GURU KASHI UNIVERSITY

Master of Science (Vegetable Science)

Session : 2023-24

Department of Horticulture

Graduate Outcomes of the programme

The students will know about the packages of practices of warm season, winter season and underexploited vegetable crops.The students will know about the breeding programmes, morphological, evolution, classification of vegetable crops. The making of experiment of vegetable genetics and breeding. The scientific writings of thesis by using computer programming and application.

Program Learning Outcomes

After completing the programme, the learner will be able to:

1. Learn about the packages of practices of warm season, cool season and organic production of vegetables.
2. Educate about principles and practices adopted for breeding of Self- and cross pollinated vegetable crops and familiar with principles and practices of processing of vegetable crops.
3. Inculcate knowledge about morphological, cytological and molecular taxonomy of Vegetable crops and their evolution.
4. Establish specific plant breeding activities, such as election of parental germplasm, observation and recording of phenotypic variation and selection among progeny
5. Acquire practical exposure with package and practices of underexploited vegetables so as to enhance their production.
6. Able develop concepts about the knowledge of basic principles of computer programming and agricultural statistics.

Course Structure of the Master of Science in Vegetable Science

SEMESTER 1ST						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MVS132	Production of Cool Season Vegetables Crops	Major	2	0	2	3
MVS113	Principles of Plant Breeding.	Major	2	0	2	3
MVS133	Protected Cultivation of Vegetable Crops	Major	2	0	2	3
MFS201	Tropical Fruit Production	Minor (CBCS)	2	0	2	3
MFS135	Commercial Production of Cut Flowers					
MAR121	Agriculture Statistics	Supporting	3	0	2	4
MAR125	Lab- Library and Information Services	Common	0	0	4	2
MVS100	Mater Research	Research	-	-	-	2 (NC)
Total			**11**	**0**	**12**	**18+ 2 (NC)**

SEMESTER 2ND						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MVS201	Production Technology of Summer Season Vegetable Crops*	Major	2	0	2	3
MVS202	Breeding of Cross Pollinated Vegetable Crops	Major	2	0	2	3
MVS203	Postharvest Management of Vegetable Crops	Major	1	0	2	2
MFS103	Sub- Tropical and Temperate Fruit Production	Minor (CBCS)	2	0	2	3

MFS203	Commercial Production of Loose Flowers	Minor (CBCS)				
MVS204	Seminar	Seminar	-	-	-	2
MAR206	Lab- Fundamentals of Computer Applications	Supporting	0	0	4	2
MVS100	Master Research	Research	-	-	-	5 (NC)
Total			**6**	**0**	**11**	**15+ 5 (NC)**

SEMESTER 3RD

Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MVS301	Breeding of Self Pollinated and Vegetative Propagated Vegetable Crops*	Major	2	0	2	3
MVS302	Organic Vegetable Production	Minor	1	0	2	2
MVS303	Systematic of Vegetable Crops	Major	2	0	2	3
MAR304	Lab- Technical Writing and Communication Skills	Common	0	0	4	2
MVS100	Master Research	Research	-	-	-	10 (NC)
Total			**5**	**0**	**10**	**10+10 (NC)**

SEMESTER 4TH						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MVS401	Growth and Development of Vegetable Crops	Major	2	0	2	3
MVS402	Seed Production of Vegetable Crops	Major	1	0	2	2
MAR402	Intellectual Property and its management in Agriculture	Common	2	0	0	2
MVS100	Master Research	Thesis Research	-	-	-	13
Total			**4**	**0**	**2**	**7+13(NC)**
TOTAL NUMBER OF CREDITS						**50+30(NC)**

***CBCS (Choice Based Credit System)**

***NC (Non Credit)**

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [25 Marks]

i. CA1 (10 Marks)

ii. CA2 (10 Marks)

iii. CA3 (5 Marks)

B. Attendance (5 marks)

Course Title: Production of Cool Season Vegetable Crops	**L**	**T**	**P**	**Credits**
Course Code: MVS132	**2**	**0**	**2**	**3**

C. Mid Semester Test: (30 Marks)

D. End-Term Exam: (40 Marks)

For the CAs the teacher shall take surprised test/term paper/quiz/Surprise Test.

Evaluation Criteria for other courses has been given separately with the respective courses.

Evaluation Criteria for practical Courses

The syllabus of subject is divided into five experiments, each experiment contain 20 marks (10 lab performance, 5 viva, 5 lab record)- Total marks 100

Evaluation Criteria for Seminar

It is of total Marks-100

Collection of review of literature - 20marks

Data Analysis -20 marks

Power Point Presentation - 20 marks

Presentation skills - 20 marks

Viva voce - 20 marks

Evaluation Criteria for Master Research

The evaluation is Satisfactory or Unsatisfactory on the basis of the performance of the candidate.

Semester IST

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Acquaint with winter vegetable crops growing in a vegetable garden, their

2. Distinguish about cultural practices and identification concepts.
3. Know about the preparation of land for cultivation of vegetable crops.
4. Impart Special horticultural practices, weed control, mulching, role of plant growth regulators.

Theory Content

Unit I **7Hours**

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, raising of nursery, sowing/ planting time and precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, special horticultural practices, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marketing), pest and disease management and production economics of crops.

Bulb and tuber crops—Onion, garlic and potato

Unit II **7Hours**

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, raising of nursery, sowing/ planting time and precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, special horticultural practices, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest

management (grading, packaging and marketing), pest and disease management and production economics of crops.

Root crops—Carrot, radish, turnip and beetroot.

Unit III **8Hours**

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, raising of nursery, sowing/ planting time and precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, special horticultural practices, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marketing), pest and disease management and production economics of crops.

Cole crops—Cabbage, cauliflower, kohlrabi, broccoli, Brussels sprouts and kale

Unit IV **8Hours**

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, sowing/ planting time and precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, special horticultural practices, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marketing), pest and disease management and production economics of crops.

Peas and beans—Garden peas and broad bean.

Leafy vegetables—Beet leaf, fenugreek, coriander and lettuce.

Practical Content **Total Hours: 30**

1. Scientific raising of nursery and seed treatment
2. Sowing and transplanting.
3. Description of commercial varieties and hybrids.
4. Demonstration on methods of irrigation, fertilizers and micronutrients application
5. Mulching practices, weed management
6. Use of plant growth substances in cool season vegetable crops;
7. Study of nutritional and physiological disorders
8. Identification of important pest and diseases and their control
9. Preparation of cropping scheme for commercial farms
10. Visit to vegetable market
11. Analysis of benefit to cost ratio.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Cooperative Learning, Classroom lectures, Assignment (written and speaking), Student presentation, Hands on training of different procedures.

Suggested Readings

- *Hazra P and Banerjee MK and Chattopadhyay A. 2012. Varieties of vegetable crops in India, (Second edition), Kalyani publishers, Ludhiana, 199 p.*
- *Hazra P. 2016. Vegetable Science. 2nd edn, Kalyani publishers, Ludhiana.*
- *Hazra P. 2019. Vegetable production and technology. New India publishing agency, New Delhi.*

Course Title: Principles of Plant Breeding.

Course Code: MVS113

L	T	P	Credits
2	0	2	3

- *Hazra P, Chattopadhyay A, Karmakar K and Dutta S. 2011. Modern technology for vegetable production, New India publishing agency, New Delhi, 413p*
- *Rana MK. 2008. Olericulture in India. Kalyani publishers, New Delhi.*
- *Rana MK. 2008. Scientific cultivation of vegetables. Kalyani publishers, New Delhi.*
- *Rana MK. 2014. Technology for vegetable production. Kalyani publishers, New Delhi.*
- *Rubatzky VE and Yamaguchi M. (Eds.). 1997. World vegetables: principles, production and nutritive values. Chapman and Hall.*
- *Singh DK. 2007. Modern vegetable varieties and production technology. International bookdistributing Co.*

Total Hours: 60

Learning outcome: After completion of this course, the learner will be able to:

1. Acquire knowledge about the principles of vegetable breeding.
2. Improve yield, quality, abiotic and biotic resistance, other important traits of vegetable crops.
3. Understand how the basic principles are important to start breeding of vegetable crops.

4. Conceptualize about genetic consequences of different plant reproductive systems.

Theory Content

Unit I **4Hours**

Importance, history and evolutionary aspects of vegetable breeding and its variation from cereal crop breeding.

Unit II **5Hours**

Selection procedures- Techniques of selfing and crossing; Breeding systems and methods; Selection procedures and hybridization; Genetic architecture; Breeding for biotic stress (diseases, insect pests and nematode), abiotic stress (temperature, moisture and salt) resistance and quality improvement; Breeding for water use efficiency (WUE) and nutrients use efficiency (NUE).

Unit III **3Hours**

Heterosis breeding- Types, mechanisms and basis of heterosis, facilitating mechanisms like male sterility, self-incompatibility and sex forms.

Unit IV **3Hours**

Mutation and Polyploidy breeding; Improvement of asexually propagated vegetable crops and vegetables suitable for protected environment.

Practical Content **Total Hours: 30**

1. Floral biology and pollination behaviour of different vegetables.
2. Techniques of selfing and crossing of Cole crops.
3. Techniques of selfing and crossing of okra.
4. Techniques of selfing and crossing of Cucurbits.
5. Techniques of selfing and crossing of tomato, eggplant and hot pepper
6. Breeding system and handling of filial generations of different vegetables.
7. Exposure to biotechnological lab practices.
8. Visit to breeding farms.

Course Title: Protected Cultivation of Vegetable Crops

Course Code: MVS133

L	T	P	Credits
2	0	2	3

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Cooperative Learning, Classroom lectures, Assignment (written and speaking), Student presentation, Hands on training of different procedures.

Suggested Reading

- *Allard RW. 1960. Principle of plant breeding. John Willey and Sons, USA.*
- *Kalloo G. 1988. Vegetable breeding (Vol. I, II, III). CRC Press, Fl, USA.*
- *Kole CR. 2007. Genome mapping and molecular breeding in plants-vegetables. Springer, USA.*
- *Peter KVand Pradeep Kumar T. 1998. Genetics and breeding of vegetables. ICAR, New Delhi, p.488.*
- *Prohens J and Nuez F. 2007. Handbook of plant breeding-vegetables (Vol I and II). Springer,USA.*
- *Singh BD. 2007. Plant breeding- principles and methods (8th edn.). Kalyani Publishers, New Delhi.*
- *Singh Ram J. 2007. Genetic resources, chromosome engineering, and crop improvement-vegetablecrops (Vol. 3). CRC Press, Fl, USA.*

Total Hours: 60

Learning outcome: After completion of this course, the learner will be able to:

1. Understand the scope and scenario of protected cultivation of vegetable crops in India.

2. Acquire knowledge about the effect of abiotic factors on growth, flowering and production of vegetable crops.
3. Gain knowledge about the designing of various low cost protected structures.
4. Adoptthe methods of raising of vegetable seedlings in low cost protected structures as entrepreneur.

Theory Content

Unit I **2Hours**

Concept, scope and importance of protected cultivation of vegetable crops; Principles, design, orientation of structure, low and high cost polyhouses/ greenhouse structures.

Unit II **4Hours**

Types of protected structure- Classification and types of protected structures greenhouse/ polyhouses, plastic-non plastic low tunnels, plastic walk in tunnels,high roof tunnels with ventilation, insect proof net houses, shed net houses, rain shelters, NVP, climate control greenhouses, hydroponics and aeroponics; Soil and soilless media for bed preparation; Design and installation of drip irrigation and fertigation system.

Unit III **4Hours**

Abiotic factors- Effect of environmental factors and manipulation of temperature, light, carbon dioxide, humidity, etc. on growth and yield of different vegetables.

Unit IV **5Hour**

Nursery raising- High tech vegetable nursery raising in protected structures using plugs and portrays, different media for growing nursery under protected cultivation; Nursery problems and management technologies including fertigation.

Practical Content **Total Hours: 30**

1. Study of various types of protected structure.

2. Study of different methods to control temperature, carbon dioxide and light.
3. Study of different types of growing media, training and pruning systems in greenhouse crops.
4. Study of fertigation and nutrient management under protected structures.
5. Study of insect pests and diseases in greenhouse and its control.
6. Use of protected structures in hybrid seed production of vegetables.
7. Economics of protected cultivation (Any one crop).
8. Visit to established green/ polyhouses/ shade net houses in the region.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Cooperative Learning, Classroom lectures, Assignment (written and speaking), Student presentation, Hands on training of different procedures.

Suggested Reading

- *Chadha KL and Kalloo G. (Eds.). 1993-94. Advances in horticulture. Malhotra Pub. House.*
- *Chandra S and Som V. 2000. Cultivating vegetables in green house. Indian horticulture 45:17- 18.*
- *Kalloo G and Singh K. (Eds.). 2000. Emerging scenario in vegetable research and development.Research periodicals and Book publ. house.*
- *Parvatha RP. 2016. Sustainable crop protection under protected cultivation. E-Book Springer.*
- *Prasad S and Kumar U. 2005. Greenhouse management for horticultural crops. 2nd Ed.Agrobios.*
- *Resh HM. 2012. Hydroponic food production. 7thEdn. CRC Press.*
- *Singh B. 2005. Protected cultivation of vegetable crops. Kalyani publishers, New Delhi*

- *Singh DK and Peter KV. 2014. Protected cultivation of horticultural crops (1st Edition) New India publishing agency, New Delhi.*

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1 Equip themselves with know-how on agro-techniques for establishment and management of an orchard leading to optimum and quality fruit production of tropical fruits.

Course Title: Tropical Fruit Production

Course Code: MFS201

L	T	P	Credits
2	0	2	3

2 Learn the importance and identification of different agri export zone for fruit crops.

3 Study the importance of flowering, pollination, fruit set and fruiting, harvesting and physiology of tropical fruit crops.

4 Design the strategy storage marketing, post-harvest technology with knowhow of export and industrial potential.

Theory content

Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements. Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-

regulators, abiotic factors limiting fruit production. Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit I **8 hours**

Fruit crops- Citrus, mango, papaya, pineapple.

Unit II **7 hours**

Fruit crops- Banana, avocado, sapota, guava.

Unit III **7 hours**

Fruit crops- Ber, amla, jack fruit, annonas.

Unit IV **8 hours**

Fruit crops- Minor Tropical Fruit crops.

Practical content **Total Hours: 30**

1. Distinguished features of tropical fruit species, cultivars and rootstocks.
2. Demonstration of planting systems, training and pruning.
3. Hands on practices on pollination and crop regulation.
4. Leaf sampling and nutrient analysis.
5. Physiological disorders-malady diagnosis.
6. Physico-chemical analysis of fruit quality attributes.

7. Field/ Exposure visits to tropical orchards.
8. Project preparation for establishing commercial orchards.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Bose TK, Mitra SK and Sanyal D. 2002. Fruits of India – Tropical and Sub-Tropical.3rd Edn. Naya Udyog, Kolkata.*
- *Dhillon WS. 2013. Fruit Production in India. Narendra Publ. House, New Delhi.*
- *Litz RE. 2009. The Mango: Botany, Production and Uses. CAB International.*
- *Madhawa Rao VN. 2013. Banana. ICAR, New Delhi. Midmore D. 2015. Principles of Tropical Horticulture. CAB International.*
- *Mitra SK and Sanyal D. 2013. Guava, ICAR, New Delhi. Morton JF. 2013. Fruits of Warm Climates. Echo Point Book Media, USA.*

Course Title:Commercial Production of Cut Flowers

Course Code: MFS135

L	T	P	Credits
2	0	2	3

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Recall understanding of production and post harvest management of flower crops.
2. Acquire the required skills to prepare project reports on different crops for financing.
3. Prioritize the preparation of land for cultivation of cut Flower crops
4. Gain knowledge about innovative nursery raising technique for cut flower crops for raising quality and disease-free seedlings.

Theory Content

National and International scenario, importance and scope of cut flower trade, constraints for cut flower production in India. Growing environment: Soli analysis, soil health card, Growing environment, open cultivation, protected cultivation, soil/ media requirements, land preparation, planting methods, influence of light, temperature, moisture, humidity and microclimate management on growth and flowering. Crop management: Commercial Flower production – Commercial varieties, water and nutrient management, fertigation, weed management, crop specific practices, ratooning, training and pruning, pinching, deshooting, bending, desuckering, disbudding. Use of growth regulators, physiological disorders and remedies, IPM and IDM. Flower regulation: Flower forcing and year round/ offseason flower production through physiological interventions, chemical regulation, environmental manipulation.

Unit I **8 hours**

Flower crops-. Rose, chrysanthemum, gladiolus, tuberose, carnation.

Unit II **7 hours**

Vegetable crops- Gerbera, orchids, lilium, anthurium, china aster.

Unit III **7 hours**

Vegetable crops- Alstroemeria, bird of paradise, heliconia, alpinia, ornamental ginger.

Unit IV **8 hours**

Flower crops- Dahlia, gypsophila, solidago, limonium, stock, cut greens and fillers.

Practical Content **Total Hours: 30**

1. Identification of varieties.
2. Propagation.
3. Microclimate management.
4. Training and pruning techniques
5. Pinching, deshooting, disbudding, desuckering.
6. Practices in manuring, drip and fertigation, foliar nutrition, growth regulator application.
7. No Blocks Units Horticultural Sciences–Floriculture and Landscaping. Harvesting techniques, post-harvest handling, cold chain.
8. Economics, Project preparation for regionally important cut flowers, crop specific guidelines for project financing (NHB guidelines).
9. Visit to commercial cut flower units.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

- *Arora JS. 2010. Introductory Ornamental Horticulture. Kalyani Publishers. 6th edition, pp. 230.*
- *Bhattacharjee SK. 2018. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ. Reprint, pp. 2065.*
- *Bose TK, Maiti, RG, Dhua RS and Das P. 1999. Floriculture and Landscaping. Prokash, Kolkata, India.*
- *Bose TK and Yadav LP. 1989. Commercial Flowers. Naya Prokash, Kolkata, India.*
- *Chadha KL and Bhattacharjee SK. 1995. Advances in Horticulture: Ornamental Plants. Vol. XII, Parts 1 & 2. pp. 533, pp. 574. Malhotra Publ. House, New Delhi, India.*
- *Reddy S, Janakiram T, Balaji Kulkarni S and Misra RL. 2007. Hi- Tech Floriculture. Indian Society of Ornamental Horticulture, New Delhi, India.*
- *Singh AK. 2006. Flower Crops: Cultivation and Management. New India Publ. Agency, New Delhi, India. pp. 475.*

Course Title: Agricultural Statistics

Course Code: MAR121

L	T	P	Credits
3	0	2	4

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1 Study about statistical principles apply in all the areas of experimental work

2 Understand the requirement at the national level and farm level for agriculture policy making,

3. Study the importance of statistics in agriculture, helps to ascertain the volume of crop that needs to be produced based on output and demand of previous year

4. Acquire knowledge about land utilization and irrigation including the net area

sown gross cultivated area, current follow, cultivable waste.

Theory Content

Unit-1 15Hrs

Frequency distribution, standard error and deviation, correlation and regression analyses, co-efficient of variation.

Unit-2 10Hrs

Hypothesis testing. Concept of p-value. Tests of significance-t, F and chi-square (X 2).

Unit-3 10Hrs

Data transformation and missing plot techniques; Design of experiments and their basic principles, completely randomized, randomized block, split plot, strip-plot, factorial and simple confounding designs

Unit-4 10Hrs

Efficiency of designs; Methods of statistical analysis for cropping systems including intercropping; Pooled analysis.

Practical Content **Total Hours: 30**

1. Correlation analysis.
2. Regression analysis (exponential, power function, quadratic, multi-variate, selection of variables, validation of models, ANOVA and testing of hypothesis).
3. Tests of significance (Z-test, t-test, F-test and Chi-square test).
4. Analysis of variance.
5. Completely randomized design.
6. Randomized block designs.
7. Latin square designs.
8. Missing plot and analysis of covariance. 23, 24 and 33 simple and confounded experiments. Split plot designs.
9. Factorial in split plot designs.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Panse, V.G. and Sukhatme, P.V. 1954. Statistical methods for agricultural*
- *workers. pp. 361.*
- *Gupta, S.C. and Kapoor, V.K. 2014. Fundamentals of Mathematical Statistics.*
- *Sultan Chand & Sons, New Delhi.pp. 230.*
- *Snecdecor, G.W. and Cochran, W.G. 1989. Statistical Methods, 8thEdition. Wiley-Blackwell. Pp.524.*
- *Rangaswamy, R. 2016. Textbook of Agricultural Statistics.New Age International(P) Ltd. New Delhi. pp. 531.*

Course Title: Lab- Library and Information Services	**L**	**T**	**P**	**Credits**
Course Code: MAR125	**0**	**0**	**2**	**1**

Total Hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:

1 Identify library services and availability of resources in order to develop a realistic overall plan for research

2 Use general information resources to increase familiarity with the topic and disciplinary vocabulary

3 Learn about the research topic, question or thesis to achieve a manageable focus appropriate to the assignment criteria, available resources, and evidence needed to support thesis

4 Effectively search information resources.

Practical Content

1. Introduction to Library and its services
2. Five laws of library science; type of documents; classification and cataloguing; organization of documents; sources of information primary, secondary and tertiary.
3. Current awareness and SDI services
4. Tracing information from reference sources
5. Library survey; preparation of bibliography.
6. Use of Online Public Access Catalogue
7. Use of CD-ROM databases and other computerized library services, CeRA, J-Gate.
8. Use of Internet including search engines and its resources; e-resources.

Course Title: Master Research	**L**	**T**	**P**	**Credits**
Course Code: MVS100	**0**	**0**	**0**	**2 (NC)**

Learning Outcomes: After completion of this course, the learner will be able to:

1 Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques

2 Negotiate, plan, design and execute a research-based project.

3 Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format.

4 Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments

5 Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Semester 2nd

Course Title: Production Technology of Summer Season Vegetable Crops	**L**	**T**	**P**	**Credits**
Course Code: MVS201	**2**	**0**	**2**	**3**

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Impart knowledge Production, quality and yield of summer vegetable crops
2. Acquaint with production technology of summer vegetable crops.
3. Gain practical knowledge for the preparation of land for cultivation of vegetable crops
4. Acquire knowledge about the production technology and post-harvest handling of warm season vegetable crops and Calculate the economics of vegetable production in India

Theory Content

Unit I **7hour**

Introduction, commercial and nutritional importance, origin and distribution, botanyand taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, raising of nursery including grafting technique, sowing/ planting time and methods, precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marking), pest and disease management and economics of crops.

Fruit vegetables—Tomato, brinjal, hot pepper, sweet pepper and okra.

Unit II **8Hour**

Introduction, commercial and nutritional importance, origin and distribution, botanyand taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, raising of nursery including grafting technique, sowing/ planting time and methods, precision farming, cropping

system, nutritional including micronutrients and irrigation requirements, intercultural operations, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marking), pest and disease management and economics of crops.

Beans—French bean, Indian bean (Sem), cluster bean and cowpea.

Unit III **8Hours**

Introduction, commercial and nutritional importance, origin and distribution, botanyand taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, raising of nursery including grafting technique, sowing/ planting time and methods, precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marking), pest and disease management and economics of crops.

Cucurbits—Cucumber, melons, gourds, pumpkin and squashes.

Unit IV **7Hour**

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, raising of nursery including grafting technique, sowing/ planting time and methods, precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marking), pest and disease management and economics of crops.

Tuber crops—Sweet potato, elephant foot yam, tapioca, taro and yam and Leafy vegetables—Amaranth and drumstick.

Practical Content **Total Hours: 30**

1. Scientific raising of nursery and seed treatment
2. Sowing and transplanting.
3. Description of commercial varieties and hybrids.
4. Demonstration on methods of irrigation, fertilizers and micronutrients application
5. Mulching practices, weed management
6. Use of plant growth substances in summer season vegetable crops.
7. Study of nutritional and physiological disorders
8. Identification of important pest and diseases and their control
9. Preparation of cropping scheme for commercial farms

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Cooperative Learning, Classroom lectures, Assignment (written and speaking), Student presentation, Hands on training of different procedures.

Suggested Readings

- *Swarup, V. 2006. Vegetable Science and Technology In India: Kalyani Publishers, India. Pp 656.*
- *Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 1: Naya Prokash, India. Pp 668.*
- *Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 2: Naya Prokash, India. Pp 489*
- *Kabir, J., Maity, T. K., Bose, T. K. 2003. Vegetable Crops Vol. 3: Naya Prokash, India. Pp 550*
- *Hazra, P., Karmakar, K., Chattopadhyay,A. 2011. Modern Technology in Vegetable Production.: New India Publishing Agency, India. Pp 442*

Course Title: Breeding of Cross Pollinated Vegetable Crops

Course Code: MVS202

L	T	P	Credits
2	0	2	3

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Have knowledge about principles and practices adopted for breeding of Cross pollinated vegetable crops
2. Get acquaint about floral biology of cross pollinated vegetable crops
3. Impartknowledgeaboutdifferentmethodsofbreedingfollowedforbreeding.
4. Use basic biometric genetics in computation of various parameters of Cross-pollinated vegetables

Theory Content

Unit-1 **6Hour**

History of vegetable breeding, Origin, botany, taxonomy, cytogenetic, genetics , breeding objectives, breeding methods (introduction ,selection, hybridization, mutation),quality improvement of capsicum, chilli, muskmelon, watermelon.

Unit-2 **7Hour**

History of vegetable breeding, Origin, botany, taxonomy, cytogenetic, genetics , Breeding objectives, breeding methods (introduction ,selection, hybridization, mutation),quality improvement cucumber, bottlegourd, long melon, bitter gourd, sponge gourd, summer squash.

Unit-3 **7Hour**

History of vegetable breeding, Origin, botany, taxonomy, cytogenetic, genetics , Breeding objectives, breeding methods (introduction ,selection, hybridization, mutation),quality improvement of ole crops (cabbage, cauliflower, broccoli, brussels'), asparagus, leafy vegetables and spices (black pepper, turmeric, cardamom, coriander).

Unit-4 **10Hour**

Molecular marker, marker assisted breeding and QTLs, biotechnology and their use in breeding cross pollinated vegetable crops. Present status of varietal/hybrid development in India. New approaches in breeding of cross-pollinated vegetables.

PracticalContents **Total Hours: 30**

1. Selection indices in cole crops,
2. Selection indices of cucurbitaceous crops, bulb crops,
3. Selection indices of root crops, leafy vegetablesand spices.
4. Selfing and crossing techniques in cross pollinated vegetable crops.
5. Biometricalanalysis -Line x tester analysis, North Carolina Designs,
6. Stability analysis, Triple test crossanalysis, generation mean analysis, diallel analysis.
7. Estimation of heritability, heterosis andcombiningability.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Ram, H. H. 2012. Vegetable Breeding: Principle and Practices. Kalyani Publishers, India. Pp 791.*
- *Bergh, B. 2012. Genetic Improvement of Vegetable Crops. Elsevier Science, Netherlands. Pp 846*
- *Peter,K V and Pradeep Kumar,T. 1998 Genetics and Breeding of*

Vegetables,ICAR,Krishi Anusandhan Bhawan, New Delhi, India. Pp 333(Revised 2009).

Course Title: Postharvest Management of Vegetable Crops	**L**	**T**	**P**	**Credits**
Course Code: MVS203	**1**	**0**	**2**	**2**

Total Hours 45

Learning outcome: After completion of this course, the learner will be able to:

1. Learn about regulation of postharvest losses by using chemicals and growth regulators.
2. Inculcate Pre and postharvest treatments for extending shelf life of vegetable crops.
3. Establish knowledge about Packinghouse operations for extending the shelf life of vegetable crops.
4. Plan the methods of storage of vegetable crops.

Theory Content

Unit I **5Hrs**

Importance and scope of post-harvest management of Vegetables. Maturity indices and standards for different vegetables; Methods of maturity determination; Biochemistry of maturity and ripening; Enzymatic and textural changes; Ethylene evolution and ethylene management; Respiration and transpiration along with their regulation methods

Unit II **5Hrs**

Harvesting tools and practices for specific market requirement; Postharvest physical and biochemical changes; Pre-harvest practices and other factors affecting postharvest losses

Unit III **3Hrs**

Packing house operations; Commodity pretreatments chemicals, wax coating, precooling and irradiation; Packaging of vegetables, prevention from infestation, management of postharvest diseases and principles of transportation

Unit IV **2Hrs**

Ventilated, refrigerated, modified atmosphere and controlled atmosphere storage, hypobaric storage and cold storage; Zero-energy cool chamber, storage disorders like chilling injury in vegetables

Practical Content **Total Hrs. 30**

1. Studies on stages and maturing indices.
2. Ripening of commercially important vegetable crops.
3. Studies of harvesting, pre-cooling, pre-treatments, physiological disorders- chilling injury.
4. Improved packaging.
5. Use of chemicals for ripening and enhancing shelf life of vegetables.
6. Physiological loss in weight, estimation of transpiration, respiration rate andethylene release
7. Storage of important vegetables
8. Cold chain management.
9. Visit to commercial packinghouse, cold storage and control atmosphere storage

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Thompson AK. (Ed.). 2014. Fruit and vegetables: harvesting, handling and storage (Vol. 1 and Blackwell Publishing Ltd, Oxford, UK. ISBN: 9781118654040.*
- *Verma LR and Joshi VK. 2000. Postharvest technology of fruits and vegetables: handling, processing, fermentation and waste management. Indus Publishing Company, New Delhi,India. ISBN 8173871086.*
- *Willis R, McGlassen WB, Graham D and Joyce D. 1998. Postharvest: An introduction to the physiology and handling of fruits, vegetables and ornamentals. CABI.*
- *Wills RBH and Golding J. 2016. Postharvest: an introduction to the physiology and handling offruit and vegetables, CABI Publishing, ISBN 9781786391483.*
- *Wills RBH and Golding J. 2017. Advances*

Course Title: Sub- tropical and Temperate Fruit Production.	**L**	**T**	**P**	**Credits**
Course Code: MFS103	**2**	**0**	**2**	**3**

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1 Get familiarize with the basic knowledge of importance, uses, origin, distribution, area and production of subtropical and temperate fruits.

2 Acquire technical knowhow regarding soil, climatic, water quality, biotic/abiotic factors limiting fruit production.

3 Learn the importance and methods of planting, root stock, propagation, fruit growth and development, fertigation, fertilization, nutrient and water management.

4 Develop the methodology of training, pruning, quality improvement, pollination, fruit set, physiology and plant protection of sub-tropical and temperate fruits.

Theory content

Origin, distribution, commercial importance and export potential. Eco-physiological requirements. Species and varieties. Rootstocks and propagation. Planting, root zone, training and pruning, Nutrition and water requirements, fertigation, role of bio-regulators, major pests, diseases, physiological disorders and their control measures, Nutrition and water requirements, fertigation, role of bio-regulators, major pests, diseases, physiological disorders and their control measures, Abiotic factors limiting fruit production. Flowering,

pollination and fruit set. Quality improvement. Storage and ripening techniques. Industrial and export potential, Agri. Expert Zones (AEZ) and industrial support.

Unit I **8 hours**

Fruit Crops -Apple, pear, quince, grapes, plum, peach,

Unit II **7 hours**

Fruit Crops - Apricot, cherries, hazelnut, litchi, loquat, persimmon.

Unit III **7 hours**

Fruit Crops - Kiwifruit, strawberry, walnut, almond, pistachio, pecan, mangosteen, carambola,

Unit IV

8 hours

Fruit Crops – Bael, wood apple, fig, jamun, rambutan and pomegranate.

Practical Content **Total Hours: 30**

1. Description and identification of species and varieties.
2. Growth and development.
3. Growth regulation.
4. Nutritional and physiological disorders and their control.
5. Rejuvenation of old and unproductive trees.
6. Visit to commercial orchards.
7. Project preparation for establishing commercial orchards.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

- *Yadav, P.K.2014. Production Technology of Tropical and Subtropical Fruits. New india publishing Agency. pp. 384.*
- *Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp.1057.*
- *Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. Advances in Citriculture. Jagmander Book Agency. pp.256.*

Course Title: Commercial Production of Loose Flowers

Course Code: MFS203

L	T	P	Credits
2	0	2	3

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Learn about production and post harvest management of loose flowers.
2. Develop the required skills on commercial production management.
3. Identify deficiency symptoms of nutrients in loose flower crops.
4. Acquaint with production technology of loose flower crops.

Theory Content

Scope, scenario and importance of loose flowers, constraints and opportunities in loose flower production. Growing environment: Nursery management, pro-tray nursery under shade nets, soil and climate requirement, Field preparation, systems of planting. Crop management: Soli analysis, soil health card, water and nutrient management, weed management, training and pruning, special

horticultural practices such as pinching and disbudding, use of growth regulators, physiological disorders and remedies, INM, IPM and IDM. Crop regulation: Flower forcing and year round flowering, production for special occasions through physiological interventions and chemical regulation.

Unit-I **5 hours**

Flower Crops- Rose, jasmine, chrysanthemum, marigold, tuberose, china aster,

Unit-II **8 hours**

Flower Crops- Crossandra, gaillardia, spider lily, hibiscus, nerium,

Unit-III **7 hours**

Flower Crops- Barleria, celosia, gomphrena, Madar (Calotropis gigantea), nyctanthes (Harsingar),

Unit-IV **10 hours**

Flower Crops- Tabernaemontana (Chandni), lotus, water lily, michelia (Champa), gardenia, ixora and balsam.

Practical Content **Total Hours: 30**

1. Identification of species and varieties.
2. Propagation and nursery management.
3. Training and pruning techniques.
4. Fertigation, foliar nutrition, growth regulator application.
5. Crop protection of loose flowers.
6. Pinching, disbudding, staking, harvesting techniques.
7. Post-harvest handling, storage and cold chain.
8. Project preparation for regionally important commercial loose flowers.

Course Title: Seminar

L	T	P	Credits

9. Crop specific guidelines for project financing (NHB guidelines).
10. Cost Economics and exposure Visits to fields.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

- Arora JS. 2010. Introductory Ornamental Horticulture. Kalyani Publishers. 6th edition, pp. 230.
- Bhattacharjee SK. 2018. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ. Reprint, pp. 2065.
- Bose TK, Maiti, RG, Dhua RS and Das P. 1999. Floriculture and Landscaping. Prokash, Kolkata, India.
- Bose TK and Yadav LP. 1989. Commercial Flowers. Naya Prokash, Kolkata, India.
- Chadha KL and Bhattacharjee SK. 1995. Advances in Horticulture: Ornamental Plants. Vol. XII, Parts 1 & 2. pp. 533, pp. 574. Malhotra Publ. House, New Delhi, India.
- Chadha KL and Chaudhury B. 1992. Ornamental Horticulture in India. ICAR, New Delhi, India.
- Dole JM and Wilkins HF. 2004. Floriculture-Principles and Species. Prentice Hall. 2nd edition, pp. 1048.

Course Code: MVS204

0	**0**	**1**	**1**

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1 Show competence in identifying relevant information, defining and explaining topics under discussion
2 Present the classical and innovative work related to plant pathology subject.
3 Reach across diverse disciplines to apply theories, methods and knowledge bases from multiple fields to a single question or problem
4 Judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject

Course Title: Lab-Fundamentals of Computer Applications

Course Code: MAR206

L	**T**	**P**	**Credits**
0	**0**	**4**	**2**

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1 Learn and understand about basics of MS-Word, Excel, preparation of Graphs
2 Read, understand, and interpret material on technology. They will have an appreciation for some of the ideas, issues, and problems involved in writing about technology and in workplace writing.
3 Understand the operating systems, peripheral devices, networking, multimedia and internet

4 Familiarize with basic sources and methods of research and documentation on topics in technology, including on-line research, integrate material from primary and secondary sources with their own ideas in research papers.

Practical Content

1. Ms-word: creating a document and saving and editing,
2. Use of options from tool bars, format, insert and tools(spelling and grammar), alignment of text.
3. Creating a table, merging cells, column and row width.
4. Ms-excel: entering expressions through the formula tool.
5. Use of inbuilt functions, sum, average, max, min.
6. Creating graphs and saving with and without data in Ms-excel.
7. Ms-access: creating database, structuring with different types of fields.
8. Ms-power point: preparation of slides on power point.
9. Internet Browsing: browsing a web page and creating of E-Mail ID. Agri. Net (ARIS).

Suggested Readings:

- Salaria, R.S. 2017. *Computer Fundamentals.*Daryaganj, New Delhi. pp. 486.
- Manish, S. and Bhatt, A. 2016. *Computers in Agriculture: Fundamentals and Applications.* New India Publishing Agency.New Delhi. pp. 190.
- Manjunath, B.E. 2010.*Computer Basics.*Vasan Publications, Bengaluru, Karnataka. Pp. 356.

Course Title: Master Research	L	T	P	Credits
Course Code: MVS100	0	0	0	5 (NC)

Learning Outcomes: After completion of this course, the learner will be able to:

1 Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques

2 Negotiate, plan, design and execute a research-based project.

3 Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format.

4 Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments and Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Semester 3rd

Course Title: Breeding of Self Pollinated and Vegetative Propagated Vegetable Crops	L	T	P	Credits
Course Code: MVS301	2	0	2	3

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Gain practical knowledge about the selection of parents, Analysis of different qualitative and quantitative characters in germplasm, hybrids and segregating generations.
2. Know about the use of molecular markers and biotechnology in Self-pollinated vegetables.

3. Have knowledge about the different methods of breeding and screening for self-pollinated vegetables for abiotic and biotic stress.
4. Gain practical knowledge about the different methods of hybrid seed production of self-pollinated and use basic biometric techniques in computation of various parameters of Self-pollinated vegetables.

Theory Content

Unit-I **5 Hours**

Selection of desirable plants from breeding population. Observations and analysis of various qualitative and quantitative traits using germplasm, hybrids and segregating generations.

Unit-II **6Hours**

Induction of flowering. Selfing and crossing techniques in vegetable crops. Hybrid seed production of vegetable crops in bulk. Screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops.

Unit-III **7Hours**

Demonstration of sib-mating and mixed population.

Unit-IV **12Hours**

Molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques.

Practical Content **Total Hours: 30**

Selection of desirable plants from breeding population.

1. Observations and analysis of various qualitative and quantitative traits using germplasm, hybrids and segregating generations.
2. Observations and analysis of various quantitative traits using

germplasm, hybrids and segregating generations

3. Induction of flowering.
4. Selfing and crossing techniques in vegetable crops.
5. Crossing techniques in vegetable crops
6. Hybrid seed production of vegetable crops in bulk.
7. Screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops.
8. Demonstration of sib-mating and mixed population.
9. Molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- Ram, H. H. 2012. Vegetable Breeding: Principle And Practices: Kalyani Publishers, India. Pp 791.
- Bergh, B. 2012. Genetic Improvement of Vegetable Crops: Elsevier Science, Netherlands. Pp 846
- Peter, K V and Pradeep Kumar, T. 1998 Genetics and Breeding of Vegetables, ICAR, Krishi Anusandhan Bhawan, New Delhi, India. Pp 333(Revised 2009).

Course Title: Organic Vegetable Production

Course Code: MVS302

L	T	P	Credits
1	0	2	2

Total Hours: 45

Learning outcome: After completion of this course, the learner will be able to:

1. Appreciate the scope and scenario of organic vegetable production in India.
2. Acquire knowledge about the organic vegetable production technology.
3. Manage soil fertility, crop rotation and post harvest of organic vegetables.
4. Adopt production of organic vegetable crops a s entrepreneur.

Theory Content

Unit I **3Hours**

Importance, principles, perspective, concepts and components of organic farming in vegetable crops

Unit II **4Hours**

Organic production of vegetable crops, viz. Solanaceous, Cucurbitaceous, Cole, root and tuber crops

Unit III **4Hours**

Managing soil fertility, mulching, raising green manurecrops, weed management in organic farming system; Crop rotation in organic production; Processing and quality control of organic vegetable produce

Unit IV **4Hours**

Indigenous methods of composting, Panchyagavvya, Biodynamics preparations and their application; ITKs in organic vegetable farming; Role of botanicals and bio-control agents in the management of pests and diseases in vegetable crops Certification and export—Techniques of natural vegetable farming, GAP and GMP certification of organic products; Export- opportunity and challenges.

Practical Content **Total Hours: 30**

1. Methods of preparation and use of compost, vermicompost, biofertilizers and biopesticides.
2. Soil solarisation.
3. Use of green manures.
4. Waste management; Organic soil amendments in organic production of vegetable crops.
5. Weed, pest and disease management in organic vegetable production.
6. Visit to organic fields and marketing centres.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- Dahama AK. 2005. *Organic farming for sustainable agriculture*. 2nd Ed. Agrobios.
- Gehlot G. 2005. *Organic farming; standards, accreditation certification and inspection*. Agrobios.
- Palaniappan SP and Annadorai K. 2003. *Organic farming, theory and practice*. Scientific publ.
- Pradeepkumar T, Suma B, Jyothibhaskar and Satheesan KN. 2008. *Management of horticultural crops*. New India Publ. Agency.
- Shivashankar K. 1997. *Food security in harmony with nature. 3rd IFOAMASIA*, Scientific Conf. 1- 4 December, UAS, Bangalore.

Course Title: Systematic of Vegetable Crops	**L**	**T**	**P**	**Credits**
Course Code: MVS303	**2**	**0**	**2**	**3**

Total Hours: 60

Learning outcome: After completion of this course, the learner will be able to:

1. Acquire knowledge on identification, description, classification and maintenance of vegetable species and varieties.
2. Attainknowledge of code of nomenclature, historyand distribution of vegetable crops
3. Botanical and morphological description of all parts of vegetables.
4. Secure Knowledge cytological level and importance of molecular markers in vegetables.

Theory Content

Unit I **4Hours**

Significance of systematics and crop diversity in vegetable crops; Principles of classification; different methods of classification; Salient features of international code of nomenclature of vegetable crops

Unit II **3Hours**

Origin, history, evolution and distribution of vegetable crops

Unit III **4Hours**

Botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables; Morphological keys to identify important families, floral biology, floral formula and diagram; Morphological description of all parts of vegetables

Unit IV **4Hours**

Cytological level of various vegetable crops with descriptive keys. Molecular markers—Importance of molecular markers in evolution of vegetablecrops; Molecular markers as an aid in characterization and taxonomy of vegetable crops.

Practical Content **Total Hours: 30**

1. Identification and description.
2. Classification and maintenance of vegetable species and varieties;
3. Survey, collection of allied species and genera locally available;
4. Preparation of keys to the species and varieties;
5. Methods of preparation of herbarium and specimens.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- Chopra GL. 1968. *Angiosperms- systematics and life cycle*. S. Nagin
- Dutta AC. 1986. *A class book of botany*. Oxford Univ. Press.
- Pandey BP. 1999. *Taxonomy of angiosperm*. S. Chand and Co
- Peter KV and Pradeepkumar T. 2008. *Genetics and breeding of vegetables*. (Revised), ICAR.
- Peter KV and Hazra P. (Eds). 2012. *Hand book of vegetables*. Studium Press LLC, P.O. Box
- 722200, Houston, Texas 77072, USA, 678p.
- Peter KV and Hazra P. (Eds). 2015. *Hand book of vegetables* Volume II.Studium press LLC.

Course Title: Lab- Technical Writing and Communication Skills	**L**	**T**	**P**	**Credits**
Course Code: MAR304	**0**	**0**	**4**	**2**

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1 Understand and know how to follow the stages of the writing process (prewriting/writing/rewriting) and

2 Apply them to technical and workplace writing tasks

3 Produce a set of documents related to technology and writing in the workplace and will have improved their ability to write clearly and accurately

4 Establish the basic components of definitions, descriptions, process explanations, and other common forms of technical writing.

Practical Content

1. Various forms of scientific writings: theses, technical papers, review, manuals etc.
2. Various parts of thesis and research communications: title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion; writing of abstracts, summaries, precis, citations etc.
3. Commonly used abbreviations in the theses and research communications
4. Illustrations, photographs and drawings with suitable captions; paginations, numbering of tables and illustrations
5. Writing of numbers and dates in scientific write-ups; editing and proof reading; writing a review article, access methods.

Course Title: Master Research

Course Code: MVS100

L	T	P	Credits
0	0	0	10 (NC)

Learning Outcomes: After completion of this course, the learner will be able to:

1 Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques

2 Negotiate, plan, design and execute a research-based project.

3 Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format.

4 Learn the methodology of planning, layout, data recording, analysis, interpretation, report writing of plant pathology experiments and familiarize with indexing databases, citation databases: web of science, scopus, etc.

Semester 4th

Course Title: Growth and Development of Vegetable Crops	**L**	**T**	**P**	**Credits**
Course Code: MVS401	**2**	**0**	**2**	**3**

Total Hours: 60

Learning outcome: After completion of this course, the learner will be able to:

1. Acquire knowledge about the growth and development of plants in vegetable crops
2. Distinguish between primary and secondary growth in plant stems.
3. Obtain knowledge how to apply synthetic PGRs, role and mode of action in vegetable crop production
4. Understand how hormones affect the growth and development of vegetable crops

Theory Content

Unit I **3Hours**

Definition of growth and development; Cellular structures and their functions; Physiology of phyto-hormones functioning/ biosynthesis and mode of action; Growth analysis and its importance in vegetable production.

Unit II **4Hours**

Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellilns, cyktokinins and abscissic acid; Application of synthetic PGRs including plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production.

Unit III **4Hours**

Abiotic factors—Impact of light, temperature, photoperiod, carbon dioxide, oxygen and other gases on growth, development of underground parts, flowering and sex expression in vegetable crops; Apical dominance.

Unit IV **4Hours**

Physiology of fruit set, fruit development, fruit growth, flowerand fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening. Morphogenesis and tissue culture techniques in vegetable crops; Grafting techniques in different vegetable crops.

Practical Content **Total Hours: 30**

1. Preparation of plant growth regulator's solutions and their application.
2. Experiments in breaking and induction of dormancy by chemicals.
3. Induction of parthenocarpy and fruit ripening.
4. Application of plant growth substances for improving flower initiation, changing sex expression in cucurbits.
5. Checking flower and fruit drops and improving fruit set in solanaceous vegetables with plant growth substances.
6. Growth analysis techniques in vegetable crops.
7. Grafting techniques in tomato, brinjal, cucumber and sweet pepper.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- Bleasdale JKA. 1984. *Plant physiology in relation to horticulture* (2nd Edition) MacMillan.
- Gupta US. Eds. 1978. *Crop physiology*. Oxford and IBH, New Delhi.

- Kalloo G. 2017. *Vegetable grafting: Principles and practices*. CAB International
- Krishnamoorti HN. 1981. *Application growth substances and their uses in agriculture*. Tata McGraw Hill, New Delhi.
- Leopold AC and Kriedemann PE. 1981. *Plant growth and development*, Tata McGraw-Hill, New Delhi.
- Peter KV and Hazra P. (Eds). 2012. *Hand book of vegetables*.Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.
- Peter KV. (Eds). 2008. *Basics of horticulture*. New India publication agency, New Delhi.
- Rana MK. 2011. *Physio-biochemistry and Biotechnology of Vegetables*. New India Publishing Agency, Pritam Pura, New Delhi.
- Saini *et al.* (Eds.). 2001. *Laboratory manual of analytical techniques in horticulture*. Agrobios,Jodhpur.
- Wien HC. (Eds.). 1997. *The physiology of vegetable crops*. CAB International

Course Title: Seed Production of Vegetable Crops	**L**	**T**	**P**	**Credits**
Course Code: MVS402	**1**	**0**	**2**	**2**

Total Hours 45

Learning outcome: After completion of this course, the learner will be able to:

1. Learn the scope and scenario of seed production of vegetable crops in India
2. Acquire knowledge about the complete seed production technology, extraction and post-extraction processing of vegetable seeds.
3. Inculcate Field and seed standards in important vegetable crops.
4. Adopt of seed production of vegetable crops as entrepreneur

Theory

Unit I **3Hrs**

Introduction, definition of seed and its quality, seed morphology, development and maturation; Apomixis and fertilization; Modes of propagation and reproductive behaviour; Pollination mechanisms and sex forms in vegetables; History of vegetable seed production; Status and share of vegetable seeds in seed industry

Unit II **5Hrs**

Agro-climate and its influence on quality seed production; Deterioration of crop varieties, genetical and agronomic principles of vegetable seed production; Methods of seed production, hybrid seeds and techniques of large scale hybrid seed production; Seed village concept

Unit III **4Hrs**

Seed multiplication ratios and replacement rates in vegetables; Generation system of seed multiplication; Maintenance and production of nucleus, breeder, foundation, certified/ truthful label seeds; Seed quality and mechanisms of genetic purity testing

Unit IV **3Hrs**

Maturity standards; Seed harvesting, curing and extraction; Seed processing, viz., cleaning, drying and treatment of seeds, seed health and quality

enhancement, packaging and marketing; Principles of seed storage; Orthodox and recalcitrant seeds; Seed dormancy. Improved agro-techniques; Field and seed standards in important solanaceous, leguminous and cucurbitaceous vegetables, cole crops, leafy vegetables, bulbous and root crops and okra; clonal propagation and multiplication in vegetative propagated crops; Seed plot technique and true potato seed production in potato

Practical **30Hrs**

1. Study of floral biology and pollination mechanisms in vegetables;
2. Determination of modes of pollination;
3. Field and seed standards;
4. Use of pollination control mechanisms in hybrid seed production of important
5. vegetables;
6. Maturity standards and seed extraction methods;
7. Seed sampling and testing;
8. Visit to commercial seed production areas;
9. Visit to seed processing plant;
10. Visit to seed testing laboratories.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- *Agarwal PK and Anuradha V. 2018. Fundamentals of seed science and technology. Brilliant publications, New Delhi.*
- *Agrawal PK and Dadlani M. (Eds.). 1992. Techniques in seed science and technology. South asian Publ.*
- *Agrawal RL. (Ed.). 1997. Seed technology. Oxford and IBH.*
- *Basra AS. 2000. Hybrid seed production in vegetables. CRC press, Florida, USA.*

- *Bench ALR and Sanchez RA. 2004. Handbook of seed physiology. Food products press, NY/London.*
- *Bendell PE. (Eds.). 1998. Seed science and technology: Indian forestry species. Allied Publ.*
- *Chakraborty SK, Prakash S, Sharma SP and Dadlani M. 2002. Testing of distinctiveness, uniformity and stability for plant variety protection. IARI, New Delhi*
- *Copland LO and McDonald MB. 2004. Seed science and technology, Kluwer Academic Press.*
- *Fageria MS, Arya PS and Choudhary AK. 2000. Vegetable crops: breeding and seed production. Vol. I. Kalyani Publishers, New Delhi.*
- *George RAT. 1999. Vegetable seed production (2nd Edition). CAB International.*
- *Kalloo G, Jain SK, Vari AK and Srivastava U. 2006. Seed: A global perspective. Associated publishing company, New Delhi*

Course Title: Intellectual Property and its management in Agriculture	L	T	P	Credits
Course Code: MAR402	2	0	0	2

Total Hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Management in Agriculture.
2. Identify the significance of practice and procedure of Patents.
3. Make the students to understand the statutory provisions of different forms of Intellectual Property Management in simple forms.
4. Develop the procedure of obtaining Patents, Copyrights, Trade Marks, Industrial Design and to keep their IP rights alive.

Theory Content **8Hrs**

Unit-I

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR).

Unit-II **8Hrs**

Benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks. protection of plant varieties and farmers' rights and biodiversity protection.

Unit-III **7Hrs**

Protection of plant varieties and farmers' rights and biodiversity protection;protectable subject matters, protection in biotechnology, protection

of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity.

Unit-IV **7Hrs**

International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested readings:

- Erbisch FH and Maredia K.1998. *Intellectual Property Rights in Agricultural*
  Biotechnology. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC and Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M and Scott N. (Ed.). 2003. *Intellectual Property Rights in AnimalBreeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.

Course Title: Master Research

Course Code: MVS100

L	T	P	Credits
0	0	0	30 (NC)

Learning Outcomes: After completion of this course, the learner will be able to:

1 Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques

2 Negotiate, plan, design and execute a research-based project.

3 Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format.

4 Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments

5 Familiarize with indexing databases, citation databases: web of science, scopus, etc.