**Department of Botany**

**University of Kashmir**

**Syllabus for Undergraduate Course in Botany**

**Under Choice Based Credit System**

**5th Semester**

SEMESTER-I Core 01 Biodiversity

[Viruses, Bacteria, Fungi, Algae, Bryophytes, Pteridophytes and Gymnosperms]

SEMESTER-II Core 02 Plant Ecology and Taxonomy

SEMESTER-III Core 03 Plant Anatomy and Embryology

SEMESTER-IV Core 04 Physiology and Metabolism

SEMESTER-V DSE-01A Cell and Molecular Biology

 or

 DSE-01B Analytical Techniques

 or

 DSE-01C Plant Biochemistry

 or

 DSC-01D Fundamentals of Horticulture

SEMESTER-VI DSE-02A Economic Botany and Biotechnology

 or

 DSE-02B Genetics and Plant Breeding

 or

 DSE-02C Plant Pathology

 or

 DSC-02D Applied Horticulture

**SKILL ENHANCEMENT COURSES**

SEMESTER-III SEC-03A Ethnobotany Students have to select

SEC-03B Medicinal Botany -I Any one paper

SEC-03C Mushroom Cultivation

SEC-03D Horticulture-I

SEMESTER-IV SEC-04A Medicinal Botany -II Students have to select

 SEC-04B Biofertilizers Any one paper

SEC-04C Horticulture-II

SEMESTER-V SEC-05A Floriculture Students have to select

 SEC-05B Seed Technology-I Any one paper

SEC-5C Fruit Preservation

SEC-5D Horticulture-III

SEMESTER-VI SEC-6A Seed Technology-II Students have to select

 SEC-6B Weed Management Any one paper

SEC-6C Nursery and Gardening

SEC-6D Horticulture-IV

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| **SEMESTER** | **COURSE CODE** | **COURSE TITLE** | **CREDITS** | **TEACHING HOURS** |
| SEM-I | Core-01 | Biodiversity[Viruses, Bacteria, Fungi, Algae, Bryophytes, Pteridophytes and Gymnosperms]  | 6 credits[theory 4Practical 2] | 60 hoursor90 lectures of 40 minutes duration |
|  |
| SEM-II | Core-02 | Plant Ecology and Taxonomy | 6 credits | 60 hours |
|  |
| SEM-III | Core-03 | Plant Anatomy and Embryology | 6 credits | 60 hours |
| SEC-01ASEC-01BSEC-01CSEC-01D | EthnobotanyMedicinal Botany -IMushroom CultivationHorticulture-I**Students have to select only one paper** | 4 credits | 45 hours |
|  |
| SEM-IV | Core-04 | Physiology and Metabolism | 6 credits | 60 hours |
| SEC-04ASEC-04BSEC-04C | Medicinal Botany -IIBiofertilizersHorticulture-II**Students have to select only one paper** | 4 credits | 45 hours |
|  |
| SEM-V | DSE-01ADSE-01BDSE-01CDSE-041D | Cell and Molecular BiologyAnalytical TechniquesPlant BiochemistryFundamentals Horticulture**Students have to select only one paper** | 6 credits | 60 hours |
| SEC-05ASEC-05BSEC-05CSEC-05D | FloricultureSeed Technology-IFruit PreservationHorticulture-III**Students have to select only one paper** | 4 credits | 45 hours |
|  |
| SEM-VI | DSE-02ADSE-02BDSE-02CDSE-02D | Economic Botany and BiotechnologyGenetics and Plant BreedingPlant PathologyApplied Horticulture**Students have to select only one paper** | 6 credits | 60 hours |
| SEC-06ASEC-06BSEC-06CSEC-06D | Seed Technology-IIWeed ManagementNursery and GardeningHorticulture-IV**Students have to select only one paper** | 4 credits | 45 hours |

**Legend:** SEM-semester; DSE- Discipline Specific Elective Course; SEC- Skill Enhanced Courses

**Department of Botany**

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**Under Choice Based Credit System**

**5th Semester**

SEMESTER-V DSE-01A Cell and Molecular Biology

 or

 DSE-01B Analytical Techniques

 or

 DSE-01C Plant Biochemistry

 or

 DSC-01D Fundamentals of Horticulture

**SKILL ENHANCEMENT COURSES**

SEMESTER-V SEC-05A Floriculture Students have to select

 SEC-05B Seed Technology-I Any one paper

SEC-5C Fruit Preservation

SEC-5D Horticulture-III

**DSE-01A Cell and Molecular Biology**

**Discipline Specific Elective (DSE-01)**

**(Credits: Theory-4, Practicals-2)**

**THEORY Lectures: 60 of one-hourduration / 90 lectures of 45 minutes**

**Unit 1: Cell as a unit of Life, Cell wall and Plasma membranes (16 Hours)**

The cell theory; prokaryotic and eukaryotic cells; properties of cell; eukaryotic cell components.

Biomembranes; structure and function, fluid mosaic concept, fluidity of biomembranes;membrane proteins and their functions; carbohydrates in the plasma membrane; Faces of the membranes. Cell wall-structure and functions.

**Unit 2: Cell Organelles (20 hours)**

**Non-membranous organelles:**Structure and functions of ribosomes, centrioles and basal bodies

**Single membrane bound organelles:**endoplasmic reticulum, golgi bodies and lysosomes, peroxisomes and glyoxisomes.

**Double membrane bound organelles:**Mitochondria; structure and functions, semi-autonomous nature; endosymbiont hypothesis; mitochondrial DNA.

Chloroplast; structure and functions; semiautonomous nature, chloroplast DNA.

Nucleus: Nuclear Envelope- structure of interphase nucleus; chromatin material, euchromatin and heterochromatin, nucleolus.

**Unit 3: Cell Cycle & Genetic Material (12hours)**

Overview of Cell cycle, mitosis and meiosis.

DNA- Watson and Crick’s model, Griffith’s and Avery’s transformation experiments.

Hershey-Chase bacteriophage experiment,

DNA- structure, types, replication (Prokaryotes and eukaryotes).

**Unit 4: Gene Expression & Gene Regulation(12 hours)**

Types of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Transcription and translation in prokaryotes, genetic code.

Gene regulation in Prokaryotes:Lac operon and Tryptophan operon

**Practical**

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.

2. Study of the photomicrographs of cell organelles

3. To study the structure of plant cell through temporary mounts.

4. Study of mitosis and meiosis (temporary mounts and permanent slides).

5. Study the effect of temperature, organic solvent on semi permeable membrane.

6. Study of plasmolysis and deplasmolysisin onion peelings.

7. Study the structure of nuclear pore complex by photograph.

8. Study of special chromosomes (polytene &lampbrush) either by slides or photographs.

9. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

**Suggested Readings**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Alberts, James Watson, Dennis Bray, J. Lewis. Molecular Biology of Cell. Garland Science publishers.
6. Bruce Alberts & Lewis. Essential Cell Biology. Garland Science.
7. Watson J.D. Molecular Biology of the Gene. 7th Edition. Melno Park Calif, Benjamin/Cummings
8. Lodish*et al*. Molecular Cell Biology. W.H.Freeman and Co.
9. David E. Sadava. Cell Biology: Organelle Structure and Function.Jones and Bartlett Pub.
10. David Freifelder. Molecular Biology.

DSE-01B Discipline Specific Elective Botany

Analytical Techniques in Plant Sciences

(Credits: 06)------ 60 Lectures

Unit 1: **Microscopy 10 Lectures**

* Principle and types of microscopy
* Light Microscopy: Structure of a bright field compound microscope
* Introduction, Principle, working and application of fluorescence microscope.
* Scanning And transmission electron microscope: Principle and working; Sample preparation for Scanning Electron Microscope(SEM)

Unit 2: **Centrifugation, Spectrophotometery and Histological Techniques**. **18 lectures**

* Centrifugation and types of centrifugation
* Ultra- centrifugation: Differential and Density Gradient centrifugation, Sucrose density gradient centrifugation and CsCl2  Gradient centrifugation.
* Spectrophotometery: Principle working and applications in biological research; Atomic absoption spectrophotometery: Principle and applications
* Histological Techniques: Sample Preparations:- Fixation, Processing, dehydration, clearing, and Embedding, Sectioning, Staining: Preparation of different types of stains.

Unit 3: **Chromatography and Electrophoresis 18 lectures**

* Principle and types of chromatography
* Paper Chromatography: Solvent and mobile phase
* Thin Layer Chromatography (TLC): Applications, mobile and stationary phase.
* Column chromatography: Stationary phase, mobile phase, types of columns
* Gas Liquid Chromatography: Principle and applications, Preparation of sample, column types and detectors.
* High Performance Liquid Chromatography (HPLC); Principle and applications, Basic instrumentatation.
* Electrophoresis: Principle and Basic instrumentation, Agarose gel electrophoresis (AGE); Polyacrlamide gel electrophoresis(PAGE); Sodium dodycl sulphate (SDS- PAGE)

Unit 4: **Biostatistics 14 lectures**

Statistics: Introduction and application in biological research, Data sampling,Sampling techniques, Representation of data: Tabular and Graphical, Arithmetic mean, mode and median,Standard deviation and standard error, Chi square test

**Practicals**

1. Study of Blotting Techniques: Southern , Northern and western Blotting, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. To separate photosynthetic pigments by Paper chromatography
3. To separate sugar by thin layer chromatography
4. To separate chloroplast pigments by column chromatography.
5. Demonstration of Gel electrophoresis apparatus
6. Study of different microscopic techniques using photographs/micrographs (Freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
7. Preparation of different types of stains.
8. Preparation of permanent slides (double staining)
9. Study of various instruments( SEM, Flourescence microscope, AAS, Centrifuges, Electrophoresis apparatus) through photographs.
10. Two visits to laboratories having facility of instruments like Scanning electron microscope, Atomic Absorption spectrophotometer, Flourescence microscope, Ultracentrifuges etc.

**DSE-01C Plant Biochemistry**

**Discipline Specific Elective (DSE-03)**

**(Credits: Theory-4, Practicals-2)**

 **(Total duration 60hours)**

**Unit-IMicrobiomolecules (14 hours)**

Metabolism and its types; types and significance of chemical bonds; structure and properties of water. pH and buffers. Brief account of isomerism and polymerization in biomolecules.

Nomenclature, classification and biological significance of monosaccharides; biologically important disaccharides.

Amino acids: structure, biologically important properties and significance of amino acids.

Fatty acids: types, biologically important properties and significance of fatty acids, alcohols, sterols and steroids.

Nucleosides and nucleotides- structure, biologically important properties and significance of nucleosides, nucleotides and dinucleotides.

**Unit-II Macrobiomolecules**

Structure, types, properties and biological significance of- polysaccharides; conjugate carbohydrates; proteins; conjugate proteins; fats, oils and waxes; RNA and DNA.

**Unit-III**

Enzymes- nature, properties, classification, mechanism of action and regulation. Phytohormones – types, structure, properties, physiological roles and applications. Coenzymes- types and biological roles.

**Unit-IV**

Carbohydrate metabolism- CO2 fixation-C3, C4 and CAM pathways, photorespiratory pathway.

Glycolysis, Pentose Phosphate Pathway, TCA cycle

Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms;

Nitrogen metabolism - Biological nitrogen fixation, nitrite and nitrate reduction, nitrogen assimilation, Nitrate and ammonium assimilation; amino acid biosynthesis.

Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

**Practical:**

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion.
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Study the phenomenon of plasmolysis and deplasmolysis.
5. Study the effect of organic solvent and temperature on membrane permeability.
6. Chemical separation of photosynthetic pigments.
7. To study the effect of light intensity on the rate of photosynthesis.
8. Effect of carbon dioxide on the rate of photosynthesis.
9. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.
10. Demonstration of fluorescence by isolated chlorophyll pigments.
11. Demonstration of absorption spectrum of photosynthetic pigments.

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.

2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.

3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.

4. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning

5. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

6. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

7. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

8. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.

9. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.

10. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker’s World of the Cell, Pearson Education Inc. U.S.A. 8th edition.

11. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5thW.H.Freeman

12. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

13. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.

14. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.

15. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker’s World of the Cell, Pearson Education Inc. U.S.A. 8th edition.

16. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco

**DSE-01D Fundamentals of Horticulture (Credits: 4)**

**Unit:I 15 lectures**

* Scope and importance of horticulture with special reference of J & K, classification of horticulture crops, important temperature fruit crops grown in Kashmir.
* Area, production and productivity of rosaceous fruits in J & K with special reference to Apple, Peach, Almond and Apricot.
* Orchard layout and its types, square, rectangle, quincunx, hexagons, fencing of orchard.
* Planting techniques, traditional and high density planting, precautions during plantation of fruit crops.

**Unit: II 15 lectures**

* Propagation of fruit crops- concept of scion and rootstock, stock-scion relationship and its significance, Rootstock types- seedling and clonal rootstocks, merits and demerits.
* Techniques of generating clonal rootstocks (cutting, layering, stooling), Grafting techniques – scion and bud grafting, merits and demerits.
* Soil fertility and factors affecting fertility in horticultural crops, essential micro and macro elements and their deficiency symptoms in fruit crops.
* Role of microbes in maintaining soil fertility in horticultural crops

**Unit: III 15 lectures**

* Pollination mechanisms in major fruit crops, concept of self-incompatibility.
* Concept and role of pollinators, importance of bee keeping in enhancing crop production.
* Fruit characteristics with special reference to Apple, Almond, Cherry, Pear, Walnut, Important fruit quality traits in apple and cherry affecting marketability.
* Fruit fall – early, mid and late fruit fall vis-à-vis rosaceous fruits, causes and concerns.

**Unit: IV 15lectures**

* Major diseases, disease symptoms and management practices in apple, cherry, pear and apricot.
* Integrated pest/disease management (IPM) – biological and cultural practices.
* Factors affecting fruit set and fruit production (light and temperature), role of chilling in flowering and fruit set, chilling units for various fruits crops.
* Role of plant growth regulators in fruit production and ripening, impact of synthetic substances in fruit ripening

**Practicals (Credits = 2)**

* Study of the morphological symptoms of mineral deficiency in horticultural crops.
* Collection of soil sample from an orchard and its nutrient evaluations.
* Estimation of soil moisture content, soil pH and Soil fertility.
* Practical demonstration on drip and sprinkle irrigation.
* Field visit to study various methods of asexual propagation of a fruit plant.
* Study of characteristics of fruit with special reference to apple, pear, walnut, cherry.
* Identification of different varieties of apple based on fruit quality traits.
* Field study of bearing habit of fruit crops
* Filed visit on understanding of pruning and thinning in fruit crops
* Study of grafting techniques – scion grafting and bud grafting – practical demonstration on Apple/ Cherry plant.
* Practical demonstration of disease symptoms of apple scab, alternaria, powdery mildew and red mite, causative agent and control measures.

**Suggested Readings**

1. Adams, C.R. and M. P. Early. 2004. Principles of horticulture. Butterworth – Heinemam, Oxford University Press.
2. Bansil. P.C. 2008. Horticulture in India. CBS Publishers and Distributors, New Delhi.
3. Kumar, N.1997. Introduction to Horticulture, Rajalakshmi Publication, Nagercoil.
4. Chadha, K.L. 2001, Handbook of Horticulture, ICAR, New Delhi.
5. Chandra, R. and M. Mishra. 2003. Micropropagation of horticultural crops. International Book Distributing Co., Lucknow.
6. Chattopadhyaya, P.K.2001. A text book on Pomology (Fundamentals of fruit growing) Kalyani Publication, New Delhi.
7. Christopher, E.P. 2001. Introductory Horticulture, Biotech Books, New Delhi.
8. Edmond, J.B. T.L.Senn, F.S. Andrews and P.G.Halfacre, 1975. Fundamentals of Horticulture, Tata MC. Graw Hill Publishing Co.New Delhi.
9. George Acquaah, 2002, Horticulture-principles and practices. Prentice-Half of India pvt. Ltd., New Delhi.
10. VijaikumarUmRao. 2008. Horticulture terms – Definitions and Terminology. IBD publishers, Dehradun.
11. Genin, A. 1994. Application of Botany in Horticulture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Hartmann, H.T., D.E. Kester, F.T. Davies and R.L. Greneve. 2006 Plant Propagation. Principles and Practices. Prentice Hall of India Private Ltd., New Delhi.
13. Bose T.K.S.K. Mitra, M.K. Sadhu, B. Mitra., 2001 Propagation of tropical and subtropical horticultural crops, Naya Prakash 206, Bidhan Sarani, Calcutta, Six. India.
14. Prasad, S. and U. Kumar, 2005. Principle of Horticulture. 3rd edition, Agrobios, India.
15. Manibhushan K. Rao. 1991. Text Book of horticulture. Macmillan India Ltd., 2/10, Ansari Road, Daryaganj, New Delhi 110 002
16. Nanda, K.K and V.K. Kochhar., 1995. Vegatative propagation of plants. Kalyani publishers, New Delhi. 7. Sadhu. M.K. 1989. Plant Propagation. Wiley Eastern Ltd., 4835 / 24, Ansari Road, Daryaganj, New Delhi 110 002.

**SKILL ENHANCEMENT COURSES**

**SEC-05A Floriculture**

**(Credits -4)**

Lectures 60

**Unit-1: Landscape and Garden Designing (18 Hours)**

Principals and elements of garden landscaping. Types of gardens. Importance and scope of floriculture and landscape designing. Famous gardens of world and India.

Turf grasses-types, species, varieties, hybrids; selection of grasses for different locations; grouping according to climatic requirement and adaptation.

Lawns; establishment and maintenance, special types of gardens: roof gardening, terrace gardening, and vertical gardening.

Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, dam-sites, IT parks, corporate.

Garden plant components, arboreium, shrubbery, fernery, palmatum, arches and pergolas, edges and hedges, climbers and creepers, cacti and succulents, herbs, annuals, flower borders and beds, ground covers, carpet beds

**Unit-3: Floricultural Techniques and Nutrient Management**  **(18 hours)**

Horticultural techniques for ornamentals: Nursery raising from seeds. Seed and soil treatment; sowing techniques; planting techniques. Methods of propagation of ornamental plants in outdoor and green house. Transplant techniques. Pruning, punching and disbudding. Hardening of green house nurseries.

Breeding methods suitable for sexually and asexually propagated flower crops and ornamental. Plants-introduction; selection; domestication, polyploid and mutation breeding for varietal development. Role of heterosis; production of hybrids; male sterility.

Water and nutrient management. Organic and inorganic manures. Mulching; role of plant growth regulators. Weed management; diseases and pest management in ornamental plants.

Introduction to Bonsai; principles of bonsai; styles of bonsai; techniques in bonsai; containers, media, plants, cultivation and maintenance of bonsai.

**Unit-5: Commercial Floriculture (14 Hours)**

Commercial floriculture; eco-tourism; theme parks; indoor gardening; therapeutic gardening. Commercial production of seeds and nurseries of ornamental plants. Seed quality, packing, storage, certification and testing. Asexual propagation through rooting of soft and hard wood cutting under mist by growth regulators. Rooting of cuttings in hotbeds. Layering, Budding and grafting, selection of elite mother plants.

Scope of cut flowers in global trade. Global Scenario of cut flower production, varietal wealth and diversity, area under cut flowers and production problems in India- Patent rights; nursery management; media for nursery; special nursery practices. Cultivation of important cut flower crops (Carnations, Roses, Chrysanthemum, Peony, Gladiolus, Tulips, Dahlia, Lilies, and Orchids).

**Unit-6: Floriculture Marketing** (**10 hours)**

Harvesting techniques, post-harvest handling and grading, packing and storage. Cut flower standards and grades, harvest indices. Packaging and transportation of cut flowers. Marketing and Expert potential. Methods of prolonging vase life. Prospects of value addition, National and global scenario.

Quarantine methods: Import/export Permits. Role of Plant Quarantine in India. Pesticide Legislation in India (Brief idea) Domestic Quarantine Regulations. Plant Quarantine Facilities/stations in India

**Two Field visits /on the sport training mandatory as project assignment**

**Books recommended**

1. Prasad, S., and Kumar, U., 1998. Commercial Floriculture.
2. Bose, T.K., Yadav,L.P., Pal, P., Das, P., and Parthasarathy.V.A. , Commercial flowers, 2002: Vol. 1 & Vol.2
3. Arora, J.S., 1998. Introductory ornamental Horticulture
4. Swaroop, U., 1997, Ornamental Horticulture
5. S.K. Bhattacharjee, and L.C. De.2005. Post-harvest technology of Flowers and Ornamental Plants
6. Agarwal V.K. and Sinclair J.B., Principles of Seed Pathology, Vol. II, CRC Press, 168 (1987)

**SEC-05B Seed Technology – I**

**(Credits – 04) (60 hr.)**

**Unit 1: Seed Development & morphology**

* Seed development (sporogenesis, fertilization, embryogenesis & seed formation) in a typical dicot and monocot crop.
* Endosperm types and functions, cotyledons.
* Seed coat structure, permeability, seed dormancy and factors causing dormancy of seeds.
* Seed dispersal strategies, types of seeds; economic importance of seeds.

**Unit 2: Seed production and Processing**

* Seed as basic input in agriculture; importance of genetic purity in seed production; seed production in self and cross pollinated crops; methods of hybrid seed development; custom seed production in India.
* Seed processing: Introduction and importance; Equipments used for seed cleaning, drying, grading, destoning & gravity separating.
* Seed treatments (physical and chemical), benefits and precautions.
* Seed storage – introduction, steps, factors affecting storage; insect, rodent and bird control of storage houses.

**Unit 3: Seed germination and Vigour**

* Seed germination – introduction & types; germination requirements in agriculture and horticulture crop seeds.
* Factors affecting seed germination, role of promoters and inhibitors.
* Seed vigour – concept, factors affecting seed vigour, physiological and genetic basis of seed vigour.
* Methods of measuring seed vigour; seed & seedling vigour in relation to crop establishment and yield.

**Unit 4: Seed testing and seed certification**

* National seed testing rules and organizations; seed sampling, heterogeneity test, sample receipt and registration.
* Moisture test, tetrazolium test – principles, procedure and evaluation; methods to break seed dormancy.
* Seed certification – concept, purpose and phases of seed certification, certification agency, certified seed level, certification tag and validity period of certification.
* Seeds Act, rules & law enforcement; seed control order & seed policy; role of “**Quality Control**” for import and export of seeds.

**Suggested readings:**

1. Bhojwani SS & Bhatnagar SP. 1999. *The embryology of Angiosperm.* Vikas publications.
2. Copeland LO & McDonald MB.2001. *Principles of seed science and Technology. 4th Ed.* Chapman & Hall.
3. Agarwal RL. 1997. *Seed Technology. 2nd Ed.* Oxford & IBH.
4. Kelly AF. 1998. *Seed Production of Agricultural Crops.* Longman.
5. McDonald MB Jr & Copeland Lo. 1997. *Seed Production: Principles and Practices*. Chapman & Hall.
6. Barton LV. 1985. *Seed Preservation & Longevity*. International Books and Periodicals Supply Service. New Delhi.
7. Justice OL & Bass LN. 1978. *Principles and Practices of seed storage*. Castle House Publ. Ltd.
8. Nema NP. 1986. *Principles of Seed Certification and Testing.* AlliedPublications*.*
9. Tunwar NS & Singh SN. 1988. *Indian Minimum Seed Certification Standards*. CSCB, Ministry of Agriculture, New Delhi.

**SEC-05C Preservation of Fruits and Vegetables**

**( 4 Credits)**

**Theory Lectures: 60 Hrs.**

**UNIT 1**.

**Need and Scope for Preservation of Fruits & Vegetables:**

Concept and significance

Fruit and vegetable spoilage: Causes and consequences

Nutritional importance of fruits and vegetables

Principles and methods of fruits and vegetable preservation.

Selection of fruits and vegetables for preservation

Quality evaluation of fruit and vegetable products .

  **(14 Lectures)**

**Unit II**

**Preparation of preserved products I.**

Drying and dehydration of fruits and vegetables.

Dried Fruits and vegetables. Frozen fruits and vegetables.

Preparation of fruit candy, chutney, sauces and ketchups.

Preparation of jam, jellies,Marmalades(Apple,plum, peach).

Preparation of preserves.

FSSAI specifications of various fruit and vegetable products**.**

 **(16 lectures)**

**Unit III**

**Preparation of preserved products II.**

Tomato products-Juice, paste, puree, ketchup,cocktail.

Pickles and causes of spoilage of pickles.

Preparation of mixed vegetable pickle.

Preparation of tomato juice, sauce/ ketchup.

Preparation and preservation of apple juice

 **(14 lectures)**

**UNIT IV**

**Processing and Preservation:**

Freezing-Types of freezing.

Packing and storage of dehydrated products.

Canning and bottling of fruits and vegetables.

Containers for packing. Spoilage of canned foods.

Certified colours. banned colours.

Requirements for a small scale fruit and vegetable based processing plant.

Equipment and Products for small scale manufacture.

Medium and large sized multi-commodity processing.

 **(16 lectures)**

**References**

1. Home scale preservation of fruits and vegetables-CFTRI Lab Manual.

2. The technology of Food preservation by Desrosier.

3. Food science by N.N.Potter.

4. Fruits vegetable products by Girdhari Lal, Siddhapa & Tandon.

5. Preservation of fruits & vegetables:Girdhari lal,G.S.S.Siddapa and G.L..Tandon IARI New Delhi.

6. Fruit and vegetable preservation by Srivastava.

7. Post- harvest Technology of Fruits & Vegetables-L.R.Verma & V.K.Joshi.

8. Post- harvest management & processing of fruits and vegetables-Satish Kumar Sharma New India Publishing agency-New Delhi.

9. Food preservation principles and practices:Arti Sankhla,Renu Mogra and Kusum Babel.Agrotech Publishing Academy Udaipur- India.

**SEC-05D Horticulture-III**

**(Propagation and Management of Horticultural Crops)**

**Total Credits = 04**

**Unit-I 15 lectures**

* Horticulture- meaning, definition and scope. Horticulture crops of J&K a brief overview.
* Methods of propagation of fruit crops, types of rootstock (seedling & clonal), types & technique of grafting (scion grafting, bud grafting).
* Layering – concept, principles and applications, methods of layering; Types of cuttings - factors influencing rooting of cuttings, use of growth regulators for root initiation.
* Cultivation practices in apple, cherry, walnut (land preparation, plantation, irrigation, fertilizer application, disease management, pruning, harvesting and storage etc.)

**Unit-II 15 lectures**

* Planning, layout and management of orchards with special reference to apple crop.
* Management of tree canopy and aeration, techniques of pruning and thinning in fruit crops, advantages and disadvantages,.
* Principle and types of fruit grading, storage and packaging with special reference to apple, cherry, walnut, almond.
* Principle of fruit processing, nutritional importance of various fruits (apple, cherry, pear, apricot, walnut).

**Unit-III 15 lectures**

* Major diseases, disease symptoms and control measures (apple, cherry, apricot, almond).
* Integrated pest/disease management – Cultural practices and biological control in horticultural crops
* Pre-harvest and post harvest management of horticulture crops (care, storage, processing and disease control).
* Water management in horticulture crops– Drip irrigation & sprinkle irrigation system – concept, structure and importance.

**Unit-IV 15 lectures**

* Concept and principle of value addition in major fruit crops, suitability of various fruits for processing (Jam, Jelly, Juice, squash, fruit candy, pickles etc.).
* Organic fruit – concept, development, applications and limitations.
* Concept and importance of intercropping in fruit orchards, weed and nutrient management in orchards.
* Marketing of fruits, types of marketing, modern satellite mandies, unfair practices in fruit marketing and their implications.

**Suggested Readings**

1. Adams, C.R. and M. P. Early. 2004. Principles of horticulture. Butterworth – Heinemam, Oxford University Press.
2. Bansil. P.C. 2008. Horticulture in India. CBS Publishers and Distributors, New Delhi.
3. Kumar, N.1997. Introduction to Horticulture, Rajalakshmi Publication, Nagercoil.
4. Chadha, K.L. 2001, Handbook of Horticulture, ICAR, New Delhi.
5. Chandra, R. and M. Mishra. 2003. Micropropagation of horticultural crops. International Book Distributing Co., Lucknow.
6. Chattopadhyaya, P.K.2001. A text book on Pomology (Fundamentals of fruit growing) Kalyani Publication, New Delhi.
7. Christopher, E.P. 2001. Introductory Horticulture, Biotech Books, New Delhi.
8. Edmond, J.B. T.L.Senn, F.S. Andrews and P.G.Halfacre, 1975. Fundamentals of Horticulture, Tata MC. Graw Hill Publishing Co.New Delhi.
9. George Acquaah, 2002, Horticulture-principles and practices. Prentice-Half of India pvt. Ltd., New Delhi.
10. VijaikumarUmRao. 2008. Horticulture terms – Definitions and Terminology. IBD publishers, Dehradun.
11. Genin, A. 1994. Application of Botany in Horticulture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

**Department of Botany**

**University of Kashmir**

**Syllabus for Undergraduate Course in Botany**

**Under Choice Based Credit System**

**6th Semester**

SEMESTER-VI DSE-02A Economic Botany and Biotechnology

 or

 DSE-02B Genetics and Plant Breeding

 or

 DSE-02C Plant Pathology

 or

 DSC-02D Applied Horticulture

**SKILL ENHANCEMENT COURSES**

SEMESTER-VI SEC-6A Seed Technology-II Students have to select

 SEC-6B Weed Management Any one paper

SEC-6C Nursery and Gardening

SEC-6D Horticulture-IV

**DSE-02A Economic Botany and Biotechnology**

**(Credits: Theory – 04; Practical – 02)**

**Theory 60 – hours**

**Unit – 1: Origin of cultivated plants**

* Concept of centers of origin, their importance with reference to Vavilov’s work; crop domestication and loss of genetic diversity; importance of germplasm diversity.
* **Cereals:** Origin, morphology and uses of Wheat, Rice and Maize.
* Brief account of millets and pseudocereals.

**Unit – 2: Legumes, Spices and Sugars**

* **Legumes:** Introduction, importance to man and ecosystem with special reference to Gram, Soyabean and Kidney Bean.
* **Spices and condiments:** Introduction; systematic position, morphological features and uses of *Crocus* *sativus*; *Curcuma domestica; Syzgium aromaticum; Piper nigrum; Elettaria cardamomum* & *Bunium persicum.*
* General account of Starch and Sugars with special reference to Potato & Sugar cane.

**Unit – 3: Beverages, Oils, fibres & Medicinal plants**

* **Beverages:** Introduction; processing and uses of Tea.
* General account of Oils and Fats; extraction methods of essential oils; Systematic position and uses of Brassica, Coconut, Lavender.
* **Fibres:** Classification of fibres (Based on origin); morphology, extraction & uses of Cotton.
* **Medicinal & Narcotic Plants:** Systematic position, chemical constituents and uses of *Saussurea costus, Arnebia benthamii* & *Papaver somniferum.*

**Unit – 4: Biotechnology & Biotechnological techniques:**

* Introduction & importance of Biotechnology; brief account of planttissueculture, concept of somaclonal variation; germplasm storage (cryopreservation). Concept of restriction enzymes.
* **Cloning Vectors for recombinant DNA:** Plasmids (Ti & Ri plasmids of *Agrobacterium*), Transposons (Ac & Ds of Maize).
* **Biotechnological techniques:** Gene transfer techniques in plants, transgenic plants with special reference to Bt- Cotton & Golden rice; Blotting techniques (Northern, Southern and Western), DNA finger printing; Molecular DNA Markers (RAPD, RFLP& SNPs).
* Principle and applications of Polymerase Chain Reaction (PCR);Hybridoma& monoclonal antibodies;

**Practicals**

1. Study of economically important plants:

**Maize**, **Rice** & **Potato** – (Habit sketch, starch grains and micro-chemical tests)

1. Study the distribution of oil bodies in some oil yielding seeds – Almond, Walnut, Ground nut, Sarson.
2. Study the surface fibres (Cotton) and Bast fibres (Hemp).
3. Study the different types of spices & condiments – Saffron, Piper, Curcuma, Clove, Cardamom, Black Caraway.
4. Preparation of basic standard culture media from dry powdered media.
5. Study through photographs the 4-step and 3-step micro-propagation of plant material.
6. Study through photographs the process of DNA finger priting.
7. Study through photographs the procedures of AFLP, RFLP and SNPs.

**Suggested readings:**

1. Bhojwani, S. S. & Razdan, M. K. (1996). Plant tissue culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Chrispeels, M. J. & Sadava (2003). Plants, Genes and Agriculture. Jones and Bartlett Publishers.
3. Glick, B. R., Pasternak, J. J. (2003). Molecular Biotechnology- Principles & applications of recombinant DNA. ASM Press, Washington.
4. Kochhar, S. L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
5. Panday, B. P. (1999) Economic Botany. S. Chand and Company Ltd.
6. Sambamurthy A.V.S.S. & Sambamurthy(2000). Economic Botany of Crop Plants. Asiatech Publishers Inc.
7. Simmonds N. W. (1984). Evolution of crop plants (edited by Norman Willison Simmonds). Longman Inc., New York.

Wickens, G. E. (2001). Economic Botany- Principles & Practices. Kulwer Academic Publishers. The Netherlands.

**DSE-02B Genetics and Plant Breeding**

**Discipline Specific Elective (DSE-07)**

**(Credits: Theory-4, Practical-2)**

**THEORY Lectures: 60**

**Unit 1: Heredity (16hours)**

Mendelian principles of inheritance; modified Mendelian ratios: 2:1- lethal Genes; 1:2:1- Co- dominance, incomplete dominance; 9:7; 9:4:3; 13:3; 12:3:1 and 15:1.

Multiple allelism and pleiotropy with examples.

Quantitative inheritance: concept, monogenic vs polygenic inheritance.

**Unit 2: Genes and Chromosomes (20 hours)**

Chromosomal theory of inheritance, Chromosomal mechanisms of sex-determination and sex-linked Inheritance.

Linkage: concept; complete & incomplete linkage, Bridges experiment.

Crossing over: concept and significance.

Numerical changesin chromosomes– euploidy, aneuploidy

Structural changes - deletions, duplications, inversions &translocations.

**Unit 3: Plant Breeding: (12hours)**

Concept and conservation of germplasm.

Origin and domestication of crop plants with reference to rice and wheat, plant genetic resources.

Plant introduction, acclimatization.

Selection methods for self-pollinated, cross-pollinated and vegetatively propagated plants.

**Unit 4: Methods of crop improvement(12 hours)**

Polyploidy and distant hybridization - their role in crop improvement.

of inbreeding depression and heterosis; applications.

Inbreeding depression and heterosis - genetic basis

Hybridizationtechniques and utility in propagated plants; advantages & limitations.

Concept of point mutations, their role in crop improvement.

**Practical**

1. Mendel’s laws through seed ratios. Laboratory exercises in probability and chi-square.
2. Problems based on Mendelian ratios and non-Mendelian ratios through probability reframe and Ch—square test. – 3:1 and 9:3:3:1.
3. Chromosome mapping using point test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
7. Hybridization techniques - Emasculation, Bagging (For demonstration only).

**Suggested Readings:**

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. WileyIndia.

2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.

3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings

4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

5. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning

6. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.

7. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.

8. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

9. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.

10. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker’s World of the Cell, Pearson Education Inc. U.S.A. 8th edition.

**DSE-02C Plant Pathology**

**Credits (Theory 4 + Practicals 2)**

**Theory lectures: 60 hours.**

**Unit I**

**Introduction to Plant Pathology:** Scope and importance of plant pathology, terms used in plant pathology.

**Plant Pathogen** (General characters): Fungi, Bacteria, Nematodes, Virus, MLO’S and RLO’S.

**Plant disease:** Concept and classification of plant disease, Symptoms and identification of plant disease, Koch’s postulates.

**Parasitism and disease development:** Parasitism and pathogenicity, pathogenesis, Disease cycle**,** Inoculum, inoculation, penetration, infection, invasion and colonization, Dissemination of pathogen, by soil, water and dispersal of various categories of pathogens.

 **(20 Lectures)**

**Unit II**

**Disease development**: Factors affecting disease development, role of enzyme and toxin in disease development.

**Disease Epidemics:** Elements of disease epidemics, role of host and pathogenic factors on disease epidemics.

**Plant Disease Diagnostics:** Methods of plant disease diagnostics.

 **(10 Lectures)**

**Unit III**

**Plant Disease Management**

**Regularity methods:** Quarantine and inspections.

**Physical methods:** Soil sterilization, Hot water treatment, Hot air treatment, Radiation, Refrigeration.

**Cultural methods:** Sanitation, Ploughing, Crop rotation, mix cropping, inter cropping and Organic amendments.

**Chemical methods:** types of chemicals used for plant disease control.

**Biological control:** Fungal and bacterial antagonists as bio-agents.

 **(15 Lectures)**

**Unit IV**

**Specific Plant Diseases**

**Symptoms, causal organism, disease cycle and control of:** Late blight of Potato, Downy mildew of Onion, Powdery mildew of Cucurbits, Paddy blast, Root knot of tomato and brinjal, Alternaria leaf blight of apple, Brown rot of apple and peach, bacterial blight of rice and Potato mosaic virus disease.

 **(15 Lectures)**

**Practicals/Project Work (2 Credits)**

1. Methods of Sterilization.

2. Preparation of culture media: PDA and Richards medium.

3. Preparation of different stains used in Plant Pathology.

4. Techniques of inoculation.

5. Culturing of some Fungi such as *Rhizopus, Penicillium, Alternaria.*

6. Isolation of plant pathogens from infected tissue by tissue segment method.

7.Symptoms and studies of some local diseased plant materials through temporary/permanent mounts: Apple scab, Powdery mildew of Cucurbits, *Alternaria* leaf blight of apple and Downey mildew of Onion.

**Note: Practicals/Project Work is optional and students can opt either of the two.**

**Books recommended**

1) Plant pathology by E. J. Butler and S.G. Jones: Mac Millan & Co Ltd.

2) Plant pathology by G.N. Agrios: Elsevier.

3) Plant pathology by R.S. Singh. Oxford & IBH Publishing Co. Pvt Ltd New Delhi.

4) Plant Diseases by R.S. Singh.Oxford & IBH Publishing Co. Pvt Ltd New Delhi.

5) Plant pathology by B.P. Pandey (S.Chand).

**DSE-02D Applied Horticulture (Credits: 6)**

**Unit – I 15 lectures**

* Bearing habit of fruits trees – Central ladder system, open center system, advanced systems, alternate bearing and its implications.
* Concept, principles and methods of pruning and thinning in fruit crops –advantages and disadvantages, management of tree canopy and aeration.
* Spacing in orchard management (row to row and plant to plant), advantages and limitations.
* Concept of high-density plantation – applications and limitations.

**Unit–II 15 lectures**

* Introduction, definition and scope of post harvest technology in J&K State
* Pre-harvest and post harvest losses in fruit crops-causes and implications, methods of preventing post harvest losses.
* Different systems of storage and marketing of horticultural crops.
* Organic fruit production, its Prospects and limitations

**Unit – III 15 lectures**

* Types of fertilizers and their applications in horticultural crops, concept of bio-fertilizers and their utility.
* Types of organic manures and their applications in horticultural crops, vermi-composting and green manuring.
* Importance of irrigation at critical stages of fruit crops, effect of water stress in horticulture fruit production.
* Irrigation practices of fruit orchards, concept of drip irrigation, sprinkle irrigation – prospects and limitations. Harvesting and management of water for irrigation.

**Unit – IV 15 lectures**

* Nursery techniques and production of healthy plantation materials in temperate fruit crops (special reference to Apple, Peach, Almond and Apricot)
* Rejuvenation of old and senile orchards, factors influencing fruitfulness.
* Introduction of new exotic varieties and their impact on indigenous varieties and economy.
* Principles and applications of fruit processing; handling, processing and value addition in fruit crops (apple, cherry, peach, plum).

**Laboratory Exercise: DSE-09 (Credits=2)**

* Study of various planning and layout of an orchard.
* Training and pruning and thinning of orchard trees, canopy management.
* Field visit to local orchards for practical demonstration on various diseases and disease symptoms in horticultural crops.
* Filed visit to local fruit mandies for training on grading and packing of apple and its marketing.
* Seed identification of common vegetables and flowers.
* Seed viability test by common and TZ method.
* Identification and sample collection of common diseases and pests of fruits/vegetables
* Estimation of soil moisture content, soil pH and Soil fertility.
* Preparation of fertilizer mixtures and methods of application.
* Determination of soil fertility and soil moisture content through standard techniques.
* Practical demonstration on drip and sprinkle irrigation.
* Identification of various physiological and pathological disorders in nursery plants.
* Site visit of nearby plant propagation nurseries.
* Field visit to local green house / Net House facility
* Practical demonstration of preparation of biofertilizers/vermicompost.

**Suggested Readings**

1. Adams, C.R. and M. P. Early. 2004. Principles of horticulture. Butterworth – Heinemam, Oxford University Press.
2. Bansil. P.C. 2008. Horticulture in India. CBS Publishers and Distributors, New Delhi.
3. Kumar, N.1997. Introduction to Horticulture, Rajalakshmi Publication, Nagercoil.
4. Chadha, K.L. 2001, Handbook of Horticulture, ICAR, New Delhi.
5. Chandra, R. and M. Mishra. 2003. Micropropagation of horticultural crops. International Book Distributing Co., Lucknow.
6. Chattopadhyaya, P.K.2001. A text book on Pomology (Fundamentals of fruit growing) Kalyani Publication, New Delhi.
7. Christopher, E.P. 2001. Introductory Horticulture, Biotech Books, New Delhi.
8. Edmond, J.B. T.L.Senn, F.S. Andrews and P.G.Halfacre, 1975. Fundamentals of Horticulture, Tata MC. Graw Hill Publishing Co.New Delhi.
9. George Acquaah, 2002, Horticulture-principles and practices. Prentice-Half of India pvt. Ltd., New Delhi.
10. VijaikumarUmRao. 2008. Horticulture terms – Definitions and Terminology. IBD publishers, Dehradun.
11. Genin, A. 1994. Application of Botany in Horticulture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

**SKILL ENHANCEMENT COURSES**

**SEC-6A Seed Technology – II**

**(Credits – 04) (60hr.)**

**Unit 1: Seed Pathology**

* Introduction and importance of seed pathology.
* Brief account of seed borne fungi, bacteria, viruses and nematodes (any two examples of each group); mechanism of seed infection and transmission of seed pathogens.
* Influence of environmental factors on seed borne diseases.
* Methods of seed crop management.

**Unit 2: Seed Entomology**

* Introduction to seed entomology; economic importance and losses caused by insects.
* Study of insect, their nature of damage and management of following crops:

Paddy – *Grasshopper*

Maize – *Army* *worm*

Pea – *Pea* *pod* *borer*

Cabbage – *Caterpillar*

Tomato – *Leaf* *minor*

* Methods of insect pest control (cultural, mechanical, physical and chemical).
* Seed protectants and their impact on seed viability.

**Unit 3: Seed Farm Management**

* Scope, basic principles in seed farm management.
* Concept of various production practices, field practices as tillage, green house, irrigation, sowing, plant protection, harvesting and threshing; maintenance of soil fertility, weeds and their control.
* Crop rotation, mixed cropping, multiple cropping and dry land farming.
* Farm planning; farm surveys, data collection and analysis.

**Unit 4: Seed Marketing**

* Basic concepts of marketing; supply and demand.
* Seed transportation, storage & packing.
* Organizations for seed marketing, seed markets in India structure and working.
* Seed market surveys; seed industry in relation to global market; concept of WTO (World Trade Organization).
* Seed Quarantine: introduction, objectives and importance.

**Suggested Readings:**

1. Agarwal VK & Sinclair JB. 1997. *Principles of Seed Pathology*. Boca Raton.
2. Neergaard P. 1988. *Seed Pathology*. Mac Millan.
3. Kohls RL & Uhl JN. 1980. *Marketing of Agricultural products*. Mac Millan.
4. Karuna V. 2007. *Seed Health Testing*. Kalyani.
5. Kundu KK & Suhag KS. 2006. Teaching Manual on Seed Marketing and Management. Department of agricultural Economics CCS HAU Hisar.
6. Anonymous 1992. Legislation on Seeds. NSC Ltd. Department of agriculture & Cooperation, Ministry of agriculture, New Delhi.
7. Nema NP. 1986. *Principles of Seed Certification and Testing*. Allied Publications.

**SEC-6B Weed Management**

 **(Credits – 04) (60 hr.)**

**Unit 1: Weed biology**

* Introduction, characteristics, classification, harmful aspects; weed-crop association.
* Crop – weed competition, weeds & climate, factors that control the degree of competition.
* Weed reproduction and dispersal, seed dormancy (causes & classes), consequences of weed seed dormancy.
* Invasive weed species – introduction, identity of invasive species, why do invasions occur, consequences of plant invasions; concept of allelopathy.
* Identification of perennial weeds of crop fields, road sides, waste lands and irrigation channels; preparation of weed herbarium.

**Unit 2: Principles and practices of weed management**

* Introduction to weed prevention, control, eradication and management.
* Weed control principles & management practices in vegetable crops, orchards, grain crops, pulses & oil seeds and ornamental crops.
* Concept of integrated weed management; weed control under specific situations – intercropping system, dry lands and non cropping areas.
* Noxious farm weed, parasitic weeds and their management.
* Role of molecular biology in weed management.

**Unit 3: Methods of weed control**

* Mechanical methods (Hand-Pulling, Hand-Hoeing, Tillage, Mowing and Flooding, salt water, draining & chaining) of weed control.
* Cultural methods of weed control – crop competition, planting date and population, companion cropping, crop rotation & fertility manipulation.
* Chemical control through herbicides; introduction to herbicides, types of herbicide formulation (liquid & dry formulations, surfactants and adjuvants); herbicide – pesticide and fertilizer interactions. Residue management of herbicides.
* Impact of herbicides on crop plants, soil biota, mammals and environment.
* Weed resistance to herbicides.

**Unit 4: Biological weed control**

* Introduction, advantages & disadvantages of biological weed control
* Biological weed control agents or bioherbicides – classical or inoculative biological control insects, inundative or augmentative fungi and broad- spectrum control viz., fish, aquatic mammals & vertebrates.
* Test the viability of weed seeds (any five) by germination methods.
* Evaluate the effect of different herbicides on the seed germination of some common weeds of your area.
* Field tour and visit to experimental field and problem areas.

**Suggested readings:**

1. Fundamentals of weed science 3rd Ed.by Robert L. Zimdahl Academic Press.
2. Principles and practices of weed management by SS Rana & MC Rana2016
3. Weed management – principles and practices by OP Gupta, Agrobios Pub. (India).
4. Handbook of sustainable weed management by H. Pal Singh; D. Rani Batish & Ravinder K. Kohli, CRC Press
5. Recent Advances in Weed Management by BS Chauhan & Gulshan Mahajan. Springer, New York.
6. Weed Management by V.N. Saraswat, V.M.Bhan & N.T. Yaduraju (ICAR).
7. All about Weed control by S. Subramaniam, A. M. Ali & R. Jaykumar.

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**SEC-6C Skill Enhancement Course**

**Nursery and Gardening**

**(Credits -4)**

Lectures 60

**Unit 1:**

 Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities -Nursery raising and their transplantation

 Seed bed preparation and method of plant propagation. Handling and Maintenance of gardening equipments.

Types of soils – composition, Reaction, Soil Amendment, Pot Mixture, manures and fertilizer, organic and inorganic, Bio-fertilizer, method and time of fertilizer use. **(15 hours)**

**Unit 2:**

Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage and processing: Seed banks, factors affecting seed viability,

Seed production technology sowing, after care etc. harvesting,

Seed testing and certification.

Disease and pest management, effective and safe pest control methods,, potential hazards of some pest control techniques.

 **(15 hours)**

**Unit 3:**

Vegetative propagation: air-layering, cutting, selection of cutting, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber,

Cultivation of annual seeding, budding, cutting and layering techniques of propagation and their method.  **(15 hours)**

**Unit 4:**

Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation and nursery raising of different vegetable crops (cabbage, brinjal, lady’s finger, onion, garlic, tomatoes, and carrots), fruit crops (apple, pear, peach, plum, quince, apricot, cheery, walnut), and flowers (Carnations, Roses, Chrysanthemum, Peony, Gladiolus, Dahlia, Lilies,

Storage, packing and marketing procedures

Propagation of different types of herbs and shrubs for Hedge purpose.

**(15 hours)**

 **Suggested Readings**

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.

2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.

3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.

4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.

5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.

6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

**SEC-6D Horticulture-IV**

**Protected cultivation and Nursery management**

 **Total Credits = 06**

**Unit – I 15 lectures**

* Bearing habit of fruits trees – Central ladder system, open center system, advanced systems, alternate bearing and its implications.
* Concept, principles and methods of pruning and thinning in fruit crops –advantages and disadvantages, management of tree canopy and aeration.
* Spacing in orchard management (row to row and plant to plant), advantages and limitations.
* Concept of high-density plantation – applications and limitations.

**Unit–II 15 lectures**

* Introduction, definition and scope of post harvest technology in J&K State
* Pre-harvest and post harvest losses in fruit crops-causes and implications, methods of preventing post harvest losses.
* Different systems of storage and marketing of horticultural crops.
* Organic fruit production, its Prospects and limitations

**Unit – III 15 lectures**

* Types of fertilizers and their applications in horticultural crops, concept of bio-fertilizers and their utility.
* Types of organic manures and their applications in horticultural crops, vermi-composting and green manuring.
* Importance of irrigation at critical stages of fruit crops, effect of water stress in horticulture fruit production.
* Irrigation practices of fruit orchards, concept of drip irrigation, sprinkle irrigation – prospects and limitations. Harvesting and management of water for irrigation.

**Unit – IV 15 lectures**

* Nursery techniques and production of healthy plantation materials in temperate fruit crops (special reference to Apple, Peach, Almond and Apricot)
* Rejuvenation of old and senile orchards, factors influencing fruitfulness.
* Introduction of new exotic varieties and their impact on indigenous varieties and economy.
* Principles and applications of fruit processing; handling, processing and value addition in fruit crops (apple, cherry, peach, plum).

**Practicals**

* Study of various planning and layout of an orchard.
* Training and pruning and thinning of orchard trees, canopy management.
* Field visit to local orchards for practical demonstration on various diseases and disease symptoms in horticultural crops.
* Filed visit to local fruit mandies for training on grading and packing of apple and its marketing.
* Seed identification of common vegetables and flowers.
* Seed viability test by common and TZ method.
* Identification and sample collection of common diseases and pests of fruits/vegetables
* Estimation of soil moisture content, soil pH and Soil fertility.
* Preparation of fertilizer mixtures and methods of application.
* Determination of soil fertility and soil moisture content through standard techniques.
* Practical demonstration on drip and sprinkle irrigation.
* Identification of various physiological and pathological disorders in nursery plants.
* Site visit of nearby plant propagation nurseries.
* Field visit to local green house / Net House facility
* Practical demonstration of preparation of biofertilizers/vermicompost.

**Suggested Readings**

1. Adams, C.R. and M. P. Early. 2004. Principles of horticulture. Butterworth – Heinemam, Oxford University Press.
2. Bansil. P.C. 2008. Horticulture in India. CBS Publishers and Distributors, New Delhi.
3. Kumar, N.1997. Introduction to Horticulture, Rajalakshmi Publication, Nagercoil.
4. Chadha, K.L. 2001, Handbook of Horticulture, ICAR, New Delhi.
5. Chandra, R. and M. Mishra. 2003. Micropropagation of horticultural crops. International Book Distributing Co., Lucknow.
6. Chattopadhyaya, P.K.2001. A text book on Pomology (Fundamentals of fruit growing) Kalyani Publication, New Delhi.
7. Christopher, E.P. 2001. Introductory Horticulture, Biotech Books, New Delhi.
8. Edmond, J.B. T.L.Senn, F.S. Andrews and P.G.Halfacre, 1975. Fundamentals of Horticulture, Tata MC. Graw Hill Publishing Co.New Delhi.
9. George Acquaah, 2002, Horticulture-principles and practices. Prentice-Half of India pvt. Ltd., New Delhi.
10. VijaikumarUmRao. 2008. Horticulture terms – Definitions and Terminology. IBD publishers, Dehradun.
11. Genin, A. 1994. Application of Botany in Horticulture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.