

SYLLABUS
MASTER OF SCIENCE IN FRUIT SCIENCE
SEMESTER-II

COURSE CODE	COURSE TITLE	CREDITS
MAJOR		
FSC 504	Breeding of Fruit Crops	2+1
FSC 506	Canopy Management of Fruit Crops	1+1
FSC 507	Growth and Development of Fruit Crops	2+1
MINOR		
PHM 501	Postharvest Management of Horticultural Produce	2+1
PHM 505	Principles and Methods of Fruit and Vegetable Preservation	2+1
SUPPORTING		
STAT 512	Basic Sampling Techniques	2+1
NON-CREDIT		
PGS 504 (e-Course)	Basic Concepts in Laboratory Techniques	0+1
PGS 505 (e-Course)	Agricultural Research, Research Ethics and Rural Development Programmes	1+0



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
FSC 504	Breeding of 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 impart comprehensive knowledge on principles and practices of fruit breeding.

The course organisation is as under:

No.	Blocks	Units
1	Introduction	Importance, Taxonomy and Genetic Resources
2	Reproductive Biology	Blossom Biology and Breeding Systems
3	Breeding approaches	Conventional and Non-Conventional Breeding

Theory

Unit I: Mango, Banana, Pineapple and Citrus

Block 1: Introduction

Importance, Taxonomy and Genetic Resources: Introduction and importance, origin and distribution, taxonomical status – species and cultivars, cytogenetics, genetic resources.

Block 2: Reproductive Biology

Blossom Biology and Breeding Systems: Blossom biology, breeding systems – spontaneous mutations, polyploidy, incompatibility, sterility, parthenocarpy, apomixis, breeding objectives, ideotypes.

Block 3: Breeding Approaches

Conventional and Non-Conventional Breeding: Approaches for crop improvement – direct introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrusts.

Unit II: Grapes, Litchi, Guava, Pomegranate and Papaya

Block 1: Introduction

Importance, Taxonomy and Genetic Resources: Introduction and importance, origin and distribution, taxonomical status – species and cultivars, cytogenetics, genetic resources.

Block 2: Reproductive Biology

Blossom Biology and Breeding Systems: Blossom biology, breeding systems – spontaneous mutations, polyploidy, incompatibility, sterility, parthenocarpy, apomixis, breeding objectives, ideotypes.

Block 3: Breeding Approaches

Conventional and Non-Conventional Breeding: Approaches for crop improvement – direct introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrusts.

Unit III: Apple, Pear and Plum

Block 1: Introduction

Importance, Taxonomy and Genetic Resources: Introduction and importance, origin and distribution, taxonomical status – species and cultivars, cytogenetics, genetic resources.

Block 2: Reproductive Biology

Blossom Biology and Breeding Systems: Blossom biology, breeding systems – spontaneous mutations, polyploidy, incompatibility, sterility, parthenocarpy, apomixis, breeding objectives, ideotypes.

Block 3: Breeding Approaches

Conventional and Non-Conventional Breeding: Approaches for crop improvement – direct introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrusts.

Unit IV: Peach, Apricot and Cherries

Block 1: Introduction

Importance, Taxonomy and Genetic Resources: Introduction and importance, origin and distribution, taxonomical status – species and cultivars, cytogenetics, genetic resources.

Block 2: Reproductive Biology

Blossom Biology and Breeding Systems: Blossom biology, breeding systems – spontaneous mutations, polyploidy, incompatibility, sterility, parthenocarpy, apomixis, breeding objectives, ideotypes.

Block 3: Breeding Approaches

Conventional and Non-Conventional Breeding: Approaches for crop improvement – direct introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrusts.

Unit V: Strawberry, Kiwifruit and Nuts

Block 1: Introduction

Importance, Taxonomy and Genetic Resources: Introduction and importance, origin and distribution, taxonomical status – species and cultivars, cytogenetics, genetic resources.

Block 2: Reproductive Biology

Blossom Biology and Breeding Systems: Blossom biology, breeding systems – spontaneous mutations, polyploidy, incompatibility, sterility, parthenocarpy, apomixis, breeding objectives, ideotypes.

Block 3: Breeding Approaches

Conventional and Non-Conventional Breeding: Approaches for crop improvement – direct introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrusts.

Practicals

- Exercises on bearing habit, floral biology (2);
- Pollen viability and fertility studies (1);
- Hands on practices in hybridization (3);
- Raising and handling of hybrid progenies (2);
- Induction of mutations and polyploidy (2);
- Evaluation of biometrical traits and quality traits (2);
- Screening for resistance against abiotic stresses (2);
- Developing breeding programme for specific traits (2);
- Visit to research stations working on fruit breeding (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 students are expected to

- Have an understanding on importance and peculiarities of fruit breeding
- Have an updated knowledge on reproductive biology, genetics and inherent breeding systems.
- Have detailed knowledge of various methods/ approaches of breeding fruit crops

Suggested Reading

- Abraham Z. 2017. *Fruit Breeding*. Agri-Horti Press, New Delhi.
- Badenes ML and Byrne DH. 2012. *Fruit Breeding*. Springer Science, New York.
- Dinesh MR. 2015. *Fruit Breeding*, New India Publishing Agency, New Delhi.
- Ghosh SN, Verma MK and Thakur A. 2018. *Temperate Fruit Crop Breeding-Domestication to Cultivar Development*. NIPA, New Delhi.
- Hancock JF. 2008. *Temperate Fruit Crop Breeding: Germplasm to Genomics*. Springer Science, New York.
- Jain SN and Priyadarshan PM. 2009. *Breeding Plantation and Tree Crops: Tropical Species*. Springer Science, New York.
- Jain S and Priyadarshan PM. 2009. *Breeding Plantation and Tree Crops: Temperate Species*. Springer Science, New York.
- Janick J and Moore JN. 1996. *Fruit Breeding*. Vols. I–III. John Wiley & Sons, USA.
- Kumar N. 2014. *Breeding of Horticultural Crops: Principles and Practices*. NIPA, N. Delhi.
- Moore JN and Janick J. 1983. *Methods in Fruit Breeding*. Purdue University Press, USA.
- Ray PK. 2002. *Breeding Tropical and Subtropical Fruits*. Narosa Publ. House, New Delhi.

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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	
FSC 506	Canopy Management of Fruit Crops	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 impart knowledge on principles and practices in management of canopy architecture for quality fruit production.

The course organisation is as follows:

No.	Blocks	Units
1	Canopy Architecture	Introduction, types and Classification
2	Canopy Management	Physical Manipulation and Growth regulation

Theory

Unit I: Canopy Architecture

Introduction, Types and Classification: Canopy management – importance and factors affecting canopy development.

Unit II: Canopy Architecture

Canopy types and structures, canopy manipulation for optimum utilization of light and its interception. Spacing and utilization of land area – Canopy classification.

Unit III: Canopy Management

Physical Manipulation and Growth Regulation: Canopy management through rootstock and scion.

Unit IV: Canopy Management

Canopy management through plant growth regulators, training and pruning and management practices

Unit V: Canopy Management

Canopy development and management in relation to growth, flowering, fruiting and fruit quality.

Practicals

- Study of different types of canopies (2);
- Training of plants for different canopy types (2);
- Canopy development through pruning (2);
- Understanding bearing behaviour and canopy management in different fruits (2);
- Use of plant growth regulators (2);
- Geometry of planting (1);
- Development of effective canopy with support system (2);
- Study on effect of different canopy types on production and quality of fruits (2).

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 students are expected to learn

- The basic principles of canopy management to modify plant architecture
- The skills on training and pruning of fruit crops, and growth regulation

Suggested Reading

- Bakshi JC, Uppal DK and Khajuria HN. 1988. *The Pruning of Fruit Trees and Vines*. Kalyani Publishers, New Delhi.
- Chadha KL and Shikhamany SD. 1999. *The Grape, Improvement, Production and Post Harvest Management*. Malhotra Publishing House, Delhi.
- Iyer CPA and Kurian RM. 2006. *High Density Planting in Tropical Fruits: Principles and Practices*. IBDC Publishers, New Delhi.
- Pradeep kumar T. 2008. *Management of Horticultural Crops*. NIPA, New Delhi.
- Singh G. 2010. *Practical Manual on Canopy Management in Fruit Crops*. Dept. of Agriculture and Co-operation, Ministry of Agriculture (GoI), New Delhi.
- Srivastava KK. 2012. *Canopy Management in Fruits*. ICAR, New Delhi

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FSC 507	Growth and Development of 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 develop comprehensive understanding on growth and development of fruit crops.

The course is structured as under:-

No.	Blocks	Units
1	Introduction	General Concepts and Principles
2	Environment and Development	Climatic Factors, Hormones and Developmental Physiology
3	Stress Management	Strategies for Overcoming Stress

Theory

Unit I: Introduction

General Concepts and Principles: Growth and development- definition, parameters of growth and development, growth dynamics and morphogenesis.

Unit II: Environment and Development

Climatic Factors, Hormones and Developmental Physiology: Environmental impact on growth and development- effect of light, temperature, photosynthesis and photoperiodism, vernalisation, heat units and thermoperiodism.

Unit III: Environment and Development

Assimilate partitioning, influence of water and mineral nutrition in growth and development; concepts of plant hormone and bioregulators, history, biosynthesis and physiological role of auxins, gibberellins, cytokinins, abscissic acid, ethylene, growth inhibitors and retardant, brassinosteroids, other New PGRs.

Unit IV: Environment and Development

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: Stress Management

Strategies for Overcoming Stress: Growth and developmental process during stress – manipulation of growth and development, impact of pruning and training, chemical manipulations and Commercial application of PGRs in fruit crops, molecular and genetic approaches in plant growth and development.

Practicals

- Understanding dormancy mechanisms in fruit crops and seed stratification (2);
- Techniques of growth analysis (2);
- Evaluation of photosynthetic efficiency under different environments (2);
- Exercises on hormone assays (2);
- Practical on use of growth regulators (2);

- Understanding ripening phenomenon in fruits (2);
- Study on impact of physical manipulations on growth and development (1);
- Study on chemical manipulations on growth and development (1);
- Understanding stress impact on growth and development (1).

Teaching Methods/ Activities

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

Learning outcome

Consequent upon successful completion of the course, the students are expected to have

- Equipped with understanding of various growth and development processes
- Learned about the role of environment and growth substances
- Acquired the skills to realise optimum growth and development under stress conditions

Suggested Reading

- Bhatnagar P. 2017. *Physiology of Growth and Development of Horticultural Crops*. Agrobios (India).
- Buchanan B, Gruissem W and Jones R. 2002. *Biochemistry and Molecular Biology of Plants*. John Wiley & Sons, NY, USA.
- Dhillon WS and Bhatt ZA. 2011. *Fruit Tree Physiology*. Narendra Publishing House, New Delhi.
- Durner E. 2013. *Principles of Horticultural Physiology*. CAB International.
- Epstein E. 1972. *Mineral Nutrition of Plants: Principles and Perspectives*. John Wiley & Sons, NY, USA.
- Faust M. 1989. *Physiology of Temperate Zone Fruit Trees*. John Wiley & Sons, NY, USA.
- Fosket DE. 1994. *Plant Growth and Development: a Molecular Approach*. Academic Press, USA.
- Leopold AC and Kriedemann PE. 1985. *Plant Growth and Development*. 3rd Ed. McGraw-Hill, New Delhi.
- Roberts J, Downs S and Parker P. 2002. Plant Growth Development. In: Salisbury FB and Ross CW. (Eds.) *Plant Physiology*. 4th Ed. Wadsworth Publications, USA.
- Schaefer, B. and Anderson, P. 1994. *Handbook of Environmental Physiology of Fruit Crops*. Vol. 1 & 2. CRC Press. USA.
- Seymour GB, Taylor JE and Tucker GA. 1993. *Biochemistry of Fruit Ripening*. Chapman & Hall, London.

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PHM 501	Postharvest Management of 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 impart comprehensive knowledge on management of horticultural produce thus extending the post-harvest life of the produce by various treatments.

The course is organized as follows:

No	Blocks	Units
1	Postharvest management of horticultural produce	I Importance and scope II Regulation of ripening III Treatments for extending shelf life IV Handling system and marketing of horticultural crops

Theory

Block 1: Postharvest Management of Horticultural Produce

Unit I: History, Importance and scope of Postharvest technology of horticultural produce. Nature and structure of horticultural produce. Pre and Postharvest losses and their causes.

Unit II: Climacteric and non-climacteric fruits. Regulation of ripening by use of chemicals and growth regulators. Control of sprouting, rooting and discoloration in vegetables.

Unit III: Maturity indices for harvest. Harvesting and harvesting tools. Curing in roots and tubers. Prepackage Operation: Precooling, washing, sorting, grading of horticultural perishables for local markets and export. Postharvest handling of spices, plantation crops, medicinal and aromatic plants. Equipments for washing, sizing, grading.

Unit IV: Pre and Postharvest treatments for extending storage life/ vase life. VHT, irradiation treatment, skin coating, degreening, etc. Prepackaging, Packaging techniques for local market and export. Standards and specifications for fresh produce.

Unit V: Postharvest handling system for horticulture crops of regional importance. Principles of transport, modes of transportation, types of vehicles and transit requirements for different horticultural produce. Marketing: Factors influencing marketing of perishable crops, marketing systems and organizations.

Practical

- Study of maturity indices for harvest of fruits, vegetables, spices and plantation crops;
- Protective skin coating with wax emulsion and pre and Postharvest treatment with fungicides, chemicals and growth regulators to extend the shelf life of fruits and vegetables;

- Prepackaging of perishables;
- Extension of vase life of cut flowers by use of chemicals and growth regulators;
- Control of sprouting of potato and onion by using growth regulators;
- Study of modern harvesting, sorting and grading equipments;
- Study of effect of pre-cooling on shelf-life and quality of fresh fruits, vegetables and flowers;
- Visit to packaging centers;
- Visit to local markets, cooperative organizations, super markets dealing with marketing of Perishables.

Teaching Methods/ Activities

- Lectures
- Assignments (Reading/ Writing)
- Exposure visits
- Student presentation
- Group Work/ seminars

Learning outcome

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

- Regulation of ripening by use of chemicals and growth regulators
- Pre and Postharvest treatments for extending storage life/ vase life
- Standards and specifications for fresh produce

Suggested Reading

- Bhattacharjee SK and Dee LC. 2005. Postharvest technology of flowers and ornamental plants. Pointer publishers, Jaipur.
- Chattopadhyay SK. 2007. Handling, transportation and storage of fruit and vegetables. GeneTech books, New Delhi.
- FAO. 2007. Handling and Preservation of Fruits and Vegetables by Combined methods for Rural Areas-Technical Manual. FAO Agr.Ser.Bull., 149.
- Kader AA. 1992. Postharvest technology of horticultural crops. 2nd ed university of California.
- Paliyath G, Murr DP, Handa AK and Lurie S. 2008. Postharvest Biology and Technology of Fruits, Vegetables and Flowers, Wiley-Blackwell, ISBN: 9780813804088.
- Pruthi JS. 2001 (Reprint). Major spices of India crop management and Postharvest technology. ICAR, New Delhi
- Stawley J Kays. 1998. Postharvest physiology of perishable plant products. CBS publishers.
- Sudheer KP, Indira V. 2007. Postharvest Technology of Horticultural Crops, Peter K.V. (Ed.), New India Publishing Agency, ISBN 9788189422431.
- Sunil Pareek (Ed.) 2016. Postharvest Ripening Physiology of Crops, CRC Press, ISBN 9781498703802.
- Thompson AK. (Ed.) 2014. Fruit and Vegetables: Harvesting, Handling and Storage (Vol. 1 & 2) Blackwell Publishing Ltd, Oxford, UK. ISBN: 9781118654040.
- Verma LR and Joshi VK. 2000. Postharvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management. Indus Publishing Company, New Delhi,

- India. ISBN 8173871086. Wills RBH and Golding J. 2016. Postharvest: an introduction to the physiology and handling of fruit and vegetables, CABI Publishing, ISBN 9781786391483.
- Wills RBH and Golding J. 2017. Advances in Postharvest Fruit and Vegetable Technology, CRC Press, ISBN 9781138894051.

Websites:

- Horticulture-Post harvest management CSIR-NISTADS
<http://www.nistads.res.in/indiasnt2008/t6rural/t6rur13.htm>
- Post-harvest technology- MANAGE
<http://www.manage.gov.in/ftfitt/prgReports/iibr.pdf>
- Role of post-harvest management <http://www.fao.org/3/y5431e/y5431e02.html>

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		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHM 505	Principles and Methods of Fruit and Vegetable Preservation	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

Understanding spoilage, underlying principles and methods of processing of fruits and vegetables.

Learning outcome

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

- Understand Principles and different methods of preservation
- Principal spoilage organisms, food poisoning and their control measures
- Canning of fruits and vegetables
- Processing equipments and layout of processing industry

Theory

Block 1: Principles and Methods of Fruit and Vegetable Processing

Unit I: Introduction, Historical development in food processing, type of food and causes for food spoilage. Basic principles of fruits and vegetables processing;

Unit II: Thermal processing, pH classification of foods, heat resistance of microorganism; Heat resistance of enzymes in foods, Spoilage of thermal processed food; Containers – canning, rigid tin plates and cans, aluminium cans, glass containers – types; flexible packaging materials, Composite can, specification, corrosion of cans, heat penetration into containers and methods for determination of process time.

Unit III: Effects of low temperature on fresh commodities and prepared product. Freezing preservation, freezing points of foods, slow and quick freezing, Cryogenic freezing and frozen food storage. Drying and dehydration, sun drying solar dehydration, mechanical drying types of driers, osmotic dehydration.

Unit IV: Food fermentation – alcoholic, acetic and lactic fermentation. Pickling and curing; Effect of salt on food preservation, types of salt cured products. Traditional and new products; chemical preservation, SO₂, benzoic acid, sorbic acid, antioxidants and antibiotics, newer preservatives. Preservation by controlling water activity – high sugar products, intermediate moisture food, food concentration.

Unit V: Food irradiation, principles, types and sources of radiation, mode of action of ionizing radiation; radiation effect on food constituents and regulation.

Practical

- List and cost of equipment, utensils, and additives required for small scale processing industry;
- Chemical analysis for nutritive value of fresh and processed fruits and vegetables;

- Preparation and preservation of fruit based beverages and blended products from fruits and vegetables;
- Evaluation of pectin grade; preparation and quality evaluation of fruit jam;
- Preparation of papain;
- Blanching and its effects on enzyme;
- Preparation of dehydrated vegetables;
- Study of different types of spoilages in fresh as well as processed horticultural produce;
- Study of biochemical changes and enzymes associated with spoilage;
- Sensory evaluation of fresh and processed fruits and vegetables;
- Visit to processing units.

Teaching Methods/ Activities

- Lecture
- Assignment (Reading/ Writing)
- Exposure visits
- Student presentation
- Group Work

Suggested Reading

- Barret DM, Somogyi LP and Ramaswamy H. Eds. 2005. Processing Fruits: Science and Technology (2nd Edition), CRC Press, ISBN 9780849314780.
- FAO. 2007. Handling and Preservation of Fruits and Vegetables by Combined Methods for Rural Areas- Technical Manual. FAO Agricultural Services Bulletin 149.
- Fellows PJ. 2009. Food Processing Technology: Principles and Practice (3rd Edition), Woodhead Publishing, ISBN 9781845692162.
- Lal G, Siddappa GS and Tandon GL. 1998. Preservation of Fruits and Vegetables. ICAR, ISBN 9788171640904.
- Ramaswamy H and Marcotte M. 2006. Food Processing: Principles and Applications. Taylor & Francis.
- Salunkhe DK and Kadam SS. 1995. Handbook of Fruit Science and Technology: Production, Composition and Processing. Marcel Dekker.
- Srivastava RP and Kumar S. 2014. Fruit and Vegetable Preservation: Principles and Practices (3rd Edition), CBS Publishing, ISBN 9788123924373.
- Verma LR and Joshi VK. 2000. Postharvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management. Indus Publishing Company, New Delhi, India. ISBN 8173871086.

Websites

- <http://agriinfo.in/default.aspx?page=topic&superid=2&topicid=2065>
- <http://www.fao.org/docrep/x0209e/x0209e02.htm>
- http://www.cstaricalcutta.gov.in/images/CTS%20Fruits_and_Vegetables%20NSQF.pdf

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STAT 512	Basic Sampling Techniques	50	30	0	15	5	2	1	3

Legends: L - Lecture; P – Practical;

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

Objective

This course is meant for students of agricultural and animal sciences other than Statistics. The students would be exposed to elementary sampling techniques. It would help them in understanding the concepts involved in planning and designing their surveys, presentation of survey data analysis of survey data and presentation of results. This course would be especially important to the students of social sciences.

Theory

Unit I

Concept of sampling, sample survey vs complete enumeration, planning of sample survey.

Unit II

Sampling from a finite population. Simple random sampling with and without replacement, sampling for proportion.

Unit III

Determination of sample size; inverse sampling, Stratified sampling. Cluster sampling,

Unit IV

Multi-stage sampling, double sampling, systematic sampling; Introduction to PPS sampling, Use of auxiliary information at estimation.

Unit V

Ratio product and regression estimators. Double Sampling, sampling and non-sampling errors

Practical

- Random sampling ~ use of random number tables, concepts of unbiasedness, variance, etc.;
- Simple random sampling, determination of sample size, inverse sampling, stratified sampling, cluster sampling and systematic sampling;
- Estimation using ratio and regression estimators;
- Estimation using multistage design, double sampling.

Suggested Readings

- Cochran WG. 1977. Sampling Techniques. John Wiley.
- Murthy MN. 1977. Sampling Theory and Methods. 2nd Ed. Statistical Publ. Soc., Calcutta.
- Singh D, Singh P & Kumar P. 1982. Handbook on Sampling Methods. IASRI Publ.
- Sukhatme PV, Sukhatme BV, Sukhatme S & Asok C. 1984. Sampling Theory of Surveys with Applications. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.
- Cochran WG. 2007. Sampling Techniques, 3rd Edition. John Wiley & Sons Publication

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PGS 504 (e-Course)	Basic Concepts in Laboratory Techniques	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 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 agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation 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

Suggested Readings

- Furr AK. 2000. *CRC HandBook of Laboratory Safety*. CRC Press.
- Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

(Prof. Vinod Dhar)
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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
PGS 505 (e-Course)	Agricultural Research, Research Ethics and Rural Development Programmes	50	40	10	00	00	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

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.

Theory

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;

Unit II: 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 III: Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics. Concept and connotations of rural development, rural development policies and strategies.

Unit IV: 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

Unit V: 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.

