Faculty of Agriculture Science & Technology

Department of Agriculture Science

Study and Evaluation Scheme

Of

M.Sc (Ag) Horticulture (Fruit Science)

(Applicable w.e.f Academic Session 2014-16 till revised)

AKS UNIVERSITY, SATNA

Study and Evaluation Scheme

**** The University Authorities reserve all the rights to make any additions/ deletions or changes/ modifications to this syllabus as deemed necessary**

M. Sc. (Ag)
(Two Year Master Degree Programme)
Requirement of credit hours for award of the degree

S.No	Nature of courses	Credit hours
1	Major courses	23
2	Minor courses	06
3	Supporting courses	06
4	Master Seminar	01
5	Master Research	20
	Total credits	56

Major Subject: The subject (Department/Discipline) in which a student takes admission
Minor Subject**:** The subject closely related to a student's major subject.

Supporting subject**:** The subject not related to the major subject. It could be any subject considered relevant for student's research work or necessary for building his overall competence.

Non-Credit compulsory Courses**:** Six courses (PGS 1 –PGS 6) are of general nature and are compulsory

M.Sc (Ag) Horticulture (Fruit Science)

Semester wise distribution of courses

First Semester:

A. Major Courses *			
S.No.	Course code	Title of Course	Credit Hours
1	FSC 501*	Tropical and Dry land fruit Production	2+1=3
2	FSC 504*	Canopy Management of Fruit Crop	1+1=2
3	FSC 505*	Propagation & Nursery Management for Fruit Crops	2+1=3
4	FSC 603*	Advances in Growth Regulators of Fruit Crops	2+1=3
		Total	11(7+4)
B. Minor Courses **			
1	FSC 506	Breeding of Fruit Crops	2+1=3
		Total	3(2+1)
C. Supporting Courses			
1	STAT 511	Statistical Methods in applied science	2+1=3
		Total	3(2+1)
D. Non Credit Courses			
1	PGS 502	Technical Writing & Communication Skill	N.C.
2	PGS 503	Intellectual Property & its management in Agriculture	N.C.
		Total	**17**

Second Semester:

A. Major Courses *			
S.No.	Course code	Title of Course	Credit Hours
1	FSC 502*	Sub Tropical and temperate fruit production	2+1=3
2	FSC 507*	Post harvest technology for fruit crops	2+1=3
3	FSC 508*	Growth and Development of Horticultural Crop	2+1=3
4	FSC 511*	Protected Cultivation	2+1=3
		Total	12(8+4)
B. Minor Courses **			
1	FSC 509	Biotechnology of Horticultural Crop	2+1=3
		Total	3(2+1)
C. Supporting Courses			
1	STAT 512	Experimental Design	2+1=3
		Total	
D. Non Credit Courses			
1	PGS 504	Library & Information Services	N.C.
2	PGS 501	Basic Concepts in Laboratory Techniques	N.C.
		Total	**18**

Third Semester

A. Major courses*			
S.No	**Courses Code**	**Title of Course**	**Credit hours**
1	FSC 591	Master Seminar	1(0+1)
2	FSC 599	Master's Research	10(0+10)
		Total	11 (1+10)
B. Non Credit Course**			
1	PGS 506	Disaster Management	N.C.
2	PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	N.C.
		Grand Total	

Fourth Semester

A. Major courses*			
S.No	**Courses Code**	**Title of Course**	**Credit hours**
1	FSC 599	Master's Research Seminar	10(0+10)
		Total	10(0+10)

M.Sc (Ag) Horticulture (Fruit Science)
1st Semester

Major Courses

FSC 501 TROPICAL AND DRY LAND FRUIT PRODUCTION 2+1

Objective

To impart basic knowledge about the importance and management of
Tropical and dry land fruits grown in India.

Theory

Commercial varieties of regional, national and international importance,ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bioregulators, abiotic factors limiting fruit production, physiology of flowering, pollination fruit set and development, honeybees in cross

Pollination, physiological disorders- causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques ;industrial and export potential, Agri. Export Zones (AEZ) and industrial supports. Crops

UNIT I: Mango and Banana
UNIT II: Citrus and Papaya
UNIT III: Guava, Sapota and Jackfruit
UNIT IV: Pineapple, Annonas and Avocado
UNIT V: Aonla, Pomegranate, Phalsa and Ber, minor fruits of tropics

Practical

1. Identification of important cultivars of tropical & dry land fruit crop
2 Observations on growth and development of tropical & dry land fruit crop.
3. Practices in growth regulation of tropical & dry land fruit crops.
4. Analyses of quality attributes of tropical & dry land fruit crop.
5. Project preparation for establishing commercial orchards.

Book & Reference:

Bose TK, Mitra SK & Rathore DS. (Eds.). 1988. ***Temperate Fruits -Horticulture***. Allied Publ.
Bose TK, Mitra SK & Sanyal D. 2001. (Eds.). ***Fruits -Tropical and Subtropical***. Naya Udyog.
Chadha KL & Pareek OP. 1996. (Eds.). ***Advances in Horticulture***. Vols. IIIV.
Malhotra Publ. House.
Nakasone HY & Paul RE. 1998. ***Tropical Fruits***. CABI.
Peter KV. 2008. (Ed.). ***Basics of Horticulture***. New India Publ. Agency.
Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008.
Management of Horticultural Crops. Parts I, II. New India Publ.Agency.
Radha T & Mathew L. 2007. ***Fruit Crops*****.** New India Publ. Agency.
Singh HP, Negi JP & Samuel JC. (Eds.). 2002. ***Approaches for Sustainable Development of Horticulture***. National Horticultural Board.

M.Sc (Ag) Horticulture (Fruit Science)
1st Semester

FSC 504 CANOPY MANAGEMENT IN FRUIT CROPS 1+1

Objective

To impart knowledge about the principles and practices in canopy management of fruit crops.

Theory

UNIT I

Canopy management - importance and advantages; factors affecting canopy development.

UNIT II

Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of tree canopies.

UNIT III

Spacing and utilization of land area - Canopy classification; Canopy management through rootstock and scion.

UNIT IV

Canopy management through plant growth inhibitors, training and pruning and management practices.

UNIT V

Canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruits, grapes, passion fruits, mango, sapota, guava, citrus and ber.

Practical

1. Study of different types of canopies.
2 Training of plants for different canopy types.
3. Canopy development through pruning.
4. Use of plant growth inhibitors in fruit crops.
5. Geometry of planting.
6. Study on effect of different canopy types on production and quality of fruits.

Book & Reference:

Chadha KL & Shikhamany SD. 1999. ***The Grape, Improvement, Production and Post Harvest Management***. Malhotra Publ. House.

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

M.Sc (Ag) Horticulture (Fruit Science)
1st Semester

FSC 505 PROPAGATION AND NURSERY MANAGEMENT FOR FRUIT CROPS 2+1

Objective

Familiarization with principles and practices of propagation and nursery management for fruit crops.

Theory

UNIT I

Introduction, life cycles in plants, cellular basis for propagation, sexual propagation, apomixis, polyembryony, chimeras. Principles factors influencing seed germination of horticultural crops, dormancy, hormonal regulation of germination and seedling growth.

UNIT II

Seed quality, treatment, packing, storage, certification, testing. Asexual propagation – rooting of soft and hard wood cutting under mist by growth regulators. Rooting of cuttings in hotbeds. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering – principle and methods.

UNIT III

Budding and grafting – selection of elite mother plants, methods. Establishment of bud wood bank, stock, scion and inter stock, relationship – Incompatibility. Rejuvenation through top working –Progeny orchard and scion bank.

UNIT IV

Micro-propagation – principles and concepts, commercial exploitation in horticultural crops. Techniques - *in vitro* clonal propagation, direct organogenesis, embryogenesis, micro grafting, meristem culture. Hardening, packing and transport of micro-propagules.

UNIT V

Nursery – types, structures, components, planning and layout. Nursery management practices for healthy propagule production.

Practical

1. Anatomical studies in rooting of cutting and graft union.
2. Construction of propagation structures.
3. Study of media and PGR.
4. Hardening – case studies, micro propagation, explants preparation, media preparation.
5. Visit to TC labs and nurseries.

Book & Reference:

Hartmann HT & Kester DE. 1989**.** ***Plant Propagation – Principles and Practices***.Prentice Hall of India.
Bose TK, Mitra SK & Sadhu MK. 1991. ***Propagation of Tropical and Subtropical Horticultural Crops***. Naya Prokash.
Peter KV. (Ed.). 2008. ***Basics of Horticulture***. New India Publ. Agency.
Singh SP. 1989 ***Mist Propagation***. Metropolitan Book Co.
Rajan S & Baby LM. 2007. ***Propagation of Horticultural Crops***. New IndiaPubl. Agency.
Radha T & Mathew L. 2007. ***Fruit Crops***. New India Publ. Agency.

M.Sc (Ag) Horticulture (Fruit Science)
1st Semester

FSC 603 ADVANCES IN GROWTH REGULATION OF FRUIT CROPS 2+1

Objective

Appraisal on the advances in growth regulation of fruit crops.

Theory

UNIT I

Ecophysiological influences on growth and development of fruit cropsflowering, fruit set- Crop load and assimilate partitioning and distribution.

UNIT II

Root and canopy regulation, study of plant growth regulators in fruitculture- structure, biosynthesis, metabolic and morphogenetic effects of different plant growth promoters and growth retardants.

UNIT III

Absorption, translocation and degradation of phytohormones – internal and external factors influencing hormonal synthesis, biochemical action, growth promotion and inhibition, canopy management for fertigated orchards.

UNIT IV

Growth regulation aspects of propagation, embryogenesis, seed and bud dormancy, fruit bud initiation, regulation of flowering, off season production.

UNIT V

Flower drop and thinning, fruitset and development, fruit drop, parthenocarpy, fruit maturity and ripening and storage, molecular approaches in crop growth regulation- current topics.

Practical

1. Root- shoots studies.
2. Quantifying the physiological and biochemical effects of physical and chemical growth regulation.
3. Bioassay and isolation through chromatographic analysis for auxins, gibberellins, experiments on growth regulation during propagation,
4. Dormancy, flowering, fruitset and fruit development stages.

Suggested Readings

Buchanan B, Gruiessam W & Jones R. 2002. ***Biochemistry & Molecular Biology of Plants***. John Wiley & Sons.

Epstein E. 1972. ***Mineral Nutrition of Plants: Principles and Perspectives***. Wiley.

Fosket DE. 1994. ***Plant Growth and Development: A Molecular Approach***.Academic Press.

Leoplod AC & Kriedermann PE. 1985. ***Plant Growth and Development***. 3rdEd. McGraw-Hill.

Radha T & Mathew L. 2007. ***Fruit Crops***. New India Publ. Agency.

Roberts J, Downs S & Parker P. 2002. Plant Growth Development. **In:*Plants*** (I. Ridge, Ed.), pp. 221-274, Oxford University Press.

M.Sc (Ag) Horticulture (Fruit Science)
1st Semester

Minor Courses

FSC 506 BREEDING OF FRUIT CROPS 2+1

Objective

To impart comprehensive knowledge about the principles and practices of breeding of fruit crops.

Theory

Origin and distribution, taxonomical status - species and cultivars, cytogenetics, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement - introduction, selection, hybridization, mutation breeding, polyploidy breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrust in the following selected fruit crops.

Crops

UNIT I: Mango, banana and pineapple
UNIT II: Citrus, grapes, guava and sapota
UNIT III: Jackfruit, papaya, custard apple, aonla, avocado and ber
UNIT IV: Litchi, jamun, phalsa, mulberry, raspberry, and nuts.
UNIT V**:** Apple, pear, plums, peach, apricot, cherries and strawberry

Practical

1. Characterization of germplasm, blossom biology.
2. Study of anthesis, estimating fertility status.
3. Practices in hybridization, ploidy breeding. mutation breeding,
4. Evaluation of biometrical traits and quality traits.
5. Visit to research stations working on tropical, subtropical and temperate fruit improvement

Book & Reference:

Bose TK, Mitra SK & Sanyol D. (Eds.). 2002. ***Fruits of India – Tropical and Sub-tropical***. 3rd Ed. Vols. I, II. Naya Udyog.
Chadha KL & Pareek OP. 1996. (Eds**.**)**.** ***Advances in Horticulture***. Vol. I.Malhotra Publ. House.
Chadha KL & Shikhamany SD. 1999. ***The Grape: Improvement, Production and Post-Harvest Management***. Malhotra Publ. House.
Janick J & Moore JN. 1996. ***Fruit Breeding*****.** Vols.I-III. John Wiley & Sons.
Nijjar GS. 1977. (Eds.). ***Fruit Breeding in India***. Oxford & IBH.
Radha T & Mathew L. 2007. ***Fruit Crops*****. New** India Publ. Agency.
Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. ***Advances in Citriculture*****.**
Jagmander Book Agency.

M.Sc (Ag) Horticulture (Fruit Science)
1st Semester

Supporting Courses

STAT 511 STATISTICAL METHODS FOR APPLIED SCIENCES 3(2+1)

Objective

It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, and tests of significance, regression and multivariate analytical techniques.

Theory

UNIT I

Classification, tabulation and graphical, representation of data. Box-plot, Descriptive statistics. Exploratory data analysis;

UNIT II

Measures of central tendency- Mean, Median, Mode, Geometric mean, Harmonic mean.

UNIT III

Measures of Dispersion- Range, Quartile deviation, Mean deviation, Standard deviation.

UNIT IV

Theory of probability. Random variable and mathematical expectation. Discrete and continuous probability distributions. Correlation and regression

UNIT V

Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and Fdistributions. Tests of significance based on Normal, chi-square, t and F distributions.

Practical

1. Exploratory data analysis, Box-Cox plots; fitting of distributions.
2. Binomial, Poisson, Negative Binomial, Normal; Large
3. Sample tests, testing of hypothesis based on exact sampling distributions-chi square, t and F;
4.Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution.
5. Correlation and regression analysis, fitting of orthogonal polynomial regression;
6. Applications of dimensionality reduction and discriminant function analysis.
7. Nonparametric tests.

Book & Reference:

- Anderson TW. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.
- Goon AM, Gupta MK & Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I
- Goon AM, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I.
- Hoel PG. 1971. Introduction to Mathematical Statistics. John Wiley.

M.Sc (Ag) Horticulture (Fruit Science)
1st Semester

Non Credit Courses

PGS 502: Technical Writing and Communications Skills (0+1)

Objective

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

Practical

Technical Writing Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills:

Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Book & Reference:

- English Dictionary. 1995. Harper Collins. Gordon HM & Walter JA. 1970.
- Technical Writing. 3rd Ed. Holt, Rinehart & Winston. Hornby AS. 2000. Comp.
- James HS. 1994. Handbook for Technical Writing. NTC
- Mohan K. 2005. Speaking English Effectively.
- High School English Grammar and Composition. S. Chand & Co.

M.Sc (Ag) Horticulture (Fruit Science)
1st Semester

Non Credit Courses

PGS 503 Intellectual Property and Its management in Agriculture 1(1+0)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledgebasedeconomy.

Theory

Unit I:

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs;

Unit II:

Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection;

Unit III:

Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.

Unit IV

National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture.

Unit V:

Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Book & Reference:

Erbisch FH & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI. Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill. *Intellectual Property Rights: Key to New Wealth Generation. 2001*. NRDC & Aesthetic Technologies. Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation. Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI. Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House. *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological DiversityAct, 2003.*

M.Sc (Ag) Horticulture (Fruit Science)
2nd Semester

Major Courses

FSC 502 SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION 2+1

Objective

To impart basic knowledge about the importance and management of subtropical and temperate fruits grown in India.

Theory

Commercial varieties of regional, national and international importance,ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation,bioregulation, abiotic factors limiting fruit production, physiology of flowering, fruit set and development, abiotic factors limiting production,physiological disorders-causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, precooling, storage, transportation and ripening techniques; industrial and export potential, Agri Export Zones(AEZ) and industrial support.

Crops

UNIT I: Apple, pear, grapes.
UNIT II: Plums, peach, apricot, cherries, hazelnut.
UNIT III: Litchi, loquat, persimmon, kiwifruit, strawberry.
UNIT IV: Nuts- walnut, almond, pistachio, pecan.
UNIT V: Minor fruits-carambola, bael, wood apple, fig, jamun, rambutan, pomegranate

Practical

1. Identification of important cultivars SUBTROPICAL AND TEMPERATE FRUIT.
2. Observations on growth and development of Sub tropical and Temperate Fruit..
3. Analyses of quality attributes
4. Project preparation for establishing commercial orchards.

Book & Reference:

Bose TK, Mitra SK & Sanyol D. (Ed.). 2002. ***Fruits of India – Tropical and Sub-tropical***. 3rd Ed. Vols. I, II. Naya Udyog.

Chadha KL & Pareek OP. 1996. (Eds.). ***Advances in Horticulture***. Vol. I.Malhotra Publ. House.

Chadha KL & Shikhamany SD. 1999. ***The Grape: Improvement, Production and Post-Harvest Management.*** Malhotra Publ. House.

Janick J & Moore JN. 1996. ***Fruit Breeding***. Vols.I-III. John Wiley & Sons.

Nijjar GS. 1977. (Eds.). ***Fruit Breeding in India.*** Oxford & IBH.

Radha T & Mathew L. 2007. ***Fruit Crops.*** New India Publ. Agency.

Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. ***Advances in Citriculture***. Jagmander Book Agency.

M.Sc (Ag) Horticulture (Fruit Science)
2nd Semester

FSC 507 POST HARVEST TECHNOLOGIES FOR FRUIT CROPS 2+1

Objective

To facilitate deeper understanding on principles and practices of post harvest management of fruit crops.

Theory

UNIT I

Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes, respiration, and transpiration.

UNIT II

Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling.

UNIT III

Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage ventilated, refrigerated, MAS, CA storage, physical injuries and disorders.

UNIT IV

Packing methods and transport, principles and methods of preservation, food processing, canning, fruit juices, beverages, pickles, jam, jellies,

Candies.

UNIT V

Dried and dehydrated products, nutritionally enriched products, fermented fruit beverages, packaging technology, processing waste management, food safety standards.

Practical

1. Analyzing maturity stages of commercially important horticultural crops.
2. Improved packing and storage of important horticultural commodities.
3. Physiological loss in weight of fruits and vegetables.
4. Estimation of transpiration, respiration rate, ethylene release.
5. Estimation of quality characteristics in stored fruits.
6. Cold chain management -visit to cold storage and CA storage units,
7. Visit to fruit and vegetable processing units,

Book & Reference:

Bhutani RC. 2003. *Fruit and Vegetable Preservation*. Biotech Books.

Chadha KL & Pareek OP. (Eds.). 1996 *Advances in Horticulture*. Vol. IV.
Malhotra Publ. House.

Haid NF & Salunkhe SK. 1997. *Post Harvest Physiology and Handling of Fruits and Vegetables*. Grenada Publ.

Mitra SK. 1997. *Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits*. CABI.

Ranganna S. 1997. *Hand Book of Analysis and Quality Control for Fruit and Vegetable Products*. Tata McGraw-Hill.

Sudheer KP & Indira V. 2007. *Post Harvest Technology of Horticultural Crops*. New India Publ. Agency.

M.Sc (Ag) Horticulture (Fruit Science)
2nd Semester

FSC 508 GROWTH AND DEVELOPMENT OF HORTICULTURAL CROPS 2+1

Objective

To develop understanding of growth and development of horticultural crops which have implications in their management.

Theory

UNIT I

Growth and development- definition, parameters of growth and development, growth dynamics, morphogenesis.

UNIT II

Annual, semi-perennial and perennial horticultural crops, environmental impact on growth and development, effect of light, photosynthesis and photoperiodism vernalisation, effect of temperature, heat units,thermoperiodism.

UNIT III

Assimilate partitioning during growth and development, influence of water and mineral nutrition during growth and development, biosynthesis of auxins, gibberellins, cytokinins, abscissic acid, ethylene, brasssinosteroids, growth inhibitors, morphactins, role of plant growth promoters and inhibitors.

UNIT IV

Developmental physiology and biochemistry during dormancy, bud break, juvenility, vegetative to reproductive interphase, flowering, pollination, fertilization and fruit set, fruit drop, fruit growth, ripening and seed development.

UNIT V

Growth and developmental process during stress - manipulation of growth and development, impact of pruning and training, chemical manipulations in horticultural crops, molecular and genetic approaches in plant growth development.

Practical

1. Understanding dormancy mechanisms in seeds, tubers and bulbs and stratification of seeds, tubers and bulbs.
2. Visit to arid, subtropical and temperate horticultural zones to identify growth and development patterns, techniques of growth analysis.
3. Evaluation of photosynthetic efficiency under different environments, study of growth regulator functions, hormone assays.
4. Understanding ripening phenomenon in fruits and vegetables.
5. Study of impact of physical manipulations on growth and development.
6. Study of chemical manipulations on growth and development.
7. Understanding stress impact on growth and development.

Book & Reference:

Buchanan B, Gruiessam W & Jones R. 2002. ***Biochemistry & Molecular Biology of Plants***. John Wiley & Sons.

Epstein E. 1972. ***Mineral Nutrition of Plants: Principles and Perspectives***. Wiley.

Fosket DE. 1994. ***Plant Growth and Development: a Molecular Approach.*** Academic Press.

M.Sc (Ag) Horticulture (Fruit Science)
2nd Semester

FSC 511 PROTECTED FRUIT CULTURE 2+1

Objective

Understanding the principles, theoretical aspects and developing skills in protected cultivation of fruit crops.

Theory

UNIT I

Greenhouse – World scenario, Indian situation: present and future, Different agro-climatic zones in India, Environmental factors and their effects on plant growth.

UNIT II

Basics of greenhouse design, different types of structures – glasshouse, shade net, poly tunnels - Design and development of low cost greenhousestructures.

UNIT III

Interaction of light, temperature, humidity, CO_2, water on crop regulation -Greenhouse heating, cooling, ventilation and shading.

UNIT IV

Types of ventilation- Forced cooling techniques - Glazing materials - Micro irrigation and Fertigation.

UNIT V

Automated greenhouses, microcontrollers, waste water recycling, Management of pest and diseases – IPM.

Practical

1. Designs of greenhouse, nethouse- Regulation of light, temperature, humidity in greenhouses.
3. Media for greenhouse cooling systems, ventilation systems, fertigation systems.
4. Special management practices
5 Project preparation for greenhouses, visit to greenhouses.

Book & Reference:

Aldrich RA & Bartok JW. 1994. ***Green House Engineering***. NRAES,
Riley, Robb Hall, Cornell University, Ithaca, New York.
Bhatcharjee BS. 1959. ***Rose Growing in Tropics***. Thackarspink & Co.
Laurie A, Kiplingr DD & Nelson KS. 1968. ***Commercial Flower Forcing***.McGraw-Hill.
Mears DR, Kim MK & Roberts WJ. 1971. ***Structural Analysis at an Experimental Cable-supported Air Inflated Green Houses***. Trans.ASAE.
Pant V Nelson. 1991. ***Green House Operation and Management***. Bali Publ.
Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2007.
Management of Horticultural Crops. Parts I, II. New India Publ.Agency.

M.Sc (Ag) Horticulture (Fruit Science)
2nd Semester

Minor Courses

FSC 509 BIOTECHNOLOGIES OF HORTICULTURAL CROPS 2+1

Objective

Understanding the principles, theoretical aspects and developing skills in biotechnology of horticultural crops.

Theory

UNIT I

Harnessing bio-technology in horticultural crops, influence of plant materials, physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture.

UNIT II

Callus culture – types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis.

UNIT III

Use of bioreactors and *in vitro* methods for production of secondary metabolites, suspension culture, nutrition of tissues and cells, regeneration of tissues, ex vitro, establishment of tissue cultured plants.

UNIT IV

Physiology of hardening - hardening and field transfer, organ culture –meristem, embryo, anther, ovule culture, embryo rescue, somaclonal variation, protoplast culture and fusion.

UNIT V

Construction and identification of somatic hybrids and cybrids, wide hybridization, *in vitro* pollination and fertilization, haploids, *in vitro* mutation, artificial seeds, cryopreservation, rapid clonal propagation, genetic engineering in horticulture crops, use of molecular markers. *In vitro* selection for biotic and abiotic stress, achievements of biotechnology in horticultural crops.

Practical

1. An exposure to low cost, commercial and homestead tissue culture Laboratories.
2 Media preparation, inoculation of explants for clonal propagation, callus induction and culture.
3. Regeneration of plantlets from callus, sub-culturing..
4 techniques on anther, ovule, embryo culture.
5. Somaclonal variation, *in vitro* mutant selection against abiotic stress, protoplast culture development.
6. Project development for establishment of commercial tissue culture laboratory.

Book & Reference:

Bajaj YPS. (Ed.).1989**.** ***Biotechnology in Agriculture and Forestry*****.** Vol. V,
Brown TA. 2001. ***Gene Cloning and DNA Analysis and Introduction***.Blackwell Publ.
Chopra VL & Nasim A. 1990. ***Genetic Engineering and Biotechnology – Concepts, Methods and Applications***. Oxford & IBH.
Gorden H & Rubsell S. 1960. ***Hormones and Cell Culture***. AB Book Publ.
Keshavachandran R & Peter KV. 2008. ***Plant Biotechnology: Tissue Culture and Gene Transfer***. Orient & Longman (Universal Press).

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2nd Semester

Supporting Courses

STAT 512 **EXPERIMENTAL DESIGNS** 2+1

Objective

This course is meant for students of agricultural and animal sciences other than Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT I

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

UNIT II

Uniformity trials, size and shape of plots and blocks; Analysis of variance; completely randomized design, randomized block design and Latin square design.

UNIT III

Factorial experiments, (symmetrical as well as asymmetrical). Orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT IV

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT V

Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

Practical

1. Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law;
2. Analysis of data obtained from CRD, RBD, and LSD;
3. Analysis of factorial experiments without and with confounding;
4. Analysis with missing data; Split plot and strip plot designs; Transformation of data;
5. Analysis of resolvable designs; Fitting of response surfaces.

Book & Reference:

Cochran WG & Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley. Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer. Federer WT. 1985. Experimental Designs. MacMillan. Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd. Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. Design Resources Server: www.iasri.res.in/design.

M.Sc (Ag) Horticulture (Fruit Science)
2nd Semester

Non Credit Courses

PGS 504: **Basic Concepts in Laboratory Techniques** 1(0+1)

Objective:

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical:

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

Book & Reference:

Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press. Gabb MH & Latchem WE.1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.8. FMPE 503: Testing and Evaluation of Tractors and Farm Equipment

M.Sc (Ag) Horticulture (Fruit Science)
2nd Semester

PGS 501: Library and Information Services 1(0+1)

Objective:

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical:

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

Book & Reference:

ICTBasedLibraryandInformationServices by **Akhtar Hussain** ESS ESS Publication

Foundations of Library and Information Science, Third Edition by Richard Rubin

Information Literacy Instruction: Theory and Practice, Second Edition (Information Literacy Sourcebooks) by Esther S. Grassian and Joan R. Kaplowitz (Jul 31, 2009)

PGS 505 AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.

Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.

Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.

Singh K.. 1998. *Rural Development - Principles, Policies and Management.* Sage Publ.