SYLLABUS

MASTER OF SCIENCE IN FRUIT SCIENCE

SEMESTER-I

COURSE CODE	COURSETITLE	CREDITS
MAJOR		
FSC 501	Tropical fruit production	2+1
FSC 502	Sub-Tropical and Temperate Fruit Production	2+1
FSC 503	Propagation and Nursery Management for Fruit Crops	2+1
MINOR		
PHM 503	Packaging and Storage of fresh Horticultural Produce	1+1
PHM 504	Packaging of Processed Horticultural Produce	1+1
SUPPORTING		
STAT 511	Experimental Designs	2+1
NON-CREDIT		
PGS501	Library and Information Services	0+1
PGS502	Technical Writing and Communications Skills	0+1
PGS503	Intellectual Property and its Management in Agriculture	1+0

Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Agriculture
M.Sc. (Ag.) Fruit Science

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
FSC 501	Tropical Fruit Production	50	30	00	15	05	2	1	3

1. Legends: L - Lecture**; P –** Practical
**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project /Participation in Class.

Aim of the course

To impart comprehensive knowledge to the students on cultural and management practices for growing tropical fruits.

The course is organised as follows:

No.	Blocks	Units
1	Introduction	I Importance and Background
2	Agro-Techniques	I Propagation, Planting and Orchard Floor Management
3	Crop Management	I Flowering, Fruit-Set and Harvesting

Theory

Unit I: Mango and Banana

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit II: Guava and Pineapple

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit III: Papaya and Avocado

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit IV: Jackfruit and Annonas

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit V: Aonla and Ber

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Practicals

• Distinguished features of tropical fruit species, cultivars and rootstocks (2);
• Demonstration of planting systems, training and pruning (3);
• Hands on practices on pollination and crop regulation (2);
• Leaf sampling and nutrient analysis (3);
• Physiological disorders-malady diagnosis (1);
• Physico-chemical analysis of fruit quality attributes (3);
• Field/ Exposure visits to tropical orchards (1);
• Project preparation for establishing commercial orchards (1).

Teaching Methods/ Activities

• Class room Lectures
• Laboratory/ Field Practicals
• Student Seminars/ Presentations
• Field Tours/ Demonstrations
• Assignments

Learning outcome

The students are expected to equip themselves with know-how on agro-techniques for establishment and management of an orchard leading to optimum and quality fruit production of tropical fruits.

Suggested Reading

- Bartholomew DP, Paull RE and Rohrbach KG. 2002. The Pineapple: Botany, Production, and Uses. CAB International.
- Bose TK, Mitra SK and Sanyal D. 2002. Fruits of India – Tropical and Sub-Tropical.3rd Edn. Naya Udyog, Kolkata.
- Dhillon WS. 2013. Fruit Production in India. Narendra Publ. House, New Delhi.
- Iyer CPA and Kurian RM. 2006. High Density Planting in Tropical Fruits: Principles and Practices. IBDC Publishers, New Delhi.
- Litz RE. 2009. The Mango: Botany, Production and Uses. CAB International.
- Madhawa Rao VN. 2013. Banana. ICAR, New Delhi.
- Midmore D. 2015. Principles of Tropical Horticulture. CAB International.
- Mitra SK and Sanyal D. 2013. Guava, ICAR, New Delhi.
- Morton JF. 2013. Fruits of Warm Climates. Echo Point Book Media, USA.
- Nakasome HY and Paull RE. 1998. Tropical Fruits. CAB International.
- Paull RE and Duarte O. 2011. Tropical Fruits (Vol. 1). CAB International.

- Rani S, Sharma A and Wali VK. 2018. Guava (Psidium guajava L.). Astral, New Delhi.
- Robinson JC and Saúco VG. 2010. Bananas and Plantains. CAB International.
- Sandhu S and Gill BS. 2013. Physiological Disorders of Fruit Crops. NIPA, New Delhi.
- Schaffer B, Wolstenholme BN and Whiley AW. 2013. The Avocado: Botany, Production andUses. CAB International.
- Sharma KK and Singh NP. 2011. Soil and Orchard Management. Daya Publishing House,New Delhi.
- Valavi SG, Peter KV and Thottappilly G. 2011. The Jackfruit. Stadium Press, USA.

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Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
FSC 502	Subtropical and Temperate Fruit Production	50	30	00	15	05	2	1	3

1. Legends: L - Lecture**; P –** Practical

**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course

To impart comprehensive knowledge to the students on cultural and management practices for growing subtropical and temperate fruits.

The course is organised as follows:

No.	Blocks	Units
1	Introduction	Importance and Background
2	Agro-Techniques	Propagation, Planting and Orchard Floor Management
3	Crop Management	Flowering, Fruit-Set and Harvesting

Theory

Unit I: Citrus, Grapes and Litchi

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit II: Pomegranate, Apple and Pear

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit III: Peach, Plum and Apricot

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit IV: Apricot, Cherries, Berries, Persimmon and Kiwifruit

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit V: Nuts- Walnut, Almond and Pecan

Block 1: Introduction

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block 2: Agro-techniques

Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block 3: Crop Management

Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Practicals

• Distinguished features of fruit species, cultivars and rootstocks (2);
• Demonstration of planting systems, training and pruning (3);
• Hands on practices on pollination and crop regulation (2);
• Leaf sampling and nutrient analysis (3)
• Physiological disorders-malady diagnosis (1);
• Physico-chemical analysis of fruit quality attributes (3);
• Field/ Exposure visits to subtropical and temperate orchards (1);
• Project preparation for establishing commercial orchards (1).

Teaching Methods/ Activities

• Class room Lectures
• Laboratory/ Field Practicals
• Student Seminars/ Presentations
• Field Tours/ Demonstrations
• Assignments

Learning outcome

After successful completion of the course, the student are expected to equip themselves with principles and practices of producing subtropical (citrus, grapes, litchi, pomegranate, etc.) and temperate fruits (apple, pear, peach, plum, apricot, cherries, berries, kiwifruit, etc.) and nuts (almond, walnut, pecan, etc.)

Suggested Reading

- Chadha KL and Awasthi RP. 2005. The Apple. Malhotra Publishing House, New Delhi.
- Chadha TR. 2011. A Text Book of Temperate Fruits. ICAR, New Delhi
- Childers NF, Morris JR and Sibbett GS. 1995. Modern Fruit Science: Orchard and Small Fruit Culture. Horticultural Publications, USA.
- Creasy G and Creasy L. 2018. Grapes. CAB International.
- Davies FS and Albrigo LG. 1994. Citrus. CAB International.
- Dhillon WS. 2013. Fruit Production in India. Narendra Publishing House, New Delhi.
- Jackson D, Thiele G, Looney NE and Morley-Bunker M. 2011. Temperate and Subtropical Fruit Production. CAB International.
- Ladanyia M. 2010. Citrus Fruit: Biology, Technology and Evaluation. Academic Press.
- Layne DR and Bassi D. 2008. The Peach: Botany, Production and Uses. CABI.
- Menzel CM and Waite GK. 2005. Litchi and Longan: Botany, Production and Uses. CAB International.

- Pandey RM and Randey SN. 1996. The Grape in India. ICAR, New Delhi.
- Rajput CBS, and Haribabu RS. 2006. Citriculture, Kalyani Publishers, New Delhi.
- Sandhu S and Gill BS. 2013. Physiological Disorders of Fruit Crops. NIPA, New Delhi.
- Sharma RM, Pandey SN and Pandey V. 2015. The Pear – Production, Post-harvest Management and Protection. IBDC Publisher, New Delhi.
- Sharma RR and Krishna H. 2018. Textbook of Temperate Fruits. CBS Publishers and Distributors Pvt. Ltd., New Delhi.
- Singh S, Shivshankar VJ, Srivastava AK and Singh IP. 2004. Advances in Citriculture. NIPA,New Delhi.
- Tromp J, Webster AS and Wertheim SJ. 2005. Fundamentals of Temperate Zone Tree Fruit Production. Backhuys Publishers, Lieden, The Netherlands.
- Webster A and Looney N. Cherries: Crop Physiology, Production and Uses. CABI.

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Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
FSC 503	Propagation and Nursery Management for Fruit Crops	50	30	00	15	05	2	1	3

1. Legends: L - Lecture**; P –** Practical
**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course

To understand the principles and methods of propagation and nursery management in fruit crops.

The course is organised as follows:

No.	Blocks	Units
1	Introduction	I General Concepts and Phenomena
2	Propagation	I Conventional Asexual Propagation
		II Micropropagation
3	Nursery	I Management Practices and Regulation

Theory

Unit 1: Introduction

General Concepts and Phenomena: Introduction, understanding cellular basis for propagation, sexual and asexual propagation, apomixis, polyembryony, chimeras. Factors influencing seed germination of fruit crops, dormancy, hormonal regulation of seed germination and seedling growth. Seed quality, treatment, packing, storage, certification and testing.

Unit II: Propagation

Conventional Asexual Propagation: Cutting– methods, rooting of soft and hardwood cuttings under mist and hotbeds. Use of PGR in propagation, Physiological, anatomical and biochemical aspects of root induction in cuttings.

Unit III: Propagation

Layering – principle and methods. Budding and grafting – principles and methods, establishment and management of bud wood bank. Stock, scion and inter stock relationship– graft incompatibility, physiology of rootstock and top working.

Unit IV: Micropropagation: Micro-propagation – principles and concepts, commercial exploitation in horticultural crops. Techniques – in-vitro clonal propagation, direct organogenesis, embryogenesis, micrografting, meristem culture, genetic fidelity testing. Hardening, packaging and transport of micro-propagules.

Unit V: Nursery

Management Practices and Regulation: Nursery – types, structures, components, planning

and layout. Nursery management practices for healthy propagule production. Nursery Act, nursery accreditation, import and export of seeds and planting material and quarantine.

Practical

• Hands on practices on rooting of dormant and summer cuttings (3);
• Anatomical studies in rooting of cutting and graft union(1);
• Hands on practices on various methods of budding and grafting (4);
• Propagation by layering and stooling (2);
• Micropropagation- explant preparation, media preparation, culturing – meristem tip culture, axillary bud culture, micro-grafting, hardening (4);
• Visit to commercial tissue culture laboratories and accredited nurseries (2).

Teaching Methods/ Activities

• Class room Lectures
• Laboratory/ Field Practicals
• Student Seminars/ Presentations
• Field Tours/ Demonstrations
• Assignments

Learning outcome

The student would be expected to equip to acquire skills and knowledge on principles and practices of macro and micropropagation and the handling of propagated material in nursery.

Suggested Reading

- Bose TK, Mitra SK and Sadhu MK. 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prokash, Kolkatta.
- Davies FT, Geneve RL and Wilson SB. 2018. Hartmann and Kester's Plant Propagation: Principles and Practices. Pearson, USA/ Prentice Hall of India. New Delhi.
- Gill SS, Bal JS and Sandhu AS. 2016. Raising Fruit Nursery. Kalyani Publishers, New Delhi.
- Jain S and Ishil K. 2003. Micropropagation of Woody Trees and Fruits. Springer.
- Jain S and Hoggmann H. 2007. Protocols for Micropropagation of Woody Trees and Fruits. Springer.
- Joshi P. 2015. Nursery Management of Fruit Crops in India. NIPA, New Delhi.
- Peter KV, eds. 2008. Basics of Horticulture. New India Publishing Agency, New Delhi.
- Rajan S and Baby LM. 2007. Propagation of Horticultural Crops. NIPA, New Delhi.
- Sharma RR. 2014. Propagation of Horticultural Crops. Kalyani Publishers, New Delhi.
- Sharma RR and Srivastav M. 2004. Propagation and Nursery Management. Intl. Book Publishing Co., Lucknow.

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M.Sc. (Ag.) Fruit Science

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHM 503	Packaging and Storage of fresh Horticultural Produce	50	30	00	15	05	1	1	2

1. Legends: L - Lecture**; P –** Practical
**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course

To acquaint with the different storage systems and packaging systems for perishable horticultural produce.

The course is organized as follows:

No	Blocks	Units
1	Storage systems	I. Importance of storage
		II. Different methods of storage
		III. Modified methods of storage
2	Packaging	I. Importance of packaging and packaging methods
		II. New technologies in packaging

Theory

Unit I: Storage Systems

Importance of storage of horticultural produce, present status and future scope. Principles and methods of storage – field storage structures and designs for bulk storage of horticultural produce- onion and potato, etc. Evaporative cool chambers. Physiological changes during storage.

Unit II: Refrigerated storage – principles of refrigeration, types of refrigerants, refrigeration equipments. Cold storage rooms – Calculation of refrigeration load. Storage requirements of different fruits, vegetables, flowers. Storage disorder symptoms and control.

Unit III: Controlled or modified atmosphere (CA/MA) storage – principles, uses, structures and equipments, methods and requirements. Effect of CA storage on the physiology of stored produce. Hypobaric storageprinciple, uses, and requirements. Storage disorders.

Unit IV: Packaging

Importance of packaging of fresh and processed horticultural produce, present status and future scope. Gaps in packaging concepts. Packaging requirements of fresh horticultural produce. Packaging patterns and methods. Food packaging systems: Different forms of packaging such as rigid, semi-rigid, flexible forms. Traditional, improved and specialized packages. Paper based packages: corrugated fibre board boxes – raw material and types of boxes. Flexible packaging materials – types and their properties. Consumer and intermediate flexible bulk containers. Testing of flexible packaging material. Barrier properties of packaging materials.

Unit V: New technology in packaging – stretch wrapping system, vacuum packaging, gas

packaging, controlled atmosphere (active and intelligent) packaging, vibra packaging, skin packaging, shrink packaging, formfill-seal packaging, Packaging machines.Quality control and safety aspects of packaging materials.

Practical

• Study of special storage structures for bulk storage of onion/ potato, etc.;
• Study of storage behavior of different fruits and vegetables in zero energy cool chamber;
• Determination of refrigeration requirements (capacity) for given quantity of fruits and vegetables;
• Study of storage behaviour of different fruits and vegetables in cold room;
• Study of chilling injury and storage disorders;
• Study of shelf-life of fruits and vegetables in modified atmosphere packaging. Visit to special storage structures, cold storage units. Study of types of packaging materials, types of plastic films and their properties;
• Determination of water vapour transmission rate (WVTR) and gas transmission rate (GTR) of packaging material;
• Applications of packaging material for fresh fruits and vegetables, beverages, spice products;
• Determination of shelf-life of fresh products in different types of packages;
• Study of packaging machines – vacuum packaging machine, shrink wrapping machine, double seamer, etc. Visit to packaging unit.

Teaching Methods/ Activities

• Lectures
• Assignments (Reading/ Writing)
• Exposure visits
• Student presentations
• Group Work/ seminars

Learning outcome

After successful completion of this course, the students are expected to be able to understand:

• Importance of storage of horticultural produce
• Different methods of storage
• Importance of packaging for fresh horticultural produce
• Different methods of packaging

Suggested Reading

- Ahvenainen R. 2003. Novel Food Packaging Techniques, CRC Press, ISBN 0849317894.
- Ahvenainen R. 2001. Novel Food Packaging Techniques. CRC.
- Burg SP (Ed.). 2004. Postharvest physiology and hypobaric storage of fresh produce, CABI Publishing, ISBN 0851998011.
- Chattopadhya SK. 2007. Handling, transportation and storage of fruits and vegetables. GeneTech books, New Delhi.
- Chandra GopalaRao. 2015. Engineering for Storage of Fruits and Vegetables; Academic Press, 1st Edition.
- Coles R, McDowell D and Kirwan MJ. (Eds.). 2003. Food Packaging Technology, Blackwell Publishing, ISBN 1841272213.

- Mahadevaiah M and Gowramma RV. 1996. Food packaging materials. Tata McGraw Hill.
- Painy FA. 1992. A handbook of food packaging. Blackie Academic.
- Pantastico B. 1975. Postharvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. AVI Publ.
- Robertson GL. (Ed.). 2010. Food packaging and shelf life: a practical guide CRC Press, ISBN 9781420078442.
- Thompson AK. 2010. Controlled atmosphere storage of fruits and vegetables (2nd Edition), CABI International, ISBN 9781845936464.
- Wilson CL. (Ed.). 2007. Intelligent and active packaging for fruits and vegetables, CRC Press, ISBN 9780849391668.

Websites

- Storage practices and structures UCANR http://ucanr.edu/datastoreFiles/234-1303.pdf
- Low cost storage technologies for preservation-IARI http://www.iari.res.in/download/pdf/story4_eng.pdf
- https://energypedia.info/wiki/Cold_Storage_of_Agricultural_Products

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHM 504	Packaging of Processed Horticultural Produce	50	30	00	15	05	2	1	3

1. Legends: L - Lecture**; P –** Practical
**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course
To acquaint with the different and packaging systems for processed horticultural produce.
The course is organized as follows:

No	Blocks	Units
1	Packaging principles and functions	Functions of packaging Basic principles of packaging materials Manufacture of packaging materials Types of packaging materials Testing of packaging

Theory
Block 1: Packaging principles and functions
Unit I: Functions of packaging; Type of packaging materials; Selection of packaging material for different foods; Selective properties of packaging film; Methods of packaging and packaging equipment.
Unit II: Mechanical strength of different packaging materials; Printing of packages; Barcodes and other marking; Interactions between packaging material and foods; Environmental and cost consideration in selecting packaging materials.
Unit III: Manufacture of packaging materials; Potential of biocomposite materials for food packaging; Packaging regulations; Packaging and food preservation; Disposal of packaging materials.
Unit IV: Metal cans: types, fabrication, lacquering and tin quality. Double seaming technology – defects and causes. Glass containers – types; testing quality – thermal shock resistance, thermal shock breakage, impact breakage.
Unit V: Testing of packaging; Rigid and semi rigid containers; Flexible containers; Sealing Equipment. Labeling; Aseptic and shrink packaging; Secondary and transport packaging. Different packaging systems for dehydrated foods, frozen foods, dairy foods, fresh fruits and vegetables.

Practical
• Testing of packaging material: compression strength/drop test/thermal shock test/ seam evaluation/ seam defects;
• Determination of shelf-life of processed products in different types of packages;

• Study of packaging machines – vacuum packaging machine, shrink wrapping machine, double seamer, etc.;
• Visit to packaging units.

Teaching Methods/ Activities
• Lectures
• Assignments (Reading/ Writing)
• Exposure visits
• Student presentations
• Group Discussions

Learning outcome
After successful completion of this course, the students are expected to be able to understand:
• Importance of packaging for processed horticultural produce
• Different methods of packaging, methods and their applications in food industry.

Suggested Reading

- Ahvenainen R. 2001. Novel Food Packaging Techniques. CRC
- Ahvenainen R. 2003. Novel Food Packaging Techniques, CRC Press, ISBN 0849317894.
- Coles R, McDowell D and Kirwan MJ. (Eds.) 2003. Food Packaging Technology, Blackwell Publishing, ISBN 1841272213.
- Joseph H Hotchkiss. 1987. Food and Packaging Interactions, (ACS symposium series - 365, April 5-10, 1987. American Chemical Society, Washington DC. 1988)
- Mahadevaiah M and Gowramma RV. 1996. Food packaging materials. Tata McGraw Hill.
- Painy FA. 1992. A handbook of food packaging. Blackie Academic.
- Robertson G. L. Ed. 2010. Food packaging and shelf life: a practical guide CRC Press, ISBN 9781420078442.
- Thompson AK. 2010. Controlled Atmosphere Storage of Fruits and Vegetables, CABI Publishing; 2nd revised edition.
- Wilson CL. (Ed.). 2007. Intelligent and active packaging for fruits and vegetables, CRC Press. ISBN 9780849391668.

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Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Agriculture
M.Sc. Ag. Horticulture (Fruit Science)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
STAT 511	Experimental Designs	50	30	00	15	05	2	1	3

1. Legends: L - Lecture**; P –** Practical
**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course
This course is meant for students of agricultural and animal sciences other than Agricultural 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. Concept of confounding.
Unit IV
Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications
Unit V:
Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

Practical
• Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments,
• Analysis with missing data,
• Split plot and strip plot designs.

Suggested Reading

- Cochran WG and Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. *Design and Analysis of Experiments*. Springer.
- Montgomery DC. 2012. *Design and Analysis of Experiments*, 8th Ed. John Wiley.
- Federer WT. 1985. *Experimental Designs*. MacMillan.
- Fisher RA. 1953. *Design and Analysis of Experiments*. Oliver & Boyd.
- Nigam AK and 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.
- www.drs.icar.gov.in

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M.Sc. (Ag.) Fruit Science

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PGS 501	Library and Information Services	00	00	00	60	40	0	1	1

1. Legends: L - Lecture**; P –** Practical
**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

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; e-resources access methods.

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Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PGS 502	Technical Writing and Communications Skills	00	00	00	60	40	0	1	1

1. Legends: L - Lecture**; P –** Practical
**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

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.

Suggested Readings
1. Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
2. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
3. Collins' Cobuild English Dictionary. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
5. Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
6. James HS. 1994. Handbook for Technical Writing. NTC Business Books.

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Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PGS 503	Intellectual Property and Its Management in Agriculture	00	00	00	60	40	1	0	1

1. Legends: L - Lecture**; P –** Practical
**2. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

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 knowledge based economy.

Theory
Unit I:
Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement
Unit II:
Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties
Unit III:
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 IV:
Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity
Unit V:
International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings
1. Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
2. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.

3. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.
4. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol.
V. Technology Generation and IPR Issues. Academic Foundation.
5. Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
6. Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.
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; The Biological Diversity Act, 2002.

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