SYLLABI AND SCHEME OF EXAMINATIONS FOR SKILL ENHANCEMENT COURSES FOR UNDER GRADUATE PROGRAM (SINGLE MAJOR/MULTIDISCIPLINARY PROGRAMS) OFFERED BY THE DEPARTMENT OF BOTANY

(Based on Curriculum and Credit Framework for UG Programs under NEP 2020)

WITH EFFECT FROM THE SESSION 2024-25

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

SCHEME OF EXAMINATIONS FOR SKILL ENHANCEMENT COURSES FOR UNDER GRADUATE PROGRAM (SINGLE MAJOR/MULTIDISCIPLINARY PROGRAMS) OFFERED BY THE DEPARTMENT OF BOTANY

Skill Enhancement Course (SEC)	Nomenclature of Course	Course Code	Credits Distribution			Total Credits	Workload			Total Workload	Marks			
			L	T	P		L	T	P		Theory		Practical	Total Marks
											Internal	External	Internal External	
SEMESTER I (2024-25)														
SEC 1 @ 3 credits	Biofertilizres & Biopesticides	24BOT401SE01	2	0	1	3	2	0	2	4	15	35	25	75
SEMESTER II (2024-25)														
SEC 2 @ 3 credits	Florticulture	24BOT402SE01	2	0	1	3	2	0	2	4	15	35	25	75
SEMESTER III (2025-26)														
SEC 3 @ 3 credits	Plants Propagation & Nursery Techniques	25BOT403SE01	2	0	1	3	2	0	2	4	15	35	25	75
SEMESTER VI (2026-27)														
SEC 4 @ 2 credits (offered only in case of Single Major Programme)	Home Gardening	26BOT406SE01	0	0	2	2	0	0	4	4	0	0	50	50
SEMESTER VII (2027-28)														
SEC 5 @ 4 credits (if offered as an option)	Mushroom Culture Technology	24BOTH201SE01	2	0	2	4	2	0	4	6	15	35	50	100
SEMESTER VIII (2027-28)														
SEC 6 @ 4 credits (if offered as an option)	Essentials of Floriculture	24BOTH202SE01	2	0	2	4	2	0	4	6	15	35	50	100

L: Lecture; T: Tutorial; P: Practical

SYLLABI FOR SKILL ENHANCEMENT COURSE FOR UNDER GRADUATE PROGRAM (SINGLE MAJOR/MULTIDISCIPLINARY PROGRAMS) OFFERED BY THE DEPARTMENT OF BOTANY

Semester –I (Session: 2024-25)

Name of Program	**Bachelor of Science (Life Sciences)**	**Program Code**	**UMLS4**
Paper No.	**Paper 1 (Theory)**	**Nomenclature**	**Biofertilizers and Biopesticides**
Name of the Course	**Skill Enhancement Course (SEC-1)**	**Course Code**	**24BOT401SE01**
Hours per Week	**02**	**Maximum Marks**	**50**
Credits	**02**	**Internal marks**	**15**
Time of Examination	**03 hrs.**	**External marks**	**35**

Note:
Examiner will set nine (09) questions and the candidates will be required to attempt five questions in all. Question number one (01) will be compulsory containing short answer type questions covering the entire syllabus from all units. Further, examiner will set two (02) questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Objectives: To gain knowledge on eco-friendly fertilizers like *Rhizobium, Azospirilium, Azotobactor*, cyanobacteria and mycorrhizae, their identification, growth multiplication and practical application of organic farming and recycling of the organic waste. Knowledge of eco-friendly biopesticides.

Course Learning Outcomes (CLO):

CLO 1: Identify different microbes used as biofertilizers and biopesticides and also to understand the advantages and disadvantages of biofertilizers and biopesticides.

CLO 2: Acquire skills on isolation, culture of microbial agents, process of production and application of biofertilizers and biopesticides.

CLO 3: Evaluate the economic and environmental impacts of using biofertilizers and biopesticides.

CLO 4: Gain knowledge about the regulations on the production and use of biofertilizers and biopesticides.

Unit 1

Introduction to Biofertilizers: Biofertilizers: Definition, scope, status, and importance; Advantages

and limitations of biofertilizers compared to chemical fertilizers, Types of biofertilizers (e.g. nitrogen-fixing, phosphate-solubilizing, plant growth promoting), Structure and characteristic features of bacterial (*Azospirillum, Azotobacter, Rhizobium*), actinomycetes (*Frankia*), cyanobacterial (*Anabaena, Nostoc, Hapalosiphon*) and fungal (AM and ectomycorrhiza) biofertilizers.
Unit 2 **Production and applications of biofertilizers:** Production of biofertilizers: Strain selection, sterilization, growth, equipment, fermentation (solid state and liquid), mass production of carrier based and liquid bio fertilizers, Factors affecting the production of biofertilizers (i.e., temperature, pH, aeration, carbon source); quality control of biofertilizers, Application methods and dosage of biofertilizers, Effect of biofertilizers on soil fertility, plant growth, and yield.
Unit 3 **Commercialization and future prospects of biofertilizers:** Biofertilizers -storage, shelf life, quality control and marketing; regulatory framework and certification for biofertilizers, Application technology for seeds, seedlings, tubers, sets etc.; factors influencing the efficacy of bio fertilizers, Economic feasibility and cost-benefit analysis of using biofertilizers, Future prospects and potential of biofertilizers in sustainable agriculture and environmental protection.
Unit 4 **Biopesticides and Applications:** Biopesticides: Definition and classification; advantages and limitations of biopesticides compared to chemical pesticides. Modes of action and mechanisms of biopesticides, Characteristics and applications of microbial pesticides – bacteria, fungi and viruses, Characteristics and applications of botanical pesticides (plant extracts and essential oils) and biochemical (pheromones and repellents), Biocontrol agents (*Trichoderma* spp., *Pseudomonas* spp. and *Bacillus* spp) and their efficacy on seed borne and soil borne plant pathogens.

Semester –I (Session: 2024-25)

Name of Program	**Bachelor of Science (Life Sciences) with**	**Program Code**	**UMLS4**
Paper No.	**Paper 1 (Practical)**	**Nomenclature**	**Biofertilizers and Biopesticides**
Name of the Course	**Skill Enhancement Course (SEC-1)**	**Course Code**	**24BOT401SE01**
Hours per Week	**02**	**Maximum Marks**	**25**
Credits	**01**	**Duration of Examination**	**02 hrs.**

Course Objectives: To gain knowledge on eco-friendly fertilizers like *Rhizobium, Azospirilium, Azotobactor,* cyanobacteria and mycorrhizae, their identification, growth multiplication and practical application of organic farming and recycling of the organic waste. Knowledge of eco-friendly biopesticides.

Course Learning Outcomes (CLO):

CLO 1: Identify different microbes used as biofertilizers and biopesticides and also to understand the advantages and disadvantages of biofertilizers and biopesticides.

CLO 2: Acquire skills on isolation, culture of microbial agents, process of production and application of biofertilizers and biopesticides.

CLO 3: Evaluate the economic and environmental impacts of using biofertilizers and biopesticides.

CLO 4: Gain knowledge about the regulations on the production and use of biofertilizers and biopesticides.

List of Practical:

1. Nutritional media and their preparations.
2. Enumeration of microbial population in soil- bacteria, BGA, fungi, actinomycetes.
3. Methods of isolation and purification of microbial cultures.
4. Isolation of Rhizobium from legume root nodule.
5. Isolation of BGA from rhizosphere.
6. Isolation of Mycorrhiza.
7. Culture of *Trichoderma* spp., *Pseudomonas* spp. and *Bacillus* spp.
8. Quality control tests for biofertilizers, Biopesticides and bioagents.

Suggested student activities:

1. Collection of data on utilization of biofertilizers and biopesticides by farmers and conducting awareness campaign at farmers' fields.
2. Collection of literature on various biofertilizers, biopesticides and biocontrol agents.
3. Visits to production units of biofertilizers, biopesticides and biocontrol agents.
4. Case studies on efficacy of biofertilizers, biopesticides and biocontrol agents.
5. Report on mass production technologies of biofertilizers, biopesticides and biocontrol agents.
6. Case study on ill effects of chemical fertilizers and pesticides.

Pattern of Practical examination:

1. Identify the microbes A & B and write a brief note on it (5)

2. Experiment on quality control test of biofertilizers/ biopesticides or isolation of microbes used as biofertilizers or biopesticides (4)
3. Submission of project report on topic allotted to student (6)
4. Practical records (3)
5. Viva-voce (2)

References/Suggested readings:

1. Subba Rao, N.S. (1993) Biofertilizers in Agriculture and Forestry, Oxford and IBH. Publ. Co., New Delhi.
2. Das, A. C., & Mukherjee, A. K. (2019). Biofertilizers for sustainable agriculture: a review of principles, processes, and practices. Springer.
3. Sadasivam, S., & Manickam, A. (2018). Biofertilizers technology. Springer.
4. S. S. Gnanamanickam, (2011) Biopesticides: Pest Management and Regulation, CAB International, Wallingford, UK.
5. B.S. Bisht, J.S. Panwar, and V.P. Bhatt, (2016) Handbook of Microbial Biofertilizers, CRC Press, Boca Raton, FL.
6. Gupta, S., & Prasad, R. (2018). Microbial inoculants in sustainable agricultural productivity. Springer.
7. Akhtar, M. S., & Siddiqui, Z. A. (2018). Role of rhizobacteria in soil: interactions and mechanisms. Springer.
8. N. Amaresan, N. Kumar, and A.K. Gupta, (2011) Handbook of Biofertilizers and Microbial
9. Pesticides, Springer Science & Business Media, New York, NY.
10. Opender Koul and G.S. Dhaliwal, (2009) Biopesticides: State of the Art and Future
11. Opportunities, Springer Science & Business Media, New York, NY. Franklin R. Hall and Julius
12. J. Menn, (1999) Biopesticides: Use and Delivery, Humana Press, Totowa, NJ.

Semester –II (Session: 2024-25)

Name of Program	**Bachelor of Science (Life Sciences)**	**Program Code**	**UMLS4**
Paper No.	**Paper 2 (Theory)**	**Nomenclature**	**Floriculture**
Name of the Course	**Skill Enhancement Course (SEC 2)**	**Course Code**	**24BOT402SE01**
Hours per Week	**02**	**Maximum Marks**	**50**
Credits	**02**	**Internal marks**	**15**
Time of Examination	**03 hrs.**	**External marks**	**35**

Note:
Examiner will set nine (09) questions and the candidates will be required to attempt five questions in all. Question number one (01) will be compulsory containing short answer type questions covering the entire syllabus from all units. Further, examiner will set two (02) questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Objectives: To have knowledge of gardening and cultivation of ornamental plants and knowledge of landscaping, soil condition.

Course Learning Outcomes (CLO): After completing this course, the learner will be able to:

CLO 1: Understand the importance and scope of floriculture, management of nursery and gardens methods of plant propagation.

CLO 2: Develop a conceptual understanding of different types of ornamental plants.

CLO 3: Gain knowledge about the various types of gardens and importance of landscaping.

CLO 4: Students will learn about commercial floriculture and cultivation of important cut flowers

Unit 1

Introduction: History of gardening; 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.

Unit 2

Ornamental Plants: Flowering annuals (*Petunia, Chrysanthemum*); perennials (Rose, China Rose); Divine vines (Money plant, Monstera); 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.

Unit 3

Principles of Garden Design and landscaping ideas; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden.

Unit 4

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, Lilium, Orchids).

Semester –II (Session: 2024-25)

Name of Program	**Bachelor of Science (Life Sciences)**	**Program Code**	**UMLS4**
Paper No.	**Paper 2 (Practical)**	**Nomenclature**	**Floriculture**
Name of the Course	**Skill Enhancement Course (SEC 2)**	**Course Code**	**24BOT402SE01**
Hours per Week	**02**	**Maximum Marks**	**25**
Credits	**01**	**Duration of Examination**	**02 hrs.**

Note:

Course Objectives: To have knowledge of gardening and cultivation of ornamental plants and knowledge of landscaping, soil condition.

Course Learning Outcomes (CLO): After completing this course, the learner will be able to:

CLO 1: Understand the importance and scope of floriculture, management of nursery and gardens, methods of plant propagation.

CLO 2: Students will develop a conceptual understanding of different types of ornamental plants.

CLO 3: Gain knowledge about the various types of gardens and importance of landscaping.

CLO 4: Students will learn about commercial floriculture and cultivation of important cut flowers

List of practical:

1. Plant propagation by cutting.
2. Plant propagation by grafting.
3. Plant propagation by air-layering.
4. Investigating the effect of different flower preservatives on the vase life of common ornamental flowers.
5. Setting up a laboratory scale hydroponics setup.
6. Preparation of different types of floral arrangements.
7. Morpho-anatomical study of different types of flowers.
8. Study of different diseases in ornamental plants.

Pattern of Practical examination

1. Identify the given flower/ plant A & B and write a short note on its cultivation. (10)
2. Demonstrate the activity on grafting/ cutting/ air layering (5)

3. Practical records	(3)
4. Viva-voce	(2)

References/Suggested readings:

1. Randhawa, G.S., Mukhopadhyay, A. (1986). Floriculture in India. New York, NY: Allied Publishers.
2. Adams, C., M. Early and J. Brrok (2011). Principles of Horticulture. Routledge, U.K.
3. A.K. Singh.2006. Flower crops, cultivation and management. New India publishing agency, Pitampura, New Delhi.
4. T.K. Bose, L.P. Yadav, P. Patil, P. Das and V.A. Partha Sarthy. 2003. Commercial
5. Flowers. Partha Sankar Basu, Nayaudyog, 206, Bidhan Sarani, Kolkata.
6. S.K. Bhattacharjee and L.C. De. 2003. Advanced Commercial Floriculture. Aavishkar Publishers,Distributors, Jaipur.
7. Dewasish Choudhary and Amal Mehta. 2010. Flower crops cultivation and management. Oxford book company Jaipur, India. Randhawa,
8. G.S. Amitabha Mukhopadhyay, 2004. Floriculture in India. Allied Publishers Pvt. Ltd.
9. Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana.
10. Bhattacharjee, S.K. Advanced Commercial Floriculture. Aavishkar Publishers Distributors, Jaipur.
11. Sheela, V.L. 2008. Flower for trade. New India Publishing Agency, Pitampura, New Delhi-110088.
12. Abhinov Kumar. 2000. Production Technology of Ornamental Crops, Medicinal Plants and Landscaping. Kalyani Publishers, New Delhi.

Semester –III (Session: 2025-26)

Name of Program	**Bachelor of Science (Life Sciences)**	**Program Code**	**UMLS4**
Paper No.	**Paper 3 (Theory)**	**Nomenclature**	**Plant Propagation and Nursery Techniques**
Name of the Course	**Skill Enhancement Course (SEC 3)**	**Course Code**	**25BOT403SE01**
Hours per Week	**02**	**Maximum Marks**	**50**
Credits	**02**	**Internal marks**	**15**
Time of Examination	**03 hrs.**	**External marks**	**35**

Note:
Examiner will set nine (09) questions and the candidates will be required to attempt five questions in all. Question number one (01) will be compulsory containing short answer type questions covering the entire syllabus from all units. Further, examiner will set two (02) questions from each of the four units and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Objectives: To have knowledge about gardening and cultivation of ornamental plants and knowledge of landscaping and soil condition.

Course Learning Outcomes (CLO): After completing this course, the learner will be able to:
CLO 1: Understand to use various tools and implements used in nursery.

CLO 2: Understand the infrastructure of nursery propagation structures.

CLO 3: Develop a conceptual understanding of common diseases and their management.

CLO 4: Gain knowledge about the vegetative propagation methods.

Unit 1

Nursery: Objectives and scope; infrastructure for development of nursery; Propagation structures: Mist chambers, humidifiers, greenhouses, glasshouses, cold frames, hotbeds, poly-houses; nursery tools and implements; planning and seasonal activities.

Unit 2

Seed: Structure and types; Seed dormancy: causes and methods of breaking dormancy; Seed storage: Seed banks, factors affecting seed viability.

Preparation of Soil: Land preparation, manuring, watering, sowing/raising of seeds and seedlings; transplantation of seedlings.

Unit 3

Potting media: media for propagation and growing nursery plants- soil, sand, peat, sphagnum moss, vermiculite, perlite.

Vermicompost production-preparation, use of vermicompost in the nursery.

Common diseases and their management: Anthracnose, blights, die back, leaf spots, powdery mildew; Insect/pest/disease control in the nursery.

Unit 4

Propagation: Need and potentialities for plant multiplication, vegetative propagation: cutting, layering, grafting and budding and propagation through specialized organs; rhizome, corm, runners and suckers. Use of growth regulators in vegetative propagation. Factors influencing rooting of cuttings and layering, graft incompatibility. Maintenance of mother trees, collection of scion wood sticks, scion-stock relationship and their influences.

Semester –III (Session: 2025-26)

Name of Program	**Bachelor of Science (Life Sciences)**	**Program Code**	**UMLS4**
Paper No.	**Paper 3 (Practical)**	**Nomenclature**	**Plant Propagation and Nursery Techniques**
Name of the Course	**Skill Enhancement Course (SEC 3)**	**Course Code**	**25BOT403SE01**
Hours per Week	**02**	**Maximum Marks**	**25**
Credits	**01**	**Duration of Examination**	**02 hrs.**

Course Objectives: To have knowledge of gardening and cultivation of ornamental plants and knowledge of landscaping and soil condition.

Course Learning Outcomes (CLO): After completing this course, the learner will be able to:

CLO 1: Understand the use of various tools and implements used in nursery.

CLO 2: Understand the infrastructure of nursery propagation structures.

CLO 3: Develop a conceptual understanding of common diseases and their management.

CLO 4: Gain knowledge about the vegetative propagation methods.

List of practical:

1. Study of different tools and implements used in nursery.
2. Study of seed dormancy breakage by scarification and stratification.
3. Investigating the effect of different environmental conditions on seed germination.
4. Preparation and application of growth regulators
5. Bed preparation for growth of seedlings.
6. Raising of seedlings and transplantation.
7. Study of different methods of vegetative propagation.
8. Study of common diseases (as given in the theory syllabus)

Pattern of Practical examination

1. Identify and comment upon the given method of vegetative propagation. (5)
2. Identify the plant disease and write its causal organism, symptoms and control measures. (5)
3. Submit one plant propagated by using techniques mentioned in the syllabus along with geo-tagged photographs. (3)
4. Practical Records (5)
5. Viva-voce (2)

References/Suggested readings:

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

Semester –VI (Session: 2026-27)

Name of Program	**Bachelor of Science (Life Sciences)**	**Program Code**	**UMLS4**
Paper No.	**Paper 4 (Practical)**	**Nomenclature**	**Home Gardening**
Name of the Course	**Skill Enhancement Course (SEC 4)**	**Course Code**	**26BOT406SE01**
Hours per Week	**04**	**Maximum Marks**	**50**
Credits	**02**	**Duration of Examination**	**02 hrs.**

Course Objectives:

Course Learning Outcomes (CLO): After completing this course, the learner will be able to:

CLO 1: Planning of layout of home garden

CLO 2: Soil health and deficiency symptoms

CLO 3: Botanical description of vegetative and floral character

List of practical:

1. Practice of grafting, budding, cutting and layering, anatomical studies of rooting of cuttings and grafting union.

2. Planning and layout for home gardens.
3. Planning and layout for vertical home gardens
4. Identification and control of important diseases and insects of available fruits, vegetables and ornamental plants.
5. Soil and foliar application of fertilizers.
6. Study of deficiency symptoms of elements.
7. Practice of pruning and training.
8. Physical practices to induce flowering, use of bio-regulators,
9. Identification and botanical description (vegetative and floral features) of available fruits, vegetables and ornamental plants.
10. Cultivation of Crops under protected environment: Rose, Dahlia, Gerbera, Calandula, Marigold and chrysanthemum; Capsicum, Tomatoes, Onion etc.
11. Preparation of bonsai.
12. Methods of preparation of compost, vermi-compost, green manuring, preparation of neem products and application.
13. Experiments on growing of insect pest repellent plants in home gardens.
14. Preparation of project report on Home Gardening.

Pattern of Practical examination

1. Experiment on vegetative propagation, anatomical studies, vegetative and floral features studies of available fruits, vegetables and ornamental plants. (8)
2. Experiment on identification and control of important diseases and insects of available fruits, vegetables and ornamental plants, nutrients and their deficiency symptoms. (6)
3. Any other experiment from list. (6)
4. project report on Home Gardening. (7)
5. Note Book (4)
6. Viva-voce (4)

References/Suggested readings:

1. Bose, T.K., Mitra, S.K. and Sadhu, M.K., 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prokash.
2. Peter, K.V. 2008. Basic of Horticulture. New India Publ. Agency.
3. Radha, T. and Mathew, L. 2007. Fruit Crops. New India Publ. Agency.
4. Rajan, S. and Baby, L.M. 2007. Propagation of Horticultural Crops. New India Publ. Agency.

5. Dhillon, W.S. and Bhatt. 2011. Fruit Tree Physiology. Narendra Publishing House, New Delhi.
6. Mazumdar, B.C. 2004. Orchard Irrigation and Soil Management Practices. Daya Publishing Agency, New Delhi.
7. Shanmugavelu, K.G.1989. Production Technology of Fruit Crops. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Spichiger, R.E., Savolainen, V., Figeat, M. and Jeanmond, D. 2004. Systematic Botany of Flowering Plants, 2nd Edition. Enfield, New Hampshire Science Publishers.
9. Prasad, S. 2005. Greenhouse Management for Horticultural Crops. Agrobios, Jodhpur.
10. Singh, B. 2006. Protected Cultivation of Vegetable Crops. Kalyani Publishers, Ludhiana.
11. Sabina, G.T. and Peter, K.V. 2008. Ornamental Plants for Gardens. New India Publ. Agency.
12. Sathe, T. V.2004. Vermiculture and Organic Farming. Daya Publishing House, New Delhi.
13. Sharma, A. K. 2011. Handbook of Organic farming. Agrobios (India), Jodhpur.