

# **CURRICULUM OF HORTICULTURE**

(Revised 2005)



**HIGHER EDUCATION COMMISSION  
ISLAMABAD**

## **CURRICULUM DIVISION, HEC**

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## PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum one can judge the state of intellectual development and the state of progress of the nation. The world has turned into a global village; new ideas and information are pouring in like a stream. It is, therefore, imperative to update our curricula regularly by introducing the recent developments in the relevant fields of knowledge.

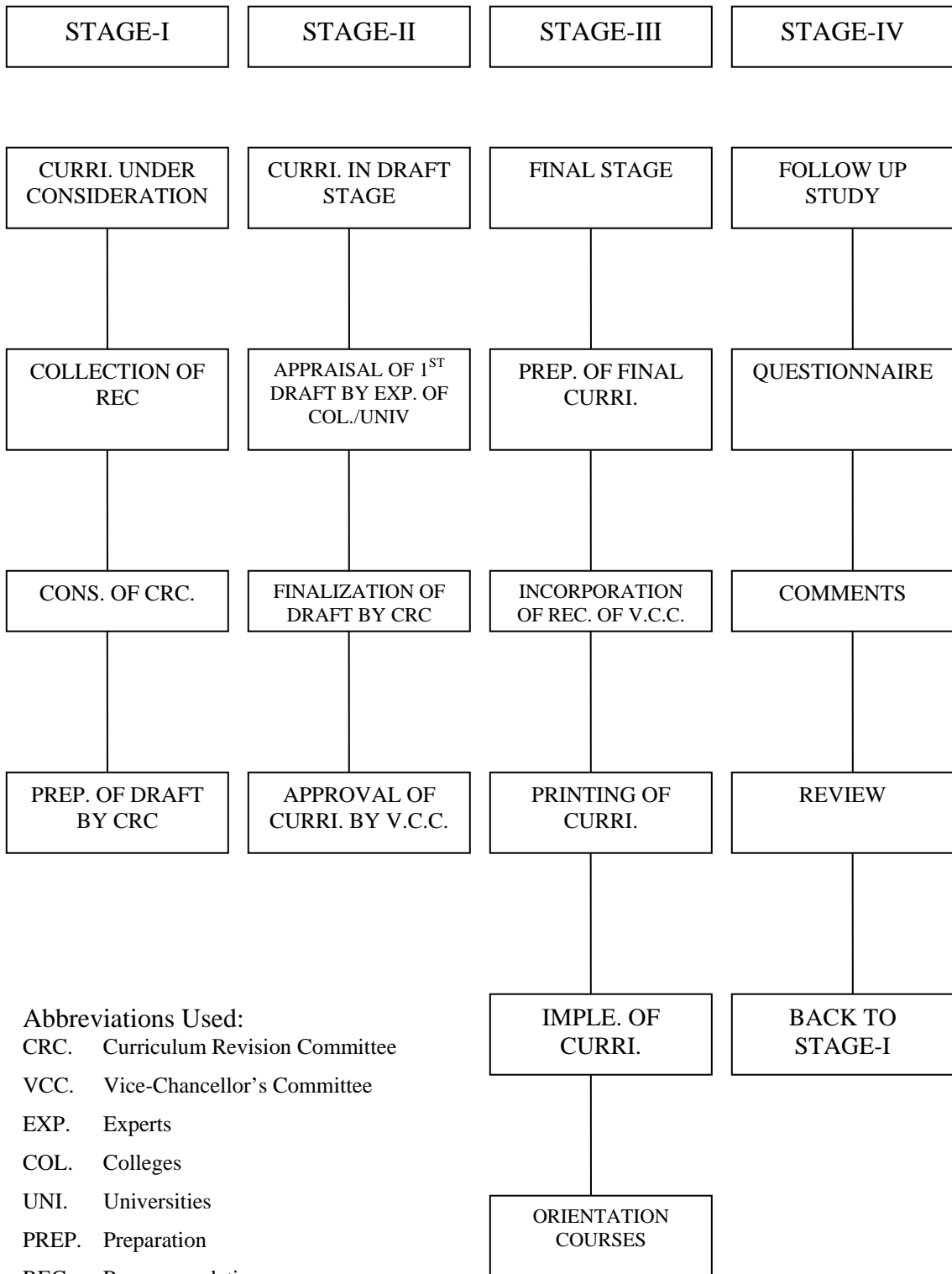
In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification no. D773/76-JEA (Cur.), dated December 4, 1976, appointed University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various committees are constituted at the national level comprising senior teachers nominated by universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these committees. The National Curriculum Revision Committee for Horticulture in its meeting held in June 20-22, 2005 at the HEC Regional Centre, Lahore revised the curriculum after due consideration of the comments and suggestions received from universities and colleges where the subject under consideration is taught. The final draft prepared by the National Curriculum Revision Committee duly approved by the Competent Authority is being circulated for implementation by architectural institutions.

**(PROF. DR. ALTAF ALI G. SHAIKH)**  
**Adviser (Acad/R&D)**

July 2005

# CURRICULUM DEVELOPMENT





## INTRODUCTION

National Curriculum Revision Committee final meeting to finalize the draft curriculum for Horticulture was held on June 20-22, 2005 at HEC, Regional Centre, Lahore. Following attended:

1. Prof. Dr. Faridullah Khan Wazir  
Chairman,  
Department of Horticulture,  
NWFP Agricultural University, Peshawar  
Convener
2. Prof. Dr. Muhammad Jamil Ahmed  
Department of Horticulture,  
Faculty of Agriculture,  
Rawalakot, Azad Kashmir  
Member
3. Mr. Munir Ahmad Shaikh  
Associate Professor,  
Department. of Horticulture,  
Sindh Agriculture University, Tandojam  
Member
4. Dr. Muhammad Akbar Anjum  
Scientific Secretary,  
Pakistan Council for Science & Technology,  
Sharah-e-Jamhuriat, G-5/2, Islamabad  
Member
5. Mr. Farrukh Naveed  
Assistant Professor,  
University College of Agriculture,  
Bahauddin Zakariya University, Multan  
Member
6. Dr. Mohammad Abdul Rauf  
Research Officer,  
Agricultural Research Station (N),  
Mingora, Swat  
Member
7. Mr. Sardar Waseem Baran  
Lecturer/Head,  
Department of Horticulture,  
Balochistan Agriculture College,  
Chaman Road, Baleli, Quetta  
Member
8. Mr. Shawkat Ali  
Lecturer,  
Department of Biotechnology,  
University of Malakand, Chakdara (Dir)  
Member

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| 9.  | Dr. Imran Hassan<br>Lecturer,<br>Department of Horticulture,<br>University of Arid Agriculture, Rawalpindi   | Member           |
| 10. | Dr. Muhammad Munir<br>Head/Assistant Professor,<br>Department of Horticulture,<br>Gomal University, D.I.Khan | Member/Secretary |

Following members of the committee could not attend final meeting due to their pre-occupation.

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|----|---|--------|
| 1. | Prof. Dr. Muhammad Ibrahim Chaudhry<br>Director,<br>Institute of Horticultural Sciences,<br>University of Agriculture, Faisalabad | Member |
| 2. | Mr. Muhammad Amjad<br>Associate Professor,<br>Institute of Horticultural Sciences,<br>University of Agriculture, Faisalabad       | Member |
| 3. | Mr. Waqar Ahmed<br>Assistant Professor,<br>Institute of Horticultural Sciences,<br>University of Agriculture, Faisalabad          | Member |

The meeting started with recitation from the Holy Qur'an.

Mr. Tahir Ali Shah, Assistant Director (S&T), Curriculum Division, HEC, Islamabad welcomed the participants on behalf of the Chairman, HEC and briefed them of the obligations of the Commission for review, revision and development of curricula.

Mr. Muhammad Tahir Ali Shah, Assistant Director, HEC, Islamabad in his opening remarks informed the members that the Higher Education Commission is striving hard to enhance quality of education in public sector universities/institutions by making curriculum more compatible with international standard, job oriented and to match the needs of society. He introduced the

members of the committee to various Academic Programms of the commission aimed at facilitating the universities in execution of their programmes including repair and maintenance of laboratories, provision of books for libraries, institution of indigenous Ph.D. scholarships, provision of computer and other modern tools like internet and e.mail etc.

Prof. Dr. Faridullah Khan Wazir continued as Convener and Dr. Muhammad Munir as Secretary.

The committee finalized under graduate courses in Horticulture comprising general and major for all students specializing in Horticulture and relevant optional courses for their proper training in the subject. Sufficient flexibility has also been incorporated in the curriculum to cater the needs of the area where university / colleges is located. The optional courses can be adopted by the institutions according to the need of the area and availability of faculty after fulfilling the basic requirement of HEC. More emphasis has been given to the major courses in Horticulture and Research at post graduate level. Only core courses were suggested at post graduate level which should be offered by all the universities / colleges. The institutions may be introduced as many courses as possible depending upon the expertise, facilities and specific need of the region. However, there should be sufficient number of courses to strengthen the specific specialization of the students to fulfill the degree requirements. The Committee agreed to recommend the Horticulture courses for B.Sc. (Hons), M.Sc. (Hons) and Ph.D.

The committee, after three days discussion finalized draft curriculum prepared by it in its preliminary meeting held on December 20-22, 2004.

## Scheme of Study for 4-Year B.Sc (Hons) Agriculture

Mathematics / Biology	6 Credits
Statistics 1 & 2	6
Computers / IT	3
Pak Studies	2
Islamiat	2
Communications Skills	3
English	3
Basic Agriculture	3
<b>Sub-Total</b>	<b>28</b>

One subject from each of the following disciplines

Agronomy	3
Plant Breeding & Genetics	3
Entomology	3
Plant Pathology	3
Food Technology	3
Horticulture	3
Soil Sciences	3
Agriculture Economics	3
<b>Sub-Total</b>	<b>24</b>

Additional Courses from disciplines mentioned below and above

Agriculture Extension	
Forestry & Range Management	
Animal Science	
Marketing & Agri Business	
Rural Development	
Human Nutrition	
Agriculture Chemistry	
Agriculture Engineering	
Water Management	
<b>Sub-Total</b>	<b>21-25</b>

**Sub-Total during the first four semesters**      **73 – 77**

Semester 5, 6, 7    **19 Credit Hours** each      **57**  
**Final Semester**      **15**

**Grand Total**      **145 – 149**



## **OUTLINE OF COURSES FOR UNDERGRADUATE STUDIES IN HORTICULTURE**

### **HORT. 302    INTRODUCTORY HORTICULTURE                    3(2-2)**

#### **Theory:**

Introduction, history, importance and future scope, Definition and divisions of horticulture, Classification of horticultural crops, Plant parts, their modifications and functions, Plant environment; climate (temperature, light, humidity etc) and soil (structure, texture, fertility etc), Propagation of horticultural plants, Concept of tissue culture.

#### **Practical:**

Visit of experimental gardens and nurseries with general identification of important horticultural plants, Garden tools and their uses, Techniques of propagation, Visit of tissue culture laboratory.

#### **Books recommended:**

- Janick, J. 1979. Horticultural Science. W.H. Freeman and Co., San Francisco.
- Malik, M.N. 1994. Horticulture. National Book Foundations, Islamabad.,
- Edmond, J.B., T.L. Senn, F.S. Andrews and R.G. Halfacre. 1977. Fundamentals of Horticulture. Tata McGraw Hill Publishing Co., New Delhi.
- Reiley, H.E., C.L. Shry (Jr). 2002. Introductory Horticulture (6<sup>th</sup> Ed.) Thompson Learning Inc., Delmar, USA.

### **HORT. 401    PRINCIPLES OF HORTICULTURAL PRACTICES                    4(3-2)**

#### **Theory:**

Establishment of gardens; site selection, layout methods, wind breaks, Management practices; irrigation, fertilizers and manures, training and pruning, cultivation and weed control, Plant protection measures and sanitation, Harvesting and post harvest handling, Establishment and maintenance of lawns, Concept of protected horticulture.

#### **Practical:**

Practice in layout methods, Selection of plants from nursery, Planting, after care, hoeing and weeding etc. identification and nomenclature of important fruits, vegetables and ornamental plants; Planting and maintenance of lawns, Visit of plant growing structures.

**Books recommended:**

- Ali, N., M.N. Malik and A.H. Gilani. 1979. Practical Manual for Fruit Culture. Univ. of Agri., Press, Faisalabad.
- Edmond, J.B., T.L. Senn, F.S. Andrews and R.G. Halfacre. 1977. Fundamentals of Horticulture. Tata McGraw Hill Publishing Co., New Delhi.
- Malik, M.N. 1994. Horticulture. National Book Foundation, Islamabad.
- Swaider, J.M., G.W. Ware and J.P. McCollum. 1992. Producing Vegetable Crops (4<sup>th</sup> Ed.), Interstate Publishers Printers and Publishers Inc., Danville, Illinois.
- Halfacre, R.B. and I.A. Barden. 1979. Horticulture. The McGraw Hill Book Co., New York.

**HORT. 402      PRINCIPAL HORTICULTURAL CROPS      4(3-2)****Theory:**

Acreage, production, climate, soil, propagation, rootstocks, cultural practices, cultivars, important pests, harvesting and marketing of important horticultural crops (fruits, vegetables and ornamentals) of the region.

**Practical:**

Production techniques and identification of important cultivars of horticultural crops of the region. Visit of commercial gardens, nurseries and public parks.

**Books recommended:**

- Arora, J.S. 1992. Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi.
- Malik, M.N. 1994. Horticulture, National Book Foundation, Islamabad.
- Swaider, J.M., G.W. Ware and J.P. McCollum. 1992. Producing Vegetable Crops (4<sup>th</sup> Ed.), Interstate Publishers Printers and Publishers Inc., Danville, Illinois.
- Chottopadhyay, T.K. 2000. A Textbook on Pomology, Vol: II. Kalyani Publishers, New Delhi.

**HORT. 501      PRINCIPLES OF FRUIT PRODUCTION      4(3-2)****Theory:**

Introduction to fruit science, Fruit-bud formation; initiation, development and controlling factors, Pollination and fruit setting problems, Rest and dormancy, Biennial bearing in fruit plants; causes and its control, Fruit thinning, Parthenocarpy and seedlessness, Harvesting, storage and marketing of fruit crops, Use of plant growth regulators (PGRs), Improvement in fruit varieties, Bud variations and mutations.

**Practical:**

Fruit bearing habits, Training and pruning of important evergreen and deciduous fruit trees, Preparation of PGR stock solutions and their applications, Demonstration of different methods of breaking seed dormancy.

**Books recommended:**

- Gardener, V.R. 1966. Principles of Horticultural Production. Michigan State University Press, Michigan.
- Halfacre, R.B., and J.A. Barden, 1979. Horticulture. The McGraw Hill book Company, New York.
- Janick, J. 1979. Horticultural Science. W.H. Freeman and Company, San Francisco.
- Ryugo, K. 1988. Fruit Culture - its Science and Art. John Wiley and Sons Inc., New York.
- Chottopadhyay, T.K. 2001. A Textbook of Pomology - Fundamentals of Fruit Growing. Kalyani Publishers, New Delhi.

**HORT. 503 PRINCIPLES OF VEGETABLE PRODUCTION 4(3-2)****Theory:**

Introduction and importance, Classification of vegetables, Recent trends in vegetable production, Factors affecting vegetable production, Crop management and quality assurance, Physiological disorders, Succession, relay cropping and multiple cropping, Vegetable forcing, Hardening, Pruning, grafting and staking, Bulb and tuber formation, Production problems and their management, Use of growth regulators.

**Practical:**

Identification and description of flower, fruit and seed of important cultivars of vegetables, Sowing of vegetable in field, Raising nursery, hardening and transplanting of seedlings, Pruning and staking practices, Visits to vegetable farms.

**Books recommended:**

- Fordham, R. and A.G. Biggs. 1985. Principles of Vegetable Crop Production. Collins, London.
- Knot, J.E. 1987. Handbook of Vegetable Growing. Lea and Fabiger, Philadelphia.
- Bose, T.K., M.G. Som and J. Kabir. 1993. Vegetable Crops. Naya Prokash, Calcutta-Six.
- Swaider, J.M., G.W. Ware and J.P. McCollum. 1992. Producing Vegetable Crops (4<sup>th</sup> Ed.), Interstate Publishers Printers and Publishers Inc., Danville, Illinois.
- Singh, A.P. 2003. A Textbook of Vegetable Culture. Kalyani Publishers, New Delhi.

**Theory:**

Importance, present status and future scope, Raising of important annuals, Growing of flowering perennials, foliage plants, succulents and flowering bulbs with their propagation and crop management, Outdoor and indoor decoration, Flower exhibition, Flower arrangements, Concept of Bonsai.

**Practical:**

Seeding, raising and transplanting of nursery, Identification of annuals, herbaceous perennials, foliage plants, succulents and flowering bulbs with their propagation methods and management practices, Visits to ornamental nurseries, parks, cut flower shops, flower exhibitions and growing structures.

**Books recommended:**

- Arora, J.S. 2003. Introductory Ornamental Horticulture (4<sup>th</sup> Ed.). Kalyani Publishers, New Delhi.
- Larson, RA. 1980. Introduction to Floriculture. Academic Press, New York.
- Chadha, K.L and B. Choudhary. 1986. Ornamental Horticulture in India. Indian Council of Agricultural Research, New Delhi.
- Laurie, A. 2004. Floriculture: Fundamentals and Practices. McGraw Hill Book Company, New York.
- McDaniel, C.L. 1979. Ornamental Horticulture. Prentice-Hall International Inc., Reston, Virginia.
- Raj, D. 2002. Floriculture and Landscaping. Kalyani Publisher, New Delhi.

**HORT. 507 PROPAGATION AND NURSERY MANAGEMENT 4(2-4)****Theory:**

Introduction and importance, Types of horticultural nurseries, Propagation methods and their importance, Apomixis and polyembryony, Raising of stock seedlings, Pre-sowing treatments of seeds; Important nursery operations, Rootstocks for horticultural plants, Stionic interactions, Graft compatibility and incompatibility, Management practices in nursery; Use of growth regulators for propagation, Marketing of nursery plants, Concept of micropropagation.

**Practical:**

Raising of rootstocks, Identification of rootstocks for different fruit plants, Selection and preparation of bud wood, Practices in seed collection, seed treatment and propagation methods, Plant growing structures, media and mixtures, Production of certified nursery plants, Visit to germplasm units.

**Books recommended:**

- Bose, T.K., S.K. Mitra and M.K. Sadhu. 1986. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prokash, Calcutta-Six.
- Davidson, D. and R. Mecklenburg. 1981. Nursery Management; Administration and Culture. Prentice-Hall International Inc., New Jersey.
- Hartmann, H.T., D.E. Kester, E.T. Davies and R.L. Geneve. 1997. Plant Propagation—Principles and Practices (6<sup>th</sup> Ed.) Prentice-Hall International Inc., New Jersey.
- Sharma, R.R. 2002. Propagation of Horticultural Crops. Kalyani Publisher, New Delhi.

**HORT. 502****PRODUCTION OF FRUITS****4(3-2)****Theory:**

Classification of fruits, Cultivation with reference to acreage, production, botany, cultivars, rootstocks, propagation, climate, soil, cultural practices, maturity, ripening, harvesting, quality assurance and marketing of the following fruits; citrus, mango, banana, guava, date palm, apple, pear, plum, peach, apricot, almond, cherry, strawberry, walnut, loquat, grapes, ber, pome-granate, litchi, persimmon, chiku, papaya, coconut, and falsa.

**Practical:**

Practices in fruit health management, Pollination in date palm and in other commercial fruits, Cost of production, Description and identification of commercial cultivars of important fruits, Visit to research institutes and commercial orchards.

**Books recommended:**

- Bali, S.S. 2003. Fruit Growing, Kalyani Publishers, New Delhi.
- Bose, T.K. and S.K. Mitra. 1990. Fruits: Tropical and Subtropical. Naya Prokash, Calcutta-Six.
- Mitra, S.K., D.S. Rathore, and T.K. Bose. 1991. Temperate Fruits. Horticulture and Allied Publishers, Calcutta.
- Childer, N.F. 1983. Modern Fruit Science. Horticultural Publication, Gainesville, Florida.
- Samson, J.A. 1986. Tropical Fruits. Longman Scientific and Technical, Harlow, Essex.
- Westwood, M.N. 1978. Temperate Zone Pomology. W.H. Freeman and Company, San Francisco.
- Barooh, S. 1998. Modern Fruit Culture. Kalyani Publishers, New Delhi.

**Theory:**

Types of vegetable farming, Cultivation of vegetables with reference to their centers of origin, botany, cultivars, climate, soil, cultural practices, maturity indices, harvesting, grading, packing, quality assurance, marketing, production problems, important weeds, pests and diseases with their control, Off-season vegetables and mushroom growing.

**Practical:**

Practice in raising of vegetables including mushrooms, Eradication and control measures of weeds, insects and diseases, Harvesting, grading and packing of vegetables, Cost of production, Visits to vegetable farms, plastic tunnels, greenhouses and markets.

**Books recommended:**

- Bose, T.K., M.G. Som and J. Kabir. 1993. Vegetable Crops. Naya Prokash, Calcutta-Six.
- Pandey, R.K. and S.K. Ghosh. 1996. A Handbook on Mushroom Cultivation. Emkey Publications, New Delhi.
- Shanmughavelu, K.G. 1989. Production Technology of Vegetable Crops. Oxford and IBH Publishers Co. Pvt. Ltd., New Delhi.
- Swaider, J.M., G.W. Ware and J.P. McCollum. 1992. Producing Vegetable Crops (4<sup>th</sup> Ed.), Interstate Publishers Printers and Publishers Inc., Danville, Illinois.
- Das, P.C. 2003. Vegetable Crops of India. Kalyani Publisher, New Delhi.
- Ashraf, M., M.S.K. Rana and M.A. Khan. 1989. Lecture Manual on Protected Vegetable Production PARC, Islamabad.
- Singh, A.P. 2002. Vegetable Growing in India. Kalyani Publisher, New Delhi.

**Theory:**

Classification of landscape plants, Growth habits, foliage and flowering effects, Propagation and maintenance of important landscape plants, Suitability of various plants for different purposes and locations, Principles, elements and types of landscape, Establishment and maintenance of lawn and turfs.

**Practical:**

Comparative study of various landscape trees, shrubs and vines; Aesthetic study of stem, branches, leaves, flowers and fruits, Practice in the propagation of important landscape trees, shrubs, vines and palms, Visits to ornamental nurseries, parks and landscape areas.

**Books recommended:**

- Arora, J.S. 2003. Introductory Ornamental Horticulture (4<sup>th</sup> Ed.). Kalyani Publishers, New Delhi.
- Carpenter, P.L., T.D Walker and F.A. Lanphear, 1975. Plants in the Landscape. W.H. Freeman and Co., San Francisco.
- Helber, A. 1981. Ornamental Garden Shrubs. The Hamlyn Publishing Group Ltd., London.
- Raj, D. 2002. Floriculture and Landscaping. Kalyani Publishers, New Delhi.
- Ingels, J.E. 1992. Landscaping: Principles and Practices. Delmar Publishing Inc. New York.

**HORT. 508****POST-HARVEST HORTICULTURE****4(3-2)****Theory:**

Introduction and importance, Indices of crop maturity / harvesting, Curing and ripening of horticultural commodities, Packing house operations; culling, grading, washing, cleaning, colouring, waxing and packaging of important horticultural commodities, Machinery and equipment used for various operations, Packing materials and containers, Storage; principles and types, storage life and factors determining it, International standards and quality assurance, Shipment for local and foreign markets.

**Practical:**

Practices in harvesting, curing, packing and preparation of different fruits, vegetables and cut flowers for marketing, Visits to the fruit, vegetable and floral markets, packing houses and cold storages etc.

**Books Recommended:**

- Heard, N.F. and D.K. Salunkhe. 1975. Postharvest Biology and Handling of Fruits and Vegetables. The Avi Pub. Company Inc., Connecticut.
- Kader, A.A. 1992. Postharvest Technology of Horticultural Crops. University of California Press, Oakland, California.
- Mitra, S.K. 1997. Post-Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CAB International, Wallingford.
- O'Brien, M, B.F. Gargill and R.B. Findlay. 1983. Principles and Practices for Harvesting and Handling Fruits and Nuts. AVI publishing Co. Inc., Westport, Connecticut.
- Thompson, A.K. 1996. Post-Harvest Technology of Fruits and Vegetables. Blackwell Science Ltd., Oxford.
- Will, R.B.H., T.H., Lee, D. Graham, W.B. McGlasson and E.G. Hall. 1989. Post-Harvest (3<sup>rd</sup> Ed.). BSP Professional Books, Oxford.
- Pandry, P.H. 2002. Principles and Practices of Postharvest Technology. Kalyani Publishers, New Delhi.

## **HORT. 601 RESEARCH METHODS IN HORTICULTURE 4(2-4)**

### **Theory:**

Areas of research in Horticulture, Research methodology, Hypothesis and experimentation, Research parameters (morphological, physiological, biochemical, growth and yield characteristics), Sampling and data collection, Data processing, tabulation, analysis and interpretation of result, Computer application, word processing, graphics and data analysis packages.

### **Practical:**

Practices in field layout of experimental design, Sampling and data collection, *In vitro* techniques and laboratory practices in physico-chemical analyses, Use of computer (word processing, data processing and graphics) in horticultural research, Preparation of a research proposal.

### **Books recommended:**

- Redmond, W.A. 1992. Getting Started with Microsoft Windows. Version 3.1, One Microsoft Way 98052-6399 (1991-92), Microsoft Corporation, Washington.
- LeClerg, E.L, W.H. Leonard and A.G. Clark. 1962. Field Plot Techniques (2<sup>nd</sup> Ed.) Burgess Publishing Co, 426 South Street, Minneapolis, Minnesota.
- Pearce, S.C. 1976. Field Experimentation with Fruit and Other Perennial Plants. Tech. Communication No. 23. Commonwealth Bureau of Horticulture and Plantation Crops. East Malling, Kent.
- Petersen, R.G. 1994. Agricultural Field Experiments–Design and Analysis. Marcel Dekker, Inc., New York.
- Little, T.M. and F.J. Hills. 1978. Agricultural Experimentation–Design & Analysis. John Wiley and Sons, New York.

## **HORT. 603 VEGETABLE AND FLOWER SEED PRODUCTION 4(3-2)**

### **Theory:**

Principles of seed production, Seed production terminologies, Pre-basic, basic, breeder, foundation, registered and certified seed, Reproductive systems and seed production, Pure and hybrid seed production, Methods and procedures for seed production of important vegetables and flowers, Seed handling technology, Seed testing and storage, Seed certification and registration.

**Practical:**

Pollination techniques, Maintenance of self and cross pollinated lines, Methods of seed collection; Determining moisture content of the seed for storage, Seed treatments for storage, Seed testing techniques.

**Books Recommended:**

- Ashraf, M., M.S.K. Rana and M.H. Bhatti. 1988. Vegetable Seed Production. PARC, Islamabad.
- Desai, B.B., P.M. Kotecha and D.K. Salunkhe. 1997. Seeds Handbook – Biology, Production, Processing and Storage. Marcel Dekker Inc., New York.
- George, R.A.T. (1985). Vegetable Seed Production. Longman House, London.
- McDonald, M.B. and L.O. Copeland. 1998. Seed Production – Principles and Practices. CBS Publishers and Distributors, New Delhi.
- Salunkhe, D.K., B.B. Desai and N.R. Bhat. 1987. Vegetable and Flower Seed Production. Agricole Publishing Academy, New Delhi.
- Singh, A.P. 1999. Vegetable Seed Production Principles (1<sup>st</sup> Ed.). Kalyani Publisher, New Delhi.

**HORT. 605      COMMERCIAL FLOWER PRODUCTION      3(2-2)****Theory:**

Introduction, Environmental simulation, Climate and soils, propagation, crop management practices, harvesting, post harvest handling and marketing of the followings important cut flower crops; carnation chrysanthemum, roses, snapdragon, marigold, *Jasminum sambac* (motia), aster, calendula, orchids, gerbera, nemesia, pansy, stock, geranium, sweet pea, zinnia, dahlia, amaryllis, anemone, freesia, gladiolus, hyacinth, iris, lillium, daffodil (narcissus), tulip, tuberose etc.

**Practical:**

Identification, nursery raising, planting and cultural operations, harvesting and packing of important flowers for commercial production and marketing, Visit of commercial production areas and floral markets.

**Books recommended:**

- Bose, T.K. and L.P. Yadav. 1989. Commercial Flowers. Naya Prokash, Calcutta-Six.
- Salinger, J.P. 1985. Commercial Flower Growing. Butterworth Horticultural Books.
- LeGorice, E.B. 1965. Roses Growing Complete. Flow Faber and Faber, 3-Queen Square, London.
- Dole, J.M. and H.F. Wilkins. 1999. Floriculture: Principles and Species. Ball Publishing, USA.

- Yadav, I.S. and M.L. Choudhry. 1997. Progressive Floriculture—Production Technologies of Important Commercial Flower Crops. The House of Sarpan, Bangalore.
- Laurie, A. 2004. Floriculture: Fundamentals and Practices. McGraw Hill Book Company, New York.

## **HORT. 607 BREEDING OF HORTICULTURAL CROPS 4(3-2)**

### **Theory:**

Principles of plant breeding, Reproductive systems in horticultural crops, Self incompatibility and male sterility; Cytological basis of breeding, Heterosis, Theories of heterosis, Role of mutation and polyploidy in breeding, Somatic selection and chimeras, Apomixes, Breeding objective, Methods of breeding of self and cross pollinated crops, Germplasm conservation, Concept of genetic manipulation and transgenic plants.

### **Practical:**

Description of flowers of important fruits, vegetables and ornamentals. Emasculation, selfing and crossing techniques, Polyembryony tests. Pollen viability tests, Inducing polyploidy by chemicals.

### **Books recommended:**

- Eliot, E.C. 1982. Plants Breeding and Cytogenetics, McGraw Hill Book Co., New York
- Moore, J.N. and J. Janick, 1983. Methods in Fruit Breeding. Purdue University Press, West Lafayette, Indiana.
- Simmonds, N.W. 1981. Principles of Crop Improvement. Longman and Co., London.
- Bassett, M.J. 1986. Breeding Vegetable Crops. Avi Publishing Co. Inc., Westport, Connecticut.
- Singh, A.P. 2003. Vegetable Breeding and Seed Production (1<sup>st</sup> Ed.). Kalyani Publisher, New Delhi.
- Ram, H.H. 2001. Vegetable Breeding, Principles and Practices. Kalyani Publisher, New Delhi.

## **HORT. 602 INTERNSHIP IN HORTICULTURE 20(0-40)**

### **Practical:**

Study and discussion of research programmes on various horticultural crops at different national research institutes / stations, Performance of practical managerial duties, Practical demonstration of important operations in the concerned gardens, Visits of horticultural projects; study and evaluation of problems in horticultural industry; suggestions / action plans for solution, Visits to the experimental and commercial gardens, nurseries and recreational parks, Discussions with the progressive growers about

management and other relevant problems, Submission of report and oral presentation at the end of the semester.

## **HORT. 604                    SUPERVISED RESEARCH PROJECT                    4(0-8)**

### **Practical:**

Assignment of project, Consulting the relevant literature on assigned topics, Laying out of experiments in the laboratory / field; data collection, processing and report writing on the findings of assigned research proposals. The report will be evaluated by the respective supervisor / examiner(s).

### **Books Recommended:**

- Anonymous. 1999. Instructions to Authors. Amer. Soc. Hort. Sci. Alexandria, Virginia.
- Day, R.A. 1983. How to write and publish a scientific paper (2nd Ed.). ISI Press, Philadelphia.
- Sears, D.A. 1973. Harbrace Guide to the Library and the Research Paper (3<sup>rd</sup> Ed.). Horcourt Brace Javanovich Inc., New York.

## **HORT. 606                    INDOOR AND HOUSE PLANTS                    3(2-2)**

### **Theory:**

Introduction and importance of indoor plants, The indoor environment; light, temperature, humidity, oxygen and carbon dioxide, air pollutants, Cultural requirements, Production of flower and foliage plants for shade and semi-shade, Growing medium, moisture and aeration; essential nutrients and fertilizers; watering; pests and diseases, Acclimatization, Planters, Terrarium, Propagation and management practices for important indoor and house plants.

### **Practical:**

Identification of indoor and house plants. Practices in watering and fertilization, preparation of soil mixtures, potting and repotting, Diagnosis of problems and treatments. Nursery visits.

### **Books Recommended:**

- Davidson, W. 1991. House Plants. Tiger Books International, London.
- Manaker, G.H. 1981. Interior Plant Scape Installation: Maintenance and Management. Prentice-Hall Inc., New Jersey.
- Pyenson, L.L.P. 1981. Plant Health Handbook. A Guide to Better Gardening: Indoors and Outdoors. Avi Publications, Westport, Connecticut.
- Rice, L.W. and R.P. Rice. 1986. Practical Horticulture—A Guide to Growing Indoor and Outdoor Plants. Prentice-Hall, New Jersey.

- Schjenk, G. 1984. The Complete Shade Gardeners. Houghton Mifflin and Co., Boston.

## **HORT. 608**

## **GREENHOUSE CROPS**

**3(1-4)**

### **Theory:**

Introduction and economic importance, Greenhouses, plastic tunnels and other structures, Selection of location and orientation, Environment control and maintenance, Seed and nursery raising, Greenhouse crops and their cultivation, Hydroponics, Media, fertilizers, soil mixtures, containers and irrigation systems, Pruning training and staking, Insects, diseases and problem management.

### **Practical:**

Structural demonstration of greenhouses, plastic tunnels and other structures, Preparation of growing media, Tools and types of containers, Raising of crops, Visits to commercial greenhouses and plastic tunnels.

### **Books recommended:**

- Ashraf, M., M.S.K. Rana and M.A. Khan. 1989. Lecture Manual on Protected Vegetable Production. PARC, Islamabad.
- Hanan, J.J., W.D. Holley and K.J.H, Goldberryt. 1978. Greenhouse Management. Springer-Verlag, Berlin.
- Mastalerz, J.W. 1997. Greenhouse Environment. John Willey and Sons, New York.
- Nelson, P.V. 1978. Greenhouse Operation and Management. Reston Publishing Company, Inc., Virginia.

## **HORT. 610**

## **MEDICINAL AND AROMATIC PLANTS**

**3(2-2)**

### **Theory:**

Importance, origin and habitat, classification, Climatic requirements, Cultivation and production, Chemical and pharmacological properties, Products and medicinal uses, Procedures of plant collection and extraction, Processing, marketing and export potential.

### **Practical:**

Identification and description, Parts used and important ingredients, Extraction methods, Visit to various herbal institutes, "Pansari" market, Visit to herbal gardens and botanical gardens.

**Books recommended:**

- Frantisek, S, and V. Jirasek. 1981. Herbs. Hamlum, London.
- Bianchim, F.F., C. Orbetta and M. Psitolia. 1977. Kindly Fruits, Cassel and Co. Ltd. London.
- Bhattacharjee, S.K. 1999. Handbook of Medicinal Plants. Pointer Publishing Co. India.
- Joshi, S.G. 2000. Medicinal Plants. Oxford and IBH, India.
- Farooqui, M.L.H. 2000. Medicinal Plants of Prophet Muhammad (PBUH). Sidrah Publishers, Lukhnaw.
- Grieve, M. 1992. A Modern Herbal. Tiger Book International, U.K.

**HORT. 612 BUSINESS MANAGEMENT IN HORTICULTURE 3(3-0)****Theory:**

Introduction and importance of horticultural enterprise, Classified business management for fruits, vegetables and ornamental crops, Marketing channels in Pakistan, Market demand and quality control, Export prospects, International standards and product handling for export, Processing industry and marketing of value added commodities, Pricing, policy and market regulations, Global trade and Pakistan, W.T.O., Opportunities and challenges.

**Book recommended:**

- Meena, R.K. and J. Yadav. 2001. Horticulture Marketing and Post-harvest Management. Pointer Publisher, Jaipur, Rajasthan.

**SCHEME OF STUDIES  
FOR POSTGRADUATE COURSES IN HORTICULTURE**

<u>Course No.</u>	<u>Title of the course</u>	<u>Credit hours</u>
Hort. 701	Advanced Fruit Science	4(3-2)
Hort. 702	Advanced Vegetable Science	4(3-2)
Hort. 703	Vegetable Breeding	4(3-2)
Hort. 704	Fruit Breeding	4(3-2)
Hort. 705	Mineral Nutrition of Horticultural Crops	4(3-2)
Hort. 706	Plant Growth Regulators	4(3-2)
Hort. 707	Post-Harvest Physiology	4(3-2)
Hort. 708	Landscape Designs	3(2-2)
Hort. 709	Plant Tissue Culture	4(1-6)
Hort. 710	Environmental Horticulture	3(2-2)
Hort. 711	Prospective Horticultural Crops	4(3-2)
Hort. 712	Special problem	1(1-0)
Hort. 713	Seminar	1(1-0)
Hort. 714	Research and Thesis	10(0-20)

## OUTLINE OF COURSES FOR POSTGRADUATE STUDIES IN HORTICULTURE

### **Hort. 701                    ADVANCED FRUIT SCIENCE                    4(3-2)**

#### **Theory:**

Plant relations with water, nutrition, light, temperature etc, C3 and C4 plants, Pruning; principles, objectives, methods and fruiting habits, High density planting, Vegetative and reproductive physiology, Rest period and dormancy, Problems related to fruitfulness, Fruit setting and development, Commercial uses of growth substances.

#### **Practical:**

Relevant field and laboratory studies, surveys and assignments.

#### **Books Recommended:**

- Singh, A. 2003. Fruit Physiology and Production (5<sup>th</sup> Ed.). Kalyani Publishers, New Delhi.
- Gardner, V.R., F.C. Bradford and H.D. Hooker. 1957. Fundamentals of Fruit Production. McGraw Hill, New York.
- Leopold, A.C. and P.E. Kriedman. 1975. Plant Growth and Development. McGraw Hill Book Company, New York.
- Barooh, S. 1998. Modern Fruit Culture. Kalyani Publishers, New Delhi.

### **Hort. 702                    ADVANCED VEGETABLE SCIENCE                    4(3-2)**

#### **Theory:**

Introduction, Principles of crop establishment, flower induction and correlative growth in vegetables, Mechanization in vegetable production, Environmental influences on development growth and yield, Controlled environmental vegetable production, Soil-less culture and hydroponics in vegetables, Hybrid seed production and seedlessness in vegetables (watermelon, cucumber tomatoes, etc), Improvement of indigenous crops, Biotechnology, genetic engineering and germplasm conservation.

#### **Practical:**

Relevant field and laboratory studies, surveys and assignments.

#### **Books Recommended:**

- Swiader, J.M., G.W. Ware and J.P. McCollum. 1992. Producing Vegetable Crops (4<sup>th</sup> Ed.). Interstate Publisher Inc., Daniville, Illinois.
- Wein, H.C. 1997. The Physiology of Vegetable Crops. CAB. International Publications, New York.

**Theory:**

Objectives of vegetable breeding, Planning breeding programmes, Development of inbred lines, Combining ability, Exploitation of male sterility, Hybrid seed production, Breeding for diseases and stress resistance, Breeding cucurbits, solanaceous fruits, cole crops, root crops, peas, onion, lettuce, okra and spinach, Improvement of asexually propagated vegetables.

**Practical:**

Study of floral characters of self and cross-pollinated vegetables, Crossing techniques for important self-pollinated and cross pollinated vegetables, selection procedure for root crops.

**Books Recommended:**

- Bassett, M.J. 1986. Breeding Vegetable Crops. Avi. Pub. Co. Inc., Westport, Connecticut.
- Simmond, N.W. 1976. Evolution of Crop Plants. Longman Inc., New York.
- Singh, A.P. 2003. Vegetable Breeding and Seed Production. Kalyani Publishers, New Delhi.
- Ram, H.H. 2001. Vegetable Breeding-Principles and Practices. Kalyani Publishers, New Delhi.

**Theory:**

Objectives of fruit breeding, Importance of germplasm and its maintenance, Breeding techniques, Pollen and seed management, Hybridization and handling seedling population, Breeding of regionally important fruits, Breeding for disease and stress resistance, Mutation breeding.

**Practical:**

Study of floral characters of various fruits, Crossing techniques of important fruits, Selectable markers for fruit breeding, Study of different types of chimeras.

**Books Recommended:**

- Janick, J. and J.N. Moore. 1975. Advances in Fruit Breeding. Purdue Univ. Press, West Lafayette, Indiana
- Moore, G.N. and J. Janick. 1983. Methods in Fruit Breeding. Purdue Univ. Press West Lafayette, Indiana.

## **Hort. 705      MINERAL NUTRITION OF HORTICULTURAL CROPS**

**4(3-2)**

### **Theory:**

Nutrient elements in plants, Criteria of essentiality and role of mineral nutrients in plants, Requirements and plant composition, Mechanism and factors affecting absorption and translocation of nutrients, Ion interactions, Nutrient concepts, Methods for evaluation of nutrients and their application, Deficiencies and toxicities, Growth yield and quality as affected by nutrient status.

### **Practical:**

Relevant field and laboratory studies, surveys and assignments.

### **Books Recommended:**

- Devlin, R.M. and F.H. Witham. 1983. Plant Physiology (4<sup>th</sup> Ed.). Willard Grant Press, Boston.
- Marschner, H. 1995. Mineral Nutrition of Higher Plants. Academic Press, London.
- Mengel, K., and E.A. Kirkby. 1987. Principles of Plant Nutrition. International Potash, Institute, Bern, Switzerland.
- Nijjar, G.S. 1996. Nutrition of Fruit Trees. Kalyani Publisher, New Delhi.
- Kumar, D.D. 2000. Micronutrients-Their Behaviour in Soil and Plants. Kalyani Publisher, New Delhi.
- Salisbury, F.B. and C.W. Ross. 1985. Plant Physiology (2<sup>nd</sup> Ed.), Wadsworth Publishing Company. Inc.

## **Hort. 706      PLANT GROWTH REGULATORS**

**4(3-2)**

### **Theory:**

History, classification of growth regulators (PGRs); auxins, gibberellins, cytokinins and others, Biosynthetic pathways, Source sink relationship in relation to PGR, Occurrence and role of growth regulators in plants, Chemical nature of plant regulators and its relation with physiological activities, Theories of action and interactions of growth regulators, Interrelationships between growth regulators and other organic and inorganic plant substances, Applications in horticulture; growth, propagation, parthenocarpy, flower and fruit thinning, control of pre-harvest drop, fruit maturity, dormancy and storage, seed treatment and weed control, Uses in vegetable and flower nursery, Advances in PGR's.

### **Practical:**

Relevant field and Laboratory studies, surveys and assignments.

### **Books Recommended:**

- Devlin, R.M. and F.M. Witman. 1983. Plant Physiology. Willard Grant Press, Boston.

- Salisbury, F.B. and C.W. Ross. 1985. Plant Physiology (2<sup>nd</sup> Ed.), Wadsworth Publishing Company. Inc.
- Nickell, L.G. 1982. Plant Growth Regulators (Agricultural Uses). Springer-Verlag, Berlin, Heidelberg, New York.
- Wareing, P.F. and I.D.J. Phillips. 1981. Growth and Differentiation in Plants. Pergamon Press, New York.
- Wearer, R.V. 1992, Plant Growth Substances in Agriculture. W.H. Freeman Co., San Francisco.

**Hort. 707                      POST-HARVEST PHYSIOLOGY                      4(3-2)**

**Theory:**

Introduction, Pre and post-harvest factors affecting the shelf life, Perishable and non-perishable commodities, Compositional changes, Physical, chemical and biochemical processes in storage of fruits, vegetables and flowers in relations to maturation, ripening and senescence, Role of ethylene in ripening, Ethylene scrubbers, Role and regulation of environmental factors in storage, temperature, humidity, Oxygen, carbon dioxide and ethylene, Physiological and pathological disorders in storage.

**Practical:**

Relevant field and Laboratory studies, surveys and assignments.

**Books Recommended:**

- Kader, A.A. 1992. Postharvest Technology of Horticultural Crops. University of California Press, Berkley.
- Salunkhe, D.K., N.R. Bhatt and B.B. Desai. 1989. Post-Harvest Biotechnology of Flowers and Ornamental Plants. Bidhan Chandra Krishi Viswavidyalaya, Kalyani, India.
- Wills, R.B.H., T.H. Lee, D. Graham, W.B. McGlasson and E.G. Hall. 1984. Post-Harvest. The AVI Publishing Co. Inc., West Port, Connecticut.

**Hort. 708                      LANDSCAPE DESIGNS                      3(2-2)**

**Theory:**

Importance of landscape gardening and design, Principles and elements of landscape design, Landscape design materials, Types of designs; formal and informal garden designs, Chinese and Japanese gardening, Rockeries, terrace, roof and water gardens, Plants suitable for various designs, Landscape designs for public and private buildings, parks and playgrounds etc, Highway and roadside plantations, Developmental cost estimates for landscape.

**Practical:**

Visits to different parks and gardens, Landscape designs for private and community houses, schools, colleges, universities, municipal and national parks, industrial areas and roadsides; establishing various types of gardens.

**Books Recommended:**

- Arora, J.S. 1992. Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi.
- Booth, N.K. and W.H. Elsevier. 1983. Basic elements in Landscape Architecture Design. Science Publishing Co., New York.
- Khan, M.A. and T.A. Bader. 1992. Landscape Designs, Student Manual. University Printing Press, University of Agriculture, Faisalabad.
- McDaniel, G.L. 1982. Ornamental Horticulture. The Reston Publishing Company; Prentice Hall Co., Reston, Virginia.
- Raj, D. 2002. Floriculture and Landscaping. Kalyani Publisher, New Delhi.

**Hort. 709****PLANT TISSUE CULTURE****4(1-6)****Theory:**

Introduction, history and importance, Tissue culture media, Asepsis, Types of culture (organ culture, callus culture, cell suspension culture, protoplast culture), Types of regeneration (callogenesis, organogenesis and embryogenesis), Micropropagation, micrografting, Germplasm conservation, Somatic hybridization, Cytoplasmic hybridization, Genetic transformation, Somaclonal variation, Secondary plant products.

**Practical:**

Laboratory equipment and supplies, Stock solutions and media preparation, Maintenance of asepsis, Shoot-tip culture, Nodal culture, Leaf disk culture, Embryo culture, Ovule culture, Anther culture, Callus culture, Cell suspension culture, Protoplast culture, Protoplast fusion, Plantlet regeneration, *In-vitro* grafting, Production and testing of virus free plants, Transfer of plantlets from tissue culture to green house and field, Leaf disk culture for genetic transformation, Visits to tissue culture laboratories.

**Books Recommended**

- Dods, J.H. and L.W. Roberts. 1982. Experiments in Plant Tissue Culture. Cambridge University Press, London.
- Pierik, R. 1987. In Vitro Culture of Higher Plants. Martinus Nijhoff Publishers, Amsterdam.
- Evans, D.E., J.O.D. Coleman and A. Kearns. 2003. Plant Cell Culture (The Basics). BIOS Scientific Publishers, London.

- Razdan, M.K. 2004. Introduction to Plant Tissue Culture (2<sup>nd</sup> Ed.). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Chawla, H.S. 2003. Plant Biotechnology. Laboratory Manual for Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

## **Hort. 710 ENVIRONMENTAL HORTICULTURE 3(2-2)**

### **Theory:**

Introduction and importance, Pollutants and their types, Role of plants to minimize pollution, Selection of plants for various environments, Aesthetic horticulture, Plants to improve the environment; atmospheric purification, climate, surface erosion, dust, wind and noise control, Horticultural science in sociosphere, Environmental impact studies.

### **Practical:**

Identification and selection of plants for environmental control, Poster preparation for awareness, Monitoring plant health in polluted areas (industries and motor-ways etc.) and their comparison with field grown plants, Laboratory experiments, Planting for outdoor beautification, Vegetation impact on microclimate of buildings. Visits of industrial areas causing pollution.

### **Books Recommended:**

- Hussain, M. 1998. Environmental Degradation: Realities and Remedies. Feroz Sons Pvt. Ltd., Lahore.
- McKinney, M.L. and R.M. Schoch. 1998. Environmental Science: Systems and Solutions. Jones and Bartlett Pub. Inc., Sudbury.
- Robinette, G.O. 1977. Plants, People and Environmental Quality. US Department of Interior, National Park Service, Washington, DC.
- Smith, K. 1992. Environmental Hazards: Assessing Risk and Reducing Disaster. Rutledge, London.

## **Hort. 711 PROSPECTIVE HORTICULTURAL CROPS 4(3-2)**

### **Theory:**

Introduction, importance, present status and future scope, Soil and climatic requirements, propagation, cultural operations, harvesting, processing and marketing of following crops: olive, oil palm, amla, avocado, pecans, hazel nut, hickory, kiwi fruit, jack fruit, custard apple, cherimoya, currants and berries, tea, saffron, leek, celery, asparagus, broccoli and Brussel's sprout etc.

### **Practical:**

Identification of plants, their propagation, raising of nursery, management practices, harvesting and processing.



## RECOMMENDATIONS

After a comprehensive discussion the participants of the curriculum revision committee of horticulture made the following recommendations:

1. Faculty development at various universities for proper and uniform implementation of curriculum should be taken on priority.
2. Competent professionals should be inducted to overcome the shortage at various campuses, according to the need of the respective institutions.
3. Faculty recruitment should be based on well defined and transparent recruitment policy to induct only the competent and professionals with teaching aptitude.
4. In service training of the faculty members should be encouraged by the HEC in the field of horticulture inland and abroad on priority basis.
5. A uniform system of education preferably semester or term may be adopted in all the Agricultural Universities and Colleges.
6. Minimum credit hours for B.Sc. (Hons.) degree in Agriculture (Horticulture) should be uniform in all universities. A list of optional courses is also being recommended by the committee, which may be adopted by the institutions as needed.
7. In-view of the rising importance of horticultural crops, the departments of horticulture may be upgraded to the faculty of horticulture and a separate 4-year B.Sc.(Hons) Horticulture degree program should be initiated.
8. National experts in horticulture should be involved in national projects as consultant and in curriculum development as subject specialist to extend their potential.
9. HEC should arrange and supply at least two copies of each book from the list of recommended books to each university / college to strengthen the education.
10. HEC should provide adequate funds for the development of laboratories and provision of Research Journals in horticulture.

11. Faculty development programme should be established for those who hold master degrees and crossed the age limit to upgrade their qualification up to Ph.D.
12. Post Doctoral research in foreign universities / research organizations be encouraged with a special quota for scholars / teachers holding Ph.D. in horticulture from local universities.
13. HEC should arrange and finance visit of teachers to various universities / colleges in different ecological zones so that they are well informed about other universities and their research programmes.
14. Retired and experienced professionals should be included in NCRCs. Further, participation from the R&D / S&T organizations should also be ensured.
15. It has been noted that experts / faculty members invited to participate in NCRC meeting hesitate to turn up because of no proper incentives / honorarium. It is therefore suggested that in addition to TA/DA HEC should also offer honorarium to the members.