

Ch. Ranbir Singh University, Jind

**Scheme of Examination and Syllabus for
Under-Graduate Programme**

Subject: Botany

**Under Multiple Entry-Exit, Internship and CBCS-LOCF in
accordance to NEP-2020**

DEPARTMENT OF BOTANY, Ch. Ranbir Singh University, Jind
Scheme of Examination for Under-Graduate Programme
Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020
Subject : Botany

SEMESTER-1									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A & C	CC-1 MCC-1 4 credit	B23-BOT-101	Diversity of Microbes, Algae, Fungi and Archegoniates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme C only	MCC-2 4 credit	B23-BOT-102	Conservation Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A	CC-M1 2 credit	B23-BOT-103	Plant Diversity	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.
Scheme A & C	MDC-1 3 credits	B23-BOT-104	Fundamentals of Botany	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
Scheme C only	CC-M1 4 credit	From Available CC-M1 of 4 credits as per NEP							
Scheme A & C	AEC-1 2 credit	From Available AEC-1 of two credits as per NEP							
	SEC-1 3 credit	From Available SEC-1 of three credits as per NEP							
	VAC-1 2 credit	From Available VAC-1 of two credits as per NEP							

SEMESTER-2									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A & C	CC-2	B23- BOT- 201	Plant Taxonomy and Ecology	3	3	20	50	70	3 hrs.
	MCC-3		Practical	1	2	10	20	30	4 hrs.
Scheme C only	DSEC- 2	B23- BOT- 202	Plant Propagation	3	3	20	50	70	3 hrs.
	4 credit		Practical	1	2	10	20	30	4 hrs.
Scheme A only	CC-M2	B23- BOT- 203	Plants for Human Welfare	1	1	10	20	30	3 hrs.
	2 credit		Practical	1	2	5	15	20	4 hrs.
Scheme A & C	MDC-2	B23- BOT- 204	Economic Botany	2	2	15	35	50	3 hrs.
	3 credits		Practical	1	2	5	20	25	4 hrs.
Scheme C only	CC-M2	4 credit	From Available CC-M2 of 4 credits as per NEP						
Scheme A & C	AEC-2	2 credit	From Available AEC-2 of two credits as per NEP						
	SEC-2	3 credit	From Available SEC-2 of three credits as per NEP						
	VAC-2	2 credit	From Available VAC-2 of two credits as per NEP						
Internship of 4 credits of 4-6 weeks duration after 2 nd Semester									

SEMESTER-3									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-3	B23-BOT-301	Plant Physiology	3	3	20	50	70	3 hrs.
	MCC-4		Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-5	B23-BOT-302	Plant Stress Physiology	3	3	20	50	70	3 hrs.
	4 credit		Practical	1	2	10	20	30	4 hrs.
Scheme A, B & C	MDC-3	B23-BOT-303	Ornamental Plants and Propagation	2	2	15	35	50	3 hrs.
	3 credits		Practical	1	2	5	20	25	4 hrs.
Scheme A & C	CC-M3	From Available CC-M3 of 4 credits as per NEP							
Scheme B only	CC-M3 (V)	From Available CC-M3(V) of 4 credits as per NEP							
Scheme A, B & C	AEC-3	From Available AEC-3 of two credits as per NEP							
	SEC-3	From Available SEC-3 of three credits as per NEP							
Scheme C only	VAC-3	From Available VAC-3 of two credits as per NEP							
Scheme B only	MCC-3	MCC-2 FROM SCHEME C OF FIRST SEMESTER							

SEMESTER-4										
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration	
Scheme A, B & C	CC-4	B23-BOT-401	Cytology and Genetics	3	3	20	50	70	3 hrs.	
	MCC-6		Practical	1	2	10	20	30	4 hrs.	
Scheme B & C	MCC-7	B23-BOT-402	Plant Molecular Biology	3	3	20	50	70	3 hrs.	
	4 credit		Practical	1	2	10	20	30	4 hrs.	
Scheme B & C	MCC-8	B23-BOT-403	Plant Breeding	3	3	20	50	70	3 hrs.	
	4 credit		Practical	1	2	10	20	30	4 hrs.	
Scheme B & C	DSE-1	B23-BOT-404	Plant Tissue Culture	3	3	20	50	70	3 hrs.	
			Practical	1	2	10	20	30	4 hrs.	
	4 credit	Select one option	B23-BOT-405	Bioethics, Biosafety and IPR	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.	
Scheme A, B & C	CC-M4 (V)	From Available CC-M4(V) of 4 credits as per NEP								
	4 credits	AEC-4	From Available AEC-3 of two credits as per NEP							
2 credit										
Scheme C only	VAC-4	From Available VAC-4 of two credits as per NEP								
2 credits										
Scheme A & B	VAC-3	From Available VAC-3 of two credits as per NEP								
2 credits										
Internship of 4 credits of 4-6 weeks duration after 4th Semester (if not done after second semester)										

SEMESTER-5									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours / Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-5 MCC-9 4 credit	B23-BOT-501	Economic Botany and Plant Biotechnology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-10 4 credit	B23-BOT-502	Reproduction in Higher Plants	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-2 4 credit Select one Option	B23-BOT-503	Plant Biochemistry and Metabolism	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-BOT-504	Modern Plant Systematics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-3 4 credit Select one Option	B23-BOT-505	Natural Plant Products	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23-BOT-506	Plants and Medicines	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A & C	CC-M5 (V) 4 credits	From Available CC-M5(V) of 4 credits as per NEP							
Scheme A, B & C	Internship 4 credits	Internship#4 credit after 4 th semester							

SEMESTER-6									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours / Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-6 MCC-11 4 credit	B23- BOT-601	Plant Anatomy & Embryology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-12 4 credit	B23- BOT-602	Plant Pathology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-4 4 credit	B23- BOT-603	Agroforestry	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
	Select one Option	B23- BOT-604	Post-harvest Technology of Fruits & Vegetables	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-5 4 credit Select one Option	B23- BOT-605	GIS and Remote Sensing	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		B23- BOT-606	Evolutionary and Behavioural Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A only	CC-M6 4 credits	From Available CC-M6 of 4 credits as per NEP							
Scheme A only	CC-M7(V) 4 credits	From Available CC-M7(V) of 4 credits as per NEP							
Scheme B only	CC-M5(V) 4 credits	From Available CC-M5(V) of 4 credits as per NEP							
Scheme C only	CC-M6(V) 4 credits	From Available CC-M6(V) of 4 credits as per NEP							
Scheme C only	SEC-4 2 credit	From Available SEC-4 of two credits as per NEP							

SEMESTER-7 (FOR HONOURS/HONOURS WITH RESEARCH IN BOTANY)									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
for Honours in Botany/Honours with Research in Botany (For Scheme B & C)	CC-H1 4 credit	B23-BOT-701	Algae & Fungi	4	4	30	70	100	3 hrs.
	CC-H2 4 credit	B23-BOT-702	Bryophytes & Pteridophytes	4	4	30	70	100	3 hrs.
	CC-H3 4 credit	B23-BOT-703	Cytogenetics & Plant Breeding	4	4	30	70	100	3 hrs.
	DSE-H1 4 credit	B23-BOT-704	Microbiology and Biostatistics	4	4	30	70	100	3 hrs.
	Select one Option	B23-BOT-705	Basics of Genomics and Proteomics	4	4	30	70	100	3 hrs.
		B23-BOT-706	Computational Biology	4	4	30	70	100	3 hrs.
	PC-H1 4 credit	B23-BOT-707	Practical Based on B23-BOT-701 TO 704/705/707	4	8	30	70	100	6 hrs.
	CC-HM1 4 credit	From Available Minor of 4 credits as per NEP							

SEMESTER-8 (FOR HONOURS IN BOTANY)									
Remarks	Course	Paper (s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Honours in Botany (For Scheme B & C)	CC-H4 4 credit	B23-BOT-801	Microbiology and Biostatistics	4	4	30	70	100	3 hrs.
	CC-H5 4 credit	B23-BOT-802	Natural Resources & Biodiversity	4	4	30	70	100	3 hrs.
	CC-H6 4 credit	B23-BOT-803	Gymnosperm & Ethanobotany	4	4	30	70	100	3 hrs.
	DSE-H2 4 credit Select one option	B23-BOT-804	Molecular Genetics	4	4	30	70	100	3 hrs.
		B23-BOT-805	Plant Morphogenesis	4	4	30	70	100	3 hrs.
	PC-H2 4 credit	B23-BOT-806	Practical Based on B23-BOT-801 TO 804/805	4	8	30	70	100	6 hrs.
	CC-HM2 4 credit	From Available Minor of 4 credits as per NEP							
OR SEMESTER-8 (FOR HONOURS WITH RESEARCH IN BOTANY)									
Remarks	Course	Paper (s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Honours with Research in Botany (For Scheme B & C)	CC-H4 4 credit	B23-BOT-801	Microbiology and Biostatistics	4	4	30	70	100	3 hrs.
	CC-H5 4 credit	B23-BOT-802	Natural Resources & Biodiversity	4	4	30	70	100	3 hrs.
	Project/Dissertation 12 credit	B23-BOT-807	Project/Dissertation	8+4	-	-	-	-	-
	CC-HM2 4 credit	From Available Minor of 4 credits as per NEP							

Syllabus

Subject : Botany

Part A - Introduction			
Subject	BOTANY		
Semester	1 st		
Name of the Course	Diversity of Microbes, Algae, Fungi and Archegoniates		
Course Code	B23-BOT-101		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-1/MCC-1		
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. Students will be able to understand the general characteristics of bacteria, actinobacteria, viruses and fungi. 2. Students will develop a conceptual understanding of Phycology. 3. Students will gain knowledge on the concepts of Bryology. 4. Basic understanding of the biology of pteridophytes will be developed by the students. <p>5*. Students will gain the knowledge of practical aspects of <u>microorganisms, algae, fungi, lichens, bryophytes, and pteridophytes.</u></p>		
Credits	Theory	Practical	Total
	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: 20 End Term Exam Marks: 10		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	<p>Bacteria: Structure, nutrition, reproduction and economic importance.</p> <p>Viruses: General account of Viruse including structure of TMV and Bacteriophages.</p> <p>Algae: General characters, Introductory classification; economic importance; and life cycle (excluding development) of <i>Nostoc</i> (Cyanophyceae), <i>Volvox</i>, (Chlorophyceae), <i>Vaucheria</i> (Xanthophyceae), <i>Ectocarpus</i> (Phaeophyceae) and <i>Polysiphonia</i> (Rhodophyceae).</p>	11
II	<p>Fungi: General characters, Introductory classification; economic importance; and life-history of <i>Phytophthora</i> (Mastigomycotina), <i>Penicillium</i> (Ascomycotina), <i>Puccinia</i> (Basidiomycotina), <i>Colletotrichum</i> (Deuteromycotina) General account of Lichens, types, ecological and economic importance.</p> <p>Bryophyta: Bryophytes: General characteristics, classification upto classes (Smith, 1935), alternation of generations, structure and reproduction (excluding development) of <i>Marchantia</i> (Hepaticopsida), ecological and economic importance of bryophytes.</p>	11
III	<p>Pteridophyta: General characters, classification upto classes (A. R. Smith, 2006), structure and reproduction (excluding development) of Rhynia (Psilopsida): Structure and</p>	11

	reproduction (excluding development) of <i>Pteris</i> (Pteropsida). heterospory and seed habit, stelar evolution; Ecological and economic importance.	
IV	Gymnosperms: General characteristics, classification up to classes (Smith 1955), morphology, anatomy and reproduction of <i>Cycas</i> , (developmental details not to be included); Distribution and economic importance; Geological time scale.	12
V*	<p>Viruses: EMS/Models of viruses: TMV, Line drawing/Photograph of Lytic and Lysogenic Cycles.</p> <p>Bacteria: Types of Bacteria from temporary/permanent slides/photographs; Binary Fission; Conjugation; Structure of root nodule.</p> <p>Cynobacteria & Algae: Study of vegetative and reproductive structures of <i>Nostoc</i>, <i>Volvox</i>, <i>Vaucheria</i>, <i>Ectocarpus</i> and <i>Polysiphonia</i> through temporary preparations and permanent slides.</p> <p>Fungi: Study of vegetative & reproductive structures of <i>Phytophthora</i>, <i>Mucor</i>, <i>Puccinia</i>, <i>Penicillium</i> & <i>Colletotrichum</i>: Asexual and sexual stages through temporary preparations and permanent slides.</p> <p>Lichens: Study of slides/photographs of lichens (crustose, foliose and fruticose).</p> <p>Funaria- Morphology, W.M. leaf, rhizoids, operculum, peristome, annulus, spores, slides showing antheridial and archegonial heads, L.S. capsule (temporary/permanent slides).</p> <p>Pteris- Morphology, T.S. rachis, V.S. sporophyll, W.M. sporangium, W.M. spores, T.S. rhizome, W.M. prothallus with sex organs and young sporophyte (temporary/permanent slide).</p> <p>Cycas- Morphology (coralloid roots, bulbil, leaf, megasporophyll), T.S. coralloid root, T.S. rachis, V.S. leaflet, V.S. microsporophyll, W.M. microspores, L.S. ovule, T.S. root (temporary/permanent slide).</p> <p>Excursion Report: Report on excursion tours with photographs, collection and preservation specimens related to Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.</p>	30

Suggested Evaluation Methods

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

Recommended Books/e-resources/LMS:

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. (2019) Prescott's Microbiology. 11th Edition. McGraw Hill International.
- Lee, R.E. (2018) Phycology. 5th Edition. Cambridge University Press.
- Aluwalia, A.S. (2020). Phycology: Principles, Processes and Applications. Daya Publishing House, New Delhi.
- Dube, H.C. (2012). An Introduction to Fungi, Vikas Publishing House Pvt. Ltd., Delhi. 4th edition.
- Mehrotra, R.S. and Aggarwal, Ashok (2013) Fundamentals of Plant Pathology, Tata McGraw-Hill Publishing company Ltd, New Delhi
- Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
- Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi, India.
- Sharma, O.P. (2017). Text Book of Pteridophyta, McMillan India Ltd.
- Thakur, A.K. and Bassi, S.K. (2008). Diversity of Microbes and Cryptogams. S. Chand & Co., Delhi.
- Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge

University Press.

- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Gymnosperms, S. Chand. Delhi, India.
- Pandey, B.P. (2001). A Textbook of Botany-Angiosperms, S. Chand. Delhi, India

Part A – Introduction

Subject	BOTANY		
Semester	1 st		
Name of the Course	Conservation Biology		
Course Code	B23-BOT-102		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-2		
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> <p>1: Students will comprehend the fundamental principles of biodiversity.</p> <p>2: Students will acquire a conceptual understanding of the classifications used by the IUCN.</p> <p>3: Students will acquire knowledge about the principles of conservation laws and international legislation.</p> <p>4: Students will develop a foundational understanding of international legislation.</p> <p>5*: Student will learn about the practical approaches to protect and restore the biological communities.</p>		
Credits	Theory	Practical	Total
	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: 20 End Term Exam Marks: 10		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>Biodiversity: Types of Biodiversity; Level of Biodiversity: genetic, species and ecosystem; Patterns of biodiversity; Factors affecting biodiversity: over exploitation, habitat loss and degradation, invasive species, disease, natural calamities, global change.</p> <p>Concept of endemism in plants, endemic plants of Western Ghats.</p>	11
II	<p>IUCN categories: not evaluated; data deficient; least concern; near threatened, vulnerable, endangered, critically endangered, extinct in wild; extinct categories. Principles of conservation; in situ and ex situ conservation; Economics of conservation</p>	11
III	<p>Conservation laws and international legislation. Soil erosion and conservation methods. Conservation of Forests: Afforestation, Reforestation, Monoculture and their effects. Conservation of water: water scarcity, rain water harvesting, watershed management. World Biodiversity hotspots; Wetlands.</p>	11
IV	<p>Categories of Protected areas: IA Strict Nature reserves, IB Wilderness area; II National Park; III Natural monument or feature; IV Habitat or species management area; V Protected landscape/seascape; VI Protected area with sustainable use of natural resources, Sustainable development goals.</p> <p>Recent conservation approaches in India.</p>	12
V*	<ul style="list-style-type: none"> • To determine the Calcium content of soil samples using titration method. • To estimate available N₂ in a given soil sample. • To determine the role of CO₂ evolution from the given soil sample. • To calculate their phosphorous content of the given soil sample. • To interpret the Annual Forest report with reference to Haryana. • To study the Biosphere reserves of India - National park, wildlife sanctuaries in Haryana. 	30

Suggested Evaluation Methods

Internal Assessment:

➤ Theory

- Class Participation:
- Seminar/presentation/assignment/quiz/class test etc.:
- Mid-Term Exam:

➤ Practicum

- Class Participation:
- Seminar/Demonstration/Viva-voce/Lab records etc.:
- Mid-Term Exam:

End Term Examination:

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Wetlands Through Time By Stephen F. Greb, William A. DiMichele Published by Geological Society of America, 2006
- Introduction to Conservation Genetics: Richard Frankham, Jonathan D. Ballou and David A. Briscoe By Richard Frankham, David Anthony Briscoe, Jonathan D. Ballou, Karina H. Cambridge University Press, 2012
- Plant Conservation Genetics By Robert J. Henry Published by Cambridge University Press, 2012.
- Wetlands By William J. Mitsch, James G. Gosselink Published by John Wiley and Sons, 2007.
- Hunter Jr., M. L. Fundamentals of Conservation Biology. Blackwell Science, Malden, Massachusetts, U.S.A 2021.
- Red Data Books Vols. 1 to 4. Botanical Survey of India, Dehradun
- Benson EE. Plant Conservation Biotechnology. Agrosiences, New Delhi, 2014.

- Gaston KJ. Biodiversity: An Introduction, 2/e. Agrosiences, New Delhi, 2004.
- Megadiversity Conservation: Flora, Fauna and Medicinal Plants of India's Hot Spots By AB Chaudhuri, D. D. Sarkar Published by Daya Books, 2004.
- 2000 IUCN Red List of Threatened Species By Craig Hilton-Taylor, Russell A. Mittermeier, International Union for Conservation of Nature and Natural Resources Species Survival Commission, BirdLife International, Conservation International Published by IUCN, 2000.
- Ex Situ Plant Conservation: Supporting Species Survival in the Wild By Edward O. Guerrant, Kayri Havens, Mike Maunder, Peter H. Raven Published by Island Press, 2004.

Part A - Introduction			
Subject	BOTANY		
Semester	1st		
Name of the Course	Plant Diversity		
Course Code	B23-BOT-103		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-M1		
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> <p>1: The general characteristics of microorganisms, algae, fungi, and lichens will be understandable to students.</p> <p>2: Students will acquire a conceptual grasp of bryophytes and pteridophytes.</p> <p>3: Students will acquire knowledge about the fundamental features of gymnosperms.</p> <p>4: Students will acquire a foundational understanding of angiosperm morphology.</p> <p>5*. Student will gain the knowledge about the practical aspects related to identification, structure, economic values of microorganisms, algae, fungi, bryophytes, pteridophytes gymnosperms, and angiosperms.</p>		
Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
THEORY			
Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35		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

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 characteristics, morphology and economic importance of viruses, bacteria, algae, fungi and lichens.	4
II	General characteristics, morphology and economic importance of Bryophytes and Pteridophytes.	4
III	General characteristics, morphology and economic importance of Gymnosperms.	4
IV	General characteristics, morphology and economic importance of Angiosperms.	3
V*	<ul style="list-style-type: none"> • Identification of some common algae and fungi. • Morphological study of some common Bryophytes. • Morphological study of some common Pteridophytes. • Morphological study of some common Gymnosperms. • Morphological study of some common Angiosperms. 	30
Suggested Evaluation Methods		

Internal Assessment:	End Term Examination:
<p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 	

Part C-Learning Resources**Recommended Books/e-resources/LMS:**

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. (2019) Prescott's Microbiology. 11th Edition. McGraw Hill International.
- Lee, R.E. (2018) Phycology. 5th Edition. Cambridge University Press.
- Ahluwalia, A.S. (2020). Phycology: Principles, Processes and Applications. Daya Publishing House, New Delhi.
- Dube, H.C. (2012). An Introduction to Fungi, Vikas Publishing House Pvt. Ltd., Delhi. 4th edition.
- Mehrotra, R.S. and Aggarwal, Ashok (2013) Fundamentals of Plant Pathology, Tata McGraw-Hill Publishing company Ltd, New Delhi
- Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
- Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi, India.
- Sharma, O.P. (2017). Text Book of Pteridophyta, McMillan India Ltd.
- Thakur, A.K. and Bassi, S.K. (2008). Diversity of Microbes and Cryptogams. S. Chand & Co., Delhi.
- Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.
- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India
- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Gymnosperms, S. Chand. Delhi, India
- Pandey, B.P. (2001). A Textbook of Botany-Angiosperms, S. Chand. Delhi, India

Part A – Introduction

Subject	BOTANY		
Semester	1st		
Name of the Course	Fundamentals of Botany		
Course Code	B23-BOT-104		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC-1		
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> <p>1: Students will gain a foundational understanding of the biology of microorganisms, algae, fungi and lichens.</p> <p>2: Students will develop a conceptual understanding of bryophytes and pteridophytes.</p> <p>3: Students will acquire knowledge about the fundamental characteristics of gymnosperms and the challenges related to their propagation.</p> <p>4: Students will acquire a basic understanding of angiosperm morphology.</p> <p>5*: Students will be able to learn the practical aspects of microorganisms, algae, fungi and students will be able to identify the major groups of plants and compare the characteristics of higher plants(angiosperms and gymnosperms)and lower plants (bryophytes and pteridophytes).</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

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
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		Hours
I	General characteristics, morphology and economic importance of viruses, bacteria algae, fungi and lichens.	7
II	General characteristics, morphology and economic importance of Bryophytes and Pteridophytes.	7
III	General characteristics, morphology and economic importance of Gymnosperms.	8
IV	General characteristics, morphology and economic importance of Angiosperms.	8
V*	<ul style="list-style-type: none"> • Cynobacteria&Algae: Study of slides of <i>Nostoc</i> and <i>Volvox</i> through permanent slides. • <i>Penicillium</i>: Asexual stage and sexual structures through permanent slides. • <i>Agaricus</i>: Specimens of button stage and full grown mushroom. • <i>Marchantia & Funaria</i>- morphology of thallus through permanent slides. • <i>Selaginella & Equisetum</i>- morphology specimen study. • <i>Cycas & Pinus</i> - morphology specimen study. • Study of vegetative and floral characters of the one or two members of some important families • Excursion Report: Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and specimens related to Archegoniates and Angiosperms. Mounting of a collected, properly dried and pressed specimen of minimum 20 wild plants with herbarium label. 	30
Suggested Evaluation Methods		

Internal Assessment:**> Theory**

- Class Participation:
- Seminar/presentation/assignment/quiz/class test etc.:
- Mid-Term Exam:

> Practicum

- Class Participation:
- Seminar/Demonstration/Viva-voce/Lab records etc.:
- Mid-Term Exam:

End Term Examination:**Part C-Learning Resources****Recommended Books/e-resources/LMS:**

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. (2019) Prescott's Microbiology. 11th Edition. McGraw Hill International.
- Lee, R.E. (2018) Phycology. 5th Edition. Cambridge University Press.
- Ahluwalia, A.S. (2020). Phycology: Principles, Processes and Applications. Daya Publishing House, New Delhi.
- Dube, H.C. (2012). An Introduction to Fungi, Vikas Publishing House Pvt. Ltd., Delhi. 4th edition.
- Mehrotra, R.S. and Aggarwal, Ashok (2013) Fundamentals of Plant Pathology, Tata McGraw-Hill Publishing company Ltd, New Delhi
- Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
- Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi, India.
- Sharma, O.P. (2017). Text Book of Pteridophyta, McMillan India Ltd.
- Thakur, A.K. and Bassi, S.K. (2008). Diversity of Microbes and Cryptogams. S. Chand & Co., Delhi.
- Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.
- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India
- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Gymnosperms, S. Chand. Delhi, India
- Pandey, B.P. (2001). A Textbook of Botany-Angiosperms, S. Chand. Delhi, India

Second Semester

Part A - Introduction	
Subject	BOTANY
Semester	2nd
Name of the Course	Plant Taxonomy and Ecology
Course Code	B23-BOT-201
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-2/MCC-3
Level of the course (As per Annexure-I)	

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 gain knowledge about taxonomy, including the rules of nomenclature and other essential aspects. 2: Students will acquire a conceptual understanding of angiosperm classification systems and the diversity of families within them. 3. Students will gain knowledge about Ecology and Environmental interactions. 4: Students will acquire a conceptual understanding of ecosystem structure, environmental pollution and biodiversity conservation. 5*. Students will gain the knowledge about the diagnostic features, morphology, internal structure, economic value of angiosperms and ecological concepts and biodiversity indices. 		
Credits	Theory	Practical	Total
	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	<p>Botanical nomenclature and major rules of ICBN and ICN; Keys to identification of plants.</p> <p>General introduction and importance of herbaria and botanical gardens. Types of inflorescence, flower and parts of flower.</p>	11
II	<p>Artificial, natural and phylogenetic classifications. Bentham and Hooker system of classification (upto series) Diagnostic features and economic importance of the following families: Brassicaceae, Malvaceae, Leguminosae, Solanaceae and Poaceae</p>	12
III	<p>Ecology: Definition; scope and importance; levels of organization. Environmental factors- climatic factors, edaphic factors, topographic; and Biotic factors. Population Ecology: Basic concept; characteristics; biotic potential, growth curves; ecotypes and ecads.</p>	11
IV	<p>Ecosystem: Structure and functions (trophic levels, food chains, food webs, ecological pyramids and energy flow). Phyto-geography: Phyto-geographical regions of India; vegetation types of India (forests). Environmental Pollution: Sources, types and control of air and water pollution. Global Change: Greenhouse effect and greenhouse gases; impacts of global warming. Biodiversity: levels, types, significance, threats and conservation.</p>	11

V*	<ul style="list-style-type: none"> • Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter. • Determination of pH, and analysis of two soil samples for carbonates, chlorides and sulphates by rapid field test. • Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats. • To determine inorganic carbon content of given soil samples. • To determine organic carbon content of given soil samples by acid dilution method. • (a) Study of morphological adaptations of hydrophytes and 	30
	<p>xerophytes (four each). (b) Study of biotic interactions of the following: Stem parasite (<i>Cuscuta</i>), Root parasite (<i>Orobanchae</i>), Epiphytes (Orchid) and Predation (Insectivorous plants) using museum specimens/ live plants.</p> <ul style="list-style-type: none"> • Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus or nearby fields by species area curve method (species to be listed). • Quantitative analysis of herbaceous vegetation in the college campus or nearby fields for frequency and comparison with Raunkiaer's frequency distribution law. • Study of vegetative and floral characters of the one or two member of each family/sub-family mentioned in theory syllabus (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification). • Excursion Report: Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and specimens related to Angiosperms. Mounting of a collected, properly dried and pressed specimen of minimum 20 wild plants with herbarium label. 	
Suggested Evaluation Methods		
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 	<p>End Term Examination:</p>	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Singh, G. (2021). Plant Systematics: An Integrated Approach, CRC Press.
- Sharma, O.P. (2017). Plant Taxonomy, Mc Graw Hill Publication.
- Levetin, E. & McMahon, K. 2015. Plants and Society, McGraw-Hill Education. 7th edition.
- Smith, T.M. & Smith, R.L. 2014. Elements of Ecology. Pearson. 9th edition.
- Gangulee, Das and Datta (2011). College Botany Volume 1, New Central Book Agency
- Gangulee, Das and Datta (2011). College Botany Volume 2, New Central Book Agency
- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Gymnosperms, S. Chand.
- Taylor, E.L., Taylor, T.N., Krings, M. (2009). Paleobotany: The Biology and Evolution of Fossil Plants, Academic Press.
- Pandey, B.P. (2001). A Textbook of Botany-Angiosperms, S. Chand.
- Pandey, B.P. (2001). A Textbook of Botany-Angiosperms, S. Chand.
- Chapman, J.L. & Reiss, M.J. 1999. Ecology: Principles and Applications. Cambridge

University Press.

- Odum E.P. (1971): Fundamentals of Ecology 3rd edition. Saunders College Publishing/Harcourt Brace.

Part A – Introduction			
Subject	BOTANY		
Semester	2 nd		
Name of the Course	Plant Propagation		
Course Code	B23-BOT-202		
Course Type: (CC/MCC/MDC/C C- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSEC-1		
Level of the course (As per Annexure-I)			
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <p>1. Students will acquire knowledge regarding the fundamental aspects of plant propagation.</p> <p>2: Students will develop a conceptual understanding of seed propagation. 3: Students will gain knowledge about vegetative propagation methods.</p> <p>4: Students will acquire a conceptual understanding of cell and tissue propagation techniques.</p> <p>5*. Students will be able to demonstrate the basic principles and practical consideration of in vitro plant cell/tissue culture, plant propagation methods, sterilization methods, tools and techniques.</p>		
Credits	Theory	Practical	Total
	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	General aspects of plant propagation: Evolution of plant propagation techniques; Biology of plant propagation: impact of genes; Effect of environment on propagation: Greenhouse systems, environmental control	11
II	Seed propagation: Seed development, principles and practices of seed selection, techniques of seed production and handling, principles and techniques of seed propagation.	11
III	Vegetative propagation: Principles and Practices of Clonal Selection; Principles and techniques of propagation by cuttings; Principles and techniques of Grafting and Budding; Layering and Its Natural Modifications; Propagation by Specialized Stems and Roots	12
IV	Cell and Tissue propagation: Principles and Techniques of Micropropagation from Meristematic Tissue; Principles and Techniques of Plant Tissue Culture from Non-meristematic Tissue.	11
V*	<ul style="list-style-type: none"> • Study of tools used in plant propagation. • Cutting techniques of selected plants: hardwood cuttings, softwood cuttings, greenwood cuttings, semi-ripe cuttings, root cuttings and leaf cuttings. • Layering and air-layering in selected plants. • Grafting and division. • Micropropagation: Sterilization of explants, dissection of meristematic regions, media preparation and explant proliferation. • Preparation of compost/growing media. • Hardening and aftercare of propagated plants. 	30

Suggested Evaluation Methods

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 	<p>End Term Examination:</p>
<p>Part C-Learning Resources</p>	
<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> • Razdan, M.K. 2019. Introduction To Plant Tissue Culture. OXFORD & IBH Publishing. 3rd edition. • Loyola-Vargas, V.M. & Ochoa-Alejo, N. 2018. Plant cell culture protocols. Humana Press. 4th edition. • Beyl, C.A. & Trigiano, R.N. 2014. Plant Propagation Concepts and Laboratory Exercises. CRC Press, Boca Raton, FL. 2nd edition. • MacDonald, P.T. 2014. The Manual of Plant Grafting: Practical Techniques for Ornamentals, Vegetables, and Fruit. Timber Press, Portland, OR. • Kyte, L., J. Kleyn, H. Scoggins & M. Bridgen. 2013. Plants from Test Tubes: An Introduction to Micropropagation, Timber Press Inc., Portland, OR. 4th edition. • Smith, R.H. 2013. Plant Tissue culture: techniques and experiments. Elsevier. 3rd edition. • Bhojwani, S.S. & Razdan, M.K. 2009. Plant tissue culture: Theory and Practice. Elsevier India Pvt. Ltd. • George, E.F., Hall, M.A., Klerk, G.J. 2008. Plant Propagation by Tissue Culture. Springer. 3rd edition. • Dirr, M.A. & Heuser, Jr. C.W. 2006. The Reference Manual of Woody Plant Propagation From Seed to Tissue Culture. Timber Press, Inc. Portland, OR. 2nd edition. 	

Part A - Introduction

Subject	BOTANY
Semester	2nd
Name of the Course	Plants for Human Welfare
Course Code	B23-BOT-203
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-M2

Level of the course (As per Annexure-I)			
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 acquire a foundational understanding of plant diversity. 2: Students will develop a conceptual grasp of plants utilized for human welfare. 3: Students will gain knowledge about the origins of certain cultivated plants. 4: Students will acquire a conceptual understanding of the utilization of fruits, nuts, and other plant components for human welfare. 5*: Students will acquire the knowledge about the economic valuable plants and their products. 		
Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3

THEORY

Max. Marks: 50
Internal Assessment Marks: 15
End Term Exam Marks: 35

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

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	Level of plant diversity, agrodiversity. Values and uses of Biodiversity.	3
II	Role of plants in relation to Human Welfare; Economic and ecological Importance of agro and social forestry. Ornamental plants of India.	4
III	Origin of Cultivated Plants Morphology and economic importance of : Food plants - Cereals (Rice, Wheat and Maize). Pulses - Gram, Arhar and Pea.	4
IV	Fruits and nuts: Important fruit crops and their commercial importance. Spices and condiments. Wood and its uses.	4
V*	<ul style="list-style-type: none"> • Identification and study of some important medicinal plants. • Identification and study of some common ornamental plants. • Identification and study of some important cereals. • Identification and study of some important pulses. • Identification and study of some important spice yielding plants. • Study of different types of woods. • Study of different fruit types. 	30

Suggested Evaluation Methods

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

Recommended Books/e-resources/LMS:

- Singh, V., Pande, P.C., Jain, D.K. 2018. Economic Botany, Rastogi Publications.
- Kocchar, S.L. 2016. Economic Botany: A Comprehensive Study, 5 Ed, Cambridge India.
- Wickens, G.E. 2001. Economic Botany: Principles and Practices, Springer.
- Singh, V., Pande, P.C., Jain, D.K. 2018. Economic Botany, Rastogi Publications.
- Daubenmire, R.F. Plants & Environment (2nd Edn.,) John Wiley & Sons., New York 22
- Odum E.P. 2005. Fundamentals of Ecology (5nd Edn.,) Saunders & Co., Philadelphia
- S. Sundar Rajan-2007. College Botany Vol-V, Part 1: Taxonomy and Economic Botany Himalaya Publishing House.
- Susil Kumar Mukharjee-2004. College Botany Vol-III. New Central Book agency, London

Part A - Introduction			
Subject	BOTANY		
Semester	2nd		
Name of the Course	Economic Botany		
Course Code	B23-BOT-204		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC-2		
Level of the course (As per Annexure-I)			
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 gain a foundational understanding of the origins of significant cultivated plants. 2: Students will develop a conceptual understanding of important plants that yield vegetables, fiber, and oil. 3: Students will acquire knowledge about the cultivation techniques of essential plants. 4: Students will gain a conceptual understanding of the processing methods applied to economically significant plants. <p>5*. Students will be able to gain the knowledge of economic values of cereals, legumes, spices, oil & fibre yielding plants.</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			
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	Origin of Cultivated Plants Morphology and economic importance of : Food plants - Cereals (Rice, Wheat and Maize). Pulses - Gram, Arhar and Pea.	7
II	Vegetables: Potato, Tomato and Onion. Fibers: Cotton Oils: Mustard and Coconut.	7
III	Morphology and economic importance of the following: Spices: Black pepper, Coriander, Ginger, Cloves, saffron. Medicinal Plants: <i>Cinchona</i> , <i>Atropa</i> , Opium, <i>Cannabis</i> , Neem.	8
IV	Botanical description and processing of: Beverages: Tea and Coffee. Types of wood.	8
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, Coconut, Mustard and different types of wood. Collection and preparation of reports on various crops and economically important plants being cultivated/wildly available in your area. 	30

Suggested Evaluation Methods

Internal Assessment: > Theory <ul style="list-style-type: none"> Class Participation: Seminar/presentation/assignment/quiz/class test etc.: Mid-Term Exam: > Practicum <ul style="list-style-type: none"> Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.: Mid-Term Exam: 	End Term Examination:
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Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Singh, V., Pande, P.C., Jain, D.K. 2018. Economic Botany, Rastogi Publications.
- Kocchar, S.L. 2016. Economic Botany: A Comprehensive Study, 5 Ed, Cambridge India.
- Wickens, G.E. 2001. Economic Botany: Principles and Practices, Springer.
- Singh, V., Pande, P.C., Jain, D.K. 2018. Economic Botany, Rastogi Publications.
- Daubenmire, R.F. Plants & Environment (2nd Edn.,) John Wiley & Sons., New York 22
- S. Sundar Rajan-2007. College Botany Vol-V, Part 1: Taxonomy and Economic Botany Himalaya Publishing House.
- Susil Kumar Mukharjee-2004. College Botany Vol-III. New Central Book Agency, London

Third Semester

Part A - Introduction			
Subject	BOTANY		
Semester	3 rd		
Name of the Course	Plant Physiology		
Course Code	B23-BOT-301		
Course Type: (CC/MCC/MDC/C C- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-3/MCC-4		
Level of the course (As per Annexure-I)			
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 acquire an understanding of various physiological process in plants. 2: Students will develop a comprehensive knowledge of plant hormones. 3: Students will learn about photomorphogenesis and its significance. 4: Students will gain a conceptual understanding of plant growth and senescence, including the natural aging process of plants. 5*. Students will be able to demonstrate practical aspects and learn the basic concepts of various physiological and biochemical process of plant 		
Credits	Theory	Practical	Total
	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	Plant water relations: absorption, water potential and transpiration; role of micro and macro nutrients. Photosynthesis.	11
II	Biosynthesis, mechanism of action and uses of auxin, gibberellin, cytokinin, abscisic acid, ethylene, Nitrogen metabolism.	11
III	Structure and function of phytochromes; stomatal movement; photoperiodism and biological clocks; mechanism of flowering.	12
IV	Concepts of plant growth; factors affecting germination and dormancy of seeds; physiological and biochemical changes associated with senescence and abscission.	11
V*	<ul style="list-style-type: none"> • Demonstration of imbibition by plaster of Paris method. • Demonstration of Osmosis by potato osmoscope method. • To study the Osmotic pressure of onion scale/ Rhoeo leaf peel by plasmolytic method. • To separate photosynthetic pigments by thin layer/paper chromatography. • To study the phenomenon of seed germination (effect of light). • To study the induction of amylase activity in germinating 	30

	barley grains. <ul style="list-style-type: none"> • To demonstrate suction due to transpiration. • Determination of glucose by Benedict's solution. • To study the process of etiolation in the laboratory. • To study the action of Ethylene hormone on fruit ripening. 	
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Suggested Evaluation Methods

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

Recommended Books/e-resources/LMS:

- Pandey, S.N & Sinha BK. 2018. Plant Physiology .Vikas Publishing House Pvt. Ltd. 4th edition
- Jain, V. K. 2017. Fundamentals of Plant Physiology. S. Chand publishing. 20th edition
- Gupta, N.K. Bala, MKSM. Gupta, M. 2016. Practical in Plant Physiology and Biochemistry. Scientific Publishers, India
- Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. 2015. Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
- Verma, V. 2015. Plant Physiology 2nd Ed. Athena Academic.
- James, P.G. 2013. A textbook of Plant Physiology. Harpress Publishing.
- Illahi, I. 2009. *Plant Physiology. Biochemical Processes in Plants*. UGC Press.
- Hopkins, W.G. and Huner, A. 2008. Introduction to Plant Physiology. John Wiley and Sons.U.S.A. 4th edition.
- Salisbury, F.B. and Ross, C.W. 2002. Plant Physiology. Wordsworth Publishing Co. Belmont CA. 7th edition.

Part A - Introduction			
Subject	BOTANY		
Semester	3 rd		
Name of the Course	Plant Stress Physiology		
Course Code	B23-BOT-302		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-5		
Level of the course (As per Annexure-I)			
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 acquire an understanding of how plants respond physiologically to biotic stress. 2. Students will develop a comprehensive knowledge of the genetic mechanisms plants employ to defend against biotic stress. 3. Students will learn about the effects of environmental factors on plants. 4. Students will gain a conceptual understanding of how plants sense and respond to abiotic stress. 5*. Students will be able to demonstrate the practical approach of plant responses under biotic and abiotic stress, and the biochemical test for secondary metabolites. 		
Credits	Theory	Practical	Total
	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			
<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	Physiological responses of plants to biotic stress; mechanisms of defense in plants (mechanical and biochemical) against pathogens, insects, herbivores and wounding; role of plant toxins, and secondary metabolites in defense.	11
II	Genetic mechanisms of defense during biotic stress; plant-pathogen interaction; role of hormones in regulating biotic stress responses; allelopathy; local acquired resistance, induced systemic resistance and systemic acquired resistance.	11
III	Impact of environmental factors on plants; physiological and biochemical responses of plants in response to water deficit, salinity, flooding, soil compaction, high and low temperatures, high light intensity, heavy metals and nutrient deficiency.	12
IV	Abiotic stress sensing mechanisms in plants; Antioxidants and ROS scavenging pathways; molecular chaperones in abiotic stress; role of phytohormones and calcium signaling.	11
V*	<ul style="list-style-type: none"> • Study of osmotic potential of plants grown under water-deficit and salinity stress. • Study of transpiration in plants grown under ambient and high light intensities. • Effect of different NaCl concentrations on the photosynthetic rate of plants (<i>Hydrilla</i>). • Estimation of catalase activity in stressed plants (salinity and water-deficit). • Estimation of sugar (glucose) content in normal and diseased plants (Black stem rust, Bacterial blight and Leaf curl disease). • Study of the effect of soil compaction on the growth of seedlings of different plants. • Study of allelopathic effect of <i>Parthenium hysterophorus</i> crude extracts on the seed germination. 	30
Suggested Evaluation Methods		
Internal Assessment: > Theory <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: > Practicum <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 		End Term Examination:

Recommended Books/e-resources/LMS:

- Gupta, D.K. & Palma, J.M. 2021. Plant growth and stress physiology. Springer Cham.
- Pandey, S.N & Sinha BK. 2018. Plant Physiology .Vikas Publishing House Pvt Ltd. 4th edition
- Jain, V. K. 2017. Fundamentals of Plant Physiology. S. Chand publishing. 20th edition
- Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. 2015. Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
- Hota, Dharamvir. 2007. Synthetic plant growth regulators.
- Mukherji, S. & Ghosh, A. K. 2005. Plant Physiology. New Central Book Agency, Kolkata.
- Basra. A.S., 2004. Plant Growth regulators in Agriculture and Horticulture, International Book Distributing Co.
- Dwivedi & Dwivedi 2005. Physiology of abiotic stress in plants. Agro bios. India
- Panda S.K. 2002. Advances in Stress Physiology of Plants. Scientific Publishers, Jodhpur.

Part A - Introduction			
Subject	BOTANY		
Semester	3rd		
Name of the Course	Ornamental Plants and Propagation		
Course Code	B23-BOT-303		
Course Type: (CC/MCC/MDC/C C- M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC-3		
Level of the course (As per Annexure-I)			
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 acquire an understanding of the history of gardens in India and other countries. 2. Students will develop comprehensive knowledge about different groups of plants used as ornamentals. 3. Students will learn about flower and seed production. 4. Students will gain a deep understanding of vegetative propagation methods for ornamental plants. 5*. Students will be able to learn various types of gardens & their significance, management, and methods of propagation of valuable plants. 		
Credits	Theory	Practical	Tota 1

	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	History of gardens in India; terrace gardening; popular gardens of India; Types of gardens: Formal and Informal gardens; Styles of gardens: Mughal gardens, Persian gardens, Italian gardens, French gardens, English gardens, Japanese gardens.	7
II	Significance of Shrubs, trees, palms, ferns, cycads, cacti and succulents, climbers, creepers, indoor plants, water plants, bonsai plants asornamentals.	7
III	Flower and seed production; protected cultivation of ornamentals; present position and scope of floriculture in India.	8
IV	Vegetative propagation-principles and practices of clone selection; techniques of cutting, budding, grafting and layering; propagation by specialized stems and roots.	8
V*	<ul style="list-style-type: none"> • Preparation of nursery beds – flat, raised and sunken beds • Identification and description of various plants grown in ornamental gardens. • Tools, implements and containers used in ornamental gardening. • Planning, designing and establishment of garden features viz. lawn, hedge and edge, rockery etc. • To study propagation by separation and division technique. • Preparation of land for lawn and planting. • To study propagation by cuttings, layering, grafting and budding • Flower arrangement practices. • Preparation of bouquets, garland. 	30

Suggested Evaluation Methods

Internal Assessment:
➤ Theory

- Class Participation:
- Seminar/presentation/assignment/quiz/class test etc.:
- Mid-Term Exam:

➤ Practicum

- Class Participation:
- Seminar/Demonstration/Viva-voce/Lab records etc.:
- Mid-Term Exam:

End Term Examination:

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Singh, A.K. & Kumar A. 2023. Plant Propagation and Nursery management. S.K. Kataria and sons.
- Arora, J.S. 2016. Introductory Ornamental Horticulture. Kalyani Publishers. 8th edition.
- Sachdeva, P. & Tongbram, V. 2014. A Naturalist's guide to the trees & Shrubs of India. Prakash Books.
- Jain, S.M. & Ochatt, S.J. 2009. Protocols for in vitro propagation of ornamental plants: 598 (Methods in Molecular Biology). Humana Press.
- Sabina, GT and Peter KV. 2008. Ornamental Plants for Gardens. New India Publ. Agency.
- Reddy S, Janakiram B, Balaji T, Kulkarni S & Misra RL. 2007. Hightech Floriculture. Indian Society of Ornamental Horticulture, New Delhi.
- Bhattacharjee SK. 2006. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.
- Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
- Prasad S & Kumar U. 2003. Commercial Floriculture. Agrobios
- Lauria A & Victor HR. 2001. Floriculture – Fundamentals and Practices Agrobios.

Forth Semester

Part A - Introduction			
Subject	BOTANY		
Semester	4th		
Name of the Course	Cytology and Genetics		
Course Code	B23-BOT-401		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-4/MCC-6		
Level of the course (As per Annexure-I)			
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 understand the fundamental characteristics of cells. 2: Students will acquire comprehensive knowledge about cell division and the central dogma of molecular biology. 3: Students will learn about the principles of inheritance in biology. 4: Students will develop a thorough understanding of mutations, chromosomal aberrations, and the concept of linkage. <p>5*. Students will be able to understand the basic principles of <u>laws of inheritance, stains & staining techniques, cell division processes, chromosome mapping, and chromosomal aberration.</u></p>		
Credits	Theory	Practical	Total
	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	Cell as a unit of Life; The Cell Theory; Prokaryotic and eukaryotic cells; Eukaryotic Cell components Structure and functions of Cell Wall, Plasma Membrane, nucleus, Nuclear Envelope- structure of nuclear pore complex, Golgi Apparatus, Ribosome, Endoplasmic Reticulum, Chloroplast, Mitochondria and Vacuoles.	11
II	Cell Division: Mitosis and Meiosis. Chromosome: structural organization, ultrastructure of Centromere, lampbrush and polytene chromosomes. DNA: structure, types and replication. RNA: structure and types. Genetic code.	11
III	Mendel's laws of Inheritance. Lethal Genes; Codominance, incomplete dominance; Gene interaction (inter- and intra-allelic); Multiple allelism; Pleiotropism. Cytoplasmic Inheritance: leaf variegation in <i>Mirabilis jalapa</i> ,	12
IV	Complete & incomplete linkage, recombination frequency, crossing over. Chromosomal aberrations- deletions, duplications, translocations, inversions; Variations in chromosome number- aneuploidy, polyploidy; sex chromosomes and sex determination.	11
V*	<ul style="list-style-type: none"> • To study the structure and functioning of a compound microscope. • To study strains and fixatives used in cytogenetics. • To study the karyotype using a given metaphase chromosome picture (<i>Allium cepa</i>). • To work out the genetics of a cross from the given F₂ harvest. • To study different mitotic stages in root tips of <i>Allium cepa</i>. • Meiosis through temporary squash preparation. 	30

	<ul style="list-style-type: none"> • Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis. • Chromosome mapping using test cross data. • Pedigree analysis for dominant and recessive autosomal and sex linked traits. • Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4). • Chromosome anomaly : Translocation Ring, Laggards and Inversion Bridge, break etc through slides. 	
Suggested Evaluation Methods		
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 	End Term Examination:	
Part C-Learning Resources		
<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> • Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimore, D. and Darnell, J. 2021. Molecular Cell Biology, W.H. Freeman and Co., New York., USA. 9th edition. • Singh, BD. 2020. Genetics. Kalyani Publishers Delhi. • Pierce BA 2020. Genetics: A Conceptual Approach. Palgrave Macmillan U.K. 7th edition. • Cummings MR, Klug WS, Spencer, CA, Palladino, MA, Killian D. 2019. Concepts of Genetics, Pearson. 12th edition. • Karp, G. Iwasa, J. Marshall W. 2019. Cell and Molecular Biology. Concepts and Experiments. John Wiley and Sons. New York. 9th edition. • Gardner EJ, Simmons MJ, Snustad DP 2012. Principles of Genetics. Wiley India. 8th edition. • Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. 2010. Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition. • Sen, S. Kar, D.K. Johri, B.M. 2005. Cytology and Genetics. Alpha Science International Ltd. • Dyonsager, V. R. 2000. Cytology and Genetics. TATA and McGraw Hill Publication Co. Ltd, New Delhi. 3rd edition. 		

Part A - Introduction			
Subject	BOTANY		
Semester	4th		
Name of the Course	Plant Molecular Biology		
Course Code	B23-BOT-402		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-7		
Level of the course (As per Annexure-I)			
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 gain an understanding of the essential characteristics of DNA. 2: Students will acquire comprehensive knowledge about RNA and its functions. 3: Students will acquire knowledge about proteins, including their structure and functions. 4: Students will develop a comprehensive understanding of the mechanisms and regulation of gene expression. <p>5*. Students will acquire the knowledge of experimentation performed for the identification of <u>DNA/RNA as genetic material</u>, estimation of DNA/RNA, and bacterial growth medium.</p>		
Credits	Theory	Practical	Total
	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	Nucleic acids: Carriers of genetic information: Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty), Types of genetic material, denaturation and renaturation, Nucleosome. DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons)	11
II	RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).	11
III	Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins).	12
IV	Control of gene expression at transcription and translation level (regulating the expression of prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).	11
V*	<ul style="list-style-type: none"> • Preparation of LB medium and raising E. coli. • Isolation of genomic DNA from E. coli./onion roots • RNA estimation by orcinol method. • DNA estimation by diphenylamine reagent/UV Spectrophotometry. • Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, • Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments) • Study of Barr body from buccal smear preparation. 	30

Suggested Evaluation Methods

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

Recommended Books/e-resources/LMS:

- Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimore, D. and Darnell, J. 2021. Molecular Cell Biology, W.H. Freeman and Co., New York., USA. 9th edition.
- Karp, G. Iwasa, J. Marshall W. 2019. Cell and Molecular Biology. Concepts and Experiments. John Wiley and Sons. New York. 9th edition.
- Krebs, J.E. Goldstein E.S. Kilpatrick S.T. 2017. Lewin's Genes XII. Jones and Bartlett Publishers, Inc. 12th edition.
- Watson, J.D. 2017. Molecular Biology of the gene. Pearson Education India. 7th edition.
- Cooper, G.M. and Hausman, R.E. 2013. The Cell: A Molecular Approach. Sinauer Associates, Sunderland, Massachusetts U.S.A. 6th edition.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2008. The World of the Cell. Pearson Benjamin Cummings Publishing, San Francisco. 7th edition.
- Alberts, B. Johnson A. Lewis, J. Raff, M. Roberts K. & Walter P. 2007. Molecular Biology of Cell. W.W. Norton & Company. 5th edition.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. Lippincott Williams and Wilkins, New York. 8th edition.
- Sen, S. Kar, D.K. Johri, B.M. 2005. Cytology and Genetics. Alpha Science International Ltd.

Part A - Introduction	
Subject	BOTANY
Semester	4 th
Name of the Course	Plant Breeding
Course Code	B23-BOT-403
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-8
Level of the course (As per Annexure-I)	

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 develop a foundational understanding of plant breeding principles. 2. Students will acquire comprehensive knowledge about the geographical centers of origin and the process of domestication of crop plants. 3. Students will gain knowledge about the cytogenetic basis underlying plant breeding techniques. 4. Students will develop a comprehensive understanding of the development of mapping populations, QTL analysis, GWAS, and other relevant methodologies used in plant breeding research. 5*. Students will develop the practical knowledge about the tools and techniques used in plant breeding. 		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
THEORY			
Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35		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	Objectives of plant breeding; modes of reproduction in crop plants; important achievements and undesirable consequences of plant breeding; floral biology in self- and cross-pollinated species; male sterility in plant breeding.	11
II	Centers of origin and domestication of crop plants; plant genetic resources; acclimatization; selection methods for self-pollinated, cross-pollinated and vegetatively propagated plants; hybridization for self, cross and vegetatively propagated plants-procedure, advantages and limitations.	11

III	Cytogenetic basis of plant breeding-variation in chromosome number, mutation, fertility regulation mechanism, gene recombination in plant breeding; role of mutations, distant hybridization and biotechnology in crop improvement.	12
IV	Development of mapping population-RIL/NIL/double haploid including CSSL/BIL lines;QTL mapping bylinkage analysis andby association analysis (GWAS); history, applications andgenetic basis of inbreeding depression andheterosis.	11
V*	<ul style="list-style-type: none"> • To study different tools and techniques used in plant breeding. • To study grafting methods and its advantages. • To study different methods of vegetative propagation. • To estimate plant height and tiller number in a rice/wheat variety statistically. 	30

Suggested Evaluation Methods

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

Recommended Books/e-resources/LMS:

- Singh, B.D. 2022. Plant Breeding: Principles and Methods. Medtech Science Press. 12th edition.
- Singh, BD. 2020. Genetics. Kalyani Publishers Delhi.
- Cummings MR, Klug WS, Spencer, CA, Palladino, MA, Killian D. 2019. Concepts of Genetics, Pearson. 12th edition.
- Chopra, V.L. 2018. Plant Breeding: Theory and Practices New India Publishing Agency-NIPA, New Delhi. 2nd edition.
- Simmonds, N.W. & Smart J. 2013. Principles of crop improvement. Wiley India Pvt. Ltd. 2nd edition.
- Acquah, G. 2012. Principles of Plant Genetics & Breeding. Willey-Blackwell Publishing. 2nd edition.
- Gardner E.J., Simmons M.J., Snustad D.P. 2012. Principles of Genetics. Wiley India. 8th edition.
- Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. 2010. Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
- Brown, J. Caligari, P. & Campos H. 2008. Plant Breeding. Willey-Blackwell Publishing. 2nd edition.

Part A - Introduction			
Subject	BOTANY		
Semester	4th		
Name of the Course	Plant Tissue Culture		
Course Code	B23-BOT-404		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-1		
Level of the course (As per Annexure-I)			
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 acquire a fundamental understanding of plant tissue culture. 2. Students will develop comprehensive knowledge about various culture methods used in plant tissue culture. 3. Students will gain knowledge about the basic principles of recombinant DNA technology. 4. Students will develop a comprehensive understanding of transgenic plants, including methods of gene transfer and selection. <p>5*. Students will gain the knowledge about the tools and techniques used for in vitro plant cell/tissue culture, growth medium, culturing of explants, gene transfer methods genetically modified plants/crops.</p>		
Credits	Theory	Practical	Total
	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	<p>Plant Tissue Culture: Historical perspective; Aseptic tissue culture techniques, Totipotency; Differentiation and dedifferentiation.</p> <p>Methodology: Sterilization (physical and chemical methods), Composition of media; Nutrient and hormone requirements (role of vitamins and hormones), medium for micropropagation/clonal propagation of ornamental and medicinal plants. Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).</p>	11
II	<p>Callus subculture maintenance, growth measurements, morphogenesis in callus cultures : Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Anther culture, Embryo culture, Endosperm culture, Embryo rescue technique. Artificial seed production. Hardening and Acclimatization.</p>	11
III	<p>Recombinant DNA technology-I: Restriction Endonucleases (role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic and Eukaryotic. Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning). Recombinant DNA technology-II: Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain genes of interest by genetic selection; complementation, colony hybridization.</p>	12
IV	<p>Methods of gene transfer- Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics–selectable marker and reporter genes (Luciferase, GUS, GFP). Transgenic plants: Pest resistant (Bt-cotton); herbicide resistant plants (Roundup Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.</p>	11
V*	<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 	30

- using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.
- Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds.
 - Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
 - Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.
 - Isolation and quantification of genomic DNA from bacteria (*E. coli*) or Plants
 - Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
 - Production of wine from the fruit juice of grapes by fermentation process using yeast.

Suggested Evaluation Methods

Internal Assessment:

➤ Theory

- Class Participation:
- Seminar/presentation/assignment/quiz/class test etc.:
- Mid-Term Exam:

➤ Practicum

- Class Participation:
- Seminar/Demonstration/Viva-voce/Lab records etc.:
- Mid-Term Exam:

End Term Examination:

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Stewart C.N. 2016. Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A. 2nd edition.
- Singh. B.D. 2016. Biotechnology. Kalyani Publishers. 5th edition.
- Beyl, C.A. & Trigiano, R.N. 2014. Plant Propagation Concepts and Laboratory Exercises. CRC Press, Boca Raton, FL. 2nd edition.
- MacDonald, P.T. 2014. The Manual of Plant Grafting: Practical Techniques for Ornamentals, Vegetables, and Fruit. Timber Press, Portland, OR.
- Kyte, L., J. Kleyn, H. Scoggins & M. Bridgen. 2013. Plants from Test Tubes: An Introduction to Micropropagation, Timber Press Inc., Portland, OR. 4th edition.
- Smith, R.H. 2013. Plant Tissue culture: techniques and experiments. Elsevier. 3rd edition.
- Glick, B.R., Pasternak, J.J. & Patten C.L. 2010. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington. 4th edition.
- Bhojwani, S.S. & Razdan, M.K. 2009. Plant tissue culture: Theory and Practice. Elsevier India Pvt. Ltd.

- George, E.F., Hall, M.A., Klerk, G.J. 2008. Plant Propagation by Tissue Culture. Springer. 3rd edition.

Part A – Introduction			
Subject	BOTANY		
Semester	4th		
Name of the Course	Bioethics, Biosafety and IPR		
Course Code	B23-BOT-405		
Course Type: (CC/MCC/MDC/CC - M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-1		
Level of the course (As per Annexure-I)			
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 acquire a fundamental understanding of the basics of bioethics and biosafety. 2: Students will develop comprehensive knowledge about the ethical issues concerning biotechnology. 3: Students will gain knowledge about the safety of modified crops. 4: Students will develop a comprehensive understanding of the different forms of IPR. <p>5*. Students will gain the basic knowledge about the various tools and software used for the searching & formatting of scientific articles, plagiarism detection, plant breeders & farmers rights.</p>		
Credits	Theory	Practical	Total
	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	Ethical conflicts in biological sciences; bioethics in health care; artificial reproductive technologies; ethics in transplantation and stem cell research; biopiracy; biosafety levels.	11
II	Ethical issues concerning biotechnology; primary containment for biohazards; recommended biosafety levels for specific microorganisms; biosafety guidelines for industrial operations with GMOs and field trial of GM crops.	11
III	Environmental risk assessment and food and feed safety assessment; balance of genetically altered and natural population in an ecosystem; safety of modified crops; social and economic effects.	12
IV	Different forms of IPR; patents, copyrights, designs, trademarks, geographical indication, trade secrets, semiconductor integrated circuit layout designs, plant breeders and farmers rights; general concept of patenting;	11
V*	<ul style="list-style-type: none"> • Plagiarism detection tools in scientific literature. • Case studies related to scientific article retraction. • Scientific article search tools; PubMed and Google scholar. • Formatting scientific literature; APA, AMA, MLA and NLM. • Case study: Protection of Plant Varieties and Farmers' Rights Act, 2001. • Case studies related to IPR. 	30

Suggested Evaluation Methods

Internal Assessment:

> Theory

- Class Participation:
- Seminar/presentation/assignment/quiz/class test etc.:
- Mid-Term Exam:

> Practicum

- Class Participation:
- Seminar/Demonstration/Viva-voce/Lab records etc.:
- Mid-Term Exam:

End Term Examination:

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Sateesh, M.K. 2020. Bioethics and Biosafety. Wiley India.
- Fleming, D.O. & Hunt, D. L. 2014. Biological Safety: Principles and Practices. ASM Press. 4th Edition.
- Rathore, N.S. Mathur, S.M. Mathur, P. & Rathi, A. 2013. Intellectual Property Rights: Drafting, Interpretation of Patents Specification and claims. New India Publishing Agency-NIPA.
- Parashar, S. & Goel, D. 2013. IPR, Biosafety and Bioethics. Pearson Education, India.
- Poltorak, A.I. & Lerner, P.J. Wiley. 2011. Essentials of Intellectual Property: Law, Economics, and Strategy. John Wiley & Sons Inc. 2nd edition.
- Rallapalli, R. & Bali, G. 2011. Bioethics & Biosafety. APH Publication Corporation.
- Mepham, B. 2008. Bioethics: An introduction for the Biosciences. Oxford University Press. 2nd edition.
- Thomas J.A., Fuch R.L. 2002. Biotechnology and Safety Assessment. Academic Press. 3rd Edition.
- Cutter, S.I. 2003. Environmental Risks and Hazards. Publishers Prentice Hall.
- Donnellan, C. 2002. Cloning. Independent Educational Publication.

Part A - Introduction

Subject	BOTANY
Semester	3rd
Name of the Course	Organic Farming
Course Code	B23-BOT-109
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC-1

Level of the course (As per Annexure-I)			
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 need and concept of organic and integrated farming system. 2: Students will develop a conceptual understanding of plant nutrients, utilization of biofertilizers. 3: Students will gain knowledge about the disease and pest management 4: Students will learn about the use of plant products in organic farming, quality control and certification procedures of organic products. <p>-----</p> <ol style="list-style-type: none"> 5*. Students will gain the knowledge of practical aspects of organic and integrated farming system, role of nutrient in plant growth, utilization of plant and animal waste in organic farming, and also learn about the standardization procedures. 		
Credits	Theory	Practical	Total
	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	Basics of organic farming – Concept and components of organic farming, aims and objectives; Need of organic farming; Historical development of organic farming in India; Status of organic farming in India; Advantages and disadvantages of organic farming. Organic farming process- Concept of farming	11
	system, Developing organic farms, Important steps & methods; Pure organic farming and integrated farming system (combination of organic and inorganic).	
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, vermiwash, jeevamrit, beejamrit, green manures, biofertilizers.	11
III	Bio fertilizers 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 inorganic farming	12
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.	11

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. 	30
Suggested Evaluation Methods		
Internal Assessment: <ul style="list-style-type: none"> ➤ Theory <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: ➤ Practicum <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 		End Term Examination:
<ul style="list-style-type: none"> • Mid-Term Exam: 		
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

- Chandran, S., Unni M.R., Thomas, S. Meena, D.K. 2023. Organic Farming: Global Perspectives and Methods. Elsevier.
- Somasundaram, E. Udhaya Nandhini, D., Meyyappan, M. 2021. Principles of Organic Farming. CRC Press.
- Chandran, S., Thomas, S., Unni M.R. 2019. Organic Farming: New Advances Towards Sustainable Agricultural Systems. Springer.
- Giri b, 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.

Part A – Introduction	
Subject	BOTANY
Semester	4th
Name of the Course	Floriculture
Course Code	B23-BOT-209
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC-2
Level of the course (As per Annexure-I)	
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 gardens and importance of landscaping. 4. Students will learn about commercial floriculture and cultivation of important cut flowers. <p>5*. Students will gain the knowledge of practical aspects of floriculture, management of nursery, maintenance of gardens, vase life of cut flowers, various methods used for the propagation of ornamental plants, hydroponics, and disease management.</p>		
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Credits	Theory	Practical	Total
	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: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	11
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.	11
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.	12
IV	Commercial floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life. Cultivation of Important cut flowers- Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Liliium). Diseases and Pests of Ornamental Plants.	11
V*	<input type="checkbox"/> Plant propagation by cutting. <input type="checkbox"/> Plant propagation by grafting. <input type="checkbox"/> Plant propagation by air-layering. <input type="checkbox"/> Investigating the effect of different flower preservatives on the vase life of common ornamental flowers. <input type="checkbox"/> Setting up a laboratory scale hydroponics setup. <input type="checkbox"/> Preparation of different types of floral arrangements. <input type="checkbox"/> Morpho-anatomical study of different types of flowers. <input type="checkbox"/> Study of different diseases in ornamental plants.	30

Suggested Evaluation Methods

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 	<p>End Term Examination:</p>
<p>Part C-Learning Resources</p>	
<p>Recommended Books/e-resources/LMS:</p> <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 in vitro 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. 	

Part A - Introduction			
Subject	BOTANY		
Semester	5 th		
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)			
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
	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

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	<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>	11
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>	11
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>	12
IV	<p>Cultivation of different vegetables: Cabbage, Brinjal, Lady's finger, Onion, Tomatoes and carrots</p> <p>Cultivation of different flowers: Marigold, Liliium, Rose, Gerbera, Gladiolus, Chrysanthemum and Carnation.</p> <p>Storage and marketing procedures.</p>	11
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. 	30

<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 as topping, thinning, or pinching, on plant growth, 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: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 	End Term Examination:
Part C-Learning Resources	
<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> • 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 in vitro 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. 	

Part A - Introduction			
Subject	BOTANY		
Semester	6 th		
Name of the Course	Mushroom Cultivation		
Course Code	B23-VOC-309		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VA C)	VOC-4		
Level of the course (As per Annexure-I)			
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 edible mushrooms. 4. Students will learn 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
	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, nutritional and medicinal value of edible mushrooms; poisonous mushrooms, types of edible mushrooms available in India- <i>Volvariella volvacea</i> , <i>Pleurotus citrinopileatus</i> , <i>Agaricus bisporus</i> . Required infrastructure: substrates (locally available), polythene bags, vessels, inoculation hook, inoculation loop, low cost stoves, sieves, culture racks, mushroom unit (thatched house), water sprayer, tray, etc.	11
II	Pure culture: medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation- paddy straw, sugarcane trash, maize straw, banana leaves, Factors affecting the mushroom bed preparation- low cost technology, composting technology in mushroom production	11
III	Storage: short term storage, long term storage (canning, pickles, papads), drying, storage in salt solutions. Nutritional value of some common commercially available mushrooms: proteins, amino acids, mineral elements nutrition, carbohydrates, crude fibre content and vitamins.	12
IV	Food preparation: type of foods prepared from mushrooms. Medicinal value of edible mushrooms. Research centres: National level and regional level. Cost benefit ratio: marketing in India and abroad. Export value.	11
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>Pleurotus</i> sp. 5. Cultivation of <i>Agaricus</i> sp. 6. Evaluation of total soluble sugar content of commonly available mushrooms. 7. Evaluation of total protein content of commonly available mushrooms. 8. Preparation of dried mushroom powder for long term storage and its nutrient evaluation. 	30

Suggested Evaluation Methods

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

Recommended Books/e-resources/LMS:

- Bray, R. 2019. Mushroom cultivation: 12 ways to become the MacGyver of Mushrooms. Urban Homesteading.
- 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. Mycology Press.
- Cheung, P.C. 2008. Mushrooms as Functional foods. Willey-Interscience.
- Tripathi, D.P. 2005. Mushroom Cultivation. Oxford & IBH Publishing Co. PVT.LTD, New Delhi.
- Paul Stamets, J.S. & Chilton, J.S. 2004. Mushroom cultivation: A practical guide to growing mushrooms at home, Agarikon Press.
- Chang, S.F. Miles, P.G. & Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. CRC press. 2nd edition.
- Bahl, N. 2000. Handbook on Mushrooms. Oxford & IBH Publishing Co. Pvt. Ltd.

Session: 2023-24

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)

200-299

Pre-requisite for the course (if any)

Course Learning Outcomes (CLO):

After studying this course, the students will be able to understand:

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

Contact Hours

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

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	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>Nardostachys jatamansi</i> , <i>Allium</i> , <i>Saussurea obvallata</i> , <i>Sivertia chitrata</i> , <i>Oscimum</i> , <i>Azadirachta</i> , <i>Ravolfia</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>Withania somnifera</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

Internal Assessment:

> Theory

- Class Participation : 05
- Seminar/presentation/assignment/quiz/class test etc. : 05
- Mid-Term Exam : 10

> Practical

- 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

- 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

Session 2024-25

Subject - Botany

Skill Enhancement Course

Session 2024-25			
Part A - Introduction			
Subject	Botany		
Semester	2 nd		
Name of the course	PLANTS FOR HUMAN WELFARE		
Course Code	B23-BOT-205		
Course Type	SEC-2		
Course Learning Outcomes	<p>This course is intended to provide the basic understanding the origin, morphology, cultivation of major crops. It also deals with the traditional knowledge and utility of some common spices, condiments, medicinal plants and horticulture crops.</p> <p>Outcomes:</p> <p>CO1 Explain the origin of agriculture and centers of origin of various crops</p> <p>CO2 Identify the plant sources of foods, modern and traditional medicines, spices, oil, fibers, dyes, gum and timbers.</p> <p>CO3 Learn about plant sources of psychoactive compounds, ornamental plants and identification of common food adulterants</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: 5 End Term Exam Marks: 20	Time : 3 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>			
Units	Topics		Contact Hours
Unit-1	Crop plants: Origin & Idea about of common crop plants Minor Cereals, Major cereals Pseudo-cereals and pulses		7 Hours

Spices and condiments		
Unit-II	Medicinal plants: Importance of medicinal plants, role in human welfare Traditional knowledge and utility of some common medicinal plants Nutritive and medicinal value of some fruits and vegetables	7 Hours
Unit-III	Beverages Common ornamental plants Common food adulterants	8 Hours
Unit-IV	Common timber yielding plants and minor forest products General account of Fibers, dyes, tannins, gums and resins Insecticides from plants, Pyrethrum and Rotenone	8 Hours
Unit-V* Practicals	1 Study of Cereals- Wheat, Rice, Maize 2. Morphology of Medicinal Plants- Tulsi, Neem, Datura 3. Morphology of Beverages- Tea & Coffee 4. Study of Morphology and Products- Jeera, Dhaniya, Clove, Ginger 5. Study of Morphology of Turmeric, Onion, Tomato and Potato	30 Hours

Suggested Evaluation Methods

Internal Assessment:

- Theory
- ☑ Class Participation:
- ☑ Seminar/presentation/assignment/quiz/class test etc.:
- ☑ Mid-Term Exam:
- Practicum
- ☑ Class Participation:
- ☑ Seminar/Demonstration/Viva-voce/Lab records etc.:
- ☑ Mid-Term Exam: Internal Assessment:

End Term
Examinations

Part C: Learning Resources

Suggested Readings:

- Kochar, S.L. 1981. Economic Botany in the Tropics. Macmillan India Ltd., Delhi.
- Hill, A.F. 1952. Economic Botany (2nd Ed.) McGraw Hill, New York.
- Cobley, L.S. and Steele, W.M. 1976. An Introduction to the Botany of Tropical Crops (2nd Ed.) Longmans, London.
- Simmonds, N.W. 1976. Evolution of Crop Plants Longman, London, New York.
- SambaMurthy, AVS and Subrahmanyam, N.S. 1989. A Text Book of Economic Botany. Wiley Eastern Ltd., Delhi
- Schery, R.W. 1972. Plants for Man. Prentice Hall, Englewood Cliffs, N.J. USA
- Simpson B. B. M. C. Ogorzaly 2001. Economic botany: plants of our world, 3rd ed. McGraw-Hill, New York, New York, USA.

Format for Designing the Syllabus of a Course

Session: 2023-24			
Part A - Introduction			
Subject	BOTANY		
Semester	3rd		
Name of the Course	Plant Hybridization		
Course Code	B23-BOT-304		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VA C)	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. 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 <hr/> <p>5*. Gain knowledge about the floral structures and underlying plant breeding techniques.</p>		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
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	<p>General objectives of plant breeding Major achievements, Future Prospects.</p> <p>Self-incompatibility- Definition, classification, heteromorphic SI, homomorphic SI i.e. gametophytic SI and sporophytic SI, utilization of self-incompatibility in plant breeding</p>	11
II	<p>Definition and concept of population genetics, random mating population, gene and genotypic frequency Hardy-Weinberg law- Law, its validity, factors affecting gene frequency</p> <p>Heterosis- Definition, heterosis and hybrid vigour, effects and estimation of heterosis, genetic basis/theories of heterosis Inbreeding depression- Definition, effects of inbreeding.</p>	11
III	<p>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</p> <p>Wide hybridization- Definition, types, main features, interspecific and intergeneric hybridization, its examples,</p>	12

	incompatibility barriers for wide hybridization, techniques for overcoming incompatibility barriers, achievements.	
IV	<p>Methods of breeding in self-pollinated crops- Pure line selection, mass selection, pedigree method, bulk method.</p> <p>Methods of breeding in cross pollinated crops- list of plant breeding methods for cross pollinated crops</p> <p>Modes of selection- Recurrent selection, its types and its procedure</p>	11
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		
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 		End Term Examination:
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

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

Session: 2023-24	
Part A - Introduction	
Subject	BOTANY
Semester	3 rd
Name of the Course	Vertical Farming
Course Code	B23-BOT-305
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VA C)	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. Understand the principles and concepts of vertical farming systems such as such as hydroponics, aeroponics, and aquaponics 2. Learn how to select suitable crops for vertical farming and understand best practices for their cultivation 3. Understand the principles of designing and planning a vertical farm

	4. Explore the economic aspects of vertical farming, including business models, market trends, and the financial viability of vertical farming		
	5*. Gain knowledge and hand on experience in growing plants under various conditions and systems of vertical farming		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
THEORY			
Max. Marks: 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			
<u>Instructions for Paper- Setter</u>			
1. Nine questions will be set in all. All questions will carry equal marks.			
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			
Unit	Topics	Contact Hours	
I	Vertical farming: concept, application and future prospects, vertical farms in India and world Media used in vertical farming, design and working of vertical farms Types of vertical farms: abandoned buildings, shipping-container, underground	11	
II	Methods of vertical farming, selection of appropriate plants	11	

	<p>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>	
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>	11
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>	12
V*	<ol style="list-style-type: none"> 1. To grow plants under hydroponics and aeroponics 2. Compare the rate of growth and vigor of hydroponically grown plants (under nutrient-rich and nutrient-deficient water conditions). 3. To study the aquaponics system in reference to simultaneously grown plants and fish in the same system 4. To study sustainable farming techniques for urban areas. 5. Compare the rate of growth and vigor of aeroponically grown plants (under nutrient-rich and nutrient-deficient mist/fog conditions) 6. To study the wind-powered vertical farming tower 	30
Suggested Evaluation Methods		
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 		<p>End Term Examination:</p>
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

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

Session: 2023-24	
Part A - Introduction	
Subject	BOTANY
Semester	3rd
Name of the Course	Olericulture
Course Code	B23-BOT-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):	After completing this course, the learner will be able to:		
	<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: 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			
<u>Instructions for Paper- Setter</u>			
<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	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.		11

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.	11
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.	11
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.	12
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: <ul style="list-style-type: none"> ➤ Theory <ul style="list-style-type: none"> • Class Participation: • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: ➤ Practicum <ul style="list-style-type: none"> • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: • Mid-Term Exam: 		End Term Examination:
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

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

Session: 2023-24	
Part A - Introduction	
Subject	BOTANY
Semester	3 rd
Name of the Course	Biofertilizers
Course Code	B23-BOT-307
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VA C)	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. 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: 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			
<u>Instructions for Paper- Setter</u>			
1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			
Unit	Topics	Contact Hours	
I	General account about the microbes used as bio-fertilizers: <i>Rhizobium</i> -isolation, identification, mass multiplication and carrier based inoculants, Actinorrhizal symbiosis. <i>Azospirillum</i> : isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.	11	
II	<i>Azotobacter</i> : classification, characteristics-crop response to <i>Azotobacter</i> inoculum, maintenance and mass multiplication.	11	

	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.	
III	Mycorrhizal association, types of mycorrhizal association, occurrence and distribution, nutrition, growth and yield – colonization of VAM – isolation and inoculums production of VAM, and its influence on growth and yield of crop plants.	11
IV	Organic farming: Green manuring and organic fertilizers. Recycling of biodegradable municipal, agricultural and Industrial wastes- bio-compost making methods. Vermicomposting – field application. Antagonistic bacteria and fungi- role in agriculture.	12
V*	<ol style="list-style-type: none"> 1. Isolation of microbes used as biofertilizers from soil. 2. Study of <i>Rhizobium</i> from root nodules of leguminous plants by Gram staining method. 3. Test for pH, Cl and organic matter of different composts. 4. Observation of mycorrhizae from roots. 5. Production of VAM by pot culture. 6. Methods of sterilization, media preparation and inoculation of microbes. 7. Isolation of arbuscular mycorrhizal spores from rhizospheric soil. 8. Spots, Specimen /photographs of earthworm, <i>Azolla</i>, arbuscules vesicles. 9. Photographs of biocompost methods. 10. Projects on any topic mentioned in the syllabus, with <i>Rhizobium</i> technology, AMF technology, organic farming, vermicomposting, biocompost , <i>Azolla</i> culture. 	30
Suggested Evaluation Methods		

Internal Assessment:**➤ Theory**

- Class Participation:
- Seminar/presentation/assignment/quiz/class test etc.:
- Mid-Term Exam:

➤ Practicum

- Class Participation:
- Seminar/Demonstration/Viva-voce/Lab records etc.:
- Mid-Term Exam:

End Term Examination:**Part C-Learning Resources****Recommended Books/e-resources/LMS:**

- Dubey, R.C., 2005 A Text book of Biotechnology S. Chand & Co, New Delhi.
- Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
- John JothiPrakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
- Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.
- Subha Rao, 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.