POST GRADUATE DEPARTMENT OF AGRICULTURE

SYLLABUS FOR THE BATCH FROM THE YEAR

2024 TO YEAR 2026

Programme Code: MHVS

Programme Name: M.Sc. Ag. Horticulture (Vegetable Science)

(Semester I-II)

Examinations: 2024-25

Khalsa College Amritsar

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

Programme Objectives

S. No.	Programme Objectives
1.	To acquaint students about the sustainable and organic production of vegetable crops.
2.	To learn about conduct of scientific research in vegetable crops.
3.	To provide knowledge about art of growing and cultivating vegetable crops.
4.	To learn about various social, financial, environmental and functional aspects of the vegetable farm.
5.	To acquire skills and talents in the versatile field of vegetable plants.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

M.Sc. Ag. Horticulture (Vegetable Science)

Program Specific Outcomes (PSOs)

PSO-1	Basic knowledge of Vegetable Science and its various branches
PSO-2	Detailed knowledge of nursery growing and cultivation practices of vegetable crops will help the students to solve the field related problems in vegetable crops grown under field as well as protected conditions
PSO-3	To learn about the quality seed production (hybrid as well as varietal), seed certification, seed standards, seed act and law enforcement, plant quarantine and quality control
PSO-4	To acquaint the students with the history of vegetable breeding. origin, botany, taxonomy, cytogenetic, genetics, breeding objectives, breeding methods used in vegetables, resistance breeding for biotic and abiotic stress, quality improvement in vegetable crops
PSO-5	To get familiar with various biotechnological tools used in vegetable crop improvement
PSO-6	Detailed learning of different techniques and methods used in the vegetable production as well as vegetable breeding will improve the skills, decision making and research orientation of the students
PSO-7	To get the students acquainted with organic production of vegetables
PSO-8	Facilitating detailed study of post-harvest operation to increase yield and improvement of vegetable quality leading to successful marketing resulting in increasing the income of commercial vegetable growers
PSO-9	This programme will improve the communication skills of the students to deal with vegetable growers and researchers

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-I

Course Code	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
VSC-511	Principles of Vegetable Breeding	3(2+1)	50 + 25 + 25	100	8-9
VSC-512	Growth and Development of Vegetable Crops	3(2+1)	50 + 25 + 25	100	10-11
PHM-511	Postharvest Management of Horticultural Produce	3(2+1)	50 + 25 + 25	100	12-14
STAT-511	Statistical Methods for Applied/ Social Sciences	4(3+1)	57 + 18 + 25	100	15-16
*PGS-511	Technical Writing & Communications Skills	1(0+1)	100 (Pr)	100	17-18
*PGS-512	Library and Information Services	1(0+1)	100 (Pr)	100	19
*VSC-599	Masters' Research	5(0+5)	--	S/US	20
Total		**20(13+7*)**			

* Non-credit course

Total Internal Assessment = 25 marks (Mid Semester Test – 10 marks; Attendance – 10 marks; Conduct & Academic, Extra Curricular Activities – 5 marks).

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-II

Course Code	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
VSC-521	Production of Warm Season Vegetable Crops	3(2+1)	50 + 25 + 25	100	21-23
VSC-522	Breeding of Self Pollinated Vegetable Crops	3(2+1)	50 + 25 + 25	100	24-26
VSC-523	Seed Production of Vegetable Crops	3(2+1)	50 + 25 + 25	100	27-29
STAT-521	Experimental Designs	3(2+1)	50 + 25 + 25	100	30-31
*PGS-521	Agricultural Research, Research Ethics and Rural Development Programmes	1(1+0)	100 (Th)	100	32-33
*VSC-599	Masters' Research	5(0+5)	--	S/US	34
Total		**18(12+6*)**			

* Non-credit course

Total Internal Assessment = 25 marks (Mid Semester Test – 10 marks; Attendance – 10 marks; Conduct & Academic, Extra Curricular Activities – 5 marks).

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-III

Course Code	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
VSC-531	Production of Cool Season Vegetable Crops	3(2+1)	50 + 25 + 25	100	35-37
VSC-532	Breeding of Cross Pollinated Vegetable Crops	3(2+1)	50 + 25 + 25	100	38-40
VSC-533	Organic Vegetable Production	3(2+1)	50 + 25 + 25	100	41-42
VSC-591	Credit seminar	1(1+0)	100	100	43
*PGS-531	Intellectual Property & its management in Agriculture	1(1+0)	100(Th)	100	44-45
*VSC-599	Masters' Research	10(0+10)	--	S/US	46
Total		**21(10+11*)**			

* Non-credit course.

Total Internal Assessment = 25 marks (Mid Semester Test – 10 marks; Attendance – 10 marks; Conduct & Academic, Extra Curricular Activities – 5 marks).

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-IV

Course Code	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
VSC-541	Protected Cultivation of Vegetable Crops	3(2+1)	50 + 25 + 25	100	47-49
*PGS-541	Basic concepts in Laboratory Techniques	1(0+1)	100 (Pr)	100	50
*VSC-599	Masters' Research	10(0+10)	--	S/US	51
Total		**14(3+11*)**			

* Non-credit course.

Total Internal Assessment = 25 marks (Mid Semester Test – 10 marks; Attendance – 10 marks; Conduct & Academic, Extra Curricular Activities – 5 marks).

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-I

VSC-511 Principles of Vegetable Breeding

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. To teach basic principles and practices of vegetable breeding.

Course Content:
Theory:

Section-A: Importance and history- Importance, history and evolutionary aspects of vegetable breeding and its variation from cereal crop breeding.

Section-B: 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).

Section-C: Heterosis breeding- Types, mechanisms and basis of heterosis, facilitating mechanisms like male sterility, self-incompatibility and sex forms. Mutation and Polyploidy breeding; Improvement of asexually propagated vegetable crops and vegetables suitable for protected environment.

Section-D: Ideotype breeding- Ideotype breeding; varietal release procedure; DUS testing in vegetable crops; Application of In-vitro and molecular techniques in vegetable improvement.

Practical:

Floral biology and pollination behaviour of different vegetables; Techniques of selfing and crossing of different vegetables, viz., Cole crops, okra, cucurbits, tomato, eggplant, hot pepper,

etc.; Breeding system and handling of filial generations of different vegetables; Exposure to biotechnological lab practices; Visit to breeding farms.

Suggested Reading:

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

Course Outcomes:

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.

SEMESTER-I

VSC-512 Growth and Development of Vegetable Crops

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. To teach the physiology of growth and development of vegetable crops.

Course Content:
Theory:

Section-A: Introduction and phytohormones—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.

Section-B: Physiology of dormancy and germination—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.

Section-C: 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.

Morphogenesis and tissue culture—Morphogenesis and tissue culture techniques in vegetable crops; Grafting techniques in different vegetable crops.

Section-D: Fruit physiology—Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening.

Practical:

Preparation of plant growth regulator's solutions and their application; Experiments in breaking and induction of dormancy by chemicals; Induction of parthenocarpy and fruit ripening; Application of plant growth substances for improving flower initiation, changing sex expression

in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables; Growth analysis techniques in vegetable crops; Grafting techniques in tomato, brinjal, cucumber and sweet pepper.

Suggested Reading:

1. Bleasdale JKA. 1984. Plant physiology in relation to horticulture (2nd Edition) MacMillan.
2. Gupta US. Eds. 1978. Crop physiology. Oxford and IBH, New Delhi.
3. Kalloo G. 2017. Vegetable grafting: Principles and practices. CAB International
4. Krishnamoorti HN. 1981. Application growth substances and their uses in agriculture. Tata McGraw Hill, New Delhi.
5. Leopold AC and Kriedemann PE. 1981. Plant growth and development, Tata McGraw-Hill, New Delhi.
6. Peter KV and Hazra P. (Eds). 2012. Hand book of vegetables.Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.
7. Peter KV. (Eds). 2008. Basics of horticulture. New India publication agency, New Delhi.
8. Rana MK. 2011. Physio-biochemistry and Biotechnology of Vegetables. New India Publishing Agency, Pritam Pura, New Delhi.
9. Saini et al. (Eds.). 2001. Laboratory manual of analytical techniques in horticulture. Agrobios, Jodhpur.
10. Wien HC. (Eds.). 1997. The physiology of vegetable crops. CAB International.

Course Outcomes:

1. Acquire knowledge about the growth and development of plants in vegetable crops.
2. Distinguish between primary and secondary growth in plant stems.
3. Understand how hormones affect the growth and development of vegetable crops.

SEMESTER-I

PHM-511 Postharvest Management of Horticultural Produce

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. To impart comprehensive knowledge on management of horticultural produce thus extending the post-harvest life of the produce by various treatments.

Course Content:
Theory:

Section-A: History, importance and scope of Postharvest technology of horticultural produce. Nature and structure of horticultural produce. Pre and Postharvest losses and their causes. Climacteric and non-climacteric fruits. Regulation of ripening by use of chemicals and growth regulators. Control of sprouting, rooting and discoloration in vegetables.

Section-B: Maturity indices for harvest. Harvesting and harvesting tools. Curing in roots and tubers. Prepackage Operation: Preecooling, washing, sorting, grading of horticultural perishables for local markets and export. Postharvest handling of spices, plantation crops, medicinal and aromatic plants. Equipments for washing, sizing, grading.

Section-C: Pre and Postharvest treatments for extending storage life/ vase life. VHT, irradiation treatment, skin coating, degreening, etc. Prepackaging, Packaging techniques for local market and export. Standardsand specifications for fresh produce.

Section-D: Postharvest handling system for horticulture crops of regional importance. Principles of transport, modes of transportation, types of vehicles and transit requirements for different horticultural produce. Marketing: Factors influencing marketing of perishable crops, marketing systems and organizations.

Practical:

Study of maturity indices for harvest of fruits, vegetables, spices and plantation crops; Protective skin coating with wax emulsion and pre and Postharvest treatment with fungicides, chemicals and growth regulators to extend the shelf life of fruits and vegetables; Prepackaging of perishables; Extension of vaselife of cut flowers by use of chemicals and growth regulators; Control of sprouting of potato and onion by using growth regulators; Study of modern harvesting, sorting and grading equipments; Study of effect of pre-cooling on shelf-life and quality of fresh fruits, vegetables and flowers; Visit to packaging centers; Visit to local markets, cooperative organizations, super markets dealing with marketing of Perishables.

Suggested Reading:

1. Bhattacharjee SK and Dee LC. 2005. Postharvest technology of flowers and ornamental plants. Pointer publishers, Jaipur.
2. Chattopadhyay SK. 2007. Handling, transportation and storage of fruit and vegetables. Gene Tech books, New Delhi.
3. FAO. 2007. Handing and Preservation of Fruits and Vegetables by Combined methods for Rural Areas-Technical Manual. FAO Agr.Ser.Bull., 149.
4. Kader AA. 1992. Postharvest technology of horticultural crops. 2nd ed university of California.
5. Paliyath G, Murr DP, Handa AK and Lurie S. 2008. Postharvest Biology and Technology of Fruits, Vegetables and Flowers, Wiley-Blackwell, ISBN: 9780813804088.
6. Pruthi JS. 2001 (Reprint). Major spices of India crop management and Postharvest technology. ICAR, NewDelhi
7. Stawley J Kays. 1998. Postharvest physiology of perishable plant products. CBS publishers.
8. Sudheer KP, Indira V. 2007. Postharvest Technology of Horticultural Crops, Peter K.V. (Ed.), New India Publishing Agency, ISBN 9788189422431.
9. Sunil Pareek (Ed.) 2016. Postharvest Ripening Physiology of Crops, CRC Press, ISBN 9781498703802.
10. Thompson AK. (Ed.) 2014. Fruit and Vegetables: Harvesting, Handling and Storage (Vol. 1 & 2) Blackwell Publishing Ltd, Oxford, UK. ISBN: 9781118654040.
11. 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.
12. Wills RBH and Golding J. 2016. Postharvest: an introduction to the physiology and handling of fruit and vegetables, CABI Publishing, ISBN 9781786391483.
13. Wills RBH and Golding J. 2017. Advances in Postharvest Fruit and Vegetable Technology, CRC Press, ISBN 9781138894051.

Couse Outcomes:

1. Regulation of ripening by use of chemicals and growth regulators.
2. Pre and Postharvest treatments for extending storage life/ vase life.
3. Standards and specifications for fresh produce.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-I

STAT-511 Statistical Methods for Applied/ Social Sciences

Time: 3 Hours **Maximum marks: 100**
Theory: 57
Practical: 18
Internal assessment: 25
Credit hours: 4(3+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 9 marks (Comprising of 9 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (12).

Course Objectives:

1. The aim of this course is to understand the basics of statistical methods and their applications in agriculture.
2. It helps the students in understanding, analyzing and interpreting the agricultural data.
3. It also helps in making appropriate decisions in agricultural research findings.

Course Content:

Theory

Section-A: Box-plot, Descriptive statistics:- measures of central tendency, dispersion, Theory of probability:- types and introduction, Introduction to Random variable and Mathematical expectation and their properties.

Section-B: Discrete and continuous probability distributions:- Binomial, Poisson, Normal distribution and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.

Section-C: Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination.

Section-D: Non-parametric tests:- sign, Mann-Whitney U-test, Run test for the randomness of a sequence, Median test:- introduction and their applications. Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques:- SRS, cluster, stratified, systematic sampling:- introduction and their applications, Transformation of Data.

Practical:

Fitting of distributions ~ Binomial, Poisson, Normal. Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi-square, t and F. Correlation and regression analysis. Non-parametric tests. ANOVA: One way, Two Way.

Note: Students shall be trained to use computer to analysis the data, using available softwares. However, during university examination students will use scientific calculators to analyse the data.

Suggested Reading:

1. Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
2. Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
3. Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley.
4. Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan.
5. Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill.
6. Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition.
7. Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.
8. Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed. John Wiley
9. http://freestatistics.altervista.org/en/learning.php.
10. http://www.statsoft.com/textbook/stathome.html.

Course Outcome:

1. Get knowledge on probability theory, sampling techniques, standard error etc.
2. Apply Correction and regression techniques.
3. Apply T-Test, chi-square and large sample tests.

SEMESTER-I

***PGS-511 Technical Writing & Communications Skills**

Time: 3 Hours **Maximum marks: 100**
Practical: 100
Credit hours: 1(0+1)

Instructions for the Paper Setters:

1. The question paper will consist of nine skill-oriented questions.
2. The first 5 questions carry 8 marks each. There will be internal choice wherever possible. The answer should be in 50-80 words. (5×8=40 Marks)
3. There will be four essay type questions from the entire syllabus. There will be internal choice wherever possible. The answer should be in 250 words. (4×15= 60 Marks)

Course objectives:

1. To equip the students/ scholars with skills to write dissertations, research papers, etc.
2. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Course Content:

Practical:

Various forms of scientific writings- theses, technical papers, reviews, manuals etc.; 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, précis, citations, etc.; Commonly used abbreviations in the theses and research communications; Illustrations, photographs and drawings with suitable captions; pagination numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups. Editing and proof-reading. Writing of a review article; Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech; Participation in group discussion; Facing an interview; Presentation of scientific papers.

Suggested Reading:

1. Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
2. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
3. Collins' Cobuild English Dictionary. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
5. Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
6. James HS. 1994. Handbook for Technical Writing. NTC Business Books.
7. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated

East-West Press.
8. Mohan K. 2005. Speaking English Effectively. MacMillan India.
9. Richard WS. 1969. Technical Writing.
10. Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
11. Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

Course Outcomes:

1. Understand the basic components of definitions, descriptions, process explanations and other common forms of technical writing.
2. Understand various stages of the writing process and apply them to technical and workplace writing tasks.
3. Integrate material collected from primary and secondary sources with their own ideas in research papers.

SEMESTER-I

***PGS-512 Library and Information Services**

Time: 3 Hours **Maximum marks: 100**
Practical: 100
Credit hours: 1(0+1)

Instructions for the Paper Setters:

1. The question paper will consist of nine skill-oriented questions.
2. The first 5 questions carry 8 marks each. There will be internal choice wherever possible. The answer should be in 50-80 words. (5×8=40 Marks)
3. There will be four essay type questions from the entire syllabus. There will be internal choice wherever possible. The answer should be in 250 words. (4×15= 60 Marks)

Course Content:
Practical:

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

Course outcomes:

1. Understand the definitions, descriptions, process explanations and other common forms of technical writing.
2. Understand how to follow the stages of the writing process and apply them to technical and workplace writing tasks
3. Synthesize and integrate material collected from primary and secondary sources with their own ideas while writing research papers.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-I

***VSC-599** **Masters' Research**

S/US
Credits hours:5(0+5)

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-II

VSC-521 Production of Warm Season Vegetable Crops

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. To study cultivation practices of summer season vegetable crops.
2. The varietal status confining to area with respect to different crops.
3. Intercultural operations during the cropping period.
4. Protection against insect-pest in different vegetable crops.

Course Content:

Theory:

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, special horticultural practices namely hydroponics, aeroponics, 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.

Section-A: Fruit vegetables—Tomato, brinjal, hot pepper, sweet pepper and okra.
Section-B: Beans—French bean, Indian bean (Sem), cluster bean and cowpea.
Section-C: Cucurbits—Cucumber, melons, gourds, pumpkin and squashes.
Section-D: Tuber crops—Sweet potato, elephant foot yam, tapioca, taro and yam.
Leafy vegetables—Amaranth and drumstick.

Practical:

Scientific raising of nursery and seed treatment; Sowing, transplanting, vegetable grafting; Description of commercial varieties and hybrids; Demonstration on methods of irrigation, fertilizers and micronutrients application; Mulching practices, weed management; Use of plant growth substances in warm season vegetable crops; Study of nutritional and physiological disorders; Studies on hydroponics, aeroponics and other soilless culture; Identification of important pest and diseases and their control; Preparation of cropping scheme for commercial farms; Visit to commercial farm, greenhouse/ polyhouses; Visit to vegetable market; Analysis of benefit to cost ratio.

Suggested Reading:

1. Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. Vegetable crops. Vols. I-III. Naya udyog.
2. Bose TK, Som MG and Kabir J. (Eds.). 1993. Vegetable crops. Naya prokash.
3. Chadha KL and Kalloo G. (Eds.). 1993-94. Advances in horticulture Vols. V-X. Malhotra publ. house.
4. Chadha KL. (Ed.). 2002. Hand book of horticulture. ICAR.
5. Chauhan DVS. (Ed.). 1986. Vegetable production in India. Ram prasad and sons.
6. Fageria MS, Choudhary BR and Dhaka RS. 2000. Vegetable crops: production technology. Vol.II. Kalyani.
7. Gopalakrishanan TR. 2007. Vegetable crops. New India publ. agency.
8. Hazra P and Banerjee MK and Chattopadhyay A. 2012. Varieties of vegetable crops in India, (Second edition), Kalyani publishers, Ludhiana, 199 p.
9. Hazra P. 2016. Vegetable science. 2ndedn, Kalyani publishers, Ludhiana.
10. Hazra P. 2019. Vegetable production and technology. New India publishing agency, New Delhi.
11. Hazra P, Chattopadhyay A, Karmakar K and Dutta S. 2011. Modern technology for vegetable production, New India publishing agency, New Delhi, 413p
12. Rana MK. 2008. Olericulture in India. Kalyani Publishers, New Delhi.
13. Rana MK. 2008. Scientific cultivation of vegetables. Kalyani Publishers, New Delhi.
14. Rubatzky VE and Yamaguchi M. (Eds.). 1997. World vegetables: principles, production and nutritive values. Chapman and Hall.
15. Saini GS. 2001. A text book of oleri and flori culture. Aman publishing house.
16. Salunkhe DK and Kadam SS. (Ed.). 1998. Hand book of vegetable science and technology: production, composition, storage and processing. Marcel dekker.
17. Shanmugavelu KG., 1989. Production technology of vegetable crops. Oxford and IBH.
18. Singh DK. 2007. Modern vegetable varieties and production technology. International book distributing Co.
19. Singh SP. (Ed.). 1989. Production technology of vegetable crops. Agril. comm. res. centre.

20. Thamburaj S and Singh N. (Eds.). 2004. Vegetables, tuber crops and spices. ICAR.
21. Thompson HC and Kelly WC. (Eds.). 1978. Vegetable crops. Tata McGraw-Hill.

Course Outcomes:

1. Get knowledge about Introduction, nutritional value, origin botany and taxonomy, important countries and states growing vegetables along with area.
2. Learn about cultural practices, post-harvest management, plant protection measures of warm season vegetable crops.
3. Learn about seed production of warm season vegetable crops.
4. Get acquainted with polyhouse, net-house and low tunnel technology for offseason production of summer vegetables.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-II

VSC-522 Breeding of Self Pollinated Vegetable Crops

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. Present status of varietal/hybrid development in India.
2. Use of biotechnology to enhance the hybrids/varieties in self pollinated vegetable crops.
3. Protection against biotic and abiotic stress in different self-pollinated and vegetatively propagated vegetable crops.

Course Content:

Theory: Origin, botany, taxonomy, wild relatives, cytogenetics and genetics, types of pollination and fertilization mechanism, sterility, breeding objectives, breeding methods (introduction, selection, hybridization, mutation and polyploidy), varieties and varietal characterization, resistance breeding for biotic and abiotic stresses, breeding for protected environment and quality improvement, molecular markers and marker's assisted breeding; QTLs, PPV and FR Act.

Section-A: Tuber crops: Potato; Leafy vegetables- Lettuce and fenugreek.

Section-B: Fruit vegetables- Tomato, eggplant, hot pepper, sweet pepper and okra.

Section-C: Leguminous vegetables- Garden peas and cowpea.

Section-D: Leguminous vegetables: French bean, Indian bean, cluster bean and broad bean.

Practical:

Floral mechanisms favouring self and often cross pollination; Progeny testing and development of inbred lines; Selection of desirable plants from breeding population, observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations; Palynological studies, selfing and crossing techniques; Hybrid seed production of vegetable crops

in bulk; techniques for biotic and abiotic stress resistance in above mentioned crops; Molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques; Visit to breeding farms.

Suggested Reading:

1. Allard RW. 1999. Principles of plant breeding. John Wiley and Sons.
2. Basset MJ. (Ed.). 1986. Breeding vegetable crops. AVI Publ.
3. Dhillon BS, Tyagi RK, Saxena S and Randhawa GJ. 2005, Plant genetic resources: horticultural crops. Narosa Publ. House.
4. Fageria MS, Arya PS and Choudhary AK. 2000, Vegetable crops: Breeding and seed production. Vol. I. Kalyani.
5. Gardner EJ. 1975. Principles of genetics. John Wiley and Sons.
6. Hayes HK, Immer FR and Smith DC. 1955. Methods of plant breeding. McGraw-Hill.
7. Hayward MD, Bosemark NO and Romagosa I. (Eds.). 1993. Plant Breeding-principles and prospects. Chapman and Hall.
8. Hazra P and Som MG. 2015. Vegetable science (Second revised edition), Kalyani publishers, Ludhiana, 598 p.
9. Hazra P and Som MG. 2016. Vegetable seed production and hybrid technology (Second revised edition), Kalyani Publishers, Ludhiana, 459 p
10. Kalloo G. 1988. Vegetable breeding. Vols. I-III. CRC Press.
11. Kalloo G. 1998. Vegetable breeding. Vols. I-III (Combined Ed.). Panima Edu. Book Agency.
12. Kumar JC and Dhaliwal MS. 1990. Techniques of developing hybrids in vegetable crops. Agro Botanical Publ.
13. Paroda RS and Kalloo G. (Eds.). 1995. Vegetable research with special reference to hybrid technology in Asia-Pacific Region. FAO.
14. Peter KV and Pradeepkumar T. 2008. Genetics and breeding of vegetables. Revised, ICAR.
15. Peter KV and Hazra P. (Eds). 2012. Hand book of vegetables. Studium press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.
16. Peter KV and Hazra P (Eds). 2015. Hand book of vegetables Volume II.Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 509 p.
17. Peter KV and Hazra P. (Eds). 2015. Hand book of vegetables Volume III.Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 634 p.
18. Rai N and Rai M. 2006. Heterosis breeding in vegetable crops. New India Publ. Agency.
19. Ram HH. 1998. Vegetable breeding: principles and practices. Kalyani Publishers, New Delhi.
20. Simmonds NW. 1978. Principles of crop improvement. Longman. Singh BD. 1983. Plant Breeding. Kalyani Publishers, New Delhi.

21. Singh PK, Dasgupta SK and Tripathi SK. 2004. Hybrid vegetable development. International Book Distributing Co.
22. Swarup V. 1976. Breeding procedure for cross-pollinated vegetable crops. ICAR.

Course Outcomes:

1. Get knowledge about the history of vegetable breeding. Origin, botany, taxonomy, cytogenetic, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), resistance breeding for biotic and abiotic stress, quality improvement in self-pollinated crops, concept of ideotype.
2. Get information about molecular marker, marker assisted breeding and qtls, biotechnology and their use in breeding in self-pollinated and vegetatively propagated vegetable crops
3. Get acquainted with issues of patenting, PPV&FRA.
4. Get the information about present status of varietal/hybrid development in India.
5. Learn about new approaches in breeding of self-pollinated.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-II

VSC-523 Seed Production of Vegetable Crops

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. Appreciate 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. Adoption of seed production of vegetable crops as entrepreneur.

Course Content:
Theory:

Section-A: Introduction, history, propagation and reproduction-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.

Section-B: Agro-climate and methods of seed production-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

Section-C: Seed multiplication and its quality maintenance-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

Section-D: Seed harvesting, extraction and its processing-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 and field and seed standards- 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:

Study of floral biology and pollination mechanisms in vegetables; Determination of modes of pollination; Field and seed standards; Use of pollination control mechanisms in hybrid seed production of important vegetables; Maturity standards and seed extraction methods; Seed sampling and testing; Visit to commercial seed production areas; Visit to seed processing plant; Visit to seed testing laboratories.

Suggested Reading:

1. Agarwaal PK and Anuradha V. 2018. Fundamentals of seed science and technology. Brilliant publications, New Delhi.
2. Agrawal PK and Dadlani M. (Eds.). 1992. Techniques in seed science and technology. South asian Publ.
3. Agrawal RL. (Ed.). 1997. Seed technology. Oxford and IBH.
4. Basra AS. 2000. Hybrid seed production in vegetables. CRC press, Florida, USA.
5. Bench ALR and Sanchez RA. 2004. Handbook of seed physiology. Food products press, NY/ London.
6. Bendell PE. (Eds.). 1998. Seed science and technology: Indian forestry species. Allied Publ.
7. Chakraborty SK, Prakash S, Sharma SP and Dadlani M. 2002. Testing of distinctiveness, uniformity and stability for plant variety protection. IARI, New Delhi
8. Copland LO and McDonald MB. 2004. Seed science and technology, Kluwer Academic Press.
9. Fageria MS, Arya PS and Choudhary AK. 2000. Vegetable crops: breeding and seed production. Vol. I. Kalyani Publishers, New Delhi.
10. George RAT. 1999. Vegetable seed production (2nd Edition). CAB International.
11. Kalloo G, Jain SK, Vari AK and Srivastava U. 2006. Seed: A global perspective. Associated publishing company, New Delhi.
12. Hazra P and Som HG. 2015. Seed production and hybrid technology of vegetable crops. Kalyani publishers, Ludhiana.
13. Kumar JC and Dhaliwal MS. 1990. Techniques of developing hybrids in vegetable crops. Agro botanical publ.

14. More TA, Kale PB and Khule BW. 1996. Vegetable seed production technology. Maharashtra state seed corp.
15. Rajan S and Markose BL. 2007. Propagation of horticultural crops. New India publ. agency.
16. Singh NP, Singh DK, Singh YK and Kumar V. 2006. Vegetable seed production technology. International book distributing Co.
17. Singh SP. 2001. Seed production of commercial vegetables. Agrotech publ. academy.
18. Singhal NC. 2003. Hybrid seed production. Kalyani publishers, New Delhi.

Course Outcomes:

1. Get familiar with definition of seed and its quality; DUS test and scope of vegetable seed industry in India.
2. Get knowledge about agronomic principles and methods of seed production in important vegetable crops.
3. Use of growth regulators and chemicals in vegetable seed production; floral biology, pollination, breeding behaviour, seed development and maturation; methods of hybrid seed production.
4. Get acquainted with categories of seed; maintenance of nucleus, foundation and certified seed; seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control.
5. Learn about physiological maturity, seed harvesting, extraction, curing, drying, grading, seed processing, seed coating and pelleting, packaging (containers/packets), storage and cryopreservation of seeds, synthetic seed technology.

SEMESTER-II

STAT-521: Experimental Designs

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. The aim of this course is to understand the basics of statistical methods and their applications in agriculture.
2. It helps the students in understanding, analyzing and interpreting the agricultural data.
3. It also helps in making appropriate decisions in agricultural research findings.

Course Content:

Theory:

Section-A: Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

Section-B: Uniformity trials, size and shape of plots and blocks, analysis of variance, completely randomized design, randomized block design and Latin square design.

Section-C: Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.

Section-D: Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

Practical:

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments, Analysis with missing data, Split plot and strip plot designs.

Note: Students shall be trained to use computer to analysis the data, using available softwares. However, during university examination students are allowed to use scientific calculators to analysis is the data.

Note: Students are allowed to use scientific calculator in University examinations; statistical tables will be provided to students in examinations. No rigorous mathematical proofs are expected from students; stress will be on application only.

Suggested Reading:

1. Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
2. Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
3. Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley.
4. Federer WT. 1985. Experimental Designs. MacMillan.
5. Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
6. Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
7. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.
8. www.drs.icar.gov.in.

Course Outcome:

1. Get knowledge about the designs, their principles, analysis of variance and interpretation of data.
2. Study various mechanical errors in field experiments, methods of reducing it and presentation of research results.

SEMESTER-II

***PGS-521- Agricultural Research, Research Ethics and Rural Development Programmes**

Time: 3 Hours **Maximum marks: 100**
Theory: 100
Credit hours: 1 (1+0)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

Course objective:

1. The main objective of the course is to enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Course Content:
Theory:

Section A: History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR):

Section B: International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility. Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

Section C: Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme,

Section D: Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of

rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings:

1. Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
2. Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
4. Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

Course Outcomes:

1. Understand the moral judgment and reactions.
2. Identify the publication misconduct, scientific misconduct, complaints and appeals.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-II

***VSC-599** **Masters' Research**

S/US
Credits hours: 5(0+5)

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-III

VSC-531 Production of Cool Season Vegetable Crops

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. To study cultivation practices of winter season vegetable crops.
2. The varietal status confining to area with respect to different crops.
3. Intercultural operations during the cropping period.
4. Protection against insect-pest in different vegetable crops.

Course Content:

Theory:

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 methods, hrydroponics and aeroponics, 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.

Section-A: Bulb and tuber crops - Onion, garlic and potato.
Section -B: Cole crops - Cabbage, cauliflower, kohlrabi, broccoli, Brussels sprouts and kale.
Section-C: Root Crops - Carrot, radish, turnip and beetroot.
Section-D: Peas and beans (Garden peas and broad bean) and Leafy vegetables (Beet leaf, fenugreek, coriander and lettuce).

Practical:

Scientific raising of nursery and seed treatment; Sowing and transplanting; Description of

commercial varieties and hybrids; Demonstration on methods of irrigation, fertilizers and micronutrients application; Mulching practices, weed management; Use of plant growth substances in cool season vegetable crops; Study of nutritional and physiological disorders; Studies on hydroponics, aeroponics and other soilless culture; Identification of important pest and diseases and their control; Preparation of cropping scheme for commercial farms; Visit to commercial farm, greenhouse/ polyhouses; Visit to vegetable market; Analysis of benefit to cost ratio.

Suggested Reading:

1. Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. Vegetable crops. Vols. I-III. Naya udyog.
2. Bose TK, Som MG and Kabir J. (Eds.). 1993. Vegetable crops. Naya prokash.
3. Chadha KL and Kalloo G. (Eds.). 1993-94. Advances in horticulture Vols. V-X. Malhotra publ. house.
4. Chadha KL. (Ed.). 2002. Hand book of horticulture. ICAR.
5. Chauhan DVS. (Ed.). 1986. Vegetable production in India. Ram prasad and sons.
6. Fageria MS, Choudhary BR and Dhaka RS. 2000. Vegetable crops: production technology. Vol.II. Kalyani.
7. Gopalakrishanan TR. 2007. Vegetable crops. New India publ. agency.
8. Hazra P and Banerjee MK and Chattopadhyay A. 2012. Varieties of vegetable crops in India, (Second edition), Kalyani publishers, Ludhiana, 199 p.
9. Hazra P. 2016. Vegetable science. 2ndedn, Kalyani publishers, Ludhiana.
10. Hazra P. 2019. Vegetable production and technology. New India publishing agency, New Delhi.
11. Hazra P, Chattopadhyay A, Karmakar K and Dutta S. 2011. Modern technology for vegetable production, New India publishing agency, New Delhi, 413p
12. Rana MK. 2008. Olericulture in India. Kalyani Publishers, New Delhi.
13. Rana MK. 2008. Scientific cultivation of vegetables. Kalyani Publishers, New Delhi.
14. Rubatzky VE and Yamaguchi M. (Eds.). 1997. World vegetables: principles, production and nutritive values. Chapman and Hall.
15. Saini GS. 2001. A text book of oleri and flori culture. Aman publishing house.
16. Salunkhe DK and Kadam SS. (Ed.). 1998. Hand book of vegetable science and technology: production, composition, storage and processing. Marcel dekker.
17. Shanmugavelu KG., 1989. Production technology of vegetable crops. Oxford and IBH.
18. Singh DK. 2007. Modern vegetable varieties and production technology. International book distributing Co.
19. Singh SP. (Ed.). 1989. Production technology of vegetable crops. Agril. comm. res. centre.
20. Thamburaj S and Singh N. (Eds.). 2004. Vegetables, tuber crops and spices. ICAR.
21. Thompson HC and Kelly WC. (Eds.). 1978. Vegetable crops. Tata McGraw-Hill.

Course Outcomes:

1. Learn about the Introduction, nutritional value, origin, botany and taxonomy of the vegetables grown in the winter season.
2. Get the information about the important countries and states growing winter vegetables along with area.
3. Get knowledge about cultural practices of winter season vegetables, their postharvest management and plant protection measures.
4. Learn about seed production of winter season vegetable crops.

SEMESTER-III

VSC-532 Breeding of Cross Pollinated Vegetable Crops

Time: 3 Hours

Maximum marks: 100
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. Present status of varietal/hybrid development in India.
2. Use of biotechnology to enhance the hybrids/varieties in self pollinated vegetable crops.
3. Protection against biotic and abiotic stress in different self-pollinated and vegetatively propagated vegetable crops.

Course Content:

Theory: Origin, botany, taxonomy, cytogenetics, genetics, types of pollination and fertilization, mechanism, sterility and incompatibility, breeding objectives, breeding methods (introduction, selection, hybridization, mutation, polyploidy), varieties and varietal characterization, resistance breeding for biotic and abiotic stresses, quality improvement, molecular markers and marker assisted breeding, and QTLs, PPV and FR act

Section-A: Cucurbitaceous crops - Gourds, melons, cucumber, pumpkin and squashes.

Section-B: Cole crops - Cauliflower, cabbage, kohlrabi, broccoli and brussels sprouts.

Section-C: Root and bulb crops—Carrot, radish, turnip, beet root and onion.

Section-D: Tuber crops - Sweet potato, tapioca, taro and yam. Leafy vegetables - Beet leaf, spinach, amaranth and coriander.

Practical:

Floral mechanisms favouring cross pollination; Development of inbred lines; Selection of desirable plants from breeding population; Observations and analysis of various quantitative and qualitative traits in germplasm, hybrids and segregating generations; Induction of flowering,

palynological studies, selfing and crossing techniques; Hybrid seed production of vegetable crops in bulk; Screening techniques for biotic and abiotic stress resistance in above mentioned crops; Demonstration of sib-mating and mixed population; Molecular marker techniques to identify useful traits in vegetable crops and special breeding techniques; Visit to breeding blocks.

Suggested Reading:

1. Allard RW. 1999. Principles of plant breeding. John Wiley and Sons.
2. Basset MJ. (Ed.). 1986. Breeding vegetable crops. AVI Publ.
3. Dhillon BS, Tyagi RK, Saxena S and Randhawa GJ. 2005, Plant genetic resources: horticultural crops. Narosa Publ. House.
4. Fageria MS, Arya PS and Choudhary AK. 2000, Vegetable crops: Breeding and seed production. Vol. I. Kalyani.
5. Gardner EJ. 1975. Principles of genetics. John Wiley and Sons.
6. Hayes HK, Immer FR and Smith DC. 1955. Methods of plant breeding. McGraw-Hill.
7. Hayward MD, Bosemark NO and Romagosa I. (Eds.). 1993. Plant Breeding-principles and prospects. Chapman and Hall.
8. Hazra P and Som MG. 2015. Vegetable science (Second revised edition), Kalyani publishers, Ludhiana, 598 p.
9. Hazra P and Som MG. 2016. Vegetable seed production and hybrid technology (Second revised edition), Kalyani Publishers, Ludhiana, 459 p
10. Kalloo G. 1988. Vegetable breeding. Vols. I-III. CRC Press.
11. Kalloo G. 1998. Vegetable breeding. Vols. I-III (Combined Ed.). Panima Edu. Book Agency.
12. Kumar JC and Dhaliwal MS. 1990. Techniques of developing hybrids in vegetable crops. Agro Botanical Publ.
13. Paroda RS and Kalloo G. (Eds.). 1995. Vegetable research with special reference to hybrid technology in Asia-Pacific Region. FAO.
14. Peter KV and Pradeepkumar T. 2008. Genetics and breeding of vegetables. Revised, ICAR.
15. Peter KV and Hazra P. (Eds). 2012. Hand book of vegetables. Studium press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.
16. Peter KV and Hazra P (Eds). 2015. Hand book of vegetables Volume II.Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 509 p.
17. Peter KV and Hazra P. (Eds). 2015. Hand book of vegetables Volume III.Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 634 p.
18. Rai N and Rai M. 2006. Heterosis breeding in vegetable crops. New India Publ. Agency.
19. Ram HH. 1998. Vegetable breeding: principles and practices. Kalyani Publishers, New Delhi.
20. Simmonds NW. 1978. Principles of crop improvement. Longman. Singh BD. 1983. Plant Breeding. Kalyani Publishers, New Delhi.

21. Singh PK, Dasgupta SK and Tripathi SK. 2004. Hybrid vegetable development. International Book Distributing Co.
22. Swarup V. 1976. Breeding procedure for cross-pollinated vegetable crops. ICAR.

Course Outcomes:

1. Get knowledge about the history of vegetable breeding. Origin, botany, taxonomy, cytogenetic, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), resistance breeding for biotic and abiotic stress, quality improvement in self-pollinated crops, concept of ideotype.
2. Get information about molecular marker, marker assisted breeding and qtls, biotechnology and their use in breeding in self-pollinated and vegetatively propagated vegetable crops
3. Get acquainted with issues of patenting, PPV&FRA.
4. Get the information about present status of varietal/hybrid development in India.
5. Learn about new approaches in breeding of self-pollinated.

SEMESTER-III

VSC-533 Organic Vegetable Production

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. Appreciate the scope and scenario of organic vegetable production in India.
2. Acquire knowledge about the organic vegetable production technology.
3. Adopting production of organic vegetable crops a s entrepreneur.

Course Content:

Theory:

Section-A: Importance and principles-Importance, principles, perspective, concepts and components of organic farming in vegetable crops. Certification and export—Techniques of natural vegetable farming, GAP and GMPcertification of organic products; Export- opportunity and challenges.

Section -B: Organic production of vegetables-Organic production of vegetable crops, viz., Solanaceous, Cucurbitaceous, Cole, root and tuber crops

Section-C: Managing soil fertility-Managing soil fertility, mulching, raising green manure crops, weed management in organic farming system; Crop rotation in organic production; Processing and quality control of organic vegetable produce.

Section-D: Composting methods-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.

Practical:

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

Suggested Reading:

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

Course Outcomes:

1. Get acquainted with importance, principles, perspective, concept and component of organic production of vegetable crops.
2. Get knowledge about managing soil fertility, pests and diseases and weed problems in organic farming system.
3. Get information about indigenous methods of compost and biodynamics preparations etc.
4. Get information about processing and quality control, certification of organic products; organic production and export opportunity and challenges.
5. Learn about the cultural practices followed in organic production of vegetables crops.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-III

VSC-591 **CREDIT SEMINAR**

Maximum marks: 100
Credits hours: 1(1+0)

SEMESTER-III

***PGS-531 Intellectual Property & its Management in Agriculture**

Time: 3 Hours **Maximum marks: 100**
Theory: 100
Credit hours: 1 (1+0)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

Course Objectives:

1. Equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy

Course Content:
Theory:

Section A: 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), benefits of securing IPRs;

Section B: 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;

Section C: Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity;

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

Suggested Readings:

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

Course outcomes:

1. Use different tools of IPR for their rights.
2. They will be able to guide the innovative farmers regarding various IPR tools and their use for protection of their rights.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-III

VSC-599 **Masters' Research**

S/US

Credits hours: 10(0+10)

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-IV

VSC-541 Protected Cultivation of Vegetable Crops

Time: 3 Hours **Maximum marks: 100**
Theory: 50
Practical: 25
Internal assessment: 25
Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

Course Objectives:

1. Protected cultivation of vegetable crops.
2. Effect of environmental factors on crops.
3. Production of vegetable nursery.
4. Problem of growing vegetables in protected structures and their remedies.

Course Content:
Theory:

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

Section-B: 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.

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

Section-D: Cultivation of crops- Regulation of flowering and fruiting in vegetable crops. Technology for raising tomato, sweet pepper, cucumber and other vegetables in protected

structures, including varieties and hybrids, training, pruning and staking in growing vegetables under protected structures. Solutions to problems- Problems of growing vegetables in protected structures and their remedies, physiological disorders, insect and disease management in protected structures; Use of protected structures for seed production; Economics of greenhouse crop production.

Practical:

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

Suggested Reading:

1. Chadha KL and Kalloo G. (Eds.). 1993-94. Advances in horticulture. Malhotra Pub. House.
2. Chandra S and Som V. 2000. Cultivating vegetables in green house. Indian horticulture 45:17-18.
3. Kalloo G and Singh K. (Eds.). 2000. Emerging scenario in vegetable research and development.Research periodicals and Book publ. house.
4. Parvatha RP. 2016. Sustainable crop protection under protected cultivation. E-Book Springer.
5. Prasad S and Kumar U. 2005. Greenhouse management for horticultural crops. 2nd Ed.Agrobios.
6. Resh HM. 2012. Hydroponic food production. 7thEdn. CRC Press.
7. Singh B. 2005. Protected cultivation of vegetable crops. Kalyani publishers, New Delhi
8. Singh DK and Peter KV. 2014. Protected cultivation of horticultural crops (1st Edition) New
9. India publishing agency, New Delhi Singh S, Singh B and Sabir N. 2014. Advances in protected cultivation. New India publishing agency, New Delhi.
10. Tiwari GN. 2003. Green house technology for controlled environment. Narosa publ. house.

Course Outcomes:

1. Get acquainted with the importance, scope, principles, site selection, orientation, problems and remedies, classification and designs of protected cultivation of vegetable crops.
2. Get detailed information about the effect of environmental factors, viz. temperature, light, CO_2 and humidity, selection of varieties and hybrids, drip irrigation and fertigation and role of plastic mulch under protected cultivation of vegetable crops.
3. Get acquaintance with nursery raising structures, Hi-tech nursery, nursery under portable plastic low tunnels.

4. Get knowledge about use of protected structures for seed production.
5. Get acquainted the students with technology for raising tomato, sweet pepper, cucumber and other high value vegetables crops in protected structures, training and staking in vegetable crops under protected structures.
6. Learn about Hydroponics and Aeroponics.

SEMESTER-IV

***PGS-541 Basic Concepts in Laboratory Techniques**

Time: 3 Hours **Maximum marks: 100**
Practical: 100
Credit hours: 1(0+1)

Instructions for the Paper Setters:

1. The question paper will consist of nine skill-oriented questions.
2. The first 5 questions carry 8 marks each. There will be internal choice wherever possible. The answer should be in 50-80 words. (5×8=40 Marks)
3. There will be four essay type questions from the entire syllabus. There will be internal choice wherever possible. The answer should be in 250 words. (4×15= 60 Marks)

Course Objectives:

1. To acquaint the students about the basics of commonly used techniques in laboratory.
2. It will also help the students to safely use the Laboratory tools and equipments which will avoid various laboratory accidents.

Course contents:

Practical:

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; Washing, drying and sterilization of glassware; Drying of solvents/ chemicals; Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values; Use and handling of microscope, laminar flow, vacuum pumps, viscometer thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing; Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings:

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press
2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

Course outcomes:

1. Handling the laboratory chemicals and equipments safely.
2. Use the laboratory resources precisely.
3. Can guide farmers regarding preparation of doses of various agro chemicals in the field.

M.Sc. Ag. Horticulture (Vegetable Science) 2024-26

SEMESTER-IV

***VSC-599** ***Masters' Research**

S/US

Credits hours: 10(0+10)