

KURUKSHETRA UNIVERSITY KURUKSHETRA

(Established by the State Legislature Act-XII of 1956)

(‘A⁺⁺’ Grade, NAAC Accredited)



Syllabus for Under-Graduate Programme

**Subject: Botany
(5th & 6th Semesters)**

With Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-
2020 w.e.f. 2024-25

PLOs for Life Sciences

PLOs	UG Certificate in Life Sciences
After the completion of UG certificate in Life Sciences, the student should be able to:	
PLO_1: Knowledge and Understanding	<ul style="list-style-type: none"> · Demonstrate the knowledge of basic principles, concepts, facts and broad linkage of chosen subjects of Life sciences.
PLO_2: Skills And creativity	<ul style="list-style-type: none"> · Selecting and using relevant methods, tools, and materials to assess the appropriateness of approaches for solving problems associated with the chosen subjects of Life sciences.
PLO_3: Application of knowledge and Skills	<ul style="list-style-type: none"> · Apply the acquired operational or theoretical knowledge, and a range of practical skills to select and use basic methods, tools, materials, and information to generate solutions to specific problems relating to the chosen subjects of Life sciences.
PLO_4: Critical thinking	<ul style="list-style-type: none"> · Listen carefully, read texts, make judgments and make decisions based on analysis of data and evidence.
PLO_5: Ethics	<ul style="list-style-type: none"> · Put forward convincing arguments to respond to the ethical and moral issues associated with the chosen subjects, practice ethical and moral values in one's life.
PLO_6: Communication	<ul style="list-style-type: none"> · Express scientific thoughts and ideas effectively in writing and orally and communicate on scientific activities with others using appropriate media.
PLO_7: Life long Learning	<ul style="list-style-type: none"> · Acquire knowledge and skills including learning 'How to learn' that are necessary for participating in learning activities throughout life.
PLO_8: Environmental Awareness	<ul style="list-style-type: none"> · Demonstrate knowledge of effects of environmental degradation, climate change and pollution, effective waste management.
PLO_9: Digital Literacy	<ul style="list-style-type: none"> · To use ICT in a variety of learning and work situations.

PLOs	UG Diploma in Life Sciences
After the completion of UG Diploma in Life Sciences, the student should be able to:	
PLO_1: Knowledge and Understanding	<ul style="list-style-type: none"> · Demonstrate the deeper knowledge and understanding of principles, concepts, facts and broad linkage of chosen subjects of Life sciences.
PLO_2: Skills And creativity	<ul style="list-style-type: none"> · Selecting and using relevant methods, tools, and materials to assess the appropriateness of approaches from a range of sources for solving complex problems associated with the chosen subjects of Life sciences.
PLO_3: Application of knowledge and Skills	<ul style="list-style-type: none"> · Apply the acquired operational or theoretical knowledge, and a range of practical skills to select and use appropriate methods, tools, materials, and information to generate solutions to specific problems relating to the chosen subjects of Life sciences.
PLO_4: Critical thinking	<ul style="list-style-type: none"> · Listen carefully, read texts, make judgments and make decisions based on analysis of data and evidence, present complex information in a clear, scientific and concise manner.
PLO_5: Ethics	<ul style="list-style-type: none"> · Formulate arguments in support of actions to address the ethical and moral issues associated with the chosen subjects, practice ethical and moral values in one's life.

PLO_6: Communication	<ul style="list-style-type: none"> Express scientific thoughts and ideas effectively in writing and orally and communicate on scientific activities with others using appropriate media.
PLO_7: Life long Learning	<ul style="list-style-type: none"> Acquire knowledge and skills including learning ‘How to learn’ that are necessary for participating in learning activities throughout life.
PLO_8: Environmental Awareness	<ul style="list-style-type: none"> Apply knowledge, skills and attitude to mitigate the effects of environmental degradation, climate change and pollution, and effective waste management.
PLO_9: Digital Literacy	<ul style="list-style-type: none"> To use ICT in a variety of learning and work situations.

PLOs	Bachelor Degree in Life Sciences
After the completion of Bachelor degree in Life Sciences, the student should be able to:	
PLO_1: Knowledge and Understanding	<ul style="list-style-type: none"> Demonstrate the comprehensive and specialized knowledge and deep understanding of principles, concepts, and facts about current and emerging issues relevant to chosen subjects of Life sciences.
PLO_2: Skills And creativity	<ul style="list-style-type: none"> Selecting and using relevant methods, tools, and materials to assess the appropriateness of approaches for solving specific problems associated with the chosen subjects of Life sciences.
PLO_3: Application of knowledge and Skills	<ul style="list-style-type: none"> Apply the acquired operational or theoretical knowledge, and a range of practical skills to analyze quantitative and qualitative data to assess the different approaches to generate solutions to specific problems related to the chosen subjects of Life sciences.
PLO_4: Critical thinking	<ul style="list-style-type: none"> Listen carefully, read texts, make judgments and make decisions based on analysis of data and evidence, present complex information in a clear, scientific and concise manner.
PLO_5: Ethics	<ul style="list-style-type: none"> Follow ethical practices in all aspects of research and development, including avoiding unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
PLO_6: Communication	<ul style="list-style-type: none"> Able to communicate effectively on complex scientific activities with the scientific community and with society at large, such as, being able to comprehend and write effective scientific reports and design documentation, make effective presentations.
PLO_7: Life long Learning	<ul style="list-style-type: none"> Acquire knowledge and skills including learning ‘How to learn’ that are necessary for participating in learning activities throughout life.
PLO_8: Environmental Awareness	<ul style="list-style-type: none"> Apply knowledge, skills and attitude to mitigate the effects of environmental degradation, climate change and pollution, effective waste management.
PLO_9: Digital Literacy	<ul style="list-style-type: none"> To use ICT in a variety of learning and work situations, appropriate software to analyze the data.
PLO_10: Research Aptitude	<ul style="list-style-type: none"> Ask relevant/appropriate questions, identifying, formulating and analyzing the research problems and to draw conclusions from the analysis.

FIFTH SEMESTER

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	5th		
Name of the Course	Economic Botany and Plant Biotechnology		
Course Code	B23-BOT-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-5/MCC-9		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: <ol style="list-style-type: none"> 1. Understand origin, distribution, cultivation and uses of cereals, millets, pulses, fibres and oil yielding crops. 2. Understand cultivation and uses of spices, condiments, medicinal plants, rubber-yielding plants, beverages and timber yielding plants. 3. Get acquainted with concepts of tissue culture and tissue culture techniques including micropropagation, callus culture 4. Understand different strategies of genetic engineering in plants and its applications 5. *Understand lab techniques of tissue culture; get acquainted with equipments and instruments required for gene transfer techniques; culture media preparation; study of economically important plants. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70		Time: 3 Hours	
Internal Assessment Marks: 20			
End Term Exam Marks: 50			
PRACTICAL			
Max. Marks: 30		Time: 4 Hours	
Internal Assessment Marks: 10			
End Term Exam Marks: 20			
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	Food Plants: Introduction to Cereals and Millets; Origin, distribution, botanical description, brief idea of cultivation and uses of Rice, Wheat and Maize. Protein Crops (Pulses); Origin, distribution, botanical description, brief idea of cultivation and uses of Gram, Arhar, Peas.		11

	<p>Introduction to Vegetables; Origin, distribution, botanical description, brief idea of cultivation and uses of Potato, Tomato, Onion.</p> <p>Fibers: Introduction to natural fibers; Origin, distribution, botanical description, brief idea of cultivation, processing and uses of Cotton, Jute and Flax.</p> <p>Oil Yielding Crops: Origin, distribution, botanical description, brief idea of cultivation and uses of Groundnut, Mustard and Coconut.</p>	
II	<p>Spices and Condiments: Introduction to spices and condiments; Morphology of plant part used, brief idea of cultivation and uses of Coriander, Black Pepper, Ginger, Turmeric and Cloves.</p> <p>Medicinal Plants: Brief idea of Cultivation, botanical features and medicinal importance of <i>Cinchona</i>, <i>Rauwolfia</i>, <i>Atropa</i>, Opium, <i>Cannabis</i>, Indian Gooseberry and <i>Withania</i>.</p> <p>Beverages: Botanical description and processing of Tea and Coffee.</p> <p>Rubber: Botanical description and processing of <i>Hevea</i></p> <p>Sugar: Botanical description, cultivation and harvesting of Sugarcane; processing of Sugar.</p> <p>Timber: Note on important timber yielding plants.</p>	12
III	<p>Plant Tissue Culture: Concept, History, Scope and Applications; Totipotency Organogenesis Cryopreservation</p> <p>Types of culture: Seed, Embryo, callus, suspension, organs, Cell and protoplast culture</p> <p>Micropropagation/clonal propagation (different routes of multiplication- axillary bud proliferation, somatic embryogenesis, organogenesis), Synthetic seeds (a brief account)</p> <p><i>In vitro</i> haploid production Androgenic methods: Anther culture, Microspore culture Androgenesis Significance and use of haploids</p> <p>Gynogenic haploids, factors effecting gynogenesis</p> <p>Somatic hybridisation, Cybrids, Somaclonal variations</p>	11
IV	<p>Genetic Engineering in plants: Introduction and applications</p> <p>Direct DNA transfer/Physical methods of gene transfer in plants - micro projectile bombardment, electroporation, liposome mediated, Calcium phosphate mediated etc.</p> <p>Restriction Endonucleases: Types and role; brief idea about cloning vectors- Ti plasmid, BAC, Lambda phage, cosmid, shuttle vector, eukaryotic vectors (YAC)</p> <p>Plant transformation by <i>Agrobacterium tumefaciens</i> and <i>A. rhizogenes</i>.</p> <p>Strategies for gene transfer to plant cells. Binary and co-integrate vectors.</p>	11
V*	<ul style="list-style-type: none"> • Study of economically important plants: Wheat, Rice, Maize, Gram, Pea, Arhar, Black Pepper, Ginger, Clove, Tea, Coffee, Cotton, Groundnut, Coconut, Mustard and Sugarcane etc. • Study of economically important plants: Potato, Tomato, Onion, fiber-yielding and medicinal plants of the syllabus and different types of woods. • Collection and preparation of reports on various crops and economically important plants being cultivated/wildly available in your area. • Brief introduction to the components and working of the instruments- oven, autoclave, incubator, centrifuge, laminar air flow and spectrophotometer); Familiarization with basic equipments in tissue culture. 	30

	<ul style="list-style-type: none"> • Preparation of MS medium. • To prepare the slants and petri plates for plant tissue culture. • Demonstration of <i>in vitro</i> sterilization and inoculation methods using leaf and nodal explants of tobacco/<i>Datura/Brassica</i> or other available plant • Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs. • Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 	
Suggested Evaluation Methods		
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 <p>➤ Practical</p> <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 	<p>End Term Examination</p> <p>Theory: 50 Practical: 20</p>	
Part C-Learning Resources		
<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> • Kocchar, S.L. 1998: Economic Botany in Tropics, 2nd edition, MacMillan India Ltd., New Delhi. • Kocchar, S.L. 2016. Economic Botany: A Comprehensive Study, 5th Ed, Cambridge India. • Sambammurthy, A.V.S.S. and Subramanyam, N.S. 1989. A Textbook of Economic Botany, Wiley Eastern Ltd., New Delhi. • Sharma, O.P. 1996. Hill's Economic Botany (Late Dr. A.F. Hill adapted by O.P. Sharma), Tata McGraw Hill Co. Ltd., New Delhi. • Simpson, B.B. and Conner-Ogorzaly, M. 1986: Economic Botany- Plants in our World, McGraw Hill, New York. • Singh, B.D. 2021. Biotechnology 4th Edition. Kalyani Publications • Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands. • Glick, B.R., Pasternak, J.J. 2003. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington. • Stewart Jr. C.N. 2016. Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A. • Trehan, K. 1990. Biotechnology, New Age Int. Pvt. Ltrd. New Delhi India. • Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. 2019. Prescott's Microbiology. 11th Edition. McGraw Hill International. 		

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	5th		
Name of the Course	Reproduction in HigherPlants		
Course Code	B23-BOT-502		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-10		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Understand the structure of flower, microsporangium and process of pollen formation. 2. Get an idea of pollination mechanism, interaction of pollens and pistils and self-incompatibility. 3. Understand the structure of megasporangium, female gametophyte, mature embryo sac and process of double fertilization. 4. Understand the types of endosperms, process of embryogenesis and structure of dicot & monocot seeds. 5. *Understand types of ovules, embryo structure of developing seeds, embryo sac development, types of pollination and pollination mechanism 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70 Internal Assessment Marks: 20 End Term Exam Marks: 50	Time: 3 Hours		
PRACTICAL			
Max. Marks: 30 Internal Assessment Marks: 10 End Term Exam Marks: 20	Time: 4 Hours		
Part B-Contents of the Course			
Instructions for Paper- Setter			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
Unit	Topics		Contact Hours
I	Flower-a modified shoot; functions of various floral parts. Microsporangium, its wall and dehiscence mechanism. Microsporogenesis, pollen grains and its structure (pollen wall).		11
II	Pollination (types and agencies); pollen germination (microgametogenesis).		12

	Pollen-pistil interaction; self-incompatibility. Male gametophyte.	
III	Structure of megasporangium (ovule), its curvatures. Megasporogenesis and megagametogenesis. Female gametophyte (monosporic, bisporic and tetrasporic)- organization and ultrastructure of mature embryo sac. Double fertilization.	11
IV	Endosperm types and their biological importance. Embryogenesis in dicot and monocot; Polyembryony and apomixis. Structure of dicot and monocot seed. Fruit types; dispersal mechanisms in fruits and seeds.	11
V*	<ul style="list-style-type: none"> • Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/campylotropous (Permanent Slides). • Female gametophyte: <i>Polygonum</i> (monosporic) type of Embryo sac Development (Permanent slides/photographs). • Ultrastructure of mature egg apparatus cells through electron micrographs. • Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens). • Dissection of embryo/endosperm from developing seeds. 	30

Suggested Evaluation Methods

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 <p>➤ Practical</p> <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 	<p>End Term Examination</p> <p>Theory : 50 Practical : 20</p>
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Part C-Learning Resources

<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> • B.M. Johri Editor (1984) Embryology of Angiosperms Springer Verlag • Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition. • Fageri, K. and Van der Pijl 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford. • Hartmann, H.T. and Kestler, D.E. 1976. Plant Propagation; Principles and Practices. 3rd Edition. Prentice Hall of India Pvt. Ltd. New Delhi. • King, J. 1997. Reaching for the Sun: How Plants Work. Cambridge University Press, Cambridge, U.K. • P. Maheshwari (1950) An Introduction to the Embryology of Angiosperms McGraw Hill • Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London. • Raven, P.H. Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants. 5th edition. W.R. Freeman and Co., Worth Publishers, New York. • Thomas, P. 2000. Trees: Their Natural History. Cambridge University Press, Cambridge.

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	5th		
Name of the Course	Plant Biochemistry and Metabolism		
Course Code	B23-BOT-503		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Students will have a comprehensive understanding of biochemical foundations in plants. 2. Students will be able to understand biomolecule structure and properties. 3. Students will develop comprehensive knowledge about various metabolic processes occurring in plants. 4. Students will develop a comprehensive understanding of biomolecule turnover. 5*. Students will gain knowledge about the tools and techniques used for studying the biochemical and metabolic state of plants. This will be mainly done through estimation and detection of some important metabolites. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70		Time: 3 Hours	
Internal Assessment Marks: 20			
End Term Exam Marks: 50			
PRACTICAL			
Max. Marks: 30		Time: 4 Hours	
Internal Assessment Marks: 10			
End Term Exam Marks: 20			
Part B- Contents of the Course			
Instructions for Paper- Setter			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
Unit	Topics		Contact Hours
I	Biochemical Foundations: covalent and non-covalent bonds; hydrogen bond; Van der Waal's forces; Structure and properties of water; pH and buffer (inorganic and organic); Handerson-Hasselbalch equation; Isoelectric point.		11
II	Structure, classification and brief concepts of nucleic acids, proteins, carbohydrates and lipids; enzymes and enzyme kinetics; enzyme regulation; mechanism of enzyme catalysis; isozymes.		12

III	Biosynthesis, mechanism of action and uses of brassinosteroids, strigolactones, jasmonates and salicylic acid. Nucleotide biosynthesis and degradation.	11
IV	Secondary metabolites and their roles: terpenes, phenols and nitrogenous compounds; nitrate and ammonium assimilation. Amino acid biosynthesis; lipid biosynthesis, α and β -oxidation.	11
V*	<ul style="list-style-type: none"> • Qualitative test for reducing and non-reducing sugars. • Qualitative test for proteins. • Qualitative test for oils and fats. • Qualitative test for some common secondary metabolites. • Demonstration/Estimation of catalase activity. • Estimation of free fatty acid by titrimetric method. • Estimation of cell sap chloride ion by titrimetric method. • Estimation of ascorbic acid by titrimetric method 	30
Suggested Evaluation Methods		
Internal Assessment: > Theory <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 > Practical <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 		End Term Examination Theory : 50 Practical : 20
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ul style="list-style-type: none"> • Nelson, D. L., & Cox, M. M. (2021). <i>Lehninger Principles of Biochemistry</i> (8th ed.). W.H. Freeman. • Voet, D., Voet, J. G., & Pratt, C. W. (2016). <i>Fundamentals of Biochemistry</i> (5th ed.). John Wiley & Sons. • Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). <i>Biochemistry and Molecular Biology of Plants</i> (2nd ed.). Wiley-Blackwell. • Berg, J.M., Stryer, L., Tymoczko, J.L. and Gatto, G.J. (2023) <i>Biochemistry</i> (10th ed.). WH Freeman. • Heldt, H.W. (2021). <i>Plant Biochemistry</i>. (5th ed.). Elsevier Academic Press. • Bowher, C., & Tobin, A. (2021). <i>Plant Biochemistry</i>. (2nd ed.). CRC Press. 		

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	5th		
Name of the Course	Modern Plant Systematics		
Course Code	B23-BOT-504		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Students will have a comprehensive understanding of Plant Taxonomy. 2. Students will be able to understand Plant identification tools 3. Students will develop comprehensive knowledge about taxonomical evidences. 4. Students will develop a comprehensive understanding of Role of APG and economic value of various plant families. 5*. Students will gain knowledge about the tools, techniques, evidences, various system of classification used for the identification of plants. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70			
Internal Assessment Marks: 20			
End Term Exam Marks: 50			
		Time: 3 Hours	
PRACTICAL			
Max. Marks: 30			
Internal Assessment Marks: 10			
End Term Exam Marks: 20			
		Time: 4 Hours	
Part B-Contents of the Course			
Instructions for Paper- Setter			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
Unit	Topics		Contact Hours
I	Aims, principles and practices in taxonomy. Botanical Nomenclature: Brief history, Scientific names, ICN, Principles, typification, Principle of priority, author citation, effective and valid publication, rank of taxa; Floras, monographs, websites. Herbarium and botanical gardens, their role in teaching, research and conservation, Journals; Keys: Single access and Multi-access, important herbaria and botanic gardens of the World. Botanical Survey of India.		11
II	Introduction to Plant systematic; Plant Classification, Nomenclature;		12

	Evidences from palynology, Cytology, Phytochemistry, Embryology, Morphology, Anatomy, and molecular data, Identification of phytochemicals present in plants.	
III	Major contributions of Theophrastus, Linnaeus, de Candolle, Bessey, Hutchinson, Engler and Prantles, Takhtajan and Cronquist; Types of classification: Artificial; Natural and Phylogenetic; Angiosperm Phylogeny Group (APG I, II, III, IV) classification.	11
IV	Systematic study and economic importance of the following families: Fabaceae, Eupobiaceae, Cucurbitaceae, Malvaceae, Rutaceae, Annonaceae, Brassicaceae, Ranunculaceae & Poaceae; Numerical taxonomy: Characters; Variations; OTUs, character weighting and coding; Phenograms, cladograms (definitions and differences).	11
V*	<ul style="list-style-type: none"> • Description of specimens from locally available representative families. • Identification of plant specimens using floras and identification keys. • Preparation of identification keys for at least 10 specimens based on morphological features. • Study of herbarium specimens of different families covered in theory course. • Field trips within and around the campus; compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant. • Use of palynological, chemical methods in taxonomy. 	30

Suggested Evaluation Methods

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 <p>➤ Practical</p> <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 	<p>End Term Examination</p> <p>Theory : 50 Practical : 20</p>
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Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Cronquist, A. 1981. *An Integrated System of Classification of Flowering Plants*. Columbia University Press, New York.
- Cronquist, A. 1988. *The Evolution and Classification of Flowering Plants* (2nd ed.) Allen Press, U.S.A.
- Hickey, M. and King, C. 2000. *The Cambridge Illustrated Glossary of Botanical Terms*. Cambridge University Press, UK.
- Hutchinson, J. 1959. *Families of Flowering plants*. Clarendon Press, Oxford.
- Jain S.K. and Rao R.R. 1976. *Handbook of Field and Herbarium Methods*. Today and Tomorrow Publishers, New Delhi.
- Lawrence, G. H. M. 1951. *Taxonomy of Vascular Plants*. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
- Mabberly, T. J. 2009. *The Plant Book* 2nd ed. Cambridge University Press, Cambridge.

- Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998. *A Handbook of Taxonomic Training*. DST, New Delhi
- Radford A.E. 1986. *Fundamentals of Plant Systematics*. Harper and Row N Y.
- Simpson, M.G. 2010. *Plant Systematics*. Elsevier, Amsterdam.
- Singh, Gurcharan. 2010. *Plant Systematics: An Integrated approach*. 3rd edition. Science Publishers Inc., New Hampshire, USA.
- Singh, Gurcharan. 2012. *Plant Systematics: Theory and Practice*. Completely revised and enlarged 3rd edition. Oxford & IBH, New Delhi.
- Stuessy, Tod F. 2009. *Plant Taxonomy: The Systematic Evaluation of Comparative Data*. Second edition. Columbia University Press.

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	5th		
Name of the Course	Natural Plant Products		
Course Code	B23-BOT-505		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-3		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Help students to gain knowledge about structure, production, and types of natural plant products. 2. Students will understand wide range of applications including culinary, medicinal, cosmetic, nutritional uses of herbal products. 3. Students will be acquainted with various histochemical tests for screening of different natural plant products. 4. Students will get an insight how natural plant products are important for drug discovery and challenges faced by scientists in recent scenario. 5*. Students will gain knowledge about importance of herbal medicinal plants and their collection, develop skills in preparation of crude herbal extracts, detect drug adulteration and propagation methods for conservation of plants. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70 Internal Assessment Marks: 20 End Term Exam Marks: 50	Time: 3 Hours		
PRACTICAL			
Max. Marks: 30 Internal Assessment Marks: 10 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	An overview of secondary metabolism and biosynthesis of natural products: The shikimate pathway for synthesis of phenylpropanoids and aromatic amino acids; The mevalonate and methylerythritol phosphate pathways for synthesis of terpenoids and steroids; The acetate pathway for synthesis of polyketides and fatty acids; Factors affecting synthesis of secondary metabolites	11
II	Structure elucidation of natural products: General strategies for structure elucidation of natural products with few examples; Phytochemical screening and histochemical tests for alkaloids, saponins, cardenolides, flavonoids, leucoanthocyanidins, tannins, polyphenols, anthraquinones, cyanogenic glycosides, volatile oils in plant extracts. Important therapeutic classes: antimicrobial, antidiabetics, hepatoprotectives, immunomodulators, anti-cancer.	12
III	Herbal cosmetics: Importance of herbals as shampoos (soapnut), conditioners and coloring agents (amla, henna, hibiscus, tea), skin care (aloe, turmeric, lemon peel, vetiver); Flavouring agents from plants; Utilization of aromatic plants and derived products (sandalwood oil, mentha oil, lemon grass oil, eucalyptus oil); Nutraceuticals and Health Foods: Classification of Nutraceuticals; Sources and uses of health foods; Chamomile, Corn oil, Fenugreek, Ferverfew, Garlic, Ginseng, Ginkgo, Honey etc.	11
IV	Role of Natural Products (NP) in Drug Discovery: Case studies of taxol, artemisinin, etc.; Challenges associated with NP drug discovery; Multidisciplinary approach to natural products drug discovery using innovative technologies; Quality control of herbal drugs as per WHO, AYUSH; Conservation and sustainable use of medicinal plants; in-situ and ex-situ conservation methods. Centres for conservation of medicinal plants – CIMAP (Central institute of medicinal and aromatic plants) and FRLHT (Foundation for revitalization of local health traditions); TKDL (Traditional Knowledge Digital Library)	11
V*	<ul style="list-style-type: none"> • Collection of locally used ethanobotanicals and preparation of herbarium • To study the propagation and nursery techniques of medicinal and aromatic plants • Preparation of crude herbal extract • Microscopic evaluation and chemical tests (Metanil yellow test and chalk powder test). • To detect adulteration of turmeric powder. • Preparation of herbal formulation for common cold • Detection of alkaloids (Datura / Sadafuli / Tirphal), flavonoids (Green Tea / Onion) and 	30

	<ul style="list-style-type: none"> Saponins (Karando / Godekashtha) or from other suitable plant materials. 	
Suggested Evaluation Methods		
Internal Assessment: > Theory <ul style="list-style-type: none"> Class Participation : 05 Seminar/presentation/assignment/quiz/class test etc. : 05 Mid-Term Exam : 10 > Practical <ul style="list-style-type: none"> Class Participation : NA Seminar/Demonstration/Viva-voce/Lab records etc. : 10 Mid-Term Exam : NA 		End Term Examination Theory : 50 Practical : 20
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ul style="list-style-type: none"> Medicinal Natural Products: A Biosynthetic Approach, 3rd Edition, Paul M. Dewick, 2009, Wiley. From Biosynthesis to Total Synthesis: Strategies and Tactics for Natural Products, Alexandros L. Zografos, 2016, Wiley. Natural Product Biosynthesis: Chemical Logic and Enzymatic Machinery, Christopher T Walsh and Yi Tang, 2017, RSC. Trease and Evan's Pharmacognosy, 16th Edition, W.C. Evans, 2009, Elsevier. Influence of abiotic stress signals on secondary metabolites in plants. Plant signaling&behavior. Akula R, Ravishankar GA, 2011, 6(11), 1720-31. Natural Products and Drug Discovery An Integrated Approach, 1st edition, Subhash C. Mandal, Vivekananda Mandal and Tetsuya Konishi, 2018, Academic Press is an imprint of Elsevier. Integrated Approach to Nature as Source of New Drug Lead, Open access peer-reviewed chapter, In book: Molecular Insight of Drug Design, Seema Kohli, 2018, Intechopen. Lead Generation Approaches in Drug Discovery, Chapter 7: Role of Natural Products in Drug Discovery, Hugo Lachance, Stefan Wetzel, Herbert Waldmann, 2010, Wiley online library. Khandelwal, K.R. 2002. Practical Pharmacognosy: Techniques and Experiments. 9th edition. Nirali Prakashan, Pune. 		

Session: 2024-25	
Part A - Introduction	
Subject	BOTANY
Semester	5th
Name of the Course	Plants and Medicines
Course Code	B23-BOT-506
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-3
Level of the course (As per Annexure-I)	300-399
Pre-requisite for the course (if any)	
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: <ol style="list-style-type: none"> Student will get understanding of traditional and present medicinal systems as well as herbal industries.

	<ol style="list-style-type: none"> 2. Student will have a comprehensive understanding of propagation methods of plants and significance of green house technologies. 3. Students will get knowledge of various medicinal plants and their significant contribution to pharma industry. 4. Students will acquire knowledge about the principles of conservation laws; conceptual understanding of classifications used by IUCN and understanding of international legislation. 5. *Get acquainted with distribution of medicinal plants, methods of vegetative propagation and plant-based medicines. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70		Time: 3 Hours	
Internal Assessment Marks: 20			
End Term Exam Marks: 50			
PRACTICAL			
Max. Marks: 30		Time: 4 Hours	
Internal Assessment Marks: 10			
End Term Exam Marks: 20			
Part B- Contents of the Course			
Instructions for Paper- Setter			
<ol style="list-style-type: none"> 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 medicinal plants and scope of medicinal botany. Brief account of traditional medicinal systems- Ayurveda, siddha, unani, and homeopathy. Medicinal plants- past and present status in world and India. Demand and supply of medicinal plants. Herbal industries.		11
II	Agro and cultivation techniques i.e., nursery raising, cultivation, inter culture and fertilizers, pests and diseases, harvesting and profits for some economically important medicinal plants- <i>Aloe vera</i> , <i>Withaniasomnifera</i> , <i>Rauvolfiaderpentina</i> . Green house technology- principles, methodology and applications. Propagation of medicinal plants through cuttings, rhizomes, bulbs and seeds.		12
III	Important medicinal plants of India with their systematics, geographical distribution and uses, morphology, active principles and medicinal value- <i>Glycyrrhiza</i> , <i>Cinchona</i> , <i>Belladonna</i> , <i>Aloe</i> , <i>Rauwolfia</i> , <i>Neem</i> ,		11

	Ashwagandha, Amla, Bahera, Bhringraj. Plant's secondary metabolite of medicinal importance- Alkaloid, Glycosides and Sterols (brief account).	
IV	Contribution of medicinal plants to alternative and modern medicine. Concept of IUCN, red list criteria, threat categories, concept of endemism, threatened and endemic medicinal plants. Conservation, in-situ (national parks, sanctuaries, biosphere reserves and sacred grooves), ex-situ (botanical gardens, ethno medicinal herbal gardens and seed banks). Conservation through tissue culture and cryopreservation. Wildlife act. National medicinal plant board and state medicinal plant board-objectives and functions. Future of medicinal plants.	11
V*	<ul style="list-style-type: none"> • To study different methods of vegetative propagation. • Identification and description of various medicinal plants. • To test the presence of various secondary metabolite in extracts of various medicinal plants. • To study various plant-based medicines. • Preparation of survey/collection report. 	30
Suggested Evaluation Methods		
Internal Assessment: > Theory <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 > Practical <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 		End Term Examination Theory : 50 Practical : 20
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ul style="list-style-type: none"> • Indian Medicinal Plants by P.C. Trivedi (2009). • Medicinal Plants of Utrakhand by C.P. Kala (2010). • Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar. • Recent progress in Medicinal Plants Vol. 12, Globalization of Herbal Health by A.K. Sharma (2006). • Handbook of Ayurvedic Medicinal Plants by L. D. Kapoor (2005). • Indian Medicinal Plants (vol. 1-4) by K.R. Kirtikar and B.D. Basu (2006). • IUCN Red List Categories by IUCN. • Medicinal Plant Cultivation: A Scientific Approach by S.S. Purohit (2004). • Medicinal Plants: Conservation, Cultivation & utilization by A.K. Chopra, Daya publishing house, Trinagar, Delhi (2007). 		

Sixth Semester

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	6 th		
Name of the Course	Plant Anatomy and Embryology		
Course Code	B23-BOT-601		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-6/MCC-11		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Describe and differentiate various categories of plant tissues, their functions and anatomical features of plant parts and their applications in various branches of botany; general mechanism of secondary growth in plants. 2. Develop their competency on understanding morphology and anatomy of leaves and root system of plants. 3. Understand self incompatibility, pollen-pistil interaction, microsporogenesis, pollination and palynology. 4. Understand concepts of megasporogenesis, double fertilisation, embryo development, fruit types, embryo culture and anther culture. 5. *Get acquainted with practical aspects of permanent tissues, types of ovules, pollination mechanism and embryo development. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70 Internal Assessment Marks: 20 End Term Exam Marks: 50	Time: 3 Hours		
PRACTICAL			
Max. Marks: 30 Internal Assessment Marks: 10 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	Introduction, objective and scope of plant anatomy, meristematic and permanent tissues, complex tissues, plant secretory tissues, mechanical tissues and their distribution. Tissue systems (epidermal, ground and vascular), cambium, types of vascular bundles, vascular skeleton at nodes and internodes.	11
II	SAM anatomy, theories of histological organization of shoot apex, anatomy of monocot and dicot stem, secondary growth, anomalous secondary growth (<i>Dracaena</i> , <i>Boerhaavia</i> , and <i>Mirabilis</i>). Phyllotaxy, anatomy of dicot and monocot leaf, Kranz anatomy. RAM anatomy, types of roots in monocots and dicots, quiescent centre, root-stem transition, secondary growth in dicot root, structural modifications in respiratory (<i>Rhizophora</i>) storage (<i>Beta</i>) and epiphytic (<i>Vanda</i>) roots.	12
III	History and scope of plant embryology, flower-a modified shoot, floral organs. Microsporangium, its wall and dehiscence mechanism, microsporogenesis, pollen grains and its structure (pollen wall), scope of palynology. Pollen-pistil interaction, self-incompatibility. Pollination types and agencies, pollen germination and development.	11
IV	Structure of megasporangium, megasporogenesis and megagametogenesis, types of female gametophyte. Double fertilization, endosperm types, embryogenesis in dicots and monocots; polyembryony, apomixis. Structure of dicot and monocot seed, dispersal mechanisms in fruits and seeds.	11
V*	<ul style="list-style-type: none"> • Study of meristems through permanent slides and photographs. • Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs) • Preparation/observation of permanent Slides of Stem: Monocot: <i>Zea mays</i>; Dicot: <i>Helianthus</i>; Secondary: <i>Boerhaavia</i>. • Preparation/observation of permanent Slides of Root: Monocot: <i>Zea mays</i>; Dicot: <i>Helianthus</i>. • Leaf: Dicot and Monocot leaf (Permanent slides). • Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides). • Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/campylotropous (Permanent slides). • Female gametophyte: <i>Polygonum</i> (monosporic) type of Embryo sac Development (Permanent slides/photographs). • Ultrastructure of mature egg apparatus cells through electron micrographs (images/photographs). • Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens). • Dissection of embryo/endosperm from developing seeds. 	30

Suggested Evaluation Methods

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 <p>➤ Practical</p> <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 	<p>End Term Examination</p> <p>Theory : 50 Practical : 20</p>
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Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Bryan G. Bowes 1999. A Colour Atlas of Plant Structure. Manson Publishing
- Cutter, E.G. 1969. Plant Anatomy Part-I, Cells and Tissues. Edward Arnold, London.
- Cutter, E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part-II Organs, Edward Arnold London.
- Esau, K. 1977. Anatomy of Seed Plants, 2nd Edition. John Wiley & Sons, New York.
- Fahn, A. 1974. Plant Anatomy, 2nd Edition. Pergamon Press, Oxford.
- Hartmann, H.T. and Kestler, D.E. 1976. Plant Propagation; Principles and Practices. 3rd Edition. Prentice Hall of India Pvt. Ltd. New Delhi.
- King. J. 1997. Reaching for the Sun: How Plants Work. Cambridge University Press, Cambridge, U.K.
- Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.
- Pandey, B.P. 2012. Plant Anatomy. S. Chand & Co. Publisher
- Raven, P.H. Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants. 5th edition. W.R. Freeman and Co., Worth Publishers, New York.
- Sharma MK. Plant Structure (An Introduction To Plant Anatomy) JBC Press
- William C. Dickison 2015. Integrative Plant Anatomy. Academic Press
- Johri, B.M. (Ed.) 1984. Embryology of Angiosperms. Springer Verlag
- Bhojwani, S.S. & Bhatnagar, S.P. 2011. Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
- Fageri, K. and Van der Pijl 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford.
- Hartmann, H.T. and Kestler, D.E. 1976. Plant Propagation; Principles and Practices. 3rd Edition. Prentice Hall of India Pvt. Ltd. New Delhi.
- King. J. 1997. Reaching for the Sun: How Plants Work. Cambridge University Press, Cambridge, U.K.
- Maheshwari, P. 1950. An Introduction to the Embryology of Angiosperms. McGraw Hill
- Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
- Raven, P.H. Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants. 5th Edition. W.R. Freeman and Co., Worth Publishers, New York.
- Thomas, P. 2000. Trees: Their Natural History. Cambridge University Press, Cambridge.

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	6th		
Name of the Course	Plant Pathology		
Course Code	B23-BOT-602		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-12		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Understand the fundamental basis of plant-microbe interaction that leads to plant diseases and measures to be adopted for plant health management. 2. Help the students to properly understand pathogen behavior, their interaction with host to develop resistant cultivars. 3. To understand disease cycle and management of microbial diseases. 4. To help the students for isolation, inoculation, culturing, preservation, maintenance of microorganisms and handling of different instruments. 5*. Students will be acquainted with methods for cultivation, preservation, and maintenance of microbial cultures; different sterilization methods; skills in isolation and handling of microbes. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70		Time: 3 Hours	
Internal Assessment Marks: 20			
End Term Exam Marks: 50			
PRACTICAL			
Max. Marks: 30		Time: 4 Hours	
Internal Assessment Marks: 10			
End Term Exam Marks: 20			
Part B- Contents of the Course			
Instructions for Paper- Setter			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
Unit	Topics		Contact Hours
I	Disease concept; symptoms, etiology and causal complex; primary and secondary inoculation; infection, pathogenicity and pathogenesis; necrotroph and biotroph; Koch's postulates; endemic, epidemic, pandemic and sporadic disease; disease triangle; disease		11

	cycle (monocyclic, polycyclic and polyetic).	
II	Mechanism of infection, role of environment and host nutrition on disease development, defence mechanism with special reference to phytoalexin, Local acquired resistance (LAR), Induced systemic resistance (ISR) and systemic acquired resistance (SAR); RNAi as a defence mechanism; Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance.	12
III	Symptoms, causal organism, disease cycle and control measures of: late and early blight of potato, brown spot of rice, black stem rust of wheat, red rot of sugarcane, loose smut of wheat, downy mildew of grapes, apple scab, karnal bunt of wheat, green ear disease of bajra (Sorghum), tikka disease of ground nut, bacterial blight of rice, tungro disease of rice, leaf curl of tomato, root knot.	11
IV	Plant disease management-quarantine, chemical, biological and integrated management; applications of biotechnology in plant pathology; recombinant DNA technology, use of monoclonal antibodies in plant pathology; Concepts in epidemiology, Monocyclic and polycyclic pathogens; Survey, surveillance (including through remote sensing), and prediction and forecasting of diseases.	11
V*	<ul style="list-style-type: none"> • Working and handling of equipment used in microbiology laboratory. • Preparation of liquid and solid (plates and slants) culture media – Nutrient Broth, Nutrient Agar and Potato Dextrose Agar for growth of microbes by steam sterilization • Demonstration of Koch's postulates for a bacterial/fungal pathogen. • To study anatomy/mounting of spores of fungus infected specimens (rust, blight and rot). • To study Gram staining of bacteria. • Isolation of microorganisms from soil; study of colony characteristics of bacteria and fungi; preparation of pure culture of bacteria by streak plate method to obtain isolated colonies; streaking on slants. • Testing quality of milk by methylene blue dye reduction test. 	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 ➤ Practical <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 		End Term Examination Theory : 50 Practical : 20
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ul style="list-style-type: none"> • Agrios GN. 2005. Plant Pathology. 5th Ed. Academic Press, New York. • Heitefuss R & Williams PH. 1976. Physiological Plant Pathology. Springer Verlag, Berlin, New York. 		

- Mehrotra RS & Aggarwal A. 2003. Plant Pathology. 2nd Ed. Oxford & IBH, New Delhi.
- Singh RS. 2002. Introduction to Principles of Plant Pathology. Oxford & IBH, New Delhi.
- Singh DP & Singh A. 2007. Disease and Insect Resistance in Plants. Oxford & IBH, New Delhi.
- Upadhyay RK & Mukherjee KG. 1997. Toxins in Plant Disease Development and Evolving Biotechnology. Oxford & IBH, New Delhi.
- Chakravarti BP. 2005. Methods of Bacterial Plant Pathology. Agrotech, Udaipur.
- Jayaraman J & Verma JP. 2002. Fundamentals of Plant Bacteriology. Kalyani Publ., Ludhiana.

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	6th		
Name of the Course	Agroforestry		
Course Code	B23-BOT-603		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-4		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Students will have a comprehensive understanding of concepts of agroforestry and geographical distribution of crop plants. 2. Students will be able to learn about sustainable agriculture parameters. 3. Students will develop comprehensive knowledge about the cultivation of fruits crops. 4. Students will develop a comprehensive understanding of forest management. 5*. Students will gain knowledge about the tools and techniques used for agroforestry and forest management. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70		Time: 3 Hours	
Internal Assessment Marks: 20			
End Term Exam Marks: 50			
PRACTICAL			
Max. Marks: 30		Time: 4 Hours	
Internal Assessment Marks: 10			
End Term Exam Marks: 20			
Part B- Contents of the Course			
Instructions for Paper- Setter			
<ol style="list-style-type: none"> 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	Principles of crop ecology and crop adaptation, climate shift and its ecological implications, Argo-ecological regions in India. Geographical distribution of crop plants, Greenhouse effect, Climatic factors and their effect on plant processes and crop productivity, Role of GIS and GPS in agriculture. Basis of classification of agroforestry systems and principles, indigenous vs. exotic, intraspecific variations, crown architecture of tropical/temperate trees; organizational set up of agricultural research, education and extension in India.	11
II	Essential plant nutrients and their deficiency symptoms, concept of essentiality of plant nutrients, Indicators of soil fertility and productivity; Sustainable agriculture: parameters and indicators, Conservation agriculture, safe disposal of Agri-industrial waste for crop production, Argo-forestry.	11
III	Layout and establishment of orchards: Pruning and training; propagation, climatic requirement and cultivation of fruits like mango, banana, citrus, guava, grape, pineapple, papaya, apple, pear, peach and plum; cultivation of plantation crops like coconut and cashew nut and spices like black pepper, coriander, turmeric, important physiological disorders.	12
IV	Forest: Importance, types, classification, forest management, silvicultural practices, shifting cultivation, taungya system, multiple and mixed cropping, alley cropping, silvopastoral systems tree diseases, wood decay and discoloration, tree pests, integrated pest and disease management, biological and chemical wood preservation, forest conservation, Indian forest policies, Indian forest act, forest engineering, forest economics, joint forest management and tribology.	11
V*	<ul style="list-style-type: none"> • Study of quantification interactions from tree–Crop Yield Performance • Study of quantification from tree–Crop Interaction Models • Study of allelopathic Interference from mulches of plant residue • Study of allelopathic Interference from leaching and root exudation • Study of microclimate modifications in agroforestry systems • Study of effect of different plant mixtures in agroforestry systems. • Study of tree-soil-crop interactions in agroforestry systems. • Study of estimation of Land Equivalent Ratio of agroforestry systems. • Study of estimation of competition indices in agroforestry systems. • Study of measurement and interpretation of light interception in agroforestry systems • Study of soil water and drainage measurement in agroforestry systems. • Study of transpiration measurement in agroforestry systems. • Study of quantification of root distribution in agroforestry systems. • Study of use of line quantum sensor in agroforestry systems. • Study of use of SPAD chlorophyll meter in agroforestry systems 	30

Suggested Evaluation Methods	
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 <p>➤ Practical</p> <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 	<p>End Term Examination</p> <p>Theory : 50 Practical : 20</p>
Part C-Learning Resources	
<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> • Dwivedi AP. 1992. <i>Agroforestry: Principles and Practices</i>. Oxford and IBH. • Dwivedi AP. 1993. <i>A Text Book of Silviculture</i>. International Book Distributors, Dehradun. • Khanna LS. 1996. <i>Principle and Practice of Silviculture</i>. International Book Distributors. • Smith DM, Larson BC, Ketty MJ & Ashton PMS. 1997. <i>The Practices of Silviculture Applied Forest Ecology</i>. John Wiley & Sons. • Ram Parkash 1983. <i>Forest Surveying</i>. International Book Distr. • Sharpe GW, Hendee CW & Sharpe WE. 1986. <i>Introduction to Forestry</i>. McGraw-Hill. • Huxley P. 1999. <i>Tropical Agroforestry</i>. Blackwell. 	

Session: 2024-25	
Part A - Introduction	
Subject	BOTANY
Semester	6th
Name of the Course	Post-harvest Technology of Fruits & Vegetables
Course Code	B23-BOT-604
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-4
Level of the course (As per Annexure-I)	300-399
Pre-requisite for the course (if any)	
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To acquire knowledge about basic horticultural techniques and simple technologies used in reducing post-harvest losses and add value to horticultural products. 2. To have knowledge of use of phytohormones & postharvest practices like handling of fruits and vegetables, their storage and preservation. 3. To understand the marketing qualities of fruits and vegetables for export and local use. 4. To understand various factors that cause post-harvest damage and strategies/methods to minimize the loss. <p>5*. Students will gain knowledge about mechanism of ripening and maturity in different fruits and vegetables; reasons for loss, marketing quality and packaging methods for sale of fruits and vegetables</p>

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70 Internal Assessment Marks: 20 End Term Exam Marks: 50		Time: 3 Hours	
PRACTICAL			
Max. Marks: 30 Internal Assessment Marks: 10 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	Post-harvest technology of vegetable crops: scope and importance of post-harvest management, causes of post-harvest loss, Methods of assessment of maturity, physiological and biochemical changes during maturity and ripening, enzymatic changes; ethylene evolution and management, change in texture; Influence of pre-harvest practices on shelf life and post-harvest quality.		11
II	Post-harvest technology of fruit crops: scope and importance of post-harvest management, causes of post-harvest loss, Methods of assessment of maturity, physiological and biochemical changes during maturity and ripening, enzymatic changes; ethylene evolution and management, respiration, change in texture; Influence of pre-harvest practices on shelf life and post-harvest quality.		12
III	Climacteric and non-climacteric fruits and vegetables; harvesting methods and practices for specific market requirements; pre-cooling methods, grading, washing, wax coating, edible coating, packaging method and materials used; Maturity indices of fruits and vegetables; Factors responsible for deterioration of harvested fruits and vegetables; Artificial ripening of fruits and vegetables; Preparation of processed products of fruits and vegetables.		11
IV	Storage methods: cold storage, CA storage, zero energy cool chamber, hypobaric storage etc. Storage disorders: physical injury, chilling injury, post-harvest diseases and pests; principles of transport; food containers; food safety standards and export standards; Processing waste management; Importance of post-harvest management technology		11

V*	<ol style="list-style-type: none"> 1. Determination of maturity of fruits and vegetables by different methods- visual, physical, and chemical. 2. Chemical analysis of fruits and vegetables at different stages of maturity and ripening 3. Chemical analysis of nutritive value of fresh and processed fruits and vegetables 4. To study microbial load on samples. 5. Sensory analysis of fruits and vegetables: identification of basic taste, odor, texture, color. 6. Study of different packaging materials and systems for fruits and vegetables. 7. To study respiration rate and ethylene production in different fruits and vegetables. 	30
Suggested Evaluation Methods		
Internal Assessment: > Theory <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 > Practical <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 	End Term Examination Theory : 50 Practical : 20	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ol style="list-style-type: none"> 1. Mir, Shabir Ahmad, Manzoor Ahmad Shah, and Mohammad Maqbool Mir, eds. Postharvest Biology and Technology of Temperate Fruits. Cham: Springer International Publishing, 2018. http://dx.doi.org/10.1007/978-3-319-76843-4. 2. Valero, Daniel. Postharvest biology and technology for preserving fruit quality. Boca Raton, FL: Taylor & Francis Group, 2010. 3. Florkowski, Wojciech J. Postharvest handling: A systems approach. 2nd ed. Amsterdam: Elsevier/Academic Press, 2009. 4. Paliyath, Gopinadhan. Postharvest biology and technology of fruits, vegetables, and flowers. Ames, Iowa: Wiley-Blackwell, 2008. 5. Chattopadhyaya SK. 2007. Handling, transportation, and storage of fruits and vegetables Gene-Tech books, New Delhi. 6. Sudheer, K. P. Indira, V. 2007: Postharvest Technology of Horticultural Crops, New India Publishing, Delhi. 7. Verma, L. R & Joshi, V. K. 2000: Postharvest Technology of Fruits and Vegetables, Indus Publishing House, Delhi. 8. Ramaswamy, Hosahalli, G. Vijaya Raghavan, AmalenduChakraverty, and Arun Mujumdar, eds. Handbook of Postharvest Technology. CRC Press, 2003. http://dx.doi.org/10.1201/9780203911310. 		

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	6th		
Name of the Course	GIS and Remote Sensing		
Course Code	B23-BOT-605		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-5		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Understand the history, development, and characteristics of various remote sensing satellites and their sensors. 2. Acquire skills in procuring and analyzing remote sensing data, ground truth collection, and digital photogrammetry. 3. Learn cartography basics, map projections, GPS system elements, and interpretation of IRS satellite images. 4. Grasp GIS concepts, integration with RS data, and applications in groundwater exploration, agriculture, and environmental assessment. 5*. Students will gain knowledge about the interpretation of biologically relevant data using GIS and remote sensing. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70			
Internal Assessment Marks: 20			
End Term Exam Marks: 50			
	Time: 3 Hours		
PRACTICAL			
Max. Marks: 30			
Internal Assessment Marks: 10			
End Term Exam Marks: 20			
	Time: 4 Hours		
Part B- Contents of the Course			
Instructions for Paper- Setter			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
Unit	Topics		Contact Hours
I	Remote sensing; history & development, satellites and their characteristics; LANDSAT; SPOT; IRS; IKONOS satellite series, Meteorological satellites; INSAT; NOAA; GOES, sensors; MSS; TM; LISS; WiFS; PAN, techniques and instruments for visual		12

	interpretation and interpretation keys.	
II	Remote sensing data products and their procurement; ground truth collection, display forms; computer printouts; thematic maps; dot density maps, digital photogrammetry; orthophotos; digital orthophotography, theory of orientation relationship between image and corresponding ground coordinates, collinearity and coplanarity of aerial photographs, aerial mosaics.	11
III	Cartography; nature and scope, relation between digital cartography, RS & GIS, map projection; azimuthal, cylindrical, conical and rectangular projection system, GPS system elements, classification and signals, interpretation of different resolution IRS satellite images; LISS III, PAN and WiFS.	11
IV	GIS; definition, concept and history, computer fundamentals, hardware and software requirements for GIS, integration of RS and GIS data, types of GIS modelling, remote sensing in ground water exploration, agriculture, agro-meteorology, soil erosion hazard assessment and forest density mapping.	11
V*	<ul style="list-style-type: none"> • Land use / land cover mapping • Identification of degraded lands • Land utilization mapping • Soil mapping • Crop estimation studies • Identification of forest species from aerial photographs • Vegetation mapping from satellite images • Digital image enhancements for vegetation/forest • NDVI analysis • Digital classification for forest cover mapping • Forest change detection studies 	30
Suggested Evaluation Methods		
Internal Assessment: >Theory <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 >Practical <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 		End Term Examination Theory : 50 Practical : 20
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ul style="list-style-type: none"> • Campbell, J.B.2002: Introduction to Remote Sensing. Taylor Publications • Drury, S.A., 1987: Image Interpretation in Geology. Allen and Unwin • Gupta, R.P., 1990: Remote Sensing Geology. Springer Verlag • Jensen, J.R. 2000: Remote Sensing of the Environment: An Earth Resource Perspective. Prentice Hall. • Anji Reddy, M. 2004: Geoinformatics for Environmental Management.B.S. Publications • Mishra R.P and Ramesh A. 1989: Fundamentals of Cartography. Concept Publishing Company • Nag P. and Kudrat M. 1998: Digital Remote Sensing. Concept Publication 		

Session: 2024-25			
Part A - Introduction			
Subject	BOTANY		
Semester	6th		
Name of the Course	Evolutionary and Behavioural Biology		
Course Code	B23-BOT-606		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-5		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Students will have a comprehensive understanding of concepts of evolution. 2. Students will be able to understand molecular basis of evolution. 3. Students will develop comprehensive knowledge about population genetics. 4. Students will develop a comprehensive understanding of behavioural biology. 5*. Students will gain knowledge about the tools and techniques used for studying evolutionary and behavioural biology. 		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 70		Time: 3 Hours	
Internal Assessment Marks: 20			
End Term Exam Marks: 50			
PRACTICAL			
Max. Marks: 30		Time: 4 Hours	
Internal Assessment Marks: 10			
End Term Exam Marks: 20			
Part B- Contents of the Course			
Instructions for Paper- Setter			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
Unit	Topics		Contact Hours
I	Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis; the evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multi cellular organisms; stages in plant evolution.		11
II	Approaches and methods in study of behaviour; proximate and		12

	ultimate causation; altruism and evolution, group selection, kin selection, reciprocal altruism; biological clocks; development of behaviour; use of space and territoriality; mating systems, parental investment and reproductive success; parental care.	
III	Concept of environment; biotic and abiotic interactions, concept of habitat and niche; characteristics of a population; population growth curves; r and K selection; concepts of species interactions.	11
IV	Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones; ecological succession and concept of climax; energy flow and mineral cycling (C, N, P); biogeographical zones of India; hotpots and Ramsar sites.	11
V*	<ul style="list-style-type: none"> • Study of convergence and divergence. • Construction of phylogenetic trees. • Study of floral-pollinator relationship. • Study of territoriality in animals. • Study of interaction between native and invasive plant species. • Study of interaction between native and invasive plant species. • Study of different seed dispersal mechanisms. • To measure pH, EC and TDS of different soil samples. • To measure pH, EC and TDS of different water samples. • Study of NTFPs in surrounding area. • To study density and abundance of plants by quadrat method. • To calculate biodiversity indices of herbaceous vegetations. 	30

Suggested Evaluation Methods

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 <p>➤ Practical</p> <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 	<p>End Term Examination</p> <p>Theory : 50 Practical : 20</p>
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Part C-Learning Resources

<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> • Hall, B.K., & Hallgrímsson, B. (2013). <i>Strickberger's Evolution</i> (5th ed.). Jones and Bartlett Publishers. • Klug, W.S., Cummings, M.R., Spencer, C.A., Palladino, M.A., & Killian, D. (2019). <i>Concepts of Genetics</i> (11th ed.). Pearson publishers. • Russel, P.J. (2016). <i>iGenetics: A Molecular Approach</i> (3rd ed.). Pearson publishers. • Snustad, D.P., & Simmons, M.J. (2015). <i>Principles of Genetics</i> (7th ed.). Wiley, Hoboken. • Brown, T.A. (2011). <i>Introduction to Genetics: A Molecular Approach</i>. (1st ed.). Garland Science. • Davies, N.B., Krebs, J.R., & West, S.A. (2012). <i>An Introduction to Behavioural Ecology</i> (4th ed.). Wiley-Blackwell.

Session: 2024-25			
Part A-Introduction			
Subject	BOTANY		
Semester	3rd		
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):	<p>Aftercompletingthiscourse, thelearnerwillbeableto:</p> <p>1: Students will be able to understand the need and concept to forganic and integrated farming system.</p> <p>2: Students will develop a conceptual understanding of plant nutrients, utilization of biofertilizers.</p> <p>3: Students will gain knowledge about the disease and pest management</p> <p>4: Students will learn about the use of plant products in organic farming, quality control and certification procedures of organic products.</p> <p>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.</p>		
Credits	Theory	Practical	Total
	2	2	4
Contact Hours	2	4	6
THEORY			
Max. Marks: 50		Time: 3 Hours	
Internal Assessment Marks: 15			
End TermExamMarks: 35			
PRACTICAL			
Max.Marks: 50		Time: 4 Hours	
Internal Assessment Marks: 15			
End Term Exam Marks: 35			
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	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-Concept to farming system, Developing organic farms, Important steps & methods; Pure organic farming and integrated farming system (combination of organic and inorganic).	7
II	Plant nutrients: Essential plant nutrients, their role in plant growth and development, Nutrient uptake and utilization by plant. Nutrient management in organic farming: Balanced nutrients supply for organic farming system using nutrients from organic sources. Preparation, nutrient content and methods of use of following- FYM/Rural compost, mulching, city compost, oil cakes, animal wastes, vermicomposts, vermivash, jeevamrit, beejamrit, green manures, biofertilizers.	7
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 on organic sources. Weed management in organic farming	8
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. Organic farming and food security in India.	8
V*	<ul style="list-style-type: none"> • Preparation of compost by open air composting. • Preparation of vermicompost. • Comparative analysis of plants grown in compost prepared in 1 and 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 in organic and inorganic fertilizers. • Comparative analysis of phosphorous content in organic and inorganic fertilizers. 	60

Suggested Evaluation Methods	
Internal Assessment: > Theory <ul style="list-style-type: none"> • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 > Practical <ul style="list-style-type: none"> • Class Participation :05 • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 	End Term Examination Theory : 35 Practical : 35
<ul style="list-style-type: none"> • Mid-Term Exam: 	
Part C-Learning Resources	
Recommended Books/e-resources/LMS: <ul style="list-style-type: none"> • 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		
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):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 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. <p>5*. Students will gain the knowledge of practical aspects of floriculture, management of nursery, maintenance of gardens, vase life of cutflowers, various methods used for the propagation of ornamental plants, hydroponics, and disease management.</p>		
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: History, importance and scope of floriculture and landscape gardening. Nursery management and routine garden operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators	7
II	Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.	7
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.	8
IV	Commercial floriculture: Factors affecting flower production; Production and packaging of cutflowers; Flower arrangements; Methods to prolong vase life. Cultivation of Important cut flowers-Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Liliun). Diseases and Pests of Ornamental Plants.	8
V*	<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 > Practical <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: 2024-25	
Part A-Introduction	
Subject	BOTANY
Semester	5th
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-3
Level of the course(As per Annexure-I)	100-199
Pre-requisite for the course(if any)	

Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 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. <p>5*. Students will gain the knowledge of practical aspects of management of nursery, gardens, vegetative propagation methods, and cultivation of different vegetables and flowers.</p>		
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			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
Unit	Topics		Contact Hours
I	<p>Nursery: Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities—planting, direct seeding and transplants.</p> <p>Seed: Structure and types -Seed dormancy; causes and methods of breaking dormancy</p> <p>Seed storage: Seed banks, factors affecting seed viability, genetic erosion.</p> <p>Seed production technology: Seed testing and certification.</p>		7

II	<p>Gardening: definition, objectives and scope- different types of gardening-landscape and home gardening-parks and its components-plant materials and design.</p> <p>Gardening operations: Soil laying, manuring, watering, management of pests and diseases and harvesting, sowing/raising of seeds and seedlings, transplanting of seedlings.</p> <p>Computer applications in landscaping.</p>	7
III	<p>Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings.</p> <p>Hardening of plants - greenhouse - mist chamber, shed root, shade house and glass house.</p>	8
IV	<p>Cultivation of different vegetables: Cabbage, Brinjal, Lady's finger, Onion, Tomatoes and carrots</p> <p>Cultivation of different flowers: Marigold, Liliun, Rose, Gerbera, Gladiolus, Chrysanthemum and Carnation.</p> <p>Storage and marketing procedures.</p>	8
V*	<ul style="list-style-type: none"> • Study of seed dormancy breakage by scarification and stratification. • Investigating the effect of different environmental conditions on seed germination. 	60
	<ul style="list-style-type: none"> • 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		
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 <p>➤ Practical</p> <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/Demonstration/Viva-voce/Lab records etc. : 10 • Mid-Term Exam : NA 		<p>End Term Examination</p> <p>Theory : 35 Practical : 35</p>

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.
- 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 Associates Inc. 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):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 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 of mushroom cultivation

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			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
Unit	Topics		Contact Hours
I	<p>Introduction, nutritional and medicinal value of edible mushrooms; poisonous mushrooms, types of edible mushrooms available in India-<i>Volvariellavolvacea</i>, <i>Pleurotuscitrinopileatus</i>, <i>Agaricus bisporus</i>.</p> <p>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.</p>		7
II	<p>Pureculture: medium, sterilization, preparation of spawn, multiplication.</p> <p>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</p>		7
III	<p>Storage: short term storage, long term storage (canning, pickels, papads), drying, storagein salt solutions.</p> <p>Nutritional value of some common commercially available mushrooms: proteins, amino acids, mineral elements nutrition, carbohydrates, crude fibre content and vitamins.</p>		8
IV	<p>Foodpreparation: type of food sprepared from mushrooms.</p> <p>Medicinal value of edible mushrooms.</p> <p>Researchcentres: National level and regional level. Cost benefit ratio: marketing in India and abroad. Export value.</p>		8

V*	<ol style="list-style-type: none"> 1. Sterilization of media for spawn preparation. 2. Preparation of spawn and multiplication. 3. Preparation of mushroom bed with different substrates. 4. Cultivation of <i>Pleurotussp.</i> 5. Cultivation of <i>Agaricussp.</i> 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 <ul style="list-style-type: none"> • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 > Practical <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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 advanced techniques for growing Shiitake, Oyster, Lion’s mane and Maitake mushrooms at home. Storey publishing 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.Wiley-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):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 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 to 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	7
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.	7
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.	8
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	8

	Modes of selection- Recurrent selection, its types and its procedure	
V*	<ol style="list-style-type: none"> 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 <ul style="list-style-type: none"> • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 >Practical <ul style="list-style-type: none"> • 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: <ol style="list-style-type: none"> 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):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 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 <p>5*. Gain knowledge and hand on experience in growing plants under various conditions and systems of vertical farming</p>		
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		
<u>Instructions for Paper- Setter</u>		
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>		
Unit	Topics	Contact Hours
I	<p>Vertical farming: concept, application and future prospects, vertical farms in India and world</p> <p>Media used in vertical farming, design and working of vertical farms</p> <p>Types of vertical farms: abandoned buildings, shipping-container, underground</p>	7
II	<p>Methods of vertical farming, selection of appropriate plants for vertical farming</p> <p>Introduction to Hydroponics and its types, Management of variables, disinfection of system, pest management.</p> <p>Aeroponics and Aquaponics</p>	7
III	<p>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 using specialized parts.</p>	8
IV	<p>Rooftop farming/greenhouses: strategies/technological solutions for management of climate, lightning, carbon dioxide enrichment and other parameters Opportunities & advantages of vertical farming- Environmental and economic benefits. Challenges for sustainability of vertical farming.</p>	8
V*	<ol style="list-style-type: none"> To grow plants under hydroponics and aeroponics Compare the rate of growth and vigor of hydroponically grown plants (under nutrient-rich and nutrient-deficient water conditions). To study the aquaponics system in reference to simultaneously grown plants and fish in the same system 	30

	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	
Suggested Evaluation Methods		
Internal Assessment: > Theory <ul style="list-style-type: none"> • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : 04 • Mid-Term Exam : 07 > Practical <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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)	100-109		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 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			
<u>Instructions for Paper- Setter</u>			
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>			
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*	<ol style="list-style-type: none"> 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. 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. 	30
Suggested Evaluation Methods		
Internal Assessment: >Theory <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 >Practical <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Bose T K <i>et al.</i> (2003) Vegetable crops, Naya Udhog 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	3 rd		
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):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 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		
<u>Instructions for Paper- Setter</u>		
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>		
Unit	Topics	Contact Hours
I	<p>General account about the microbes used as bio-fertilizers:</p> <p><i>Rhizobium</i>-isolation, identification, mass multiplication and carrier based inoculants, Actinorrhizal symbiosis.</p> <p><i>Azospirillum</i>: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.</p>	7
II	<p><i>Azotobacter</i>: classification, characteristics-crop response to <i>Azotobacter</i> inoculum, maintenance and mass multiplication.</p> <p>Cyanobacteria (blue green algae), <i>Azolla</i> and <i>Anabaena azollae</i> association, nitrogen fixation, factors affecting growth, blue green algae and <i>Azolla</i> in rice cultivation.</p>	7
III	<p>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.</p>	8
IV	<p>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.</p>	8

V*	<ol style="list-style-type: none"> 1. Isolation of microbes used as biofertilizers from soil. 2. Study of 3. <i>Rhizobium</i> from root nodules of leguminous plants by Gram staining method. 4. Test for pH, Cl and organic matter of different composts. 5. Observation of mycorrhizae from roots. 6. Production of VAM by pot culture. 7. Methods of sterilization, media preparation and inoculation of microbes. 8. Isolation of arbuscular mycorrhizal spores from rhizospheric soil. 9. Spots, Specimen /photographs of earthworm, <i>Azolla</i>, arbuscules vesicles. 10. Photographs of bio compost methods. 11. Projects on any topic mentioned in the syllabus, with <i>Rhizobium</i> technology, AMF technology, organic farming, vermicomposting, bio compost, <i>Azolla</i> culture. 	30
Suggested Evaluation Methods		
Internal Assessment: > Theory <ul style="list-style-type: none"> • Class Participation : 05 • Seminar/presentation/assignment/quiz/class test etc. : 05 • Mid-Term Exam : 10 > Practical <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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 Akta Prakashan, Nadiad. 		

Session: 2024-25			
Part A–Introduction			
Subject	BOTANY		
Semester	4th		
Name of the Course	Basics of Medicinal Plants		
Course Code	B23-VAC-408		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VAC-4		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	<p>After studying this course, the students will be able to understand:</p> <ol style="list-style-type: none"> 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
	1	1	2
ContactHours	1	2	3
THEORY			
Max. Marks: 30 Internal Assessment Marks: 10 End Term Exam Marks: 20		Time: 3 Hours	

PRACTICAL		
Max. Marks: 20 Internal Assessment Marks: 05 End Term Exam Marks: 15		Time: 4 Hours
Part B-Contents of the Course		
Instructions for Paper-Setter		
<p>1. Nine questions will be set in all. All questions will carry equal marks.</p> <p>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.</p>		
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.	4
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.	4
III	Important medicinal plants of India and their uses: <i>Dioscorea</i> , <i>Nardostachysjatamansi</i> , <i>Allium</i> , <i>Saussureaobvallata</i> , <i>Swertia chirata</i> , <i>Oscimum</i> , <i>Azadirachta</i> , <i>Rawolfia</i> , <i>Phyllanthus</i> , <i>Vinca rosea</i> , <i>Justicia adhatoda</i> , <i>Terminalia arjuna</i> , <i>T. chebula</i> , <i>Tamarindus indica</i> , <i>Aloe vera</i> , <i>Withaniasomnifera</i> .	4
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)	3
V*	<ul style="list-style-type: none"> • Collection, drying and identification of common medicinal plants • Preparation of herbal remedies: maceration, infusion, decoction, tinctures. • Preparation of herbal remedies: compress, bathing, pills, ointments • Harvesting, grading, and post-harvest handling of medicinal plants • Microscopic evaluation of herbal drug adulteration • To study methods for essential oil extraction 	30

Suggested Evaluation Methods	
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation : 04 • Seminar/presentation/assignment/quiz/class test etc. : NA • Mid-Term Exam : 06 <p>➤ Practical</p> <ul style="list-style-type: none"> • Class Participation : NA • Seminar/Demonstration/Viva-voce/Lab records etc. : 05 • Mid-Term Exam : NA 	<p>End Term Examination</p> <p>Theory : 20 Practical : 15</p>
Part C-Learning Resources	
<ul style="list-style-type: none"> • 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–Cultivation and Utilization of Medicinal Plants. • 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, Ayurvedka Pran: Vanoshadhivigyan, Vedmata Gayatri Trust, Shaktikunj Haridwar 2004 • Chaudhry R.D., Herbal Drug Industry, Eastern Publication • Raphael Ikan, Natural Products: A Lab Guide, Academic Press, 1991, 2nd edition • Dutt Ashwin, An Introduction to Medicinal Plants, Adhyayan Publishers, and distributors, 2009, 1st edition 	