KURUKSHETRA UNIVERSITY KURUKSHETRA

(Established by the State Legislature Act-XII of 1956)
('A^{++}' Grade, NAAC Accredited)

Syllabus
for
Under-Graduate Programme

Subject: Botany
(7th & 8th Semesters)

With Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2025-26

Seventh Semester

Session: 2025-26			
Part A - Introduction			
Subject	**BOTANY**		
Semester	**7th**		
Name of the Course	**Algae and Fungi**		
Course Code	**B23-BOT-701**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-H1**		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand criteria for classification of algae, evolutionary trends and economic importance of algae. 2. Learn about the life cycle patterns, biological diversity and unusual habitats of algae. 3. Understand how to distinguish fungi from other groups and life cycle patterns of fungi. 4. Learn about different plant diseases, lichens and degeneration of sex in fungi.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4
THEORY			
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**		
Part B-Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	Criteria for algal classification (pigments, reserve food, flagella etc.) and their taxonomic importance. Comparative account of important systems classification and recent trends. Thallus organisation in algae and evolutionary trends. Economic importance of algae as food, feed, uses in industries etc, algal biofertilizers and biofuels. Origin and evolution of sex.	15
II	Biodiversity of algae in different habitats (terrestrial, freshwater, marine, thermal, psychrophilic, subaerial, symbiotic, parasitic, epiphytic, halophytic. etc)	15

	Dynamics and consequences of algal blooms and red tides. Phytoplankton, cyanophages, phycoviruses, control of algal nuisance. Morphological features, reproduction and life cycle patterns of the following: Cyanophyta: Nostoc, Nitrogen fixation, heterocyst, range of thallus Chlorophyta: Range of thallus, *Vaucheria*, and *Chara* Xanthophyta: *Botrydium* Bacillariophyta: Thallus structure, and reproduction Phaeophyta: *Ectocarpus, and Sargassum* Rhodophyta: *Batrachopsermum, Polysiphonia*	
III	General characters of fungi: Thallus organisation, nutrition, different kinds of spores and their dispersal and reproduction. Classification of fungi by Ainsworth (1973), Alexopoulos et. al (1996), Hawksworth et al. (1995). General account and life cycle of the following: Dictyosteliomycota and Myxomycota: *Dictyostelium* and *Physarum* Chytridiomycota and Oomycota: Synchytrium, Phytophthora and downy mildews Zygomycota: Rhizopus Ascomycota: Ascocarp types, Taphrina, Venturia, powdery mildew Basidiomycota: *Agracius, Puccinia, Melamspora, Ustilago, Neovossia* Deuteromycota: Sporulating structures, Fusarium, Curvularia, Alternaria, Helminthospoirum Concept of Homothallism, Heterothallism and parasexual cycle	15
IV	1. Degeneration of sex in fungi, economic importance of fungi in nutrient cycling, decomposition, humus formation, decay and deterioration of wood & timber. 2. Causal organisms, symptoms, and management of: Late and early blight of potato, downy mildew of grapes, powdery mildew of peas, green ear disease of Bajra, apple scab, wilt of pigeon pea, karnal bunt of wheat, loose smut of wheat, black, yellow and brown rust of wheat, tikka disease of groundnut Lichens: structure, classification, reproduction, and economic importance.	15
Suggested Evaluation Methods		
Internal Assessment: ➢**Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15		**End Term Examination** Theory : 70

Part C-Learning Resources
Recommended Books/e-resources/LMS: • Carr, N.G. & Whitton, B.A. (1982): The biology of Cyanobacteria Blackwell Scientific Publ., Oxford, U.K. • Dubey, R.C. (2014): Advanced Biotechnology, S Chand & Company Pvt. Ltd., New Delhi. • Fatma, T. (2005): Cyanobacterial and Algal Metabolism and Environmental Biotechnology, Narosa Publishers. • Fay, P & C van Baalen (1987): The cyanobacteria, Elsevier Science Publishers, B.V. Amsterdam, Netherlands. • Gupta, R.K. & Pandey, V.D. (2007): Advances in Applied Phycology, Daya Publishing House, Daryaganj, New Delhi. • Lee, R.E. (1999): Phycology, 4th edition, Cambridge University Press.

Session: 2025-26			
Part A - Introduction			
Subject	**BOTANY**		
Semester	**7th**		
Name of the Course	**Bryophytes & Pteridophytes**		
Course Code	**B23-BOT-702**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-H2**		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand and describe the characteristic features, classification, and the structure and development of gametophytes and sporophytes of major bryophyte orders. 2. Analyse the origin, evolution, reproduction methods, cytogenetics, and ecological and economic importance of bryophytes. 3. Understand and describe the characteristic features, classification, and the structure and development of gametophytes and sporophytes of major pteridophyte orders. 4. Analyse the structure and development of gametophytes and sporophytes of specific pteridophyte orders, and understand the evolutionary theories and economic and ecological significance of pteridophytes.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4
THEORY			
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**		

Part B- Contents of the Course		
Instructions for Paper- Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.		
Unit	**Topics**	**Contact Hours**
I	1. Characteristic features of bryophytes, classification of bryophytes (Crandall-Stotler, Strotler and Lang 2009; Stotler and Crandall-Stotler 2005; Goffinet, Buck and Shaw 2008), general account of structure and development of gametophyte and sporophyte of Marchantiales (*Riccia* and *Marchantia*), Jungermanniales (*Jungermannia*) and Anthocerotales (*Anthoceros*). 2. General account of structure and development of gametophyte and sporophyte of Sphagnales (*Sphagnum*), Funariales (*Physcomitrium*) and Polytrichales (*Polytrichum*).	15
II	1. Origin of bryophytes (algal and pteridophytic), evolution of bryophytes (progressive, regressive and recent concepts), origin of alternation of generation (homologous and antithetic theory). 2. Apogamy and apospory, vegetative reproduction and cytogenetics of bryophytes, ecological (plant succession and pollution monitoring) and economic importance of bryophytes.	15
III	1. Characteristic features of pteridophytes, classification of pteridophytes (Pteridophyte Phylogeny Group 2016, Reimers 1954 and Sporne 1966). 2. General account of structure and development of gametophyte and sporophyte of Psilophytales (*Psilophyton, Rhynia, Asteroxylon and Zosterophyllum*), Psilotales (*Psilotum*), Lycopodiales (*Lycopodium*), Selaginellales (*Selaginella*), Lepidodendrales (*Lepidodendron*) and Sphenophyllales (*Equisetum*).	15
IV	1. General account of structure and development of gametophyte and sporophyte of Ophioglossales (*Ophioglossum*), Filicales (*Dryoptesis*) and Marsileales (*Marsilea*). 2. Origin and evolution of pteridophytes (algal, bryophytic and recent concepts), stelar system in pteridophytes, telome theory, enation theory, heterospory and seed habit, economic importance of pteridophytes.	15
Suggested Evaluation Methods		
Internal Assessment: ➢**Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15		**End Term Examination** Theory : 70

Part C-Learning Resources
Recommended Books/e-resources/LMS: • Parihar, N.S. 1965. An Introduction to Embryophyta Vol. I. Bryophyta, Central Book Depot, Allahabad, India. • Schofield, W.B. 1985. Introduction to Bryology, Macmillan, New York. • Chopra, R.N. and Kumra, P.K. 1988. Biology of Bryophytes. Wiley Eastern Ltd., New Delhi. • Chopra, R.N. & Bhatla, S.C. 1990. Bryophyte Development: Physiology and Biochemistry.CRC Press, Boca Raton, USA. • Rashid, A. 1998. An Introduction to Bryophyta. Vikas Publishing House Pvt. Ltd. New Delhi. • Watson, E.V. 1967. The Structure and Life of Bryophytes. B.I. Publications, New Delhi.

Session: 2025-26			
Part A - Introduction			
Subject	**BOTANY**		
Semester	**7th**		
Name of the Course	**Cytogenetics and Plant Breeding**		
Course Code	**B23-BOT-703**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-H3**		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. The students get acquainted about the different cytogenetic and molecular techniques used for genome analysis. 2. This course will enable the students to use linkage and recombination frequencies in gene mapping. 3. The students get familiarised about the chromosomal variations and their effects on the biological system as well as the role of chromosomes in sex determination and generation of variations. 4. The students will know about the methods that can be used to create the desired genotype/phenotype through breeding techniques and use of molecular markers in breeding.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4

THEORY	
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	1. Chromatin structure and organisation: Chromosome structure and DNA packaging; euchromatin and heterochromatin. 2. Organisation of plastid and mitochondrial genomes. 3. Special Chromosomes: Structure, occurrence and behaviour of polytene, lampbrush, B and sex chromosomes. 4. Karyotype analysis, FISH, GISH and flow cytometry.	15
II	1. Cell cycle: Cell cycle phases, checkpoints and regulation. 2. Chromosome banding techniques and their applications. 3. Linkage and crossing over: Molecular mechanism of crossing over and role of different enzymes; linkage groups. 4. Chromosome mapping- Two point and three point test crosses.	15
III	1. Sex determination: Chromosomal and gene determining sex in plants, animals, *Drosophila* and humans; Gene dosage compensation. 2. Structural alterations in chromosomes – Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes. 3. Variation in chromosome number: Haploids, aneuploids and euploids- origin, production, effects and uses; polyploidy and crop improvement.	15
IV	1. Introduction to plant breeding methods for self-pollinated, cross-pollinated, and asexually propagated crops, including heterosis and hybrid vigour. 2. Overview of marker-assisted molecular breeding, molecular tagging of genes/traits, and examples of marker-assisted selection for qualitative and quantitative traits. Basics of QTL mapping, genotyping by sequencing, and genome-wide association studies, along with the evolution of markers used in breeding. 3. Concepts of male sterility, including its classification (genetic, cytoplasmic, cytoplasmic-genetic, chemical), genetic control, inheritance patterns, and breeding applications.	15

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Theory : 70

Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. Alberts B, Johnson A, Lewis J. Raff M, Roberts K and Walter P (2008) Molecular Biology of the Cell (5th Ed.). Garland Publishing Inc., New York. 2. Karp G (1999) Cell and Molecular Biology, John Wiley and Sons, USA 3. Krebs JE, Goldstein ES and Kalpatrick ST (2010) Lewin's Essential Genes (2nd Ed.), Jones and Barlett Publishers. 4. Lewin B (2010) Gene X, Jones and Barlett Publishers. 5. Lodish H, Berk A, Kaiser, CA, Krieger M, Scott MP Bretscher A Ploegh H and Matsudaira P (2008) Molecular Cell Biology (6th Ed), W.H. Freeman and Company, New York, USA. 6. Pierce BA (2012) Genetics- A Conceptual Approach (4th Ed.), W.H. Freeman and Company, New York, USA. 7. Snustad P and Simmons MJ (2011) Principles of Genetics. (6th Ed.), John Wiley, New York. 8. Watson, JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene (6th Ed.), CSHLP, New York.

Session: 2025-26			
Part A - Introduction			
Subject	**BOTANY**		
Semester	**7th**		
Name of the Course	**Basics of Genomics and Proteomics**		
Course Code	**B23-BOT-705**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**DSE-H1**		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Students will have a comprehensive understanding of eukaryotic, prokaryotic and organelle genomes. 2. Students will be able to understand molecular basis of protein structure and function. 3. Students will develop comprehensive knowledge about the concept of genomics. 4. Students will develop a comprehensive understanding of the concepts of proteomics.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4
THEORY			
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**		
Part B- Contents of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			

Unit	Topics	Contact Hours
I	Structure and organization of prokaryotic and eukaryotic genomes, nuclear and organelle genome, mitochondrial and chloroplast genomes, microbial genome, gene density, C-value paradox, intron-exon boundary, intergenic DNA, telomere and centromere, micro and mini repeats (satellites); selfish DNA; transposons.	15
II	Genetic markers, genome sequencing, contigs, genome sequencing projects with special reference to *Arabidopsis thaliana* and *Oryza sativa* genome; de novo and re-sequencing. Concepts and application of functional genomics, basics of gene annotation, gene function prediction, methods for studying gene expression (Northern blot, qRT-PCR, RNA-seq, microarray, scRNA-seq).	15
III	Basics of proteomics: amino acids structure and general properties, types of structures of proteins, protein classification, alpha-helix, beta-strands, loops and coils, evolution of protein structures, protein stability and folding, Ramachandran plot, hydrophobicity and its applications.	15
IV	Protein sequence and structure determination: mass spectrometry, protein digestion, peptide fragmentation, protein sequencing methods. Methods to study protein-protein interactions (Y2H, BiFC and CoIP) and protein-DNA interactions (Y1H, EMSA and ChIP). Post-translational modifications (Ubiquitination, phosphorylation, acetylation, etc.).	15

Suggested Evaluation Methods

Internal Assessment: ➢**Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Theory : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Hartwell, L., Goldberg, M.L., Fischer, J., Hood, D., & Aquadro, C. (2015).*Genetics: From Genes to Genomes* (5th ed.). McGraw Hill publishers.
- Primrose, S.B., & Twyman, R. (2013). *Principle of Gene Manipulation and Genomics* (7th ed.). Wiley-Blackwell.
- Hartl, D. L. (2014). *Essential Genetics: a Genomics perspective* (6th ed.). Jones and Barlett Educational Publishers.
- Thiellemen, H., Zivy, M., Damerval, C., & Mechin, V. (2011), *Plant proteomics: Methods and Protocols* (1st ed.). Springer Publishers.
- Twyman, R.M. (2004). *Principles of Proteomics*. BIOS Scientific Publishers.
- Nelson, D. L., & Cox, M. M. (2021). *Lehninger Principles of Biochemistry* (8th ed.). W.H. Freeman.
- Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of Biochemistry* (5th ed.). John Wiley & Sons.
- Berg, J.M., Stryer, L., Tymoczko, J.L. and Gatto, G.J. (2023) *Biochemistry* (10th ed.). WH Freeman.

Session: 2025-26			
Part A - Introduction			
Subject	**BOTANY**		
Semester	**7th**		
Name of the Course	**Computational Botany**		
Course Code	**B23-BOT-706**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**DSE-H1**		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Students will have a comprehensive understanding of molecular basis of protein structure and function. 2. Students will be able to understand bonded interactions 3. Students will develop comprehensive knowledge about the concept and application of molecular dynamics simulations techniques. 4. Students will develop a comprehensive understanding of drug designing methods.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4
THEORY			
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**		

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	Analysis of protein content and organization; Analysis of protein structures, comparative modeling, structure prediction algorithms and tools, threading empirical force field models; Bond stretching, angle bending and torsional terms, the harmonic oscillator model for molecules.	15
II	Non-bonded interactions; Van der Waals, electrostatic and hydrogen bonding, united atom force fields and reduced representations, Force field parameterization; Potential energy surface; Convergence criteria, Optimization; multivariable optimization algorithms, minimization methods, steepest descent and conjugate gradient methods	15
III	Molecular dynamics Simulations; Newtonian dynamics; Integrators - Leapfrog and Verlet algorithms, truncated and shifted-force potentials. Implicit and explicit solvation models, periodic boundary conditions; Temperature and pressure control in	15

	molecular dynamics simulations. Conformational analysis; Evolutionary algorithms and simulated annealing, clustering and pattern recognition techniques.	
IV	Methods in Drug design; Chemical databases, 2D and 3D database search, Similarity Search, Scaffold hoping, Lead identification, optimization and validation, Docking, De Novo Drug Design, Virtual screening. Quantitative structure activity relationship; Introduction to QSAR, descriptors QSARs, regression analysis and partial least squares analysis, combinatorial libraries.	15

Suggested Evaluation Methods

Internal Assessment: ➢**Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Theory : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- R. Leach. 2001. *Molecular Modeling Principles and Applications*, 2nd Edition, Prentice Hall USA.
- T. Schlick. , 2000. *Molecular Modeling and Simulation* - An Interdisciplinary Guide, Springer verlag
- R. Donald. 2011. *Algorithms in Structural Molecular Biology*, Massachusetts Institute of Technology Press.
- Hinchliffe. 2008. *Molecular* Modeling for Beginners, 2nd Edition, John Wiley & Sons Ltd.
- P. E. Bourne. 2009.*Structural Bioinformtics*, 2nd Edition, Wiley
- W. Mount. 2005. *Bioinformatics*: Sequence and Genome Analysis, 2nd Edition, CSH Press.
- S. G. Kochan and P. Wood. 2003. *UNIX Shell Programming*, 3rd Edition, SAMS.
- P. Bultinck. 2004. *Computational Medicina Chemistry for Drug Discovery*, Marcel Dekker Inc.

Session: 2025-26	
Part A - Introduction	
Subject	**BOTANY**
Semester	**7th**
Name of the Course	**Practical based on B23-BOT 701, 702, 703 and 704/705/706**
Course Code	**B23-BOT-707**
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**PC-H1**
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: Get acquainted with the practical aspects of algae, fungi, bryophytes and pteridophytes.cytogenetics, plant breeding, genomics, proteomics and computational Botany.

	Theory	Practical	Total
Credits	0	4	4
Contact Hours	0	8	8

Practical

Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 6 Hours**

Part B- Contents of the Course

Unit	Topics	Contact Hours
I	**B23-BOT 701 (Algae and Fungi)** 1. To prepare temporary slide of given algal sample. 2. To prepare temporary slide of given fungal sample. 3. To study plant disease by studying fresh disease sample (seasonal) or herbarium sheets. 4. To study cell size using camera lucida and micrometry. **B23-BOT 702 (Bryophytes and pteridophytes)** 1. To study morphology and reproductive structures of given bryophyte. 2. To study morphology and anatomy of given pteridophyte. **B23-BOT 703 (Cytogenetics and Plant Breeding)** 1. To study about different tools used in plant breeding. 2. To study the karyotype using given metaphase chromosomal picture (A*llium cepa*). 3. To work out the genetics of a cross from the given F_2 harvest. 4. To study different meiotic stages in root tips of *Allium cepa*. **B23-BOT705 (Basics of genomics and Proteomics)** 1. Comparison of gene, protein sequences using BLAST search. 2. To study different databases used for genomics study (Phytozome, NCBI, TAIR). 3. To study different databases used for proteomics study (SWISS-PROT, ExPasy, PDB). 4. Construction of phylogenetic trees using Clustal W. 5. To design primers for PCR. **B23-BOT 706 (Computational Botany)** 1. Study of uses of scalar and array variables to manipulate DNA sequence data 2. Study of uses of scalar and array variables to manipulate RNA sequence data 3. Study of uses of scalar and array variables to manipulate Protein sequence data 4. Concatenation DNA fragments, Transcribing DNA into RNA 5. Calculating the Reverse complement of a DNA strand 6. Translate a DNA sequence in all six reading frame 7. Study of Drug designing methods.	120

Suggested Evaluation Methods	
Internal Assessment: ➢ **Practical** • Class Participation : 05 • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Practical : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- R. Leach. 2001. *Molecular Modeling Principles and Applications*, 2nd Edition, Prentice Hall USA.
- T. Schlick. , 2000. *Molecular Modeling and Simulation* - An Interdisciplinary Guide, Springer verlag
- R. Donald. 2011. *Algorithms in Structural Molecular Biology*, Massachusetts Institute of Technology Press.
- Hinchliffe. 2008. *Molecular* Modeling for Beginners, 2nd Edition, John Wiley & Sons Ltd.
- P. E. Bourne. 2009.*Structural Bioinformtics*, 2nd Edition, Wiley
- W. Mount. 2005. *Bioinformatics*: Sequence and Genome Analysis, 2nd Edition, CSH Press.
- S. G. Kochan and P. Wood. 2003. *UNIX Shell Programming*, 3rd Edition, SAMS.
- P. Bultinck. 2004. *Computational Medicinal Chemistry for Drug Discovery*, Marcel Dekker Inc.

Session: 2025-26	
Part A - Introduction	
Subject	**BOTANY**
Semester	**8th**
Name of the Course	**Microbiology and Biostatistics**
Course Code	**B23-BOT-801**
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-H4**
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Students will understand the fundamental characteristics, structural components, and reproductive mechanisms of prokaryotes, including differences between gram-positive and gram-negative bacteria. 2. Students will explore the mechanisms of horizontal gene transfer in bacteria, the diversity among microbial groups like actinomycetes and archaebacteria, and the life cycles of viruses and bacteriophages. 3. Students will gain proficiency in sampling techniques, data representation, and statistical measures such as central tendency, dispersion, and distribution shape in biological research.

	4. Students will apply probability theorems, understand probability distributions, and perform statistical analyses including correlation, regression, and hypothesis testing in biological studies.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4

THEORY

Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	1. General features and classification of prokaryotes, size and shape, staining, cell wall and membrane system in gram positive and negative bacteria, structure of surface appendages (flagella, pili and fimbriae). 2. Endospore formation, bacterial genome, plasmids, culture media, growth curve and reproduction, sterilization techniques.	15
II	1. Horizontal gene transfer (transformation, transduction and conjugation), interrupted mating, general features of actinomycetes, mycoplasmas and cyanobacteria, archaebacteria (characteristics, important members, importance and differences from bacteria). 2. General features and classification of viruses, bacteriophage life-cycle (lytic and lysogenic), plaque assay, important plant viruses (TMV, ToLCV and CaMV), prions, viroid and virusoid.	15
III	1. Introduction, sampling techniques (random and non-random), sampling errors, graphical representation of data, measures of central tendency (mean, median and mode). 2. Measures of dispersion (range, mean deviation, variance and standard deviation), skewness and kurtosis.	15
IV	1. Theorems of probability (addition and multiplication rule), probability distributions (binomial, Poisson and normal), correlation and regression analysis. 2. Tests of significance (comparison of means of two samples and three or more samples) parametric and non-parametric test.	15

Suggested Evaluation Methods	
Internal Assessment: ➢**Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Theory : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Pelezar, MJ, Chaing, ECS & Krieg, NR (1993). Microbiology, Tata McGrawHill Publ. New Delhi.
2. Prescott, LM, Harley, JP & Klein, DA (1996). Microbiology Wm. C. Brown Publ. USA.
3. Singh R.P. (1990): Introductory Biotechnology, Central Book Depot, Allahabad, India.
4. Sumbali, G. 2005: The Fungi, Narosa Publ. House, New Delhi.
5. Statistics for Biologists (1974) Campbell R.C. Cambridge University Press, Cambridge.
6. Statistics in Biology, Vol. 1 (1967) Bliss, C.I.K, McGraw Hill, New York

Session: 2025-26			
Part A - Introduction			
Subject	**BOTANY**		
Semester	**8th**		
Name of the Course	**Natural Resources & Biodiversity**		
Course Code	**B23-BOT-802**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-H5**		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand resource types, degradation, and conservation methods, including land and water management and environmental pollution. 2. Learn about forest resources, energy types, and ecosystem restoration briefly. 3. Explore biodiversity importance, threats, distribution patterns, and hotspots globally and in India. 4. Gain knowledge on biodiversity conservation strategies, protected areas, and sustainable development principles and indicators.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4
THEORY			
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**		

Part B- Contents of the Course		
Instructions for Paper- Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.		
Unit	**Topics**	**Contact Hours**
I	1. Resources: Types, Renewable and non-renewable resources; resources degradation and conservation. 2. Land resources: Land degradation and desertification; management of waste lands in India. 3. Water resources: Pools of water and Hydrological cycles, surface water and groundwater; water-use and management. 4. Environmental pollution of air, water and soil-types, sources and effects.	15
II	1. Forest resources: Forests and their importance, Non timber forest produce, forest resources of India and forest management. 2. Types of energy resources, renewable sources of energy- wind energy, wave energy, Energy from biomass, bioconversion technologies, energy plantation and petro crops. 3. Ecosystem restoration and Environment impact assessment- Brief account.	15
III	1. Principles of resources conservation and conservation strategies. 2. Biological diversity: importance, concept and levels of biodiversity, threats to biodiversity- habitat loss and fragmentation, exotic species, pollution, species extinctions; IUCN categories of threat. 3. Distribution and global patterns of biodiversity, centres of plant diversity and endemism, mega biodiverse countries Terrestrial and marine hotspots of biodiversity, Hottest hotspots, Hotspots of biodiversity in India.	15
IV	1. *In situ* conservation of biodiversity: Protected area in India wildlife sanctuaries, national parks, biosphere reserves. 2. Conservation of biodiversity of wetlands, mangroves and coral reefs. 3. *Ex situ* biodiversity conservation: principles and practices, field gene banks, seed banks and cryopreservation. Sustainable development: concept, principles and strategies; sustainability indicators.	15

Suggested Evaluation Methods	
Internal Assessment: ➢**Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Theory : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Ball, J.B. 2001. Global forest resources: history and dynamics. In: *Forest Handbook Volume*
2. Chape, S., Fish, L. Fox, P. and Spalding, M. 2003. United Nations list of protected areas. UCN/UNEP/World Conservation Monitoring Centre, Gland, Switzerland/Cambridge.
3. Huston, M.A. 1994. *Biological Diversity*: The Coexistence of Species on Changing Landscapes. Cambridge University Press, Cambridge.
4. Raven, P.H. and Berg, L.R. 2005. Environment, 5th Edition, John Wiley & Sons Inc., New York.
5. Singh, J.S., Singh, S.P. and Gupta, S.R. 2006. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
6. Jakhar, S. (2024). Fundamentals of Ecology. TechSar Pvt. Ltd, New Delhi.

Session: 2025-26	
Part A - Introduction	
Subject	**BOTANY**
Semester	**8th**
Name of the Course	**Gymnosperm & Ethnobotany**
Course Code	**B23-BOT-803**
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-H6**
Level of the course (As per Annexure-I)	400-499
Pre-requisite for the course (if any)	
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand characteristics, classification, distribution, and economic importance of gymnosperms, and an overview of Progymnospermophyta and Pteridospermophyta. 2. Learn morphological, anatomical, and reproductive features of Cycadales, Cycadeoidales, Ginkgoales, Cordaitales, Voltziales, Coniferales, Ephedrales, Gnetales, and Welwitschiales. 3. Understand fossilization, types of fossils, paleopalynology, dating techniques, molecular tools, geological time scale, and evolutionary significance of fossil gymnosperms. 4. Explore ethnobotany, research methods, indigenous medicine systems, major Ayurveda disciplines, and herbal medicine use by tribal communities.

	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4

THEORY

Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	Characteristic features of gymnosperms, classification of gymnosperms (Gifford and Foster, 1989; Bhatnagar and Moitra, 1996), their distribution in India and economic importance. General account of Progymnospermophyta and Pteridospermophyta: Aneurophytales (*Aneurophyton*), Archaeopteridales (*Archaeopteris*), Glossopteridales (*Glossopteris*), Caytoniales (*Caytonia*).	15
II	Morpho-anatomical features and reproduction in the following: Cycadales (*Cycas*), Cycadeoidales (*Cycadeoidea*), Ginkgoales (*Ginkgo*), Cordaitales (*Cordaites*). 2. Morpho-anatomical features and reproduction in the following: Voltziales (*Voltzia*), Coniferales (*Pinus*), Ephedrales (*Ephedra*), Gnetales (*Gnetum*) and Welwitschiales (*Welwitschia*).	15
III	Fossilisation process and types of fossils, paleopalynology, dating techniques of fossils, molecular tools used in palaeobotanical studies. Geological time scale with reference to the evolution of plants, the Indian Gondwana flora with reference to the geological time scale, evolutionary significance of fossil gymnosperms.	15
IV	History, concept, scope and importance of ethnobotany, subdisciplines of ethnobotany, methods of research in ethnobotany. Systems of indigenous medicine (Ayurveda, Siddha, Unani, Homeopathy, Yoga and Naturopathy), major disciplines of ayurveda, use of herbal medicines by tribals.	15

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination**
➢**Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15	Theory : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms, New Age International Pvt. Ltd., New Delhi.
2. Dahlgren. R.H., Clifford, T and P.F Yeo 1985.The families of the monocotyledons;

structure, Evolution and Taxonomy. SpingeVerag, NY.
3. Gary J, Martin, 2004. Ethnobotany- A Methods Manual, Chapman and Hall. U.K.
4. Jain S.K. and Mundgal, 1999. Handbook of ethnobotany, London.
5. Pursrglove, J.W. 1972. Tropical Crops-Monocotyledons and Dicotyledons of ethnobotany, ethnomedicine, ethnoecology, ethnic communities.
6. Rao, P.C. 2006. Medicinal plants: Ethanobotanical Approach, Agribios, India.
7. Trivedi, P.C. 2006. Medicinal plants: Ethnobotanical Approach, Agribios, India.

Session: 2025-26			
Part A - Introduction			
Subject	**BOTANY**		
Semester	**8th**		
Name of the Course	**Molecular Genetics**		
Course Code	**B23-BOT-804**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**DSE-H2**		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. The students will have enhanced understanding of genome structure, evolution and its replication. 2. This course will impart the knowledge of basics of mutations and their importance; DNA repair mechanisms. 3. The students will learn about the methods of genetic recombination in bacteria. 4. The students will gain insight into the principle mechanisms of genome expression and its regulation.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4
THEORY			
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 3 Hours**		
Part B- Contents of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			
Unit	**Topics**		**Contact Hours**
I	1. Eukaryotic genome: Different forms of DNA, C- value paradox, unique and repetitive DNA, gene families, hybridization kinetics and split genes. 2. Transposable elements: Mechanisms of transposition;		15

	transposons in bacteria, maize, *Drosophila* and yeast. DNA Replication: Semi-conservative, bidirectional, replication origins, replication machinery.	
II	1. Mutations: types, isolation of mutants, molecular basis of mutations. 2. DNA damage and repair: Causes of DNA damage; Photoreactivation, excision, mismatch, post replication and error prone repair systems. 3. Fine structure of gene: *cis-trans* test, rII locus, fine structure analysis of eukaryotes. Bacterial genetics: conjugation, transduction and transformation.	15
III	1. Transcription: Initiation, elongation and termination in prokaryotes and eukaryotes, RNA polymerases. 2. RNA Processing: Processing of mRNA, rRNA and tRNA. 3. Genetic code: Deciphering the genetic code, characteristics. Translation: Initiation, elongation and termination in prokaryotes and eukaryotes.	15
IV	1. Regulation of gene expression in prokaryotes: Operon concept, lac operon regulation by positive and negative mechanism, trp operon, regulation by negative and attenuation. 2. Regulation of gene expression in eukaryotes: a) Transcriptional level – Regulatory sequences, nucleosome positioning, chromatin remodeling, histone modifications. b) Post-transcriptional level – RNA splicing, RNA stability. 3. Translational level and post-translational level.	15

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Theory : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Alberts B, Johnson A, Lewis J. Raff M, Roberts K and Walter P (2008) Molecular Biology of the Cell (5th Ed.). Garland Publishing Inc., New York.
2. Brown TA (1999) Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
3. Hartl DL (1999) Genetics Principles and analysis. (4th Ed.) Jones and Bartle, Boston.
4. Lewin B (2005) Genes VIII. Oxford University Press, New York.
5. Lodish H, Berk A, Kaiser, CA, Krieger M, Scott MP Bretscher A Ploegh H and Matsudaira P (2008).
6. Pierce BA (2012) Genetics- A Conceptual Approach (4th Ed.), W.H. Freeman and Company, New York, USA.
7. Russell PJ (2006) Genetics (6th Ed.), Addison Wesley Longman, California, USA.
8. Snustad P and Simmons MJ (2011), Principles of Genetics. (6th Ed.), John Wiley, New York.
9. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene (6th Ed.), CSHLP, New York.

Session: 2025-26			
Part A - Introduction			
Subject	**BOTANY**		
Semester	**8th**		
Name of the Course	**Plant Morphogenesis**		
Course Code	**B23-BOT-805**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**DSE-H2**		
Level of the course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: • Acquiring knowledge and understanding of the basic processes underlying morphogenesis and development in plants. • Exposure to the approaches and tools in developmental biology research, discussing different theories of plant morphogenesis. • Students will understand basic principles in plant development. • They learn plant developmental biology literature. • Plan experiments in plant developmental biology.		
	Theory	Practical	Total
Credits	4	0	4
Contact Hours	4	0	4
THEORY			
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**	**Time: 4 Hours**		
Part B- Contents of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			
Unit	**Topics**		**Contact Hours**
I	Introduction to morphogenesis, differentiation, polarity, totipotency, and their importance Growth- growth concept, growth curves, growth analysis. Phases of growth and development. Morphogenetic factors- light, water, temperature, mechanical factors, chemical factors and genetic factors.		15
II	Plant growth regulators- introduction, auxin, gibberellins, cytokinins, abscisic acid, ethylene- history of discovery, influence on plant growth, mechanism of action. Tropism: phototropism, role of hormones. Geotropism and nastism.		15

III	Photomorphogenesis. Phytochrome and their discovery, physiological and biochemical changes associated with senescence and abscission. Fruit ripening.	15
IV	The flowering process, photoperiodism- its significance, importance of dark periods, role of vernalisation. Nature and events during flowering. Florigen concept. Chemical control of flowering.	15

Suggested Evaluation Methods	
Internal Assessment: ➢**Theory** • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Theory : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- *Plant physiology* by Lincoln Taiz and Ederordo Zeiger Sinauev Associates, Inc. publishers.
- Pandey, S.N. and Sinha, B.K. *Plant Physiology.* Vikas publishing House Pvt Ltd, New Delhi.
- Malik, C.P. and Srivastava, S.K. *Textbook of Plant Physiology*. Kalyani publications, New Delhi.
- *Plant Physiology* by V. Verma, Ane Books India.
- Srivastava, H.S. Plant Physiology. Rastogi Publications, Meerut.
- *Plant Physiology* by Frank B Salisbury and Deonw Ross Wadsworth Biology Series.

Session: 2025-26		
Part A - Introduction		
Subject	**BOTANY**	
Semester	**8th**	
Name of the Course	**Practical Based on B23-BOT-801 TO 804/805**	
Course Code	**B23-BOT-806**	
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**PC-H2**	
Level of the course (As per Annexure-I)	400-499	
Pre-requisite for the course (if any)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: Get acquainted with the practical aspects of microbiology, biostatistics, gymnosperms and ethnobotany, natural resources, biodiversity, molecular genetics and Plant morphogenesis.	
	Practical	Total
Credits	4	4
Contact Hours	8	8

PRACTICAL		
Max. Marks: 100 **Internal Assessment Marks: 30** **End Term Exam Marks: 70**		**Time: 6 Hours**
Part B- Contents of the Course		
Unit	**Topics**	**Contact Hours**
	List of Practicals: **B23-BOT-801 (Microbiology & Biostatistics)** 1. To study about safety guidelines, Good microbiological laboratory practice (GMLP) and spillage management. 2. To study about general equipment, apparatus and materials used in microbiology lab. 3. To study about different media for culturing/sub-culturing of microbes, sterilization and disinfection methods. 4. To study numerical problems related to probability. 5. To study numerical problems related to correlation and regression analysis. 6. To study numerical problems related to tests of significance (Non-parametric test). 7. To study numerical problems related to tests of significance (Parametric test). **B23-BOT-802 (Natural Resources & Biodiversity Management)** 1. To determine the water holding capacity of agiven soil sample by using the percolationmethod. 2. To measure pH, EC, and TDS of different soilsamples. 3. To compare pH, EC, TDS, and salinity ofdifferent water samples. 4. To estimate the bulk density and moisturecontent of soil in the given area. 5. To study non-timber forest products in theUniversity Campus, KUK. 6. To find out the specific gravity of the givensoil sample. 7. To measure the height of the plant using ahypsometer. **B23-BOT-803 (Gymnosperms & Ethnobotany)** 1. Morpho-anatomical study of genus *Pinus.* 2. Morpho-anatomical study ofgenus *Cycas.* 3. Morpho-anatomical study ofgenus *Ephedra.* 4. Morpho-anatomical study ofgenus *Juniperus.* 5. Morpho-anatomical study ofgenus *Thuja* 6. Morpho-anatomical study ofgenus *Agathis.* 7. Morpho-anatomical study ofgenus *Gingko.* 8. Morpho-anatomical study ofgenus *Cedrus.* 9. Morpho-anatomical study ofgenus *Araucaria.* 10. To study common plants used in Indian traditional medicine.	120

	B23-BOT-804 (Molecular Genetics) 1. To study the different types of chemicals, their grades, handling, storage and major manufacturers. 2. To study different meiotic stages in the flower buds of *Allium cepa*. 3. To study the structure and functioning of a spectrophotometer. 4. To prepare standard curve for the estimation of proteins using Lowry's method. 5. To prepare standard curve for the estimation of RNA using orcinol reaction. 6. To study Hardy-Weinberg's law of equilibrium using given chickpeas seed mixture. 7. To calculate correlation and regression coefficient for plant height and tiller number in a wheat variety. **B23-BOT-805 (Plant morphogenesis)** 1. Demonstration of phototropism, geotropism and hydrotropism. 2. To study effect of ethylene on fruit ripening. 3. To study morphogenetic effect of light on given plant.	

Suggested Evaluation Methods	
Internal Assessment: ➢**Practical** • Class Participation : 05 • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : 15	**End Term Examination** Practical : 70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Huston, M.A. 1994. *Biological Diversity*: The Coexistence of Species on Changing Landscapes. Cambridge University Press, Cambridge.
2. Raven, P.H. and Berg, L.R. 2005. Environment, 5th Edition, John Wiley & Sons Inc., New York.
3. Singh, J.S., Singh, S.P. and Gupta, S.R. 2006. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
4. Hartl DL (1999) Genetics Principles and analysis. (4th Ed.) Jones and Bartle, Boston.
5. Lewin B (2005) Genes VIII. Oxford University Press, New York.
6. Singh R.P. (1990): Introductory Biotechnology, Central Book Depot, Allahabad, India.
7. Sumbali, G. 2005: The Fungi, Narosa Publ. House, New Delhi.
8. Statistics for Biologists (1974) Campbell R.C. Cambridge University Press, Cambridge.
9. Statistics in Biology, Vol. 1 (1967) Bliss, C.I.K, McGraw Hill, New York
10. Schultes, R. E., von Reis, S., & Raffauf, R. F. (1998). Ethnobotany: Evolution of a Discipline. Timber Press.
11. Ganguly, S., & Kar, A. K. (2011). *College Botany: Volume II*. New Central Book Agency.

Session: 2024-25			
Part A-Introduction			
Subject	**BOTANY**		
Semester	**3rd & 5th Semesters**		
Name of the Course	**Organic Farming**		
Course Code	**B23-VOC-109**		
CourseType:(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**VOC-1**		
Level ofthecourse(As perAnnexure-I	100-199		
Pre-requisite for the course(ifany)			
Course Learning Outcomes (CLO):	Aftercompletingthiscourse, thelearnerwillbeableto: 1: Students will be able to understand the need and concept to forganic and integrated farming system. 2: Students will develop a conceptual understanding of plant nutrients, utilization of biofertilizers. 3: Students will gain knowledge about the disease and pest management 4: Students will learn about the use of plant products in organic farming, quality control and certification procedures of organic products. 5*. Students will gain the knowledge of practical aspects of organic andintegrated farming system, role ofnutrient in plant growth, utilization of plant and animal waste in organic farming, and also learn about the standardization procedures.		
Credits	Theory	Practical	Total
	2	2	4
Contact Hours	2	4	6
THEORY			
Max. Marks: 50 **Internal Assessment Marks: 15** **End TermExamMarks: 35**	**Time: 3 Hours**		
PRACTICAL			
Max.Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**	**Time: 4 Hours**		

Part B-Contents of the Course		
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eightquestions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt questionNo.1 andfourmore questions selectingone questionfromeach unit.		
Unit	**Topics**	**Contact Hours**
I	Basics of organic farming – Concept and components of organic farming, aims and objectives; Need of organic farming; Historical development to organic farming in India; Status of organic farming in India; Advantages and disadvantages of organic farming. Organic farming process-Concep to farming system, Developing organic farms, Important steps & methods; Pure organic farming and integrated farming system (combination of organic and inorganic).	07
II	Plantnutrients: Essential plantnutrients, their role in plant growth and development, Nutrient uptake and utilization by plant. Nutrient management inorganic farming: Balanced nutrients supply for organic farming system using nutrients from organic sources. Preparation, nutrient content andmethods of use of following- FYM/Rural compost, mulching, city compost, oil cakes, animal wastes, vermicomposts, vermiwash, jeevamrit, beejamrit, green manures, biofertilizers.	07
III	Biofertilizers and their method of use–Nitrogenous, Phosphatic, Potassic, availability of nutrients from above sources. Recycling of organic matter in organic agriculture-Transformation of organic substances in soil. Disease and pest management in organic farming-Integrated pest & disease managements; Organic pesticides, bio-pesticides; Inorganic pesticides, disadvantages of their use; Seed, seedling and soil treatment measures; Feasibility of complete dependence onorganic sources. Weed management in organic farming	08
IV	Use of Neem and other plant products in organic farming; Organic agri-horticulture in urban &semi urban areas. Certification, Standardization, Marketing-Quality control and certification procedures of organic products. Organic standards In India. Govt. schemes related to organic farming in India. Potential demand and Marketing of organic products.Organicfarmingand food securityinIndia.	08
V*	• Preparation of compost by open air composting. • Preparation of vermicompost. • Comparative analysis of plants grown in compost prepared in 1and 2. • Determining the effectiveness of neem extract in pest control. • Comparative analysis of plants grown in the presence of organic and inorganic fertilizers. • Comparative analysis of nitrogen content inorganic and inorganic fertilizers. • Comparative analysis of phosphorous content inorganic and inorganic fertilizers.	60

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 ➢ **Practical** • Class Participation : 05 • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA	**End Term Examination** Theory : 35 Practical : 35
• Mid-Term Exam:	

Part C-Learning Resources
Recommended Books/e-resources/LMS: • Chandran, S., Unni M.R., Thomas, S.Meena, D.K. 2023. Organic Farming: Global Perspectives and Methods. Elsevier. • Somasundaram, E. Udhaya Nandhini, D., Meyyappan, M. 2021. Principles of Organic Farming. CRC Press. • Chandran, S., Thomas, S., Unni M.R. 2019. Organic Farming: New Advances Towards Sustainable Agricultural Systems. Springer. • Girib, Prasad, R. Qiang-Sheng, W. & Varma A. 2019. Biofertilizers for sustainable agriculture and environment (Soil Biology Book 55). Springer. • Chandran, S., Unni M.R., Thomas, S. 2018. Organic Farming: Global Perspectives and Methods. Elsevier. • Subbarao, N.S. 2017. Bio-fertilizers in Agriculture and Forestry. MedTech Publishers. 4th edition. • Hermary, H. 2007. Working with nature. Gaia College Inc.

Session: 2024-25	
Part A–Introduction	
Subject	**BOTANY**
Semester	**4th**
Name of the Course	**Floriculture**
Course Code	**B23-VOC-209**
CourseType:(CC/MCC /MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**VOC-2**
Level ofthecourse(As perAnnexure-I	100-199
Pre-requisiteforthecourse(ifany)	

CourseLearningOutcomes (CLO):	Aftercompletingthiscourse, thelearnerwillbeableto: 1. Students will be able to understand the importance and scope of floriculture, management of nursery and gardens, methods of plant propagation. 2. Students will develop a conceptual understanding of different types of ornamental plants. 3. Students will gain knowledge about the various types of garden sand importance of landscaping. 4. Students will learn about commercial floriculture and cultivation of important cutflowers. 5*. Students will gain the knowledge of practical aspects of floriculture, management of nursery, maintenance of gardens, vaselife of cutflowers, various methods used for the propagation of ornamental plants, hydroponics, and disease management.		
Credits	Theory	Practical	Total
	2	2	4
ContactHours	2	4	6
THEORY			
Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**	**Time: 3 Hours**		
PRACTICAL			
Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**	**Time: 4 Hours**		
Part B-Contents of the Course			

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No.1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	Introduction: History, importance andscope of floriculture and landscape gardening. Nursery management and routine garden operations: Sexual and vegetative methods of propagation; Soilsterilization; Seedsowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators	07

II	Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shadeand ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents;Palms and Cycads;Ferns and Selaginellas; Cultivation of plants in pots;Indoorgardening;Bonsai.	07
III	Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (garden wall, fencing, steps, hedge, edging, lawn, flower beds, shrubbery, borders, water garden. Some famous gardens of India. Landscaping of places of public importance: Landscaping highways and educational institutions.	08
IV	Commercial floriculture: Factors affecting flower production; Production and packaging of cutflowers; Flower arrangements; Methods to prolong vaselife. Cultivation of Important cut flowers-Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Lilium). Diseases and Pests of Ornamental Plants.	08
V*	• Plant propagation by cutting. • Plant propagation by grafting. • Plant propagation by air-layering. • Investigating the effect of different flower preservatives on the vase life of common ornamental flowers. • Setting up a laboratory scale hydroponics set up. • Preparation of different types of floral arrangements. • Morpho-anatomical study of different types of flowers. • Study of different diseases in ornamental plants.	60

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 ➢ **Practical** • Class Participation : 05 • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA	**End Term Examination** Theory : 35 Practical : 35

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Singh, A.K. & Kumar A. 2023. Plant Propagation and Nursery management. S.K. Kataria and sons.
- Arora, J.S. 2016. Introductory Ornamental Horticulture. Kalyani Publishers. 8th edition.
- Jain, S.M. & Ochatt, S.J. 2009. Protocols for invitro propagation of ornamental plants: 598 (Methods in Molecular Biology). Humana Press.
- Prasad S & Kumar U. 2003. Commercial Floriculture. Agrobios
- Lauria A &Victor HR. 2001. Floriculture–Fundamentals and Practices Agrobios.

Session: 2025-26			
Part A-Introduction			
Subject	**BOTANY**		
Semester	**4th**		
Name of the Course	**Nursery and Gardening**		
Course Code	**B23-VOC-217**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**VOC-2**		
Level of the course(As per Annexure-I	100-199		
Pre-requisite for the course(if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be ableto: 1. Students will be able to understand the infrastructure of nursery, seed production technology 2. Students will develop a conceptual understanding the gardening procedure and, management of pest and diseases. 3. Students will gain knowledge about the vegetative propagation methods. 4. Students will learn about cultivation of different vegetables and flowers. 5*. Students will gain the knowledge of practical aspects of management of nursery, gardens, vegetative propagation methods, and cultivation of different vegetables and flowers.		
Credits	Theory	Practical	Total
	2	2	4
Contact Hours	2	4	6
THEORY			
Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**		**Time: 3 Hours**	
PRACTICAL			
Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**		**Time: 4 Hours**	

Part B-Contents of the Course		
Instructions for Paper-Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. Theremaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No.1 and four more questions selecting one question from each unit.		
Unit	**Topics**	**Contact Hours**
I	Nursery: Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities–planting, direct seeding and transplants. Seed: Structure and types -Seed dormancy; causes and methods ofbreakingdormancy Seed storage: Seed banks, factors affecting seed viability, genetic erosion. Seed production technology: Seed testing and certification.	07
II	Gardening: definition, objectives and scope- different types of gardening-landscape and home gardening-parks and its components-plant materials and design. Gardening operations: Soil laying, manuring, watering, management of pests and diseases and harvesting, sowing/raising of seeds and seedlings, transplanting of seedlings. Computer applications in landscaping.	07
III	Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings. Hardening of plants - greenhouse - mist chamber, shed root, shade house and glass house.	08
IV	Cultivation of different vegetables: Cabbage, Brinjal, Lady's finger, Onion, Tomatoes and carrots Cultivation of different flowers: Marigold, Lilium, Rose, Gerbera, Gladiolus, Chrysanthemum and Carnation. Storage and marketing procedures.	08
V*	• Study of seed dormancy breakage by scarification and stratification. • Investigating the effect of different environmental conditions on seed germination.	60

	• Study of different tools used in gardening. • Bed preparation for growth of seedlings. • Raising of seedlings and transplantation. • Comparing the effects of different pruning methods, such a stopping, thinning, orpinching, onplantgrowth, branching patterns, and flower production. • Study of different methods of vegetative propagation.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 ➢ **Practical** • Class Participation : 05 • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA	**End Term Examination** Theory : 35 Practical : 35

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Singh, A.K. & KumarA. 2023. Plant Propagation and Nursery management. S.K. Kataria and sons.
- Ray, P.K. 2021. Essentials of Plant nursery management. Scientific publishers, India. 2nd edition.
- Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. 2015. Plant Physiology and Development. Sinauer AssociatesInc. USA. 6th edition.
- Ray, P.K. 2012. Plant nursery management: how to start and operate a plant nursery. Scientific publishers, India.
- Sinha, N.K., Hui, Y.H. 2011. Handbook of vegetables & vegetable processing. Wiley-Blac, A John Wiley & Sons, Ltd.
- Jain, S.M. & Ochatt, S.J. 2009. Protocols for invitro propagation of ornamental plants: 598 (Methods in Molecular Biology). Humana Press.
- Hopkins, W.G. and Huner, A. 2008. Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
- Mason, J. 2004. Nursery management. Landlinks Press.

Session: 2024-25			
Part A-Introduction			
Subject	**BOTANY**		
Semester	**6th**		
Name of the Course	**Mushroom Cultivation**		
Course Code	**B23-VOC-309**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**VOC-4**		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Students will be able to understand the nutritional and medicinal value of edible mushrooms. 2: Students will develop a conceptual understanding of various procedure and techniques used for mushroom cultivation. 3: Students will gain knowledge about the storage procedure of different types of fedible mushrooms. 4: Students will earn about different types of food prepared from mushrooms and their medicinal value. 5*. Students will gain the knowledge of practical aspects ofmushroomcultivation		
Credits	Theory	Practical	Total
	2	2	4
Contact Hours	2	4	6
THEORY			
Max.Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**		**Time: 3 Hours**	
PRACTICAL			
Max.Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**		**Time: 4 Hours**	

Part B-Contents of the Course		
Instructions for Paper-Setter		
1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.		
Unit	**Topics**	**Contact Hours**
I	Introduction, nutritional and medicinal value of edible mushrooms; poisonous mushrooms, types of edible mushrooms available in India-*Volvariellavolvacea*, *Pleurotuscitrinopileatus*, *Agaricus bisporus*. Required in frastructure: substrates (locally available), polythene bags, vessels, inoculation hook, inoculation loop, low-cost stoves, sieves, cultureracks, mushroomunit (that ched house), water sprayer, tray,etc.	07
II	Pureculture: medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation-paddy straw, sugarcane trash, maize straw, banana leaves, Factors affecting the mushroom bed preparation- low-cost technology, composting technology in mushroom production	07
III	Storage: short term storage, long term storage (canning, pickels, papads), drying, storagein salt solutions. Nutritional value of some common commercially available mushrooms: proteins, amino acids, mineral elements nutrition, carbohydrates, crude fibre content and vitamins.	08
IV	Foodpreparation: type of food sprepared from mushrooms. Medicinal value of edible mushrooms. Researchcentres: National level and regional level. Cost benefit ratio: marketing in India and abroad. Export value.	08
V*	1. Sterilization of media for spawn preparation. 2. Preparation of spawn and multiplication. 3. Preparation of mushroom bed with different substrates. 4. Cultivation of *Pleurotus*sp. 5. Cultivation of *Agaricus*sp. 6. Evaluation of total soluble sugar content of commonly available mushrooms. 7. Evaluation of total protein content of commonly available mushrooms. 8. Preparation of dried mushroom powder for longer storage and its nutrient evaluation.	60

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 ➢ **Practical** • Class Participation : 05 • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA	**End Term Examination** Theory : 35 Practical : 35

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Bray, R. 2019. Mushroom cultivation: 12 ways to become the MacGyver of Mushrooms. Urban Home steading.
- Kumaresan, V.2018. Mushroom cultivation. Saras Publication.
- Russell, S. 2014. The essential guide to cultivating mushrooms: Simple and advancedtechniques for growing Shiitake, Oyster, Lion's mane and Maitake mushrooms at home.Storeypublishing LLC.
- Gour, P.Y. 2010. Mushroom Production and Processing Technology. Agrobios India.
- Powell, M. 2010. Medicinal mushrooms: A clinical guide. MycologyPress.
- Cheung, P.C. 2008. Mushrooms as Functional foods.Willey-Interscience.
- Tripathi, D.P. 2005. Mushroom Cultivation. Oxford & IBH Publishing Co. PVT. LTD, New Delhi.
- Paul Stamets, J.S. & Chilton, J.S. 2004. Mushroom cultivation: A practical guide to growing mushrooms at home, Agarikon Press.
- Chang, S.F. Miles, P.G. & Chang, S.T. 2004.Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact.CRC press. 2nd edition.
- Bahl, N. 2000. Handbook on Mushrooms.Oxford & IBH Publishing Co. Pvt. Ltd.

Session: 2024-25	
Part A - Introduction	
Subject	**BOTANY**
Semester	**3rd**
Name of the Course	**Plant Hybridization**
Course Code	**B23-SEC-304**
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**SEC-3**
Level of the course (As per Annexure-I)	100-199

Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Gain knowledge of plant reproductive structures and processes, including flower anatomy, pollination mechanisms, and fertilization 2. Comprehend the basic principles and concepts of plant hybridization 3. Learn practical skills in plant hybridization techniques 4. Foundational understanding of plant breeding principles 5*. Gain knowledge about the floral structures and underlying plant breeding techniques.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4

THEORY

Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**	**Time: 3 Hours**

PRACTICAL

Max. Marks: 25 **Internal Assessment Marks: 05** **End Term Exam Marks: 20**	**Time: 4 Hours**

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required toj attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	General objectives of plant breeding Major achievements, Future Prospects. Self-incompatibility- Definition, classification, heteromorphic SI, homomorphic SI i.e. gametophytic SI and sporophytic SI, utilization of self-incompatibility in plant breeding	07

II	Definition and concept of population genetics, random mating population, gene and genotypic frequency Hardy-Weinberg law- Law, its validity, factors affecting gene frequency Heterosis- Definition, heterosis and hybrid vigour, effects and estimation of heterosis, genetic basis/theories of heterosis Inbreeding depression- Definition, effects of inbreeding.	07
III	Hybridization techniques- Definition, aim and objectives, types of hybridization, steps and procedure of hybridization programme choice of parents, evaluation of parents, emasculation – different methods, bagging, tagging, pollination , harvesting and storing of the F1 seeds and selfing, consequences of hybridization Wide hybridization- Definition, types, main features, interspecific and intergeneric hybridization, its examples, incompatibility barriers for wide hybridization, techniques for overcoming incompatibility barriers, achievements.	08
IV	Methods of breeding in self-pollinated crops- Pure line selection, mass selection, pedigree method, bulk method. Methods of breeding in cross pollinated crops- list of plant breeding methods for cross pollinated crops Modes of selection- Recurrent selection, its types and its procedure	08
V*	1. Study of floral structure of self- pollinated crops. 2. Study of floral structure of cross pollinated crops. 3. Emasculation methods: hand, hot water, cold water, alcohol, suction, chemical emasculation 4. Designs used in plant breeding experiment 5. Study of male sterility system 6. To test pollen viability/incompatibility	30

Suggested Evaluation Methods	
Internal Assessment: ➢**Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 ➢**Practical** • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 05 • Mid-Term Exam : NA	**End Term Examination** Theory : 35 Practical : 20

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Plant Breeding Principles and Methods by B.D. Singh, Kalyani publication, New Delhi
2. Essentials of Plant Breeding by Phundan Singh, Kalyani Publication New Delhi
3. Principles and Practices Plant Breeding by J. R. Sharma, McGraw Hill Publishing company Limited, New Delhi.
4. Plant Breeding Theory and Practices by V.L. Chopra, Oxford and IBH. Publishing Company, New Delhi.
5. Introduction to Plant Breeding by R.C. Choudhary, Oxford and IBH. Publishing Company, New Delhi.
6. Elementary Principles of Plant Breeding by R.C. Choudhary, Oxford and IBH. Publishing Company, New Delhi.

Session: 2024-25	
Part A - Introduction	
Subject	**BOTANY**
Semester	**3rd**
Name of the Course	**Vertical Farming**
Course Code	**B23-SEC-305**
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**SEC-3**
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	

Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the principles and concepts of vertical farming systems such as such as hydroponics, aeroponics, and aquaponics 2. Learn how to select suitable crops for vertical farming and understand best practices for their cultivation 3. Understand the principles of designing and planning a vertical farm 4. Explore the economic aspects of vertical farming, including business models, market trends, and the financial viability of vertical farming 5*. Gain knowledge and hand on experience in growing plants under various conditions and systems of vertical farming		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
THEORY			
Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**		**Time: 3 Hours**	
PRACTICAL			
Max. Marks: 25 **Internal Assessment Marks: 05** **End Term Exam Marks: 20**		**Time: 4 Hours**	
Part B-Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	Vertical farming: concept, application and future prospects, vertical farms in India and world Media used in vertical farming, design and working of vertical farms Types of vertical farms: abandoned buildings, shipping-container, underground	7

II	Methods of vertical farming, selection of appropriate plants for vertical farming Introduction to Hydroponics and its types, Management of variables, disinfection of system,pest management. Aeroponics and Aquaponics	7
III	Propagation of crops: sexual and asexual propagation, its advantages and disadvantages;different methods of asexual propagation: cutting, layering, budding, grafting; factors influencing successful grafting/budding union, selection of buds; propagation of plants usingspecialized parts.	8
IV	Rooftop farming/greenhouses: strategies/technological solutions for management of climate, lightning, carbon dioxide enrichment and other parameters Opportunities & amp; advantages of vertical farming- Environmental and economic benefits. Challenges for sustainability of vertical farming.	8
V*	1. To grow plants under hydroponics and aeroponics 2. Compare the rate of growth and vigor of hydroponically grown plants (under nutrient-rich and nutrient-deficient water conditions. 3. To study the aquaponics system in reference to simultaneously grown plants and fish in the same system 4. To study sustainable farming techniques for urban areas. 5. Compare the rate of growth and vigor of aeroponically grown plants (under nutrient-rich and nutrient-deficient mist/fog conditions) 6. To study the wind-powered vertical farming tower	30
Suggested Evaluation Methods		
Internal Assessment: **➢Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 **➢Practical** • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 05 • Mid-Term Exam : NA		**End Term Examination** Theory : 35 Practical : 20

Part C-Learning Resources
Recommended Books/e-resources/LMS: • Meier Schwarz. (1995). Soilless Culture Management. Advanced Series in Agricultural Sciences, vol 24. Springer, Berlin. • Hasan, M.; Sabir, N.; Singh, A.K.; Singh, M.C.; Patel, N.; Khanna, M.; Rai, T.; and Pragnya, P. (2018). Hydroponics Technology for Horticultural Crops, Tech. Bull. TB-ICN 188/2018.Publ. by I.A.R.I., New Delhi. • Misra, R.L., Misra S. (2017). Soilless Crop production. Daya Publishing House • Dickson Despommier and Majora Carter (2011). The Vertical Farm: Feeding the World in the 21st Century. Picador Publications

Session: 2024-25	
Part A - Introduction	
Subject	**BOTANY**
Semester	**3rd**
Name of the Course	**Olericulture**
Course Code	**B23-SEC-306**
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**SEC-3**
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Distinguish the growing of vegetables according to season and climate 2. Understand and explain the special intercultural operations done in vegetable crops 3. Study of morphology and taxonomy of different vegetable crops 4. Identify the diseases and pests of vegetable crops and their management 5*. Grow and produce various types of vegetables and understanding of package and practices of vegetable crops.

Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4

THEORY

Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**	**Time: 3 Hours**

PRACTICAL

Max. Marks: 25 **Internal Assessment Marks: 05** **End Term Exam Marks: 20**	**Time: 4 Hours**

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	Importance of vegetable cultivation in India and Haryana. Export and import potential of vegetables in India. Constraints in vegetable production and remedies to overcome them.	7
II	Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) Brinjal (b) Tomato (c) coriander (d) Spinach.	7
III	Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) Carrot (b) Beet root.	8
IV	Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) mung bean and (b) chick pea.	8
V*	1. Demonstration of seed germination test for a vegetable seed. 2. Demonstration of seed viability test. 3. Identification of vegetable seeds and vegetable crops at different growth stages.	30

	4. Preparing vegetable nursery beds. 5. Raising vegetable seedlings in nursery bed and portrays. 6. Identification of major diseases and insect pests of vegetables. 7. Land preparation for sowing/ transplanting of vegetable crops. 8. Sowing/ transplanting of vegetables in main field. 9. Fertilizer application for vegetable growing. 10. Irrigation practices in a vegetable crop field. 11. A report on vegetable crops in a locality. Collection and preparation of herbarium of vegetable crops in their locality.	

Suggested Evaluation Methods

Internal Assessment: ➢**Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 ➢**Practical** • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 05 • Mid-Term Exam : NA	**End Term Examination** Theory : 35 Practical : 20

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Bose T K et al. (2003) Vegetable crops, Naya Udhyog Publishers, Kolkata.
- Singh D K (2007) Modern vegetable varieties and production, IBN Publisher Technologies, International Book Distributing Co, Lucknow.
- Premnath, Sundari Velayudhan and D P Sing (1987) Vegetables for the tropical region, ICAR, New Delhi.
- Chauhan Shohaib Sheikh Ayub (2021) A textbook of Olericulture. New Visual publication

Session: 2024-25	
Part A - Introduction	
Subject	**BOTANY**
Semester	**3rd**
Name of the Course	**Biofertilizers**
Course Code	**B23-SEC-307**
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**SEC-3**

Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Perform various tests for seed germination, viability and vigour. 2. Make observations and record data on various growth stages of a given vegetable plant. 3. Identify the pathogens and suggest control measures for diseases of vegetable crops. 4. Practice suitable irrigation and fertigation methods for various horticulture crops. 5*. Isolate the microorganisms involved in biofertilizers and preparation of various types of composts		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4

THEORY

Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**	**Time: 3 Hours**

PRACTICAL

Max. Marks: 25 **Internal Assessment Marks: 05** **End Term Exam Marks: 20**	**Time: 4 Hours**

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	General account about the microbes used as bio-fertilizers: *Rhizobium*-isolation, identification, mass multiplication	7

	and carrier based inoculants, Actinorrhizal symbiosis. *Azospirillum*: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.	
II	*Azotobacter*: classification, characteristics-crop response to *Azotobacter* inoculum, maintenance and mass multiplication. Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.	7
III	Mycorrhizal association, types of mycorrhizal association, occurrence and distribution, nutrition, growth and yield – colonization of VAM – isolation and inoculums production of VAM, and its influence on growth and yield of crop plants.	8
IV	Organic farming: Green manuring and organic fertilizers. Recycling of biodegradable municipal, agricultural and Industrial wastes- bio-compost making methods. Vermicomposting – field application. Antagonistic bacteria and fungi- role in agriculture.	8
V*	1. Isolation of microbes used as biofertilizers from soil. 2. Study of *Rhizobium* from root nodules of leguminous plants by Gram staining method. 3. Test for pH, Cl and organic matter of different composts. 4. Observation of mycorrhizae from roots. 5. Production of VAM by pot culture. 6. Methods of sterilization, media preparation and inoculation of microbes. 7. Isolation of arbuscular mycorrhizal spores from rhizospheric soil. 8. Spots, Specimen /photographs of earthworm, *Azolla*, arbuscules vesicles. 9. Photographs of bio compost methods. 10. Projects on any topic mentioned in the syllabus, with Rhizobium technology, AMF technology, organic farming, vermicomposting, bio compost, Azolla culture.	30

Suggested Evaluation Methods	
Internal Assessment: ➢**Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 ➢**Practical** • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 05 • Mid-Term Exam : NA	**End Term Examination** Theory : 35 Practical : 20
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Dubey, R.C., 2005 A Textbook of Biotechnology S. Chand & Co, New Delhi. • Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi. • John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi. • Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers. • SubhaRao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi. • Vayas, S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming AktaPrakashan, Nadiad.	

Session: 2024-25	
Part A–Introduction	
Subject	**BOTANY**
Semester	**4th**
NameoftheCourse	**Basics of Medicinal Plants**
Course Code	**B23-VAC-408**
Course Type:(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**VAC-4**
Levelofthecourse(AsperAnnexure-I	100-199
Pre-requisiteforthecourse(ifany)	

CourseLearningOutcomes (CLO):	After studying this course, the students will be able tounderstand: 1. History and importance of medicinal plants at national and international level. 2. Different systems of medicine and methods to extract active compounds as well as preparation of herbal remedies. 3. Students will gain knowledge about important medicinal plants and their parts used for herbal therapy. 4. Students will get acquainted with state and national level boards to manage conservation and sustainable use of medicinal plants. 5. * Students will understand and get acquainted with practical aspects of collection, storage of medicinal plants, preparation of herbal remedies by different methods, grading and post-harvest handling of medicinal plants, essential oil extraction and microscopic evaluation of drug adulteration.		
Credits	Theory	Practical	Total
	2	0	2
ContactHours	2	0	2
THEORY			
Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**		**Time: 3 Hours**	
PRACTICAL			
Max. Marks: NA **Internal Assessment Marks: NA** **End Term Exam Marks: NA**			
Part B-Contents of the Course			

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.

2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	Medicinal plants: history, importance and prospects. Medicinal Plants – past and present status in world and India. Medicinal plants as industrial crops - constraints and remedial measures. Medicinal plant diversity & local healthcare.	7

II	Traditional system of medicine in India, Concept and principles of Ayurveda, Siddha, Unani and Homeopathy. Methods of extraction of active compounds: polar and non-polar extraction; extraction of essential oils; Types of herbal remedies: maceration, infusion, decoction, tinctures, compress, bathing, pills, ointments.	7
III	Important medicinal plants of India and their uses: *Dioscorea, Nardostachys jatamansi, Allium, Saussurea obvallata, Swertia chirata, Oscimum, Azadirachta, Rawolfia, Phyllanthus, Vinca rosea, Justicia adhatoda, Terminalia arjuna, T. chebula, Tamarindus indica, Aloe vera, Withania somnifera.*	8
IV	National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions. Other organizational initiatives for promotion of Medicinal plants at National and International levels. Herbal industries. Intellectual property rights (IPR)	8

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 ➢ **Practical** • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : NA • Mid-Term Exam : NA	**End Term Examination** Theory : 35 Practical : NA

Part C-Learning Resources

- Medicinal Plants of Uttarakhand by C.P. Kala (2010).
- Indian Medicinal Plants by P.C. Trivedi (2009).
- Handbook of MAPs by S.K. Bhattacharjee (2009).
- Panda H., Handbook of Ayurvedic Medicines, National Institute of Industrial Research, Delhi 7
- CSIR–CultivationandUtilizationofMedicinalPlants.
- Chaturvedi A. 2008. Ethnobotany and Taxonomy of Angiosperms. Rashtrasant Tukadoji Maharaj Nagpur University Press.1-295.
- Pandey B.P. 1978. Economic Botany. S. Chand and Company LTD. Ram Nagar, New Delhi. 1-534.
- Brahmvarchas, AyurvedkaPran: Vanoshadhivigyan, Vedmata Gayatri Trust, Shaktikunj Haridwar 2004
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