POST GRADUATE DEPARTMENT OF AGRICULTURE

SYLLABUS FOR THE BATCH FROM THE YEAR

2022 TO YEAR 2024

Programme Code: MHVS

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

(Semester III-IV)

Examinations: 2023-24

Khalsa College Amritsar

M.Sc. Ag. Horticulture (Vegetable Science) 2022-24

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)

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) 2022-24

SEMESTER-I

Course Code	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
VSC-511	Production Technology of Winter Season Vegetable Crops	3(2+1)	50 + 25 +25	100	8-10
VSC-512	Breeding of Self Pollinated and Vegetatively Propagated Vegetable Crops	3(2+1)	50 + 25 +25	100	11-13
AGR-511/ PBG-513 (Minor)	Modern Concepts in Crop Production/Principles of Plant Breeding	3(2+1)	50 + 25 +25	100	14-15/ 16-17
STA-414	Statistical Methods for Research Workers	3(2+1)	50 + 25 +25	100	18-19
*PGS-501	Technical Writing & Communication Skills	1(1+0)	100 (Th)	100	20-21
*PGS-502	Library and Information Services	1(0+1)	100 (Pr)	100	22
*VSC-600	Masters' Research	4(0+4)	--	S/US	23
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) 2022-24

SEMESTER-II

Course Code	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
VSC-521	Production Technology of Summer Season Vegetable Crops	3(2+1)	50 + 25 +25	100	24-26
VSC-522	Breeding of Cross Pollinated Vegetable Crops	3(2+1)	50 + 25 +25	100	27-29
AGR-521/ PBG-523 (Minor)	Principles and Practices of Weed Management/ Breeding for Biotic and Abiotic Stress Resistance	3(2+1)	50 + 25 +25	100	30-31/ 32-33
STA-524	Experimental Designs for Research Workers	3(2+1)	50 + 25 +25	100	34-35
*PGS-503	Agricultural Research and Publication Ethics	1(1+0)	100 (Th)	100	36-37
*VSC-600	Masters' Research	4(0+4)	--	S/US	38
Total		**17(12+5*)**			

* Non-credit course.

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

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SEMESTER-III

Course Code	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
VSC-531	Post-harvest Handling of Vegetable Crops	3(2+1)	50 + 25 +25	100	39-40
VSC-532	Protected Cultivation of Vegetable Crops	3(2+1)	50 + 25 +25	100	41-43
AGR-532/PBG-531 (Minor)	Principles and Practices of Organic Farming/Maintenance Breeding and Concepts of Variety Release and Seed Production	3(2+1)	50 + 25 +25	100	44-45/ 46-47
VSC-591	Credit seminar	1(1+0)	100	100	48
*PGS-504	Intellectual Property & its Management in Agriculture	1(1+0)	100 (Th)	100	49-50
*VSC-600	Masters' Research	6(0+6)	--	S/US	51
Total		**17(10+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) 2022-24

SEMESTER-IV

Course Code	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
VSC-541	Seed Production Technology of Vegetable Crops	3(2+1)	50 + 25 +25	100	52-54
VSC-542	Organic Vegetable Production Technology	3(2+1)	50 + 25 +25	100	55-56
*PGS-505	Disaster Management	1(1+0)	100(Th)	100	57-58
*VSC-600	*Masters' Research	6(0+6)	--	S/US	59
Total		**13(6+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) 2022-24

SEMESTER-I

VSC-511 Production Technology of Winter 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, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements, commercial varieties/hybrids evolved by private and public sector, sowing/transplanting time, seed rate and seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders, harvesting techniques, postharvest management, plant protection measures and seed production of:

Section-A: Potato and Bulb crops: onion and garlic.
Section-B: Cole crops: cabbage, cauliflower, knol khol, broccoli, Brussels sprouts, chinese cabbage
Section-C: Root crops: carrot, radish, turnip and beetroot
Section-D: Peas and broad bean, green leafy cool season vegetables.

Practical:

Study of nutrient deficiency symptoms. Experiments on improved water use efficiency through mulching and different irrigation methods. Different methods of weed control and

herbicide sprays. Preparation of cropping scheme for commercial farms. Quality evaluation for carotene, protein and ascorbic acid. Visit to an established vegetable farm in the region.

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.

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SEMESTER-I

VSC-512 Breeding of Self Pollinated and Vegetatively Propagated 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:

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 viz.
Section-A: tomato, brinjal, cowpea, pea, beans, okra, salad crops and
Section-B: asexually propagated crops like potato, sweet potato, colocasia and tapioca
Section-C: Molecular marker, marker assisted breeding and QTLs, biotechnology and their use in breeding in self pollinated and vegetatively propagated vegetable crops.
Section-D: Issue of patenting, PPV& FRA. Concept of ideotypes. Present status of varietal/hybrid development in India. New approaches in breeding of self pollinated vegetables.

Practical:

Selection of desirable plants from breeding population. Observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations. 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. Demonstration of sibmating and mixed population. Molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques.

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.

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SEMESTER-I

AGR-511 Modern Concepts in Crop Production (Minor)

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 relationship of environmental factors with growth and development in crops.
2. To understand physiology of yield in relation to biotic and abiotic environment.
3. Basic concepts of crop Ideotypes for maximizing crop yield.
4. To know modern concepts in farming for efficient use of resources.

Course Content:

Theory:

Section-A: Crop growth analysis in relation to environment, agroecological zones of India. Quantitative agrobiological principles and inverse yield nitrogen law; Mitscherlich yield equation its interpretation and applicability; Baule unit.

Section-B: Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.

Section-C: Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.

Section-D: Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture.

Practical:

Analysis of Growth & Development; leaf area index, Crop Growth rate, Relative growth rate, etc; Estimation of yield, mulching, cropping scheme, crop rotation, comparison of chemical & organic farming; Quality standards for organic farming.

Suggested Reading:

1. Balasubramaniyan P and Palaniappan SP. 2001. Principles and Practices of Agronomy. Agrobios.
2. Fageria NK. 1992. Maximizing Crop Yields. Marcel Dekker.
3. Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall.
4. Paroda R.S. 2003. Sustaining our Food Security. Konark Publ.
5. Reddy SR. 2000. Principles of Crop Production. Kalyani Publ.
6. Sankaran S and Mudaliar TVS. 1997. Principles of Agronomy. The Bangalore Printing & Publ.
7. Singh SS. 2006. Principles and Practices of Agronomy. Kalyani.
8. Alvin PT and kozlowski TT (ed.). 1976. Ecophysiology of Tropical Crops. Academia Pul., New York.
9. Gardner PP, Pearce GR and Mitchell RL. 1985. Physiology of Crop Plants. Scientific Pub. Jodhpur.
10. Lal R. 1989. Conservation tillage for sustainable agriculture: Tropics versus Temperate Environments. Advances in Agronomy 42: 85-197.
11. Wilsie CP. 1961. Crop Adaptation and Distribution. Euresia Pub., New Delhi

Course Outcomes:

1. Understand advanced concepts of crop growth and productivity in relation to climate change.
2. Gain knowledge on nano technology in agriculture.
3. Acquire knowledge on modern concepts in tillage and farm mechanization.
4. Gain knowledge on principles and components of organic farming.
5. Gain knowledge on ideal plant ideotypes and yield maximization.

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SEMESTER-I

PBG-513 Principles of Plant Breeding (Minor)

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 know the Importance of plant breeding methods, origin and classification of crop plants.
2. Knowledge about advanced breeding methods used to develop a variety for enhancing the crop production.
3. Knowing the testing, release and notification system in India.
4. Knowing the way of protection of variety and plant breeder rights.

Course Content:
Theory:

Section-A: History of plant breeding, objectives and achievements. Centres of origin, biodiversity and its significance. Plant introduction and role of plant genetic resources in plant breeding.
Section-B: Genetic basis of breeding self and cross pollinated crops, mating systems and response to selection. Pure line theory. Breeding methods in self, cross pollinated and asexually reproducing crops. Heterosis and inbreeding.
Section-C: Concept of plant ideotype. Transgressive breeding. Hybrid breeding. Self incompatibility and male sterility in crop plants and their commercial exploitation. Mutation breeding.
Section-D: Breeding for abiotic and biotic stresses. Testing, release and notification of varieties. Maintenance breeding. Participatory plant breeding. Plant breeder's Rights and regulations for plant variety protection and farmer's rights.

Practical:

Floral biology of self- and cross-pollinated species. Selfing and crossing techniques. Selection methods in segregating populations and evaluation of breeding material. Maintenance of experimental records. Estimation of heterosis and inbreeding depression. Techniques in hybrid seed production using male sterility in field crops.

Suggested Reading:

1. Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.
2. Chahal GS and Gossal, SS. 2002. Principles and Procedures of Plant Breeding Biotechnological and Conventional approaches. Narosa Publishing House.
3. Chopra VL. 2004. Plant Breeding. Oxford & IBH.
4. George A. 2012. Principles of Plant Genetics and Breeding. John Wiley & Sons.
5. Gupta SK. 2005. Practical Plant Breeding. Agribios.
6. Jain HK and Kharakwal MC. 2004. Plant Breeding and–Mendelian to Molecular Approach, Narosa Publications, New Delhi
7. Roy D. 2003. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ. House.
8. Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
9. Sharma JP. 2010. Principles of Vegetable Breeding. Kalyani Publ, New Delhi.
10. Simmonds NW.1990. Principles of Crop Improvement. English Language Book Society.
11. Singh BD. 2006. Plant Breeding. Kalyani Publishers, New Delhi.
12. Singh S and Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding. CBS

Course Outcomes:

1. Get basic knowledge about the importance of plant breeding.
2. Have brief knowledge on the commercial varieties, their adaptability and stability in the region.
3. Know the ideotype requirements in the particular parts of India.
4. Acquaint themselves with the breeding methods of different varieties of crops.
5. Know hybrid and transgressive breeding.
6. Study inflorescence, fruit set, maturity, harvesting and quality improvement of different crops.
7. Know breeding for physiological disorders, insect-pest and diseases of fruit crops.

SEMESTER-I

STA-414 Statistical Methods for Research Workers

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: Probability and fitting of standard frequency distribution, sampling techniques, sampling distributions, mean and standard error.

Section-B: Simple partial, multiple and intra class correlation and multiple regression.

Section-C: Tests of significance, students'-t, chi-square and large sample tests, confidence intervals.

Section-D: Analysis of variance for one way and two way classification with equal cell frequencies, transformation of data.

Practical:

Fitting of distributions, samples and sampling distributions, correlation and regression, tests of significance and analysis of variance.

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 501 Technical Writing & Communication Skills**

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. 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:

Theory:

Technical Writing- Various forms of technical writing-theses, technical papers, reviews, electronics communication etc: qualities of technical writing: parts of research communication-title page, content page, authorship, preface, introduction, review of literature, materials and methods, experimental results, documentation; photographs and drawings with suitable captions; pagination; citation; writing of abstracts; précis; synopsis; editing and proof reading. Communication Skills-defining communication; types of communication- verbal and non-verbal; assertive communication; assertive communication: using language for effective communication; techniques of dyadic communication- message pacing and message chunking, self disclosure mirroring, expressing conversation intent; paraphrasing; vocabulary building- word roots, prefixes, Greek and Latin roots.

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 502 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: Five laws of library science: type of documents; classification and cataloguing; organization of documents; sources of information-primary, secondary and tertiary; current awareness and SDI services; tracing information from references sources; library survey; preparation of bibliography; use of Online Public Access Catalogue; use of CD-Rom databases and other computerized library services, CeRA, J-Gate; use of Internet including search engines and its resources, e-resources and 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) 2022-24

SEMESTER-I

***VSC-600** **Masters' Research**

S/US
Credits hours: 4(0+4)

M.Sc. Ag. Horticulture (Vegetable Science) 2022-24

SEMESTER-II

VSC-521 Production Technology of Summer 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, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements, commercial varieties/hybrids evolved by private and public sector, sowing/transplanting time, seed rate, seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders, harvesting techniques, post-harvest management, plant protection measures and seed production of warm season vegetable crops i.e.

Section-A: solanaceous crops, okra

Section-B: cucurbitaceous crops

Section-C: cowpea, sweet potato, cluster beans, amaranth, basella, tapioca.

Section-D: Polyhouse, nethouse and low tunnel technology for offseason production of summer vegetables.

Practical:

Experiments to demonstrate the role of mineral elements. Fertigation. Chemical weed control. Hybrid seed production of summer vegetables. Use of growth regulators. Seed extraction

techniques. Identification of pests and diseases and their control. Forcing techniques for raising summer vegetables. Pruning, grafting and staking. Quality determination for sugar, capsaicin and minerals using atomic absorption.

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) 2022-24

SEMESTER-II

VSC-522 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 cross pollinated vegetable crops.
3. Protection against biotic and abiotic stress in different cross pollinated vegetable crops.

Course Content:

Theory:

History of vegetable breeding. Origin, botany, taxonomy, cytogenetic, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), quality improvement, in cross pollinated crops viz.

Section-A: capsicum, chilli, cucurbits (muskmelon, watermelon, cucumber, bottle gourd, long melon, bitter gourd, sponge gourd, summer squash)

Section-B: Cole crops (cabbage, cauliflower, broccoli, brussel's sprouts), root crops (carrot, radish, turnip)

Section-C: bulb crops (onion, garlic), asparagus, leafy vegetable and spices (black pepper, turmeric, cardamom, coriander).

Section-D: 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.

Practical:

Selection indices in cole crops, cucurbitaceous crops, bulb crops, root crops, leafy vegetables and spices. Selfing and crossing techniques in cross pollinated vegetable crops.

Biometrical analysis Line x tester analysis, North Carolina Designs, stability analysis, triple test cross analysis, generation mean analysis, diallel analysis. Estimation of heritability, heterosis and combining ability.

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. Learn about the history of vegetable breeding, Origin, botany, taxonomy, cytogenetic, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation) and quality improvement, in cross pollinated crops.
2. Get acquainted with molecular marker, marker assisted breeding and QTLs, biotechnology and their use in breeding cross pollinated vegetable crops.
3. Get information on present status of varietal/hybrid development in India.
4. Get familiar with new approaches in breeding of cross-pollinated vegetables.

SEMESTER-II

AGR-521: Principles and Practices of Weed Management (Minor)

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 understand importance of weed biology and weed ecology in weed management.
2. Classification of weeds, different methods of weed control and weed indices.
3. Classification of herbicide, formulations, mixtures, resistance and its management.
4. To understand concept of Integrated weed management bio-herbicides, mycoherbicides and allelopathy in weed management.
5. Weed management in different crops and their economic study.

Course Content:

Theory:

Section-A: Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices.

Section-B: Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.

Section-C: Herbicide structure activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio herbicides, myco herbicides and allele chemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation.

Section-D: Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control. Integrated weed management; cost : benefit analysis of weed management.

Practical:

Identification of important weeds of different crops; preparation of a weed herbarium; weed survey in crops and cropping systems; crop-weed competition studies; preparation of spray solutions of herbicides of high and low volume sprayers; use of various types of spray pumps and nozzles and calculation of swath width; economics of weed control; herbicide residue analysis in plant and soil; bioassay of herbicide residue; calculation of herbicidal requirement.

Suggested Reading:

1. Boger, Peter, Wakabayashi, Ko, Hirai, Kenji (Eds.). 2002. Herbicide Classes in Development. Mode of Action, Targets, Genetic Engineering, Chemistry. Springer.
2. Chauhan B and Mahajan G. 2014. Recent Advances in Weed Management. Springer.
3. Das TK. 2008. Weed Science: Basics and Applications, Jain Brothers (New Delhi).
4. Fennimore, Steven A and Bell, Carl. 2014. Principles of Weed Control, 4th Ed, California Weed Sci. Soc.
5. Gupta OP. 2007. Weed Management: Principles and Practices, 2nd Ed.
6. Jugulan, Mithila (ed). 2017. Biology, Physiology and Molecular Biology of Weeds. CRC Press
7. Monaco TJ, Weller SC and Ashton FM. 2014. Weed Science Principles and Practices, Wiley
8. Powles SB and Shaner DL. 2001. Herbicide Resistance and World Grains, CRC Press.
9. Walia US. 2006. Weed Management, Kalyani. Zimdahl RL. (ed). 2018. Integrated Weed Management for Sustainable Agriculture, B. D. Sci. Pub.

Course outcomes:

1. Get knowledge on weed biology and survey weeds in varied ecosystem.
2. Identify the nature, type and economic uses of weeds in varied habitats.
3. Gain knowledge on herbicide application techniques.
4. Evaluate different methods of weed control.
5. Formulate integrated weed management practices for different ecosystems.

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SEMESTER-II

PBG-523 Breeding for Biotic and Abiotic Stress Resistance (Minor)

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 know the biotic and abiotic stresses in field and fruit crops.
2. Knowledge about advanced host defense mechanism for enhancing the crop production.
3. Familiar the students about inbuilt plant resistance mechanisms of fruit crops and field crops.
4. Knowing the principles and methods of breeding for biotic and abiotic stresses.

Course Content:
Theory:

Section-A: Plant breeding with reference to biotic and abiotic stress resistance. Biotic stresses in economically important crops. Host defense responses to pathogen invasions. Biochemical and molecular mechanisms. Host-pathogen interactions.

Section-B: Gene-for-gene hypothesis. Acquired and induced immunity. Systemic acquired resistance (SAR). Concept of signal transduction and other host defense mechanisms against viruses and bacteria. Types and genetic mechanisms of resistance to biotic stresses. Phenotypic screening methods for major pests and diseases.

Section-C: Gene pyramiding. Classification of abiotic stresses moisture stress/drought, water logging and submergence, wind, acidity, salinity/alkalinity/sodicity, temperature etc. Stress due to soil factors and mineral toxicity. Physiological and phenological responses. Genetics of abiotic stress resistance.

Section-D: Genes and genomics in breeding for abiotic stresses. Utilizing MAS procedures. Breeding for resistance to abiotic stresses. Exploitation of wild relatives as a source of resistance

to biotic and abiotic factors in major field crops. Transgenics in management of biotic and abiotic stresses.

Practical:

Phenotypic screening techniques for sucking pests, chewing pests, nematodes and borers. Use of standard MAS procedures. Phenotypic screening methods for diseases caused by fungi and bacteria. Screening crops for drought, flood resistance, acidity, alkalinity and temperature etc.

Suggested Reading:

1. Blum A. 1988. Plant Breeding for Stress Environments. CRC Press.
2. Christiansen MN and Lewis CF. 1982. Breeding Plants for Less Favourable Environments. Wiley International.
3. Fritz RS and Simms EL. (Eds.). 1992. Plant Resistance to Herbivores and Pathogens: Ecology, Evolution and Genetics. The University of Chicago Press.
4. Li PH and Sakai A. 1987. Plant Cold Hardiness. Liss, New York Springer
5. Luginpill P. 1969. Developing Resistant Plants - The Ideal Method of Controlling Insects. USDA, ARS, Washington DC.
6. Maxwell FG and Jennings PR. (Eds.). 1980. Breeding Plants Resistant to Insects. John Wiley & Sons. Wiley-Blackwell.
7. Roberto F. 2018. Plant Breeding for Biotic and Abiotic Stress Tolerance. Springer.
8. Russel GE. 1978. Plant Breeding for Pest and Disease Resistance. Butterworths.
9. Sakai A and Larcher W. 1987. Frost Survival in Plants. Springer-Verlag.
10. Singh BD. 2006. Plant Breeding. Kalyani Publishers, New Delhi.
11. Turener NC and Kramer PJ. 1980. Adaptation of Plants to Water and High Temperature Stress. John Wiley & Sons.
12. Van Der Plank JE. 1982. Host-Pathogen Interactions in Plant Disease. Academic Press.

Course Outcomes:

1. To impart basic knowledge about the biotic and abiotic stresses in fruit crops.
2. Brief knowledge of resistance mechanisms in plants.
3. To know the role of genes and genomes in breeding.
4. To brief with the molecular breeding methods and protocols.
5. Role of breeding methods in crop production.
6. To study transgenic technology for quality improvement of crops.
7. Identification and screening of physiological disorders, insect-pest and diseases of different crops.

SEMESTER-II

STA-524: Experimental Designs for Research Workers

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- randomization, replication and local control, uniformity trials- size and shape of plots and blocks, analysis of variance and interpretation of data.

Section-B: Completely randomized, randomized block and latin square design, multiple comparison tests, factorial experiments- interpretation of main effects and interactions,

Section-C: Orthogonality and partitioning of degrees of freedom confounding in 2^3, 2^4 and 3^3 designs, split and strip plot designs, crossover designs and balanced incomplete block designs, response surface designs, switch over trials and long term experiments;

Section-D: Selection of experimental design, mechanical errors in field experiments and methods of reducing it, presentation of research results.

Practical:

Uniformity trials, completely randomized, randomized block and latin square designs, missing plot and analysis, of covariance, 2^3 ,2^4 and3^3 simple and confounded experiments, split and strip plot designs, cross over Uniformity trials, completely randomized, randomized block and latin square

designs, missing plot and analysis, of covariance, 2^3 ,2^4 and3^3 simple and confounded experiments, split and strip plot designs, cross over and balanced incomplete block 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-503 - Agricultural Research and Publication Ethics

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: Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions.

Section B: Publication ethics: definition, introduction and importance. Best practices/standards setting initiative and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, type.

Section C: Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals. Ethics with respect to science and research. Intellectual honesty and research integrity.

Section D: Scientific misconduct: Falsification, Fabrication, and Plagiarism (FFP); Redundant publication: duplicate and overlapping publication, salami slicing; selective reporting and misrepresentation of data.

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.

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SEMESTER-II

***VSC-600** **Masters' Research**

S/US
Credits hours: 4(0+4)

M.Sc. Ag. Horticulture (Vegetable Science) 2022-24

SEMESTER-III

VSC-531 Post-harvest Handling 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. Post harvest operation to increase yield.
2. Improvement of vegetable quality.
3. Successful marketing resulting in increasing the income of commercial vegetable growers.

Course Content:

Theory:

Section-A: Determination of maturity in different vegetable crops, assessment of post harvest losses, pre-harvest methods and practices effecting post-harvest shelf life of vegetables.

Section-B: Mechanized harvesting of vegetables, pre cooling of vegetables using different techniques, post harvest chemical and non chemical treatments to enhance shelf life, sorting and grading for packaging.

Section-C: Ripening of vegetables, packaging of vegetables including latest techniques like MAP, storage of vegetables including latest techniques like CA storage, food safety and quality, non destructive methods of quality analysis,

Section-D: Quality of raw material for processing, transportation and destination handling, marketing, treatments before shipment and storage, fresh cut vegetables.

Practical:

Practices in judging the maturity of vegetables, harvesting methods and tools. Methods used for pre cooling and their efficiency measurements. Post harvest chemical treatments to extend shelf life. Sorting and grading methods. Ripening techniques used in climacteric vegetables. Traditional and latest safe storage techniques. Respiration measurements in harvested produce. Field visit to post-harvest and processing industry.

Suggested Reading:

1. Chadha KL and Pareek OP. 1996. Advances in horticulture. Vol. IV. Malhotra Publ. House.
2. Chattopadhyay SK. 2007. Handling, transportation and storage of fruit and vegetables. Gene Tech books, New Delhi.
3. Haid NF and Salunkhe SK. 1997. Postharvest physiology and handling of fruits and vegetables. Grenada Publ.
4. Mitra SK. 1997. Postharvest physiology and storage of tropical and sub-tropical fruits. CABI.
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. Ranganna S. 1997. Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw-Hill.
7. Stawley JK. 1998. Postharvest physiology of perishable plant products. CBS publishers.
8. Sudheer KP and Indira V. 2007. Postharvest technology of horticultural crops. New India Publ. Agency.
9. Thompson AK. (Ed.). 2014. Fruit and vegetables: harvesting, handling and storage (Vol. 1 and Blackwell Publishing Ltd, Oxford, UK. ISBN: 9781118654040.
10. 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.
11. Willis R, McGlassen WB, Graham D and Joyce D. 1998. Postharvest: An introduction to the physiology and handling of fruits, vegetables and ornamentals. CABI.
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.

Course Objectives:

1. Get knowledge about assessment of post-harvest losses, pre-harvest methods, practices effecting post-harvest shelf life and determination of maturity in different vegetable crops.
2. Get acquainted with the mechanized harvesting of vegetables, pre cooling of vegetables using different techniques, post-harvest chemical and non-chemical treatments to enhance shelf life, sorting and grading for packaging.
3. Get information about ripening of vegetables, packaging of vegetables including latest techniques like MAP, storage of vegetables including latest techniques like CA storage, food safety and quality, non-destructive methods of quality analysis.
4. Get knowledge about quality of raw material for processing, transportation and destination handling, marketing, treatments before shipment and storage, fresh cut vegetables.

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SEMESTER-III

VSC-532 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-III

AGR-532 Principles and Practices of Organic Farming (Minor)

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. Organic farming for sustainable agriculture and development of entrepreneurship on organic inputs.

Course Content:

Theory:

Section-A: Organic farming - concept and definition, its relevance to India and global agriculture and future prospects;

Section-B: land and water management - land use, minimum tillage; shelter zones, hedges, pasture management**,** agro forestry**.** Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

Section-C: Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity. Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.

Section-D: Socio economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Practical:

Aerobic and anaerobic methods of making compost; making of vermicompost; identification and nursery raising of important agro forestry tress and tress for shelter belts; efficient use of biofertilizers, technique of treating legume seeds with rhizobium cultures, use of azotobacter, azospirillum, and PSB cultures in field; visit to an organic farm; quality standards,

inspection, certification and labeling and accreditation procedures for farm produce from organic farms.

Suggested Reading:

1. Ananthakrishnan TN. (Ed.). 1992. Emerging Trends in Biological Control of Phytophagous Insects. Oxford & IBH.
2. Gaur AC. 1982. A Manual of Rural Composting, FAO/UNDP Regional Project Document, FAO.
3. Joshi M. 2016. New Vistas of Organic Farming. Scientific Publishers
4. Lampin N. 1990. Organic Farming. Press Books, lpswitch, UK.
5. Palaniappan SP and Anandurai K. 1999. Organic Farming – Theory and Practice. Scientific Publ.
6. Rao BV Venkata. 1995. Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective: Publ.3, Parisaraprajna Parishtana, Bangalore.
7. Reddy MV. (Ed.). 1995. Soil Organisms and Litter Decomposition in the Tropics. Oxford & IBH.
8. Sharma A. 2002. Hand Book of Organic Farming. Agrobios.
9. Singh SP. (Ed.). 1994. Technology for Production of Natural Enemies. PDBC, Bangalore.
10. Subba Rao NS. 2002. Soil Microbiology. Oxford & IBH.
11. Trivedi RN. 1993. A Text Book of Environmental Sciences, Anmol Publ.
12. Veeresh GK, Shivashankar K and Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture. Association for Promotion of Organic Farming, Bangalore.
13. WHO. 1990. Public Health Impact of Pesticides Used in Agriculture. WHO.
14. Woolmer PL and Swift MJ. 1994. The Biological Management of Tropical Soil Fertility. TSBF & Wiley

Course Outcomes:

1. Acquire knowledge on the concepts of organic agriculture.
2. Get information about the impact of organic farming and indigenous practices on the environment.
3. Understand the procedure followed for organic certification.

SEMESTER-III

PBG-531 Maintenance Breeding and Concept of Variety Release and Seed Production (Minor)

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. Procedures linked with the development and release of variety.
2. How to maintain and multiply variety for large scale distribution.
3. Seed production of different crop varieties and hybrids, their processing, marketing and seed laws.

Course Content:

Theory:

Section-A: Variety development and maintenance. Defining variety, cultivar, extant variety, derived variety, reference variety, farmer's variety, hybrid and population.

Section-B: Variety testing, release and notification systems in India and abroad. US testing. Genetic deterioration of varieties.

Section-C: Maintenance of varieties. Principles of seed production. Generation system of seed multiplication. Quality seed production of cereals and millets, pulses, oilseeds, cotton and forages.

Section-D: Seed certification. Seed laws and plant variety protection regulations in India and international systems.

Practical:

Identification of suitable areas for seed production. Ear-to-row method and nucleus seed production. Main characteristics of released and notified varieties, hybrids and parental lines. Identification of important weeds/objectionable weeds. Determination of isolation distance and planting ratios in different crops. Seed production techniques of varieties in different crops. Hybrid seed production technology of important crops.

Suggested Reading:

1. Agarwal RL. 1997. Seed Technology. 2nd Ed. Oxford & IBH.
2. Kelly AF. 1988. Seed Production of Agricultural Crops. Longman.
3. McDonald MB Jr and Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall.
4. Poehlman JM and Borthakur D. 1969. Breeding Asian Field Crops. Oxford & IBH.
5. Singh BD. 2005. Plant Breeding: Principles and Methods. Kalyani. 2015
6. Thompson JR. 1979. An Introduction to Seed Technology. Leonard Hill

Course Outcomes:

1. To impart basic knowledge about the importance and maintenance of crops.
2. Brief knowledge of testing varieties with different advanced methods.
3. To know the agronomic production of different crops.
4. To brief with the quality seed production in different types of crops.
5. Role of different procedures and methods in preventing crop deterioration.
6. To study seed laws and plant variety protection.

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SEMESTER-III

VSC-591 **CREDIT SEMINAR**

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

SEMESTER-III

***PGS-504 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.

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SEMESTER-III

***VSC-600** ***Masters' Research**

S/US
Credits hours: 6(0+6)

M.Sc. Ag. Horticulture (Vegetable Science) 2022-24

SEMESTER-IV

VSC-541 **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.

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SEMESTER-IV

VSC-542 Organic Vegetable Production Technology

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.

SEMESTER-IV

PGS-505 **Disaster Management**

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. To provide basic conceptual understanding of disasters.
2. To understand approaches of Disaster Management.
3. To build skills to respond to disaster.

Course Content:

Theory:

Section A: hazards and disasters, risk and vulnerability in disasters, natural and man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Section B: Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) earthquakes, landside). social economics and environmental impact of disasters.

Section C: Basic principles of disasters management, disaster management cycle, disaster management policy. national and state bodies for disaster management, early warming systems, building design and construction in highly seismic zones, retrofitting of buildings.

Section D: Training and drills for disaster preparedness, awareness generation program, usages of GIS and remote sensing techniques in disaster management, mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

Suggested readings:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)

2. Damon, P. Copola, (2006) Introduction to Intemational Disaster Management, ButterworthHeineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New
5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Course outcomes:

1. Understand the types of natural and man-made disasters.
2. They will know the management techniques in any natural or man-made disaster situation.
3. They will also get familiar with various kinds of government policies and programmes for disaster prone and disaster effected places.

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SEMESTER-IV

***VSC-600** ***Masters' Research**

S/US

Credits hours: 6(0+6)