



**Department of Horticulture**  
**Mahatma Phule Krishi Vidyapeeth**  
**Rahuri-413 722, Dist. Ahmednagar (MS)**



## Master's Programme in Vegetable Science

### Course Layout

#### Minimum Credit Requirements

| Sr. No. | Subject                       | Minimum credit(s) |
|---------|-------------------------------|-------------------|
| 1.      | Major                         | 21                |
| 2.      | Minor                         | 09                |
| 3.      | Supporting                    | 06                |
| 4.      | Seminar                       | 01                |
| 5.      | Research                      | 20                |
|         | <b>Total Credits</b>          | <b>57</b>         |
| 6.      | Compulsory Non Credit Courses | 04                |

| Sr. No.                                    | Course Number | Course Title  | Credits |
|--|---------------|---|---------|
| <b>A) Major Subjects (Min. 21 credits)</b> |               |   |         |
| 1  | VSC - 501*    | Production Technology of Cool Season Vegetable Crops    | 2+1=3   |
| 2  | VSC - 502*    | Production Technology of Warm Season Vegetable Crops    | 2+1=3   |
| 3  | VSC - 503*    | Breeding of Vegetable Crops                             | 2+1=3   |
| 4  | VSC - 504*    | Growth and Development of Vegetable Crops               | 2+1=3   |
| 5  | VSC - 505     | Seed Production Technology of Vegetable Crops           | 2+1=3   |
| 6  | VSC - 507     | Production Technology of Underexploited Vegetable Crops | 1+1=2   |
| 7  | VSC - 508     | Organic Vegetable Production Technology                 | 1+1=2   |
| 8  | VSC - 509     | Fundamentals of Processing of Vegetables                | 1+1=2   |

| <b>B) Minor Subjects (Min. 09 credits)</b>      |              |   |         |
|---|--------------|---|---------|
| 1   | AGRO - 505   | Agro-Meteorology and Crop Weather Forecasting           | 2+1=3   |
| 2   | BIOCHEM -501 | Basic Biochemistry                                      | 2+1=3   |
| 3   | GP - 510     | Breeding for Biotic and Abiotic Stress Resistance       | 2+1=3   |
| <b>C) Supporting Subjects (Min. 06 credits)</b> |              |   |         |
| 1   | STAT - 511   | Statistical Methods for Applied Science                 | 2+1=3   |
| 2   | STAT - 512   | Experimental Designs                                    | 2+1=3   |
| <b>D) Seminar (1 credit)</b>                    |              |   |         |
| 1   | VSC - 591    | Seminar   | 0+1=1   |
| <b>E) Master's Research ( 20 credits)</b>       |              |   |         |
| 1   |              | Master's Research                                       | 0+20=20 |
| <b>F) Non Credit Compulsory Courses</b>         |              |   |         |
| 1   | PGS - 501    | Library and information services                        | 0+1=1   |
| 2   | PGS - 504    | Basic concepts in Laboratory Techniques                 | 0+1=1   |
| 3   | PGS - 502    | Technical Writing and Communication Skill               | 0+1=1   |
| 4   | PGS - 503    | Intellectual Property and its Management in Agriculture | 1+0=1   |

### Course Contents

**Course No. : VSC 501**

**Course Title : PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS**

**Credits : 2+1=3**

#### Theory:

|   |   |   |
|---|---|---|
| Introduction, botany and taxonomy, area, production, productivity and constraints, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of |   |   |
| <b>Unit – I</b>   | : | Potato  |
| <b>Unit – II</b>  | : | Cabbage, Cauliflower, Knol-khol, Sprouting broccoli, Brussels Sprout  |
| <b>Unit –III</b>  | : | Carrot, Radish, Turnip, Beet root   |
| <b>Unit –IV</b>   | : | Onion, Garlic   |
| <b>Unit –V</b>  | : | Garden pea, Broad bean, Indian spinach (Palak), Fenugreek, Coriander, Ghol, Spinach (Vilayati Palak), Asparagus, Globe artichoke, Lettuce |

#### Practical:

| Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of winter vegetable crops and their economics, Experiments to demonstrate the role of mineral elements, Plant growth substances and herbicides, Study of physiological disorders, Identification of important pest and diseases and their control. Preparation of cropping scheme for commercial farms; Visit to commercial greenhouse/ polyhouse |  |
|--|--|
| <b>Periods</b>   | <b>Topic</b>   |
| 1-2  | Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of winter vegetable crops and their economics |
| 3-5  | Experiments to demonstrate the role of mineral elements  |
| 6-8  | Plant growth substances and herbicides   |
| 9-11   | Study of physiological disorders   |
| 12-13  | Identification of important pest and diseases and their control.   |
| 14-15  | Preparation of cropping scheme for commercial farms;   |
| 16   | Visit to commercial greenhouse/ polyhouse  |

**Reference Books:**

- Bose TK & Som MG. (Eds.). 1986. Vegetable Crops in India. Naya Prokash.
- Bose TK, Som G & Kabir J. (Eds.). 2002. Vegetable Crops. Naya Prokash.
- Bose TK, Som MG & Kabir J. (Eds.). 1993. Vegetable Crops. Naya Prokash.
- Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. Vegetable Crops. Vols. I-III. Naya Udyog.
- Chadha KL & Kalloo G. (Eds.). 1993-94. Advances in Horticulture Vols. V-X. Malhotra Publ. House.
- Chadha KL. (Ed.). 2002. Hand Book of Horticulture. ICAR.
- Chauhan DVS. (Ed.). 1986. Vegetable Production in India. Ram Prasad & Sons.
- Decoteau DR. 2000. Vegetable Crops. Prentice Hall.
- Edmond JB, Musser AM & Andrews FS. 1951. Fundamentals of Horticulture. Blakiston Co.
- Fageria MS, Choudhary BR & Dhaka RS. 2000. Vegetable Crops: Production Technology. Vol. II. Kalyani.
- Gopalakrishanan TR. 2007. Vegetable Crops. New India Publ. Agency.
- Hazra P & Som MG. (Eds.). 1999. Technology for Vegetable Production and Improvement. Naya Prokash.
- Rana MK. 2008. Olericulture in India. Kalyani Publ.
- Rana MK. 2008. Scientific Cultivation of Vegetables. Kalyani Publ.
- Rubatzky VE & Yamaguchi M. (Eds.). 1997. World Vegetables: Principles, Production and Nutritive Values. Chapman & Hall.
- Saini GS. 2001. A Text Book of Oleri and Flori Culture. Aman Publ. House.
- Salunkhe DK & Kadam SS. (Ed.). 1998. Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing. Marcel Dekker.
- Shanmugavelu KG. 1989. Production Technology of Vegetable Crops. Oxford & IBH.
- Singh DK. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co.
- Singh SP. (Ed.). 1989. Production Technology of Vegetable Crops. Agril. Comm. Res. Centre.
- Thamburaj S & Singh N. (Eds.). 2004. Vegetables, Tuber Crops and Spices. ICAR.
- Thompson HC & Kelly WC. (Eds.). 1978. Vegetable Crops. Tata McGraw-Hill.

|                   |          |   |
|-------------------|----------|---|
| <b>Course No.</b> | <b>:</b> | <b>VSC-502</b>  |
| <b>Title</b>      | <b>:</b> | <b>Production Technology of Warm Season Vegetable crops</b> |
| <b>Credits</b>    | <b>:</b> | <b>2+1=3</b>  |

**Theory:**

|   |          |   |
|---|----------|---|
| Introduction, botany and taxonomy, Area, Production and productivity world and India, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures, economics of crop production : |          |   |
| <b>UNIT I</b>   | <b>:</b> | Tomato, eggplant, hot and sweet peppers |
| <b>UNIT II</b>  | <b>:</b> | Okra, beans and cowpea                  |
| <b>UNIT III</b>   | <b>:</b> | Cucurbitaceous crops                    |
| <b>UNIT IV</b>  | <b>:</b> | Tapioca and sweet potato                |
| <b>UNIT V</b>   | <b>:</b> | Green leafy warm season vegetables      |

**Practical:**

|  |  |  |
|--|--|--|
| Raising of nursery of vegetable crops, Cultural operations in cultivation of warm season vegetable crops, Methods of application of fertilizer for warm season vegetable crops, Mulching in vegetable crops, Use of plant growth substances in vegetable crops, Study of physiological disorders and its management, Weeds and their management, Study of deficiency of mineral elements and its management, Study of different maturity standards in vegetables. Identification and characterization of vegetable varieties. Identification of important pests and diseases and their control. Preparation of cropping schemes for commercial farms. Study of economics of warm season vegetable crops. |  |  |
| <b>Practical No.</b>   | <b>Topic</b>   |  |
| 1  | Raising of nursery of vegetable crops                                |  |
| 2  | Cultural operations in cultivation of warm season vegetable crops    |  |
| 3  | Methods of application of fertilizer for warm season vegetable crops |  |
| 4  | Mulching in vegetable crops  |  |
| 5  | Use of plant growth substances in vegetable crops                    |  |
| 6  | Study of physiological disorders and its management                  |  |
| 7-8  | Weeds and their management   |  |
| 9  | Study of deficiency of mineral elements and its management           |  |
| 10   | Study of different maturity standards in vegetables                  |  |
| 11   | Identification and characterization of vegetable varieties.          |  |
| 12-14  | Identification of important pests and diseases and their control     |  |
| 15   | Preparation of cropping schemes for commercial farms                 |  |
| 16   | Study of economics of warm season vegetable crops.                   |  |

**Reference Books:**

- Bose TK & Som MG. (Eds.). 1986. Vegetable Crops in India. Naya Prokash.
- Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. Vegetable Crops. Vols. I-III. Naya Udyog.
- Bose TK, Som MG & Kabir J. (Eds.). 2002. Vegetable Crops. Naya Prokash.
- Brown HD & Hutchison CS. Vegetable Science. JB Lippincott Co.
- Chadha KL & Kalloo G. (Eds.). 1993-94. Advances in Horticulture. Vols. V-X. Malhotra Publ. House.
- Chadha KL. (Ed.). 2002. Hand Book of Horticulture. ICAR.
- Chauhan DVS. (Ed.). 1986. Vegetable Production in India. Ram Prasad & Sons.
- Decoteau DR. 2000. Vegetable Crops. Prentice Hall.
- Edmond JB, Musser AM & Andrews FS. 1964. Fundamentals of Horticulture. Blakiston Co
- Fageria MS, Choudhary BR & Dhaka RS. 2000. Vegetable Crops: Production Technology. Vol. II. Kalyani.
- Gopalakrishanan TR. 2007. Vegetable Crops. New India Publ. Agency.
- Hazra P & Som MG. (Eds.). 1999. Technology for Vegetable Production and Improvement. Naya Prokash.
- Kaloo G & Singh K (Ed.). 2000. Emerging Scenario in Vegetable Research and Development. Research Periodicals & Book Publ.House.
- Nayer NM & More TA 1998. Cucurbits. Oxford & IBH Publ.
- Palaniswamy & Peter KV. 2007. Tuber Crops. New India Publ. Agency.
- Pandey AK & Mudranalay V. (Eds.). Vegetable Production in India: Important Varieties and Development Techniques.
- Rana MK. 2008. Olericulture in India. Kalyani.
- Rana MK. 2008. Scientific Cultivation of Vegetables. Kalyani.
- Rubatzky VE & Yamaguchi M. (Eds.). 1997. World Vegetables: Principles, Production and Nutritive Values. Chapman & Hall.
- Saini GS. 2001. A Text Book of Oleri and Flori Culture. Aman Publ. House.
- Salunkhe DK & Kadam SS. (Ed.). 1998. Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing. Marcel Dekker.
- Shanmugavelu KG. 1989. Production Technology of Vegetable Crops. Oxford & IBH.
- Singh DK. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co.
- Singh NP, Bharadwaj AK, Kumar A & Singh KM. 2004. Modern Technology on Vegetable Production. International Book Distributing Co.
- Singh SP. (Ed.). 1989. Production Technology of Vegetable Crops. Agril. Comm. Res. Centre.
- Thamburaj S & Singh N. 2004. Vegetables, Tuber Crops and Spices. ICAR.
- Thompson HC & Kelly WC. (Eds.). 1978. Vegetable Crops. Tata Mc Graw Hill.

|                   |   |                                    |
|-------------------|---|------------------------------------|
| <b>Course No.</b> | : | <b>VSC-503</b>                     |
| <b>Title</b>      | : | <b>Breeding of vegetable crops</b> |
| <b>Credit</b>     | : | <b>2+1=3</b>                       |

**Theory:**

|   |   |   |
|---|---|---|
| Origin, botany, taxonomy, cytogenetics, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics, marker assisted breeding and QTLs, biotechnology and their use in breeding in vegetable crops-Issue of patenting, PPVFR act. |   |   |
| <b>Unit-I</b>   | : | Potato and tomato                                     |
| <b>Unit-II</b>  | : | Egg plant, hot pepper, sweet pepper and okra          |
| <b>Unit-III</b>   | : | Peas, beans, amaranths and lettuce                    |
| <b>Unit-IV</b>  | : | Gourds, melons, pumpkins and squashes                 |
| <b>Unit-V</b>   | : | Cabbage, cauliflower, carrot, radish and sweet potato |

**Practical:**

| Mechanization for promoting self and cross pollination. Selection of desirable plants from breeding population. Observation and analysis of various qualitative and quantitative traits in germplasm. Techniques for development of hybrid varieties in vegetable crops. Use of segregation generation in crop improvement. Induction of flowering. Selfing and crossing techniques in vegetable crops. Hybrid seed production techniques in vegetable crops. Screening techniques for insect-pest, diseases and environmental stress in vegetable crops. Demonstration of sib-mating and mix population. Study of molecular marker technique to identify useful traits in vegetable crops. Study of special breeding techniques. Identification of male sterility. Methods of induction of polyploidy. Visit to breeding block |  |
|---|--|
| <b>Practical No.</b>  | <b>Topics</b>  |
| 1   | Mechanization for promoting self and cross pollination.                              |
| 2   | Selection of desirable plants from breeding population                               |
| 3   | Observation and analysis of various qualitative and quantitative traits in germplasm |
| 4   | Techniques for development of hybrid varieties in vegetable crops                    |
| 5   | Use of segregation generation in crop improvement                                    |
| 6   | Induction of flowering   |
| 7   | Selfing and crossing techniques in vegetable crops                                   |

|       |  |
|-------|--|
| 8     | Hybrid seed production techniques in vegetable crops                                       |
| 9     | Screening techniques for insect-pest, diseases and environmental stress in vegetable crops |
| 10    | Demonstration of sib-mating and mix population   |
| 11    | Study of molecular marker technique to identify useful traits in vegetable crops           |
| 12    | Study of special breeding techniques   |
| 13    | Identification of male sterility   |
| 14    | Methods of induction of polyploidy   |
| 15-16 | Visit to breeding block  |

### Reference Books:

Allard RW. 1999. Principles of Plant Breeding. John Wiley & Sons.

Basset MJ. (Ed.). 1986. Breeding Vegetable Crops. AVI Publ.

Dhillon BS, Tyagi RK, Saxena S. & Randhawa GJ. 2005. Plant Genetic Resources: Horticultural Crops. Narosa Publ. House.

Fageria MS, Arya PS & Choudhary AK. 2000. Vegetable Crops: Breeding and Seed Production. Vol. I. Kalyani.

Gardner EJ. 1975. Principles of Genetics. John Wiley & Sons.

Hayes HK, Immer FR & Smith DC. 1955. Methods of Plant Breeding. McGraw-Hill.

Hayward MD, Bosemark NO & Romagosa I. (Eds.). 1993. Plant Breeding-Principles and Prospects. Chapman & Hall.

Kaloo G. 1988. Vegetable Breeding. Vols. I-III. CRC Press.

Kaloo G. 1998. Vegetable Breeding. Vols. I-III (Combined Ed.). Panima Edu. Book Agency.

Kumar JC & Dhaliwal MS. 1990. Techniques of Developing Hybrids in Vegetable Crops. Agro Botanical Publ.

Paroda RS & Kaloo G. (Eds.). 1995. Vegetable Research with Special Reference to Hybrid Technology in Asia-Pacific Region. FAO.

Peter KV & Pradeepkumar T. 2008. Genetics and Breeding of Vegetables. Revised, ICAR.

Rai N & Rai M. 2006. Heterosis Breeding in Vegetable Crops. New India Publ. Agency.

Ram HH. 1998. Vegetable Breeding: Principles and Practices. Kalyani.

Simmonds NW. 1978. Principles of Crop Improvement. Longman.

Singh BD. 1983. Plant Breeding. Kalyani.

Singh PK, Dasgupta SK & Tripathi SK. 2004. Hybrid Vegetable Development. International Book Distributing Co.

Swarup V. 1976. Breeding Procedure for Cross-pollinated Vegetable Crops. ICAR.



**Course No.** : VSC 504  
**Title** : **GROWTH AND DEVELOPMENT OF VEGETABLE CROPS**  
**Credits** : 2+1=3

**Theory:**

Cellular structures and their functions. Definition of growth and development, growth analysis and its importance in vegetable production. Physiology of dormancy seeds. Physiology of dormancy tubers. Physiology of dormancy bulbs. Physiology of dormancy rhizomes. Germination of vegetable seeds, introduction, conditions /factors affecting germination, process of germination, Pattern of growth and development during germination. Role of auxins, gibberellins, cytokinins and light on growth, tuberization and abscisic acid. Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops. Role and mode of action of morphactins, anti-transpirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production. Role of light, temperature and photoperiod on growth, development of underground parts. Flowering and sex expression and apical dominance in vegetable crops; Physiology of fruit set, Physiology of fruit development, fruit growth. Physiology of flower and fruit drop. Parthenocarpy in vegetable crops. Phototropism, ethylene inhibitors, senescence and abscission in vegetable crops. Fruit ripening and physiological changes associated with ripening. Relevance of plant growth regulators in relation to vegetable production. Morphogenesis in vegetable crops. Asexual method of propagation techniques in vegetable crops. Tissue culture techniques in vegetable crops.

**Practical:**

Preparation of solutions of plant growth substances 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. Application of plant growth substances. Fruit drop, Fruit set, Growth analysis techniques in vegetable crops.

| <b>Periods</b> | <b>Topic</b>   |
|----------------|--|
| 1-2            | Preparation of solutions of plant growth substances and their application                                    |
| 3-5            | Experiments in breaking and induction of dormancy by chemicals   |
| 6-8            | Induction of parthenocarpy and fruit ripening  |
| 9-12           | Application of plant growth substances for improving flower initiation, changing sex expression in cucurbits |
| 13             | Application of plant growth substances   |
| 14             | Fruit drop   |
| 15             | Fruit set  |
| 16             | Growth analysis techniques in vegetable crops.   |

**Reference Books:**

- Bleasdale JKA. 1984. *Plant Physiology in Relation to Horticulture*. 2nd Ed. MacMillan.
- Gupta US. (Ed.). 1978. *Crop Physiology*. Oxford & IBH.
- Krishnamoorti HN. 1981. *Application Plant Growth Substances and Their Uses in Agriculture*. Tata-McGraw Hill.
- Peter KV. (Ed.). 2008. *Basics of Horticulture*. New India Publ. Agency.
- Saini RS, Sharma KD, Dhankhar OP & Kaushik RA. (Eds.). 2001. *Laboratory Manual of Analytical Techniques in Horticulture*. Agrobios.
- Wien HC. (Ed.). 1997. *The Physiology of Vegetable Crops*. CABI.

**Course No.** : VSC 505  
**Title** : SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS  
**Credits** : 2+1=3

**Theory:**

Definition of seed and its quality, new seed policies; DUS test, scope of vegetable seed industry. Genetical and agronomical principles of seed production. Methods of seed production. Use of growth regulators and chemicals in vegetable seed production. Floral biology of solanaceous cucurbits, leguminous vegetables. Pollination, breeding behavior. Seed development and maturation. Methods of hybrid seed production. Categories of seed; maintenance of nucleus, foundation and certified seed. Seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control. 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. Agro-techniques for seed production in solanaceous vegetables,

Agro-techniques for seed production in cucurbits. Agro-techniques for seed production in leguminous vegetables. Agro-techniques for seed production in cole crops. Agro-techniques for seed production in bulb crops. Agro-techniques for seed production in leafy vegetables. Agro-techniques for seed production in okra. Agro-techniques for seed production in vegetatively propagated vegetables.

**Practical:**

Seed sampling, seed testing (genetic purity, seed viability, seedling vigour, physical purity) and seed health testing. Testing, releasing and notification procedures of varieties. Floral biology -Leguminous, solanaceous, cruciferous, cole crops. Rouging of off-type. Methods of hybrid seed production in important vegetable and spice crops. Seed extraction techniques; handling of seed processing and seed testing equipments; Seed sampling; testing of vegetable seeds for seed purity, germination, vigor and health;

Visit to seed processing units, seed testing laboratory and seed production farms.

| Practical No. | Topics   |
|---------------|--|
| 1-2           | Seed sampling, seed testing (genetic purity, seed viability, seedling vigour, physical purity) and seed health testing |
| 3             | Testing, releasing and notification procedures of varieties  |
| 4-7           | Floral biology – Leguminous, solanaceous, cruciferous, cole crops.   |
| 8             | Rouging of off-type.   |
| 9-11          | Methods of hybrid seed production in important vegetable and spice crops.  |
| 12            | Seed extraction techniques; handling of seed processing and seed testing equipments;                                   |
| 13-14         | Seed sampling; testing of vegetable seeds for seed purity, germination, vigor and health;                              |
| 15-16         | Visit to seed processing units, seed testing laboratory and seed production farms.                                     |

#### Reference Books:

- Agrawal PK & Dadlani M. (Eds.). 1992. *Techniques in Seed Science and Technology*. South Asian Publ.
- Agrawal RL. (Ed.). 1997. *Seed Technology*. Oxford & IBH.
- Bendell PE. (Ed.). 1998. *Seed Science and Technology: Indian Forestry Species*. Allied Publ.
- Fageria MS, Arya PS & Choudhary AK. 2000. *Vegetable Crops: Breeding and Seed Production*. Vol. I. Kalyani.
- George RAT. 1999. *Vegetable Seed Production*. 2nd Ed. CABI.
- Kumar JC & Dhaliwal MS. 1990. *Techniques of Developing Hybrids in Vegetable Crops*. Agro Botanical Publ.
- More TA, Kale PB & Khule BW. 1996. *Vegetable Seed production Technology*. Maharashtra State Seed Corp.
- Rajan S & Baby L Markose. 2007. *Propagation of Horticultural Crops*. New India Publ. Agency.
- Singh NP, Singh DK, Singh YK & Kumar V. 2006. *Vegetable Seed Production Technology*. International Book Distributing Co.
- Singh SP. 2001. *Seed Production of Commercial Vegetables*. Agrotech Publ. Academy.

**Course No.** : VSC 506  
**Title** : SYSTEMATICS OF VEGETABLE CROPS  
**Credits** : 1+1=2

**Theory:**

|                 |   |   |
|-----------------|---|---|
| <b>Unit I</b>   | : | Principles of classification; different methods of classification; salient features of international code of nomenclature of vegetable crops.     |
| <b>Unit II</b>  | : | Origin, history, evolution and distribution of vegetable crops.   |
| <b>Unit III</b> | : | Botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables.                            |
| <b>Unit IV</b>  | : | Cytological level of various vegetable crops; descriptive keys for important vegetables.  |
| <b>Unit V</b>   | : | Importance of molecular markers in evolution of vegetable crops; molecular markers as an aid in characterization and taxonomy of vegetable crops. |

**Practical:**

|   |   |
|---|---|
| Identification, description, classification and maintenance of vegetable species and varieties. Survey, collection of allied species and genera locally available. Preparation of keys to the species and varieties. Methods of preparation of herbarium and specimens. |   |
| <b>Practical No.</b>  | <b>Topics</b>   |
| 1-3   | Identification, description, classification and maintenance of vegetable species and varieties. |
| 4-7   | Survey, collection of allied species and genera locally available.                              |
| 8-10  | Preparation of keys to the species and varieties.   |
| 11-16   | Methods of preparation of herbarium and specimens.  |

**Reference Books:**

|  |
|--|
| Chopra GL. 1968. <i>Angiosperms - Systematics and Life Cycle</i> . S. Nagin  |
| Dutta AC. 1986. <i>A Class Book of Botany</i> . Oxford Univ. Press.  |
| Pandey BP. 1999. <i>Taxonomy of Angiosperm</i> . S. Chand & Co   |
| Peter KV & Pradeepkumar T. 2008. <i>Genetics and Breeding of Vegetables</i> .(Revised), ICAR.  |
| Soule J. 1985. <i>Glossary for Horticultural Crops</i> . John Wiley & Sons.  |
| Srivastava U, Mahajan RK, Gangopadyay KK, Singh M & Dhillon BS.2001. <i>Minimal Descriptors of Agri-Horticultural Crops</i> . Part-II:Vegetable Crops. NBPGR, New Delhi. |
| Vasistha. 1998. <i>Taxonomy of Angiosperm</i> . Kalyani.   |
| Vincent ER & Yamaguchi M. 1997. <i>World Vegetables</i> . 2nd Ed. Chapman & Hall   |

**Course No. : VSC-507**  
**Course Title : PRODUCTION TECHNOLOGY OF UNDEREXPLOITED VEGETABLE CROPS**  
**Credits : 1+1=2**

**Theory:**

|  |   |
|--|---|
| Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties / hybrids, sowing / planting time and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed production of : |   |
| <b>Unit I</b>  | : Asparagus, artichoke and leek   |
| <b>Unit II</b>   | : Brussels' sprout, Chinese cabbage, broccoli and kale  |
| <b>Unit III</b>  | : Amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathua (chenopods) and cherry tomato. |
| <b>Unit IV</b>   | : Elephant foot yam, lima bean, winged bean, vegetable pigeon pea, jack bean and sword bean.                    |
| <b>Unit V</b>  | : Sweet gourd, snake gourd, pointed gourd, oriental pickling melon and little gourd (kundru).                   |

**Practical:**

| Collection and identification of seeds. Botanical description of plants. Layout and planting. Cultural practices. Seeds count and seed germination studies in underexploited vegetable crops. |   |
|---|---|
| <b>Periods</b>  | <b>Topic</b>  |
| 1-4   | Collection and identification of seeds.                                     |
| 4-7   | Botanical description of plants.  |
| 8-9   | Layout and planting.  |
| 10-14   | Cultural practices.   |
| 15-16   | Seeds count and seed germination studies in underexploited vegetable crops. |

**Reference Books:**

|   |
|---|
| <p>Bhat K. L. 2001. Minor Vegetables – Untapped Potential, Kalyani<br/>         Indira P. &amp; Peter K. V. 1984. Unexploited Tropical Vegetable. K. A. U., Kerala<br/>         Peter K. V. (Ed). 2007-08. Underutilized and Underexploited Horticultural Crops, Vols. I-IV. New India Publ. Agency.<br/>         Rubatzky V. E. &amp; Yamaguchi M. (Eds.) 1997. World Vegetables; Principles, Production and Nutritive Values. Chapman &amp; Hall<br/>         Srivastava U, Mahajan R.K., Gangopadhyay K.K., Singh M. &amp; Dhillon BS, 2001. Minimal Descriptors of Agri-Horticultural Crops. Part- II: Vegetable Crops. NBPGR, New Delhi.</p> |
|---|

**Course No** : VSC 508  
**Title** : ORGANIC VEGETABLE PRODUCTION TECHNOLOGY  
**Credits** : 1+1=2

### Theory:

Importance, principles, perspective, concept and component of organic production of vegetable crops. Organic production of vegetables crops, viz., solanaceous crops, cucurbits, cole crops, root and tuber crops. Managing soil fertility, pests and diseases and weed problems in organic farming system; crop rotation in organic horticulture; processing and quality control for organic foods. Methods for enhancing soil fertility, mulching, raising green manure crops. Indigenous methods of compost, *Panchagavya*, Biodynamics, preparation etc Pest and disease management in organic farming; ITK's in organic farming. Role of botanicals and bio-control agents. GAP and GMP- Certification of organic products; organic production and export - opportunity and challenges.

### Practical:

Method of preparation of compost (NADEF), Vermi-composting, Bio-fertilizers, Soil solarization, Bio pesticides in horticulture, Green manuring, mycorrhizae and organic crop production, waste management, Organic soil amendment for root disease, Weed management in organic horticulture. Visit to organic fields and marketing centers

| Practical No. | Topics   |
|---------------|--|
| 1-2           | Method of preparation of compost (NADEF)                 |
| 3             | Vermi-composting   |
| 4             | Bio-fertilizers  |
| 5-6           | Soil solarization  |
| 7             | Bio pesticides in horticulture,.                         |
| 8-9           | Green manuring, mycorrhizae and organic crop production, |
| 10            | Waste management,  |
| 11-12         | Organic soil amendment for root disease,                 |
| 13-14         | Weed management in organic horticulture.                 |
| 15-16         | Visit to organic fields and marketing centers            |

### Reference Books

*Agriculture*. 2nd Ed. Agrobios.

Gehlot G. 2005. *Organic Farming; Standards, Accreditation Certification and Inspection*. Agrobios.

Palaniappan SP & Annadorai K. 2003. *Organic Farming, Theory and Practice*. Scientific Publ.

Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. *Management of Horticultural Crops*. New India Publ. Agency.

Shivashankar K. 1997. *Food Security in Harmony with Nature*. 3rd IFOAMASIA, Scientific Conf.. 1- 4 December, 1997, UAS, Bangalore.

**Course No** : VSC - 509  
**Title** : FUNDAMENTALS OF PROCESSING OF VEGETABLES  
**Credit** : 2 (1+1)

**Theory:**

History of food preservation. Present status and future prospects of vegetable preservation industry in India. Spoilage of fresh and processed horticultural produce. Biochemical changes and enzymes associated with spoilage of horticultural produce, Principal spoilage organisms, food poisoning and their control measures. Role of microorganisms in food preservation. Raw materials for processing. Primary and minimal processing, processing equipments; Layout and establishment of processing industry, FPO license. Importance of hygiene, Plant sanitation, Quality assurance and quality control, TQM, GMP. Food standards – FPO, PFA, etc. Food laws and regulations. Food safety – Hazard analysis and critical control points (HACCP). Labeling and labeling act, nutrition labeling. Major value added products from vegetables. Utilization of byproducts of vegetable processing industry. Management of waste from processing factory. Investment analysis. Principles and methods of sensory evaluation of fresh and processed vegetables.

**Practical:**

Study of machinery and equipments used in processing of horticultural produce; Chemical analysis for nutritive value of fresh and processed vegetables. Study of different types of spoilages in fresh as well as processed horticultural produce. Classification and identification of spoilage organisms. Study of biochemical changes and enzymes associated with spoilage. Laboratory examination of vegetable products. Sensory evaluation of fresh and processed vegetables. Study of food standards –National, international, CODEX Alimentarius. Botanical description and commercial varieties in watermelon and muskmelon. Visit to processing units to study the layout, equipments, hygiene, sanitation and residual / waste management

| <b>Practical No.</b> | <b>Topic</b>  |
|----------------------|---|
| 1-2                  | Study of machinery and equipments used in processing of horticultural produce;            |
| 3                    | Chemical analysis for nutritive value of fresh and processed vegetables                   |
| 4-5                  | Study of different types of spoilages in fresh as well as processed horticultural produce |
| 6                    | Classification and identification of spoilage organisms                                   |
| 7-8                  | Study of biochemical changes and enzymes associated with spoilage                         |
| 9                    | Laboratory examination of vegetable products  |
| 10                   | Sensory evaluation of fresh and processed vegetables                                      |
| 11-12                | Study of food standards –National, international, CODEX Alimentations                     |
| 13                   | Botanical description and commercial varieties in watermelon and muskmelon                |

|       |  |
|-------|--|
| 14-16 | Visit to processing units to study the layout, equipments, hygiene, sanitation and residual / waste management |
|-------|--|

### Reference Books:

Arthey D & Dennis C. 1996. *Vegetable Processing*. Blackie/Springer-Verlag. Chadha DS. 2006. *The Prevention of Food Adulteration Act*. Confed. of Indian Industry.

Desrosier NW. 1977. *Elements and Technology*. AVI Publ. Co.

FAO. 1997. *Fruit and Vegetable Processing*. FAO.

FAO. *CODEX Alimentarius: Joint FAO/WHO Food Standards Programme*. 2nd Ed. Vol. VB. *Tropical Fresh Fruits and Vegetables*. FAO.

FAO. *Food Quality and Safety Systems – Training Manual on Food Hygiene and HACCP*. FAO.

Fellow's P. 1988. *Food Processing Technology*. Ellis Horwood International. Frazier WC & Westhoff DC. 1995. *Food Microbiology*. 4th Ed. Tata McGraw Hill.

Giridharilal GS, Siddappa & Tandon GL. 1986. *Preservation of Fruits and Vegetables*. ICAR.

Gisela J. 1985. *Sensory Evaluation of Food – Theory and Practices*. Ellis Horwood.

Graham HD. 1980. *Safety of Foods*. AVI Publ. Co.

Hildegrade H & Lawless HT. 1997. *Sensory Evaluation of Food*. CBS.

Joslyn M & Heid. *Food Processing Operations*. AVI Publ. Co.

Mahindru SN. 2004. *Food Safety: Concepts and Reality*. APH Publ. Corp.

Ranganna S. 1986. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2<sup>nd</sup> Ed. Tata-McGraw Hill.

Shapiro R. 1995. *Nutrition Labeling Handbook*. Marcel Dekker.

Srivastava RP & Kumar S. 2003. *Fruit and Vegetable Preservation: Principles and Practices*. 3<sup>rd</sup> Ed. International Book Distri. Co.

Tressler & Joslyn MA. 1971. *Fruit and Vegetable Juice Processing Technology*. AVI Publ. Co.

Verma LR & Joshi VK. 2000. *Post-harvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management*. Indus Publ. Co.

| <b>Seminar (1 credit)</b>              |                   |         |
|--|-------------------|---------|
| VSC - 591                              | Seminar           | 0+1=1   |
| <b>Master's Research ( 20 credits)</b> |                   |         |
|  | Master's Research | 0+20=20 |