils and need for alternative growth media.

Unit II:**Recent Advancements and Technology in Growth Media**

Novel soilless culture techniques: hydroponics, aquaponics, aeroponics.
Use of biochar, compost, and organic waste (rice husks, farmyard manure) as sustainablemedia amendments.
Integration of nanomaterials and microbial inoculants for enhanced nutrient delivery.
Advances in media sterilization and preparation techniques to minimize pathogens.
Local innovations in utilizing agro-waste for media development.
Environmental and economic aspects of choosing growth media in Vidarbha context.

Laboratory Exercises

1. Collection and preparation of local soil samples for use as growth media.
2. Preparation and sterilization of common growth media (soil-based and soilless).
3. Measurement of media physico-chemical properties: pH, EC, moisture content, bulk density.
4. Comparative germination and growth experiments using different media.
5. Setting up and managing a simple hydroponic or container system with alternative media.
6. Documentation and analysis of plant growth performance in different growth media.
7. Field visits to local nurseries/agriculture centers demonstrating media selection and use.
8. Constraints of eastern Vidarbha soils: water retention, fertility, salinity, and degradation.
9. Sustainable sourcing of growth media: use of local agro-residues and waste materials.
10. Impact of climatic factors and soil conditions on media performance.
11. Economic considerations in media selection for small and marginal farmers.
12. Case studies of successful adaptation of growth media and soilless cultivation in Vidarbha/Maharashtra/India.
13. Awareness of government schemes supporting sustainable nursery and media development.

References:

- Taiz, L., & Zeiger, E. (2018). Plant Physiology and Development (6th Ed.).
- Marschner, P. (2012). Marschner's Mineral Nutrition of Higher Plants.
- Reddy, S.R., & Ramu, R. (2016). Introduction to Agronomy. Kalyani Publishers.
- Kokate, C.K. (2017). Pharmacognosy (for phytochemical aspects relevant in growth media).
- Hilty, J. et al. (2021). "Plant growth: the What, the How, and the Why".
- Carneiro, J.S.S. et al. (2022). Studies on soilless substrates and their agronomic impact. Indian Journal of Soil Science, Indian Journal of Agricultural Sciences – articles focused onsoil and media management in Vidarbha.
- Recent Advances in hydroponic culture and media sterilization (Defence Life Science Journal, 2022).
- NCERT chapters on Plant Growth and Development.
- ICAR e-Krishi Shiksha portal on nursery and growth media management.
- Sant Gadge Baba Amravati University syllabi and resources on Nursery and Soil Management.
- Maharashtra State Agriculture Department and PDKV Akola online bulletins relevant to localsoil and nursery media.
- ScienceDirect, PubMed, and MDPI Plants for updated research on plant growth media.

Gondwana University

Semester – V (Level 05.5)

Practical Examination Scheme for Vocational Skill Course (VSC)

OPTION – I

PLANT GROWTH MEDIUM

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Identify and comment on soil type [A] based on given Physico-chemical properties 05 M

Que. 2: Identify Plant Growth media [B] based on compositions 05 M

Que. 3: Enlist locally available Agro-residue/waste material sources [C] for media preparation 05 M

Que. 4: Write Protocol for Preparation and Sterilization [D] of growth media. 05 M

Que. 5: SPOTTINGS 06 M

SPOT – E : Tools for Media Preparation (Item/Photograph)
SPOT – F : Instrument/Equipment for Media Preparation (Item/Photograph)
SPOT – G : Commercial Plant Growth Medium (Item/Photograph)

Q 6: Submission of duly certified Practical Record 02 M

Q 7: Viva-Voce. 02 M

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Vocational Skill Course (2 Credits; 60 hours) (UA-30+CA-20)
Course Code – VSC

Option II: Modern Farming Techniques

Unit I: **Basic Principles of Modern Farming**

Introduction to modern farming: Definition, scope, and significance, Overview of traditional vs. modern farming approaches.

Soil health fundamentals: Soil types of eastern Vidarbha, fertility, and management practices.

Water management: Irrigation methods suited to eastern Vidarbha's climate and waterscarcity issues.

Crop selection and crop rotation: Matching crops to local agro-climatic zones, Introduction to conservation agriculture, climate-resilient and sustainable farming concepts.

Challenges in Vidarbha's farming systems: soil degradation, drought, pest pressures.

Unit II: **Recent Advancements in Modern Farming**

Soilless farming systems: Hydroponics, Aeroponics, Vertical farming, and their practicalapplicability.

Protected cultivation techniques: Polyhouses, Greenhouses, and Shade nets.

Use of smart farming technologies: Sensors for soil moisture, drone surveillance, GPS/GIS formonitoring.

Precision agriculture: Variable rate nutrient and water management, sensor-guidedfertigation, Integration of organic farming and biofertilizers with modern practices, Biotechnology tools in crop improvement relevant to regional crops.

Laboratory Exercises

14. Collection and preparation of local soil samples for use as growth media.
15. Preparation and sterilization of common growth media (soil-based and soilless).
16. Measurement of media physico-chemical properties: pH, EC, moisture content, bulk density.
17. Seed testing: germination percentage, vigor tests. Seed bed preparation and sowing techniques.
18. Setting up and managing a simple hydroponic or container system with alternative media.
19. Setting up simple aeroponic systems using locally available media.
20. Documentation and analysis of plant growth performance in different modern farming techniques. .
21. Identification and use of fertilizers, organic manure, and biofertilizers for Hydroponics and Aeroponics.
22. Field visits to local nurseries/agriculture centers demonstrating Modern Farming Techniques.
23. Case studies of successful adaptation of soilless cultivation in Vidarbha/Maharashtra/India.
24. Awareness of government schemes supporting Modern Farming Techniques.

References:

- Taiz, L., & Zeiger, E. (2018). Plant Physiology and Development (6th Ed.).
- Marschner, P. (2012). Marschner's Mineral Nutrition of Higher Plants.
- Reddy, S.R., & Ramu, R. (2016). Introduction to Agronomy. Kalyani Publishers.
- Kokate, C.K. (2017). Pharmacognosy (for phytochemical aspects relevant in growth media).
- Hilty, J. et al. (2021). "Plant growth: the What, the How, and the Why".
- Carneiro, J.S.S. et al. (2022). Studies on soilless substrates and their agronomic impact. Indian Journal of Soil Science, Indian Journal of Agricultural Sciences – articles focused onsoil and media management in Vidarbha.
- Recent Advances in hydroponic culture and media sterilization (Defence Life Science Journal, 2022).
- NCERT chapters on Plant Growth and Development.
- ICAR e-Krishi Shiksha portal on nursery and growth media management.
- Sant Gadge Baba Amravati University syllabi and resources on Nursery and Soil Management.
- Maharashtra State Agriculture Department and PDKV Akola online bulletins relevant to local soil and nursery media.
- ScienceDirect, PubMed, and MDPI Plants for updated research on plant growth media.
- Sant Gadge Baba Amravati University: M.Sc. (Botany)and B.Sc. (Agriculture) syllabirelevant to modern farming practices.
- ICAR e-Krishi Shiksha portal and digital agriculture initiatives of the Government of India.
- ScienceDirect, PubMed, and MDPI Plants for updated research reviews on farminginnovations.
- Maharashtra State Agriculture Department and PDKV Akola's online resources on soil andwater management in Vidarbha.

Gondwana University

Semester – V (Level 05.5)

Practical Examination Scheme for Vocational Skill Course (VSC)

OPTION – II

MODERN FARMING TECHNIQUES

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Identify and comment on soil type [A] based on given Physico-chemical properties 05 M

Que. 2: Write protocol for performing seed testing [B] 05 M

Que. 3: Enlist requirements[C] for setting up Hydroponics/Aquaponic/Aeroponics 05 M

Que. 4: Write Protocol for Preparation and Sterilization [D] of growth media for Aquaponic/Aeroponics 05 M

Que. 5: SPOTTINGS 06 M

SPOT – E : Tools for Hydroponics/Aquaponic/Aeroponics Media Measurement (Item/Photograph)

SPOT – F : Instrument/Equipment for Hydroponics/Aquaponic/Aeroponics Media Preparation (Item/Photograph)

SPOT – G : Commercial Plant Growth Medium (Item/Photograph)

Q 6: Submission of duly certified Practical Record 02 M

Q 7: Viva-Voce. 02 M

B. Sc. Botany (NEP2020)
SEMESTER – V (Level 05.5)
Field Project/Community Engagement Practice Based on Major Subjects (2 Credits; 60 hours) (UA-30 +CA-20)
Course Code – FP/CEP

A detailed guideline for conduction and evaluation of the Field Project (FP)/ Community Engagement Practice (CEP) will be provided by the University separately.

GONDWANA UNIVERSITY, GADCHIROLI

FACULTY OF SCIENCE & TECHNOLOGY

SYLLABUS

FOR

B.Sc.

BOTANY

S e m e s t e r - V I

As per National Education Policy – 2020

(w.e.f.: 2026 – 27)

Gondwana University, Gadchiroli
NEP 2020 U.G. PROGRAMME SESSION 2026-27
Faculty of Science and Technology
Programme Name - B.Sc. SemesterVI (Level-5.5)

Sr. No.	Course Category	Subject name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
							Theory					Practical				
				Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	Major Subject (Core Subject)	Paper VII 2 credits Theory + 2 credits Practical **Plant Ecology**	04	02	04	06	40	10	50	20	03	30	20	50	25	100
		Paper VIII 2 credits Theory + 2 credits Practical **Plant Growth & Development**	04	02	04	06	40	10	50	20	03	30	20	50	25	100
2	Major Subject (Discipline Specific Elective)	Paper DSE II 2 credits Theory + 2 credits Practical Any one from Major Discipline Elective Subject Basket	04	02	04	06	40	10	50	20	03	30	20	50	25	100
3	Minor Subject (Core Subject)	Paper IV 4 credits Theory + 2 credits Practical **Medicinal Botany**	06	04	04	08	80	20	100	40	03	30	20	50	25	150
4	OJT/RP	Based on Major subjects (30 hrs/credit)	04	--	08	08						60	40	100	50	100
Total			22	10	24	34	200	50	250	100	12	180	120	300	150	550

Annexure – III

NEP2020 B. Sc. Botany Major

B. Sc. Semester VI

Basket for Discipline Specific Elective – II

Options	DSE – II Subjects
I	Molecular Biology and Plant Biotechnology – II
II	Ethnobotany, Ethnomedicine and Phytochemistry – II
III	Mycology and Plant Pathology – II
IV	Paleobotany – II
V	Biodiversity Conservation – II

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Major Paper – VII (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 601

Plant Ecology

Credits: 02 **Hours: 30 Hours**

Unit I:**Basic Concepts and Scope of Plant Ecology**
Introduction: Definition, scope, and importance of Plant Ecology.
Levels of ecological study: Autecology, Synecology, and Ecosystem ecology.
Abiotic environmental factors and their influence on plants: Light, Temperature, Water, Soil
Biotic factors& their influence on plants: Plant-Plant, Plant-Animal, Plant-Microbe interactions.
Ecosystem structure and function.
Energy flow, nutrient cycling, and productivity concepts.
Study of region-specific plant-environment interactions and ecological challenges (e.g., local invasive species, habitatfragmentation, water scarcity effects on local flora).

Unit II: **Types and Classification of Plant Communities**
Concept of plant communities: types and characteristics
Classification and structure of plant communities: Physiognomic, Floristic, and Ecological classification.
Community attributes: Species composition, dominance, diversity indices.
Succession: Types, mechanisms, and models of succession
Ecotones and Edge effects.
Study of local forests, grasslands, wetlands, and their community dynamics and conservation status.

Unit III: **Applications and Recent Advancements in Plant Ecology**
Role of Plant Ecology in conservation biology and ecosystem management.
Restoration ecology and ecological rehabilitation.
Urban ecology and impact of urbanization on plant ecosystems.
Climate change effects on plant distribution and phenology.
Use of remote sensing and GIS in plant ecological studies.
Recent molecular tools and ecological genomics in Plant Ecology research.
Climate resilience strategies for local crop and wild plant species, effects of pollution on local vegetation.

Unit IV: **Practical Applications and Experimental Plant Ecology**
Field methods: Quadrat sampling, transect methods, and vegetation analysis.
Population ecology: study of population density, frequency, and dispersion.
Measurement of ecological parameters: soil analysis, light intensity, and water potential measurement.
Laboratory studies on seed germination ecology and physiological responses to abiotic stresses.
Vegetation survey of local habitats, assessment of invasive species, and biodiversity documentation

Suggested Laboratory Exercises:

1. Visit to nearby Aquatic Ecosystem (Pond/Lake/River/Estuary/Sea) and study its Abiotic and Biotic components.
   Visit nearby Terrestrial Ecosystem (Grassland/Farmland/Forest/Mountain) and study its Abiotic and Biotic components.
2. Autecology of hydrophytic species (e. g., *Phormidium* sp., *Chara* sp., *Hydrilla* sp., *Trapa* sp., *Nelumbo* sp., *Nymphaea* sp., *Ipomoea* sp., etc.).
3. Autecology of xerophytic species (e. g., *Casuarina* sp., *Acacia* sp., *Opuntia* sp., *Asparagus* sp., *Ruscus* sp., *Nerium* sp., etc.).
4. Autecology of epiphytic species (e. g., *Dendrobium* sp., *Eria* sp., *Phalenopsis* sp., *Vanda* sp., etc.).
5. Autecology of halophytic species (e. g., *Avicennia* sp., *Sonneratia* sp., *Bruguier* asp.,*Rhizophora* sp., etc.).
6. T*o study different methods of plant diversity study (Plot sampling, Transect sampling, Quadrat sampling, Remote sensing and Genetic analysis).*
7. To determine minimum size of quadrat for diversity study using species-area curve method.
8. To determine minimum number of quadrat required to plot for reliable diversity study using species-area curve method.
9. To study community by quadrat method by determining quantitative characters like frequency, density and abundance of different species in the community.
10. To determine Important Value index (IVI) of different species growing in the community.
11. To estimate population size by Mark and Recapture method.
12. To study inter and intra-specific interactions in the community.
13. Measurement and analysis of soil parameters (pH, texture, moisture content) from local sites.
14. Analysis of Physico-chemical characteristics of water collected from nearby reservoirs.
15. Seed germination experiments under variable environmental conditions (temperature, light, water).
16. Study of leaf water potential and stomatal behavior of local xerophytic or hydrophytic plants.
17. Field survey and documentation of local invasive species and assessment of their ecological impact.
18. Use of GPS and basic GIS tools for mapping local vegetation patterns.

References:

Textbooks

- Odum, E.P. (2004). Fundamentals of Ecology. 5th Edition. Brooks/Cole.
- Kumar, H.D. (2020). Plant Ecology: Studies in Plant Population and Ecosystem. S. Chand Publishing.
- Sharma, P.D. (2019). Ecology and Environment. Rastogi Publications.
- Bhatnagar, G., & Moitra, A. (2007). Plant Ecology. New Age International Publishers.
- Smith, R.L. (2015). Elements of Ecology. 9th Edition. Pearson.
- Mishra, R.M. (2021). Plant Ecology. Science Publishers.

Reference Books & Manuals

- Van Dobben, W.H., & De Vries, W. (Eds.)(2018). Ecological Methods for Field andLaboratory. Wiley.
- Krebs, C.J. (2016). Ecology: The Experimental Analysis of Distribution and Abundance. 7thEdition. Pearson.
- Begon, M., Townsend, C.R., & Harper, J.L. (2006). Ecology: From Individuals to Ecosystems.Blackwell Publishing.

Research Journals & Articles

- Journal of Plant Ecology (Oxford Academic)
- Plant Ecology (Springer)
- Applied Vegetation Science (Wiley)
- Recent articles on local ecological challenges published in Current Science and regionalenvironmental journals (available via university databases)

Digital Contents

- MIT OpenCourseWare: Plant Ecology modules (video lectures and lecture notes).
- NPTEL Courses on Ecology and Environment (IIT Bombay, IISc Bangalore).
- Encyclopedia of Life (EOL) for regional biodiversity data.
- GIS and Remote Sensing tutorials relevant to plant ecology (available on Coursera, ESRI site).

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Major Paper – VIII (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 602

Plant Growth and Development

Credits: 02 **Hours: 30 Hours**

Unit I:**Basic Concepts and Scope of Plant Growth and Development**
Introduction: Definition and distinction between growth and development.
Types and patterns of growth: cell division, cell elongation, cell differentiation.
Meristems and their roles: Apical, Intercalary, Lateral meristems.
Phases of growth: Primary and Secondary growth.
Concepts of development: Morphogenesis, Differentiation, Dedifferentiation, Redifferentiation.
Impact of local environmental conditions: Effect of temperature, soil nutrients, water availability on plant growth patterns in wild orcultivated species.

Unit II:**Plant Growth Regulators and Their Applications**
Plant hormones: Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid – biosynthesis, and mechanisms of action.
Photoperiodism, vernalization and bolting in flowering plants.
Seed dormancy and germination: hormonal control and environmental influences.

Unit III:**Developmental Processes and Morphogenesis**
Organogenesis: Seed germination, seedling development, formation of root, stem, leaf, flower.
Senescence and abscission: Physiological and Biochemical aspects.
Response to environmental stimuli affecting development: Photomorphogenesis, Gravitropism, Thigmotropism.

Unit IV:**Recent Advances and Experimental Approaches**
Molecular and genetic approaches to plant growth and development.
Role of signal transduction pathways in growth regulation.
Biotechnological tools for studying and manipulating plant development (e.g., CRISPR, geneediting).
Growth kinetics models and computational biology in growth studies.

Suggested Laboratory Exercises:

1. Study and measurement of different types of growth (primary and secondary) in local plant species.
2. Microscopic study of apical, intercalary, and lateral meristems.
3. Experimental study of seed germination under varying local environmental factors (temperature, light, water).
4. Study of different dormancy breaking methods on seed germination percentage of native wild species.

5. Effects of plant growth regulators (auxin, gibberellin, cytokinin) on seedling growth and development.
6. Demonstration of Photoperiodism effects on flowering in local plants or crops.
7. Demonstration of Vernalization effects on flowering in local plants or crops.
8. Demonstration of Bolting in local rosette habit plant species.
9. Observation and analysis of plant tropic responses (Phototropism, Gravitropism, Hydrotropism).
10. Study of floral morphology and development in selected local flowering plants.
11. Measurement of growth rate parameters (absolute growth rate, relative growth rate) on local species.
12. Field survey on growth patterns of important regional crop or wild plant species under environmental stress conditions.
13. Use of simple molecular techniques (e.g., PCR for gene expression related to growth) if facilities are available.

References:

Textbooks

- Taiz, L., Zeiger, E., Møller, I.M., & Murphy, A. (2015). Plant Physiology and Development. 6thEdition. Sinauer Associates.
- Hopkins, W.G., & Huner, N.P.A. (2023). Introduction to Plant Physiology. 5th Edition. Wiley.
- Raven, P.H., Evert, R.F., & Eichhorn, S.E. (2005). Biology of Plants. 7th Edition. W.H.Freeman.
- Singh, V. (2015). Plant Growth and Development. New Age International Publishers.
- Ganapathi, T.R. (2021). Plant Growth and Development. Oxford & IBH Publishing.
- Srivastava, L.M. (2017). Plant Growth and Development - Hormones and Environment.Academic Press

Reference Books & Manuals

- Sinha, R.K. & Sanwal, S.P. (2010). Plant Growth Regulators: Principles and Applications.New India Publishing.
- Bhojwani, S.S., & Razdan, M.K. (1996). Plant Tissue Culture: Theory and Practice. Elsevier.
- Kumar, H.D. (2018). Plant Development and Reproduction. S. Chand Publishing.

Research Journals & Articles

- Plant Physiology (American Society of Plant Biologists) – for research on plant growth mechanisms and hormonal regulation.
- Journal of Experimental Botany (Oxford University Press) – contains studies on molecular biology of plant development.
- Plant Growth Regulation (Springer) – focused on plant hormones and growth responses
- Articles on locally relevant plant species growth and development in journals such as Current Science, Indian Journal of Plant Physiology, and regional agricultural research journals.

Digital Contents

- MIT Open CourseWare: Plant Growth and Development Lecture Notes and Video Lectures.
- NPTEL Courses on Plant Physiology and Development, IIT Bombay and IISc Bangalore.
- SpringerLink and ScienceDirect databases for e-books and recent articles.
- Plant Hormone Signaling Pathways tutorials available on Coursera and similar platforms.
- Local university digital repositories for theses and dissertations on plant growth studies.

Gondwana University, Gadchiroli

Theory Question Paper Pattern

B. Sc. SEMESTER – VI BOTANY (Major Papers VII and VIII)

Time: 03 Hours **Total Marks: 40**

Note: 1) All questions are compulsory and carry equal marks.
2) Draw well labelled diagram wherever necessary, but NOT necessary for Q. No. 5

Question 1. Write in detail **4 M x 2 = 08 M**

a) Unit – I
b) Unit – I

OR

c) Unit – II
d) Unit – II

Question 2. Write in detail **4 M x 2 = 08 M**

a) Unit – III
b) Unit – III

OR

c) Unit – IV
d) Unit – IV

Question 3. Write in short **2 M x 4 = 08M**

a) Unit – I
b) Unit – I
c) Unit – I
d) Unit –I

OR

e) Unit –II
f) Unit – II
g) Unit – II
h) Unit – II

Question 4. Write in short **2 M x 4 = 08 M**

a) Unit – III
b) Unit – III
c) Unit – III
d) Unit –III

OR

e) Unit –IV
f) Unit – IV
g) Unit – IV
h) Unit – IV

Question 5. Write answers to any ten questions in one or two lines only. **1 M x 8 = 08 M**

a) Unit – I	d) Unit – II	g) Unit – III	j) Unit – IV
b) Unit – I	e) Unit – II	h) Unit – III	k) Unit – IV
c) Unit – I	f) Unit – II	i) Unit – III	l) Unit – IV

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SEMESTER –VI (Level – 05.5)
Practical Examination – Botany (Major - VII)
Plant Ecology
(Based on Theory Major Paper - VII)
Course Code – USCBOT 603

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Any one Exercise [A] based on Soil analysis 05 M

Que. 2: Any one Exercise [B] based on Water analysis 05 M

Que. 3: Any one Exercise [C] based on Ecological Adaptation 05 M

Que. 4: Any one Exercise [D] based on Vegetation Analysis 05 M

Que. 5: SPOTTINGS 06 M

SPOT – E : Types of Ecosystem (Specimen/Model/Photograph)
SPOT – F : Inter-specific interactions (Specimen/Model/Photograph)
SPOT – G : Nutrient Cycles (Specimen/Model/Photograph)
SPOT – H: Food Web (Specimen/Model/Photograph)
SPOT – I : Ecological Pyramids (Specimen/Model/Photograph)
SPOT – J: GPS and basic GIS tools (Specimen/Model/Photograph)

Q 6: Submission of duly certified Practical Record 02 M

Q 7: Viva-Voce. 02 M

SEMESTER –VI (Level – 05.5)
Practical Examination – Botany (Major - VIII)
Plant Growth and Development
(Based on Theory Major Paper - VI)
Course Code – USCBOT 604

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Any one Exercise [A] based on Primary/Secondary growth identification 05 M

Que. 2: Any one Exercise [B] based on Meristem identification 05 M

Que. 3: Any one Exercise [C] based on Plant Movements 05 M

Que. 4: Any one Exercise [D] based on Photoperiodism/Vernalization/Flower Development 05 M

Que. 5: SPOTTINGS 06 M

SPOT – E : Primary Growth in root/stem in Monocot (Specimen/Slide/Photograph)
SPOT – F : Primary Growth in root/stem Dicot (Specimen/Slide/Photograph)
SPOT – G : Secondary Growth in root/stem Monocot (Specimen/Slide/Photograph)
SPOT – H: Secondary Growth in root/stem Dicot (Specimen/Slide/Photograph)
SPOT – I : Anomalous Primary Growth (Specimen/Slide/Photograph)
SPOT – J: Anomalous Secondary Growth (Specimen/Slide/Photograph)

Q 6: Submission of duly certified Practical Record 02 M

Q 7: Viva-Voce. 02 M

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Major Elective (DSE-II) Paper – II (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 605

Molecular Biology and Plant Biotechnology - II

Credits: 02 **Hours: 30**

UNIT I:Introduction to Plant Biotechnology and Plant Tissue Culture(07 Hours)
Basic Principles: Definition, history, scope, and importance of Plant Biotechnology, Concepts of totipotency and cell differentiation in plants.
Types of plant tissue culture:callus culture, organ culture, seed culture, protoplast culture
Media composition and culture conditions (MS medium basics): Components and their role.
Recent Advancements: Innovations in micropropagation techniques for elite plant varieties, Synthetic seed production and applications, Automated tissue culture and Bioreactors for large-scale propagation.

UNIT II: Haploid Production and Somatic Hybridization(08 Hours)
Haploid production: Androgenesis (Anther and Pollen culture), Gynogenesis (Ovary and Ovule culture).
Chromosome doubling: colchicine treatment and its significance
Protoplast isolation, culture, and regeneration.
Somatic hybridization and Cybrid production.
Recent Advancements: Genetic and epigenetic regulation in haploid induction, Novel techniques for somatic hybridization to overcome sexual incompatibility, Use of genome editing in haploid and somatic hybrid production.

UNIT III: Genetic Engineering and Molecular Techniques in Plant Biotechnology(07 Hours)
Plant genetic transformation methods: Agrobacterium-mediated and biolistic methods, Selection markers and reporter genes, Basics of recombinant DNA technology relevant to plants, Cloning vectors and gene transfer.
Recent Advancements: CRISPR-Cas and other genome editing technologies in plants, RNA interference (RNAi)and gene silencing for crop improvement, Development of genetically modified (GM) plants for stress tolerance and improvedyield.

UNIT IV: Plant Growth-Promoting Microorganisms and Secondary MetaboliteProduction (08 Hours)
Basic Principles: Role of plant growth-promoting Rhizobacteria (PGPR) and fungi, Nitrogen fixation and symbiotic relationships (*Rhizobium*, Mycorrhiza), Biopesticides and biological control agents.
Biotechnology of secondary metabolite production: Cell suspension cultures and elicitors
Recent Advancements: Use of microbial inoculants for sustainable agriculture, Metabolic engineering for enhanced production of medicinal phytochemicals, Commercial applications of plant cell culture for pharmaceuticals.

Suggested Laboratory Exercises:

1. Media preparation and sterilization techniques.
2. Initiation of callus culture from local plant explants.

3. Micropropagation of selected native species to study clonal propagation.
4. Anther culture and observation of callus development from local crop buds.
5. Protoplast isolation from native plants (demonstration or practical).
6. Chromosome doubling treatments on cultured plantlets.
7. DNA extraction from local plant species.
8. PCR amplification of target genes from regional crop varieties.
9. Demonstration of gel electrophoresis and genetic transformation protocols (simulation if facilities unavailable).
10. Isolation and characterization of PGPR from local soils.
11. Establishment of plant cell suspension cultures for secondary metabolite extraction.
12. Screening local plants for bioactive compounds using tissue culture techniques.

References:

Textbooks

- Plant Biotechnology and Genetics: Principles, Techniques, and Applications by C. Neal Stewart Jr., 3rd Edition (Wiley). Widely used as an introductory and advanced text, this book explains core plant biotechnology concepts, plant genetic engineering, transgenic crops, genome editing, and regulatory considerations.
- Plant Biotechnology: The Genetic Manipulation of Plants by Adrian Slater, Nigel W. Scott, and Mark R. Fowler (Oxford University Press).A comprehensive examination of the technology behind genetic manipulation of plants, with clear case studies and coverage of genomic tools.
- Applied Plant Biotechnology by V. Kumaresan. Focuses on the principles and practical applications for crop improvement and bioproduction.
- Plant Biotechnology: Methods in Tissue Culture and Gene Transfer by P. K. Gupta. Targeted for postgraduate and advanced undergraduate students; includes protocols for tissue culture and genetic transformation.
- A Text Book of Plant Biotechnology by Dr. Rajeev Kumar (Rama Publishing House). Covers principles and recent developments, aligned with current university syllabi.
- Introduction to Plant Biotechnology by H.S. Chawla, latest revised edition. An accessible standard introductory textbook explaining tissue culture, molecular markers, and genetic engineering.
- Principles of Plant Biotechnology by Phundan Singh. Covers tissue culture, genetic engineering, crops improvement, and glossary for terminology.
- ***Biotechnology Expanding Horizons***.by B. D. Singh (2009), Kalyani Publications, India.

Reference Books & Manuals

- Plant Cell, Tissue and Organ Culture: Fundamental Methods by O.L. Gamburg & G.C. Phillips (Springer Lab Manuals). Detailed guidance for laboratory protocols and management in plant cell and tissue culture.
- Practical Book of Biotechnology and Plant Tissue Culture by Nagar Santosh & Adhav Madhavi. Includes step-by-step protocols and exercises for practical understanding.
- A Text Book on Principles of Plant Biotechnology by Dr. N.P. Pathak (Akinik Publications, 2024). Focuses on biotechnology's role in agriculture and the innovation of crop varieties.

Research Papers & Review Articles

- Plant Biotechnology Journal (Wiley): Publishes peer-reviewed research and reviews on transgenic plants, genome editing, and new molecular techniques.
- Plant Cell Reports (Springer): Covers innovative plant biotechnology research and technical advances.
- Annual Review of Plant Biology: Features in-depth review articles on current research trends, methods, and breakthroughs in plant biotechnology.

Articles & Digital Content

- MIT OpenCourseWare, NPTEL, and related university MOOC resources offer open-access video lectures and reading materials on plant biotechnology, genetic engineering, and crop improvement.
- Principles of Plant Biotechnology (Pravara Institute PDF): Concise online modules summarizing core tissue culture, crop improvement, and molecular tools.
- Digital library resources such as PubMed Central, ScienceDirect, and SpringerLink provide access to current research articles and e-books in Plant Biotechnology.

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Major Elective (DSE-II) Paper – II (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 605

Ethnobotany, Ethnomedicine and Phytochemistry - II

Credits: 02 **Hours: 30**

UNIT I: Fundamentals of Phytochemistry
Basic Principles: Introduction to phytochemistry (definition, scope, and significance).
Classification of phytochemicals: Primary and secondary metabolites (alkaloids, glycosides, terpenoids, phenolics, flavonoids, tannins, saponins), Chemical nature and biosynthesis pathways of major phytochemicals, Extraction methods and phytochemical screening tests (qualitative and quantitative).
Recent Advancements: Modern chromatographic techniques (HPLC, GC-MS) in phytochemical analysis, Metabolomics and high-throughput screening approaches, Bioinformatics tools for phytochemical data analysis.

UNIT II: Phytochemical Classes and Their Biological Activities
Basic Principles: Detailed study of alkaloids, flavonoids, tannins, phenolics, glycosides, terpenoids, and volatile oils, Biological functions of phytochemicals in plants and their pharmacological importance, Role of phytochemicals as antioxidants, antimicrobials, and anti-inflammatory agents.
Recent Advancements: Identification of novel bioactive compounds using advanced spectroscopic methods (NMR, MS), Phytochemical modulation of human health and drug development, Application of nanotechnology in delivery of phytochemicals.

UNIT III: Techniques in Phytochemical Analysis
Basic Principles: Sample collection, preparation, and preservation for phytochemical study.
Use of chromatographic methods: TLC, column chromatography, HPLC, and GC.
Spectroscopic techniques: UV-Vis, IR, NMR, Mass Spectrometry basics.
Bioassays for phytochemical activity evaluation.
Recent Advancements: Integration of hyphenated techniques (GC-MS, LC-MS/MS) in complex mixtures analysis, Automation and miniaturization in phytochemical studies, Computational approaches for molecular docking and activity prediction.

UNIT IV: Applications and Recent Trends in Phytochemistry
Basic Principles: Role of phytochemicals in pharmacognosy and drug discovery, Herbal drug standardization and quality control.
Phytochemistry in agriculture: natural pesticides, growth regulators, Conservation of medicinal plants and sustainable utilization.
Recent Advancements: Phytochemical genomics and metabolic engineering, Nanoformulations and phytochemical delivery systems, Trends in herbal cosmetology and nutraceuticals.

Suggested Laboratory Exercises:

1. Extraction of phytochemicals from indigenous plantscommon in the region using solvents.
2. Qualitative tests for alkaloids, flavonoids, tannins, saponins, terpenoids in local plant samples.
3. Thin-layer chromatography (TLC) of phytochemical extracts from regional medicinal plants.
4. Quantitative estimation of phenolics and flavonoids in native plant extracts.

5. Antioxidant activity assay of regional plant samples (e.g., DPPH assay).
6. Preparation and analysis of herbal formulations from local plant sources.
7. Extraction and fractionation of phytochemicals from local plants.
8. TLC profile comparison of multiple local plant extracts.
9. Demonstration of quantitative HPLC or spectrophotometric analysis (if available).
10. Bioassay-based screening of local plant extracts for antimicrobial or antioxidant activity.
11. Preparation and standardization of herbal extracts and formulations from local plants.
12. Study of phytochemical effects on seed germination or pest deterrence in indigenous crops.
13. Survey and documentation of local ethnomedicinal plants and their phytochemical uses.

References:

Textbooks

- **Textbook of Pharmacognosy and Phytochemistry** (2012, Elsevier Health Sciences) — This comprehensive textbook covers alternative medicinal systems and modern pharmacognosy, biosynthetic pathways of metabolites, extraction and isolation methods, and applications of Ayurvedic and Chinese medicinal plants. It includes over 300 illustrations and is suitable for pharmacy and botanical students.
- **Textbook of Pharmacognosy and Phytochemistry** by Biren Shah and Vinash Seth — A modern interdisciplinary book emphasizing plant biodiversity, biosynthesis, extraction, isolation techniques with TLC identification, and bioactivity assessment. It includes chapters on Ayurvedic, marine medicinal plants, nutraceuticals, cosmeceuticals, and other specialized topics, oriented toward undergraduate and postgraduate students and researchers.
- **A Text Book of Pharmacognosy and Phytochemistry-I** (2024) by Sunil Dutt, Rajesh Kumar, and Pankaj Kalia (Bright Sky Publications) — This recently published book explores medicinal plants, chemical constituents, their pharmacological activities, and therapeutic applications with an interdisciplinary approach integrating botany, chemistry, and traditional medicine.
- **Pharmacognosy and Phytochemistry-II** by Himanshu Singh et al. — A continuation volume providing detailed coverage of phytochemical study and pharmacognosy aspects.
- **Pharmacognosy & Phytochemistry Series (Springer Reference Series)** — An ongoing book series covering plant metabolites, their chemistry, properties, applications, and analytical methods relevant to phytochemistry research and applications.
- *Text Book of Economic Botany, Ethnomedicine and Phytochemistry* (2023) — This textbook aligns with NEP 2020 syllabus requirements and covers phytochemistry fundamentals, economic botany, and ethnomedicinal plants in an integrated manner, suitable for B.Sc. students.
- *Textbook of Pharmacognosy and Phytochemistry-II* (Shashwat Publication, 2025) — A comprehensive text focusing on the chemical and biological aspects of medicinal plants and crude drug evaluation, covering phytochemicals extensively.
- *Pharmacognosy and Phytochemistry* (syllabus documents for various Indian universities, e.g., MLSU course BP 405) — These outline fundamentals of pharmacognosy including classification and evaluation of phytochemicals and crude drugs.
- *Plant Biochemistry and Metabolism* sections from university syllabi like Himachal Pradesh University cover biosynthesis and function of secondary metabolites such as phenolics, flavonoids, terpenoids, alkaloids, and steroids.

Reference Books

- *Economic Botany, Ethnomedicine and Phytochemistry* across Indian universities provides substantial information on commercial and medicinal plants, oils, dyes, and phytochemical constituents with practical relevance.
- Standard plant biochemistry texts cited in syllabi (e.g., Lehninger's *Biochemistry*, Berg et al.'s *Biochemistry*) provide foundational biochemical background related to phytochemistry, metabolism, and secondary metabolites.
- Compendiums on medicinal plants and phytochemical analysis methods used in Pharmacy and Botany curricula.

Research Papers and Journals

- For recent phytochemical research, review journals like *Journal of Ethnopharmacology*, *Phytochemistry*, *Phytochemical Analysis*, and open-access repositories (Google Scholar, PubMed) provide peer-reviewed research on plant secondary metabolites, their extraction, characterization, and medicinal applications.

Digital Contents and Open-access Resources

- Coursenotes, PDFs, and open educational materials from Indian universities such as Vardhman Mahaveer Open University, Uttarakhand Open University, and TNAU Agritech Portal that cover phytochemistry basics, secondary metabolites, tests for phytochemicals, and their applications.

Additional Educational Resources

- Syllabus-aligned textbooks combining *Economic Botany, Ethnomedicine and Phytochemistry* by authors like Dr. Devesh Kumar Jadon are used in many Indian B.Sc. programs under the National Education Policy (NEP 2020).

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Major Elective (DSE-II) Paper – II (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 605

Mycology and Plant Pathology - II

Unit-I

1. Introduction, definition objectives importance of plant disease and plant pathology in 20th century.
2. Classification of plant disease on the basis of casual agents (non-parasitic & parasitic) and symptoms caused by fungi.
3. Method of studying plant disease – field observations, cutting of pathogenic organisms, culture media preparation, sterilization, isolation & purification & identification of culture, Koch's postulates.

Unit-II

1. Impact of Environment on plant disease – effect of temperature, soil environment, relative humidity soil types & texture, wind, rainfall & light.
2. Enzymes & toxins in plant diseases – cellulolytic enzyme, pecticemzymes, pytotoxins, vivotoxins & pathotoxins.
3. Defense mechanisms in plants – defense structures (Waxes & cuticles, structure of epidermal cell wall, structure of natural openings, cork layers, tyloses, gum deposition, synthesis of phenols) & hypersensitive reaction.
4. Principles of plant disease control – biological & chemical control, uses of disease resistance varieties & plant quarantine

Unit-III

Study of following disease with respect to symptoms, casual organisms, disease cycle & management.

1. Cereals:
   a) Grain Smut of Jowar b) Ergot of Bajra
2. Pulses:
   a) Wilt of pigeon Pea b) Yellow vein mosaic of Bean
3. Vegetables:
   a) Late blight of Potato b) Little leaf of Brinjal
4. Oil seeds:
   a) Tikka disease of Groundnut. b)Damping of Mustard.

Unit-IV

Study of following disease with respect to symptoms, casual organisms, disease cycle & management.

1. Fruits – Citrus Canker
2. Cash Crops
   a) Wilt Disease of Cotton b) Red Rot of Sugarcane
3. Ornamentals – Powdery Mildew of Rose
4. Weeds – Rust of *Euphorbia*
5. Trees – *Cercospora* on *Albizzia* fruits.

Laboratory Exercises: -

Make use of permanent micro-preparation, temporary mounts, transparencies, photographs, charts etc.

1. Principles & working of tools, Equipment's and other requirements in the Mycology & Plant Pathology laboratory.
2. Collection of disease plant parts from surrounding locality.
3. Identification of diseased material, their symptoms and characters (Disease plants studied in syllabus).
4. Sterilization Processes viz. Moist heat, Dry heat, Chemical and Radiation.
5. To study the Preparation of Potato Dextrose Agar (PDA).
6. Pouring of Nutrient Media into Petri dishes and Slant preparation.
7. Isolation of fungal pathogen from leaves.
8. Isolation of fungal pathogen from stems fruits and other aerial part.
9. Preparation of pure culture of Fungi and its identification.
10. Artificial inoculation of pathogen from diseased plant part to Petri dishes containing nutrient media.
11. Pathogenicity Test – Steps to perform Koch's Postulates.
12. To test the sensitivity of microorganism against antibiotics.

Suggested Readings:

1. A text book of Modern Plant Pathology – K. S. Bilgrami & H. C. Dube
2. Experiments in Microbiology, Plant Pathology and Biotechnology – K. R. Aneja
3. Plant Pathology – R. S. Mehrotra
4. Plant Pathology – C. J. Walker
5. Fundamental of Plant Pathology – N. G. Ravichandra
6. Disease of Crop Plants in India – G. Rangaswami & A. Mahadevan

NOTE:

Frequent field visits in the surrounding areas to study the disease plant vegetation (Hosts) are necessary.

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Major Elective (DSE-II) Paper – I (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 605

Paleobotany - II

UNIT – I:

1. GEOLOGICAL TIME SCALE

Origin and evolution of the Earth; Origin and organic evolution of life on Earth; Henry Miller Experiment; Geological Time Scale

UNIT – II:

2. THEORIES OF ORIGIN AND EVOLUTION OF THE EARTH

Nebular Hypothesis; Laplace's Hypothesis; Planet Assimal Hypothesis; Tidal Theory; Binary Star Hypothesis; Supernova Hypothesis; Interstellar Hypothesis; Big Bang Theory

UNIT – III:

3. ROCK SYSTEM OF INDIA

Archean Rock; Purana Rock; Dravidian Rock; Aryan Rock

4. Earth Movement

Different Layers of Earth; Continental Drift Theory; Plate Tectonic Theory

UNIT – IV:

5. APPLIED PALAEOBOTANY

Fossil Fuels- Coal and Collification; Classification of Coal; Coal Excavation and Paleopalynology; Origin of Oil; Oil Exploration and Paleopalynology; Paleo-Ecology and Paleofloristics

Laboratory Exercises:

1. Study of Geological Time Scale Table from chart.
2. Study of Henry Miller Experiment from chart.
3. Study of different theories of origin and evolution of the earth.
4. Study of different rock system of India.
5. Study of different layers of earth by diagram.
6. Study of different theories of earth movement.
7. Study of Classification of Coal.
8. Study the process of Oil exploration from earth.

Suggested Readings:

1. Stewart, W.N. and Rothwell G.W. (1993): Palaeobotany and the Evolution ofPlants, Cambridge University Press.

2. Foster A.S. & Gifford F.M. (1967): Comparative morphology of vascular plants,Freeman Publishers, San Fransisco.

3. Eames, A.J. (1974): Morphology of Vascular Plants- lower groups, Tata Mc-Graw Hill publishing Co., New Delhi.

4. Arnold, C.A. (1947): Introduction to Palaeobotany, Mc-Graw Hill Book Co. Inc., New York and London.

5. Kubitzki K. (1990): The families and genera of vascular plants Pteridophytes and

Gymnosperms, Springer Verlag, New York

6. Agashe, S.N. (1995): Palaeobotany, Oxford & IBH, New Delhi.

7. Biswas, C & Johri, B.N. (2004): The Gymnosperms, Narosa Publishing House, New Delhi.

8. Coulter J.M. & Chamberlain C.J. (1978): Morphology of Gymnosperms, Central Book Depot, Allahabad.

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

10. Sharma O.P. (2002) Gymnosperms, Pragati Prakashan, Meerut.

11. Siddiqui, K.A. (2002): Elements of Palaeobotany, Kitab Mahal, Allahabad.

12. Bhatnagar, S.P. and Moitra A. (1996): Gymnosperms, New Age International Pvt. Ltd., New Delhi.

13. Singh, H. (1978): Embryology of Gymnosperms, Encyclopedia of Plant Anatomy X, Gebryder, Bortragear, Berlin.

14. Pant, D.D. (2003): *Cycas* and allied Cycadophytes, BSIP, Publications.

15. Bierhorst D.W. (1971): Morphology of vascular plants McMillan, New York.

16. Thomas, B.A. & Spicer R.A. (1987): The Evolution and Palaeobiology of land plants. Discordies Press, Fortland, USA.

17. Spicer, R.A. & Thomas, B.A. (1986): Systematic and taxonomic approaches in

Palaeobotany.Systematic Association Special Volume.

18. Chamberlain C.J. (1986): Gymnosperms, structure and Evolution, CBS publishers and distributors, New Delhi. On line Journals available on UGC -VSAT.

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Major Elective (DSE-II) Paper – I (2 Credits; 30 hours) (UA-40+CA-10)
Course Code – USCBOT 605

Biodiversity Conservation - II

Unit 1: Conservation of Different Ecosystems and Biomes

- Forest ecosystems: types, conservation issues, and management.
- Wetlands and freshwater ecosystems: importance and conservation strategies.
- Marine and coastal ecosystems: threats and protection measures.
- Grasslands and desert ecosystems: biodiversity and conservation challenges.
- Agroecosystems and biodiversity conservation

Unit 2: Conservation Policy, Legislation, and Governance

- National biodiversity policy frameworks and action plans.
- Wildlife laws and legal frameworks: Wildlife Protection Act, Forest Conservation Act.
- Role of governmental and non-governmental organizations in conservation.
- Community-based conservation and indigenous knowledge systems.
- Environmental impact assessment (EIA) and biodiversity management plans

Unit 3: Socioeconomic and Cultural Aspects of Biodiversity Conservation

- Biodiversity and human well-being.
- Ecotourism and sustainable livelihoods.
- Conflicts in conservation: human-wildlife conflict, resettlement issues.
- Role of education and awareness programs in biodiversity protection.
- Ethical and philosophical aspects of conservation

Unit 4: Contemporary Issues and Future Directions

- Climate change and biodiversity: adaptive management strategies.
- Role of technology in biodiversity conservation (drones, AI, big data).
- Conservation genomics and emerging biotechnological tools.
- Strategies for invasive species management.
- Future perspectives and conservation innovations

Suggested Laboratory Exercises:

1. Field visits to local protected areas or biodiversity hotspots.
2. Study of endangered species and conservation measures in situ.
3. Preparation of conservation action plans or reports.
4. Analysis of conservation policy documents.
5. Role-play or simulation exercises on human-wildlife conflict resolution.
6. Assessment of environmental impact in a local context

Suggested Reading for Paper II

- Sodhi, N. S., & Ehrlich, P. R. (2010). *Conservation Biology for All*.
- Hunter, M. L. (2002). *Fundamentals of Conservation Biology*.
- Kormondy, E. J. (1996). *Concepts of Ecology*.
- Jadhav, H., & Bawa, K. S. (1997). *Local People and Conservation*.
- IUCN Reports and Convention on Biological Diversity documents (latest editions).

Gondwana University, Gadchiroli

Theory Question Paper Pattern

B. Sc. SEMESTER – VI BOTANY (Major Papers DSE - II)

Time: 03 Hours **Total Marks: 40**

Note: 1) All questions are compulsory and carry equal marks.
2) Draw well labelled diagram wherever necessary, but NOT necessary for Q. No. 5

Question 1. Write in detail **4 M x 2 = 08 M**

a) Unit – I
b) Unit – I

OR

c) Unit – II
d) Unit – II

Question 2. Write in detail **4 M x 2 = 08 M**

a) Unit – III
b) Unit – III

OR

c) Unit – IV
d) Unit – IV

Question 3. Write in short **2 M x 4 = 08M**

a) Unit – I
b) Unit – I
c) Unit – I
d) Unit –I

OR

e) Unit –II
f) Unit – II
g) Unit – II
h) Unit – II

Question 4. Write in short **2 M x 4 = 08 M**

a) Unit – III
b) Unit – III
c) Unit – III
d) Unit –III

OR

e) Unit –IV
f) Unit – IV
g) Unit – IV
h) Unit – IV

Question 5. Write answers to any ten questions in one or two lines only. **1 M x 8 = 08 M**

a) Unit – I	d) Unit – II	g) Unit – III	j) Unit – IV
b) Unit – I	e) Unit – II	h) Unit – III	k) Unit – IV
c) Unit – I	f) Unit – II	i) Unit – III	l) Unit – IV

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SEMESTER –VI (Level – 05.5)
Practical Examination – Botany (Major DSE - II)

(Based on Theory Major DSE-II)
Course Code – USCBOT 606

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Any one Exercise [A] based on exercise from Unit I	05 M
Que. 2: Any one Exercise [B] based on exercise from Unit II	05 M
Que. 3: Any one Exercise [C] based on exercise from Unit III	05 M
Que. 4: Any one Exercise [D] based on exercise from Unit IV	05 M
Que. 5: SPOTTINGS SPOT – E :From Unit I SPOT – F :From Unit II SPOT – G :From Unit III SPOT – H: From Unit IV	04 M
Q 6: Submission of duly certified Practical Record	02 M
Q. 7 Submission of Institution Visit Report	02 M
Q 8: Viva-Voce.	02 M

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Minor Paper – IV (4 Credits; 60 hours) (UA-80+CA-20)
Course Code – USCMEMB 07

Medicinal Botany

Credits: 04 **Hours: 60**

Unit I:**Introduction, History, Scope, and Significance**

Introduction: Definition, Scope, Historical perspective and contribution of India to Medicinal Botany.

Indigenous medicinal systems: Ayurveda, Siddha, Unani, and Homeopathy. Importance of medicinal plants in human health and traditional knowledge

Plant parts used as medicines: roots, stems, leaves, flowers, fruits, seeds and fruits as medicine. Important medicinal plants in the local region and theirtraditional uses.

Conservation status and threats to medicinal plants: Red List, Endemism, and sustainableharvesting.

Unit II:**Phytochemistry, Pharmacognosy, and Plant Drug Sources**

Overview of phytochemicals: Alkaloids, Flavonoids, Tannins, Glycosides, Terpenoids, Saponins, Phenolics. Extraction and isolation techniques for plant bioactive compounds.

Pharmacognosy: Identification, authentication, and quality control of medicinal plants, Adulteration and contamination of crude drugs; powder drug analysis techniques.

Local exploration: Phytochemical profiling of locally available medicinal plants, Ethnobotanical approaches and documentation of medicinal plant knowledge in the region.

Unit III:**Cultivation, Processing, and Applications of Medicinal Plants**

Agro-techniques and inter-culture practices: Cultivation practices, nursery techniques, harvesting, and post-harvest processing of selected important medicinal plants (e.g.,*Withania*sp., *Aloe* sp., *Rauwolfia*sp.).

Industrial applications: Herbal drug formulations, standardization, and dosage. Role of medicinal plants in pharmacy, cosmetics, and nutraceutical industries.

Local relevance: Cultivation challenges and economic value of medicinal plants in the localagricultural context.

Legal and ethical considerations: Intellectual Property Rights (IPR) and regulationsin herbal drug production.

Unit IV:**Recent Advances, Biotechnology, and Conservation**

Advances in tissue culture techniques and micropropagation of medicinal plants (***Artemisia annua, Bacopa moneri***).

Molecular tools for authentication and genetic improvement of medicinal plants.

Bioinformatics databases and their role in medicinal plant research.

Conservation strategies:*In situ* and *ex situ* methods, bioprospecting, and sustainable use.

Local conservation programs and community-based medicinal plant management.

Emerging research on medicinal plants targeting local health issues and drug discovery.

Suggested Laboratory and Field Exercises

1. Identification and morphological study of local important medicinal plants.

2. Preparation and preservation of herbarium sheets of medicinal plants.
3. Microscopic examination of powdered crude drugs and plant parts.
4. Phytochemical screening tests for key secondary metabolites (alkaloids, flavonoids, tannins,etc.).
5. Extraction techniques for essential oils and other bioactive compounds.
6. Germination tests and nursery practices for selected medicinal plants.
7. Study of traditional herbal formulations and their preparation.
8. Field survey and documentation of medicinal plants in local ecosystems
9. Preparation of plant drug samples for adulteration tests.
10. Visit to a local herbal farm or industry for practical exposure

REFERENCES

Textbooks

- **Medicinal Plants: Chemistry, Biology and Omics** by Seema Rawat, Pratibha Misra,Springer Nature, 2021.
- **Pharmacognosy and Phytochemistry** by Vinod D. Rangari, 2nd Edition, Career Publications.
- **Medicinal Botany** by N.S. Subrahmanyam, CBS Publishers, 2015.
- **Textbook of Pharmacognosy & Phytochemistry** by T.E. Wallis, CBS Publishers.
- **Handbook of Medicinal Plants** by K.V. Peter, 2nd Edition, CRC Press.

Reference Books & Manuals

- **Pharmacognosy and Pharmacobiotechnology** by Ashutosh Kar, New Age International.
- **Medicinal Plants: Conservation, Cultivation and Utilization** by A.K. Singh, PointerPublishers.
- **Plant Drug Analysis: A Thin Layer Chromatography Atlas** by H. Wagner & S. Bladt,Springer.
- **Medicinal Plant Biotechnology** edited by M. Ahmad et al., Wiley-Blackwell.

Research Journals & Articles

- Journal of Ethnopharmacology (Elsevier)
- Economic Botany (Springer)
- Phytochemistry Reviews (Springer)
- Recent research articles on local medicinal plants published in Current Science, IndianJournal of Traditional Knowledge, and regional botanical journals

Digital Content & Online Resources

- NPTEL online courses on Medicinal Plants and Pharmacognosy.
- MIT OpenCourseWare: Medicinal Plant Biology modules.
- Digital herbarium and ethnobotanical databases such as The Plant List, Kew Medicinal Plant Names Services
- PubMed Central and Science Direct for latest manuscripts on medicinal plant research.
- Herbal pharmacopoeia and drug regulatory information from WHO and AYUSH ministry websites.

Gondwana University, Gadchiroli

Theory Question Paper Pattern

B. Sc. SEMESTER – VI BOTANY (Minor Paper IV)

Time: 03 Hours **Total Marks: 40**

Note: 1) All questions are compulsory and carry equal marks.
2) Draw well labelled diagram wherever necessary, but NOT necessary for Q. No. 5

Question 1. Write in detail **04 M x 02 = 08 M**

a) Unit – I
b) Unit – I

OR

c) Unit – II
d) Unit – II

Question 2. Write in detail **04 M x 02 = 08 M**

a) Unit – III
b) Unit – III

OR

c) Unit – IV
d) Unit – IV

Question 3. Write in short **02 M x 04 = 08M**

a) Unit – I
b) Unit – I
c) Unit – I
d) Unit –I

OR

e) Unit –II
f) Unit – II
g) Unit – II
h) Unit – II

Question 4. Write in short **02 M x 04 = 08M**

a) Unit – III
b) Unit – III
c) Unit – III
d) Unit –III

OR

e) Unit –IV
f) Unit – IV
g) Unit – IV
h) Unit – IV

Question 5. Write answers to any ten questions in one or two lines only. **1 M x 08 = 08 M**

a) Unit – I
b) Unit – I
c) Unit – I
d) Unit – II
e) Unit – II
f) Unit – II
g) Unit – III
h) Unit – III
i) Unit – III
j) Unit – IV
k) Unit – IV
l) Unit – IV

Practical Examination

B. Sc. SEMESTER – VI (Level 05.5)

Subject – Botany (Minor)

Medicinal Botany

Course Code: USCMEMB 08

[Time 4 Hours] [Max. Marks – 30]

Que. 1: Any one Exercise [A] based on Morphology study and identification of medicinal plant 05 M

Que. 2: Any one Exercise [B] based on Powder Microscopy of medicinal plant parts. 05 M

Que. 3: Any one Exercise [C] based on qualitative identification of Phytochemicals from crude extract 05 M

Que. 4: Any one Exercise [D] based on preparation of Herbal formulation 05 M

Que. 5: SPOTTINGS 06 M

SPOT – E : Roots used as Medicine (Specimen/Photograph)
SPOT – F : Stem used as Medicine (Specimen/Photograph)
SPOT – G : Leaves used as Medicine (Specimen/Photograph)
SPOT – H: Fruits used as Medicine (Specimen/Photograph)
SPOT – I : Seeds used as Medicine (Specimen/Photograph)
SPOT – J: Locally available commercial Herbal Formulation (Specimen/Photograph)

Q 7: Submission of duly certified Practical Record 02 M

Q 8: Viva-Voce. 02 M

B. Sc. Botany (NEP2020)
SEMESTER – VI (Level 05.5)
Research Project Based on Major Subjects (4 Credits; 120 hours) (UA-60 +CA-40)
Course Code – USCRP

A detailed guideline for conduction and evaluation of the Field Project (FP)/ Research Project (RP) will be provided by the University separately.