Part A - Introduction			
Subject	Botany		
Semester	3rd		
Name of the Course	Biofertilizers		
Course Code	B23-BOT-307		
Course Type (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC-3		
Level of the Course (as per Annexure 1)	100-199		
Prerequisite for the Course (if any)			
Course Learning Outcomes	After completing this course, the learner will be able to: 1. Understand the concept, importance, and advantages of biofertilizers in natural farming. 2. Identify different types of biofertilizers and explain their specific functions in crop production. 3. Apply biofertilizers through appropriate techniques such as seed treatment, soil treatment, and root dipping. 4. Evaluate the role of biofertilizers in sustainable agriculture and recognize government support and success cases. 5. Demonstrate practical skills in handling, applying, and promoting biofertilizers through farm visits, observations, and presentations.		
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: 4 Hours**		
Part B – Content of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in all. All questions will carry equal marks.			

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

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

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

Part C – Learning Resources

Recommended Books/e-resources/LMS:

- Dubey, R.C., 2005 A Text book of Biotechnology S. Chand & Co, New Delhi.
- Kumaresan, V. 2005, Biotechnology, SarasPublications , New Delhi.
- John JothiPrakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
- Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers. SubhaRao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
- Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming AktaPrakashan, Nadiad.

Part A - Introduction			
Subject	Botany		
Semester	3rd		
Name of the Course	Plant Hybridization		
Course Code	B23-BOT-304 B23-BOT-304		
Course Type (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC-3		
Level of the Course (as per Annexure 1)	100-199		
Prerequisite for the Course (if any)			
Course Learning Outcomes	After completing this course, the learner will be able to: 1. Gain knowledge of plant reproductive structuresand processes, including flower anatomy,pollination mechanisms, and fertilization 2.Comprehend the basic principles and conceptsof plant hybridization 3. Learn practical skills in plant hybridizationtechniques 4. Foundational understanding of plant breedingprinciples 5*. Gain knowledge about the floral structures andunderlying plant breeding techniques.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4

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

PRACTICAL	
Max. Marks: 25 **Internal Assessment Marks: 5** **End Term Exam Marks: 20**	**Time: 4 Hours**

Part B – Content of the Course

Instructions for Paper- Setter

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

UNIT	Topics	Contact Hours
I	General objectives of plant breeding Major achievements, Future Prospects. Self-incompatibility- Definition, classification, heteromorphic SI, homomorphic SI i.e. gametophytic SI and sporophytic SI, utilization of self-incompatibility in plant breeding	7
II	Definition and concept of population genetics, random mating population, gene and genotypic frequency Hardy-Weinberg law- Law,	7

	its validity, factors affecting gene frequency Heterosis- Definition, heterosis and hybrid vigour, effects and estimation of heterosis, genetic basis/theories of heterosis. Inbreeding depression - Definition, effects of inbreeding.	
III	Hybridization techniques- Definition, aim and objectives, types of hybridization, steps and procedure of hybridization programme choice of parents, evaluation of parents, emasculation – different methods, bagging, tagging, pollination , harvesting and storing of the F1 seeds and selfing, consequences of hybridization Wide hybridization- Definition, types, main features, interspecific and intergeneric hybridization, its examples, incompatibility barriers for wide hybridization, techniques for overcoming incompatibility barriers, achievements.	8
IV	Methods of breeding in self-pollinated crops- Pure line selection, mass selection, pedigree method, bulk method. Methods of breeding in cross pollinated crops- list of plant breeding methods for cross pollinated crops Modes of selection- Recurrent selection, its types and its procedure	8
V* Practicals	• Study of floral structure of self- pollinated crops. • Study of floral structure of cross pollinated crops. • Emasculation methods: hand, hot water, cold water, • alcohol, suction, chemical emasculation • Designs used in plant breeding experiment • Study of male sterility system • To test pollen viability/incompatibility	30

Suggested Evaluation Method

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

Part C – Learning Resources

Recommended Books/e-resources/LMS:

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

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 1)	100-199		
Prerequisite for the Course (if any)			
Course Learning Outcomes	After completing this course, the learner will be able to: 1. Distinguish the growing of vegetables according to season and climate 2. Understand and explain the special intercultural operations done in vegetable crops 3. Study of morphology and taxonomy of different vegetable crops 4. Identify the diseases and pests of vegetable crops and their management 5*. Grow and produce various types of vegetables and understanding of package and practices of vegetable crops.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
THEORY			
Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**	**Time: 3 Hours**		
PRACTICAL			
Max. Marks: 25 **Internal Assessment Marks: 5** **End Term Exam Marks: 20**	**Time: 4 Hours**		
Part B – Content of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in all. All questions will carry equal marks. 2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.			

UNIT	Topics	Contact Hours
I	Importance of vegetable cultivation in India and Haryana. Export and import potential of vegetables in India. Constraints in vegetable production and remedies to overcome them.	7
II	Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops:	7

	Cultivation of (a) Brinjal (b) Tomato (c) coriander (d) Spinach.	
III	Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) Carrot (b) Beet root.	8
IV	Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) mung bean and (b) chick pea.	8
V* Practicals	• Demonstration of seed germination test for a vegetable seed. • Demonstration of seed viability test. • Identification of vegetable seeds and vegetable crops at different growth stages. • Preparing vegetable nursery beds. • Raising vegetable seedlings in nursery bed and portrays. • Identification of major diseases and insect pests of vegetables. • Land preparation for sowing/ transplanting of vegetable crops. • Sowing/ transplanting of vegetables in main field. • Fertilizer application for vegetable growing. • Irrigation practices in a vegetable crop field. • A report on vegetable crops in a locality. Collection and preparation of herbarium of vegetable crops in their locality.	30

Suggested Evaluation Method

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

Part C – Learning Resources

Recommended Books/e-resources/LMS:

- Bose T K et al. (2003) Vegetable crops, NayaUdhyog Publishers, Kolkata.
- Singh D K (2007) Modern vegetable varieties and production, IBN PublisherTechnologies, International Book Distributing Co, Lucknow.
- Premnath, SundariVelayudhan and D P Sing (1987) Vegetables for the tropicalregion, ICAR, New Delhi.
- ChauhanShohaib Sheikh Ayub (2021) A textbook of Olericulture. New Visualpublication