



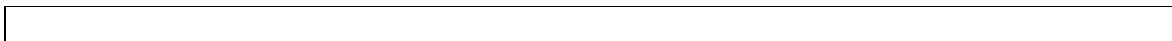
Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Agriculture
M.Sc. (Hort.) in Vegetable Science, I semester

Course Title with Credit Load
M.Sc. (Hort.) in Vegetable Science

Course Code	Course Title	Credit Hours
Major Courses (20 Credits)		
VSC 501	Production of Cool Season Vegetable Crops	2+1
VSC 502	Production of Warm Season Vegetable Crops	2+1
VSC 503	Growth and Development of Vegetable Crops	2+1
VSC 504	Principles of Vegetable Breeding	2+1
VSC 505	Breeding of Self Pollinated Vegetable Crops	2+1
VSC 506	Breeding of Cross Pollinated Vegetable Crops	2+1
VSC 507	Protected Cultivation of Vegetable Crops	1+1
VSC 508	Seed Production of Vegetable Crops	2+1
VSC 509	Production of Underutilized Vegetable Crops	2+1
VSC 510	Systematics of Vegetable Crops	1+1
VSC 511	Organic Vegetable Production	1+1
VSC 512	Production of Spice Crops	2+1
VSC 513	Processing of Vegetable	1+1
VSC 514	Postharvest Management of Vegetable Crops	2+1
	Minor Courses	08
	Supporting Courses	06
	Common Compulsory Courses	05
VSC 591	Seminar	0+1
VSC 599	Research	0+30
	Total Credits	70



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Syllabus

VSC 501: Production of Cool Season Vegetable Crops (2+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
VSC 501	Production of Cool Season Vegetable Crops	50	30	00	15	05	2	1	3

Legends: L - Lecture; P – Practical

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

Objective

To impart knowledge and skills on advancement in production technology of cool season vegetable crops.

Theory

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/hybrids, seed rate and seed treatment, raising of nursery, sowing/ planting time and methods, hydroponics and aeroponics, precision farming, cropping system, nutritional including micronutrients and irrigation requirements, inter-cultural operations, special horticultural practices, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marketing), pest and disease management and production economics of crops.



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UNIT I

Bulb and tuber crops—Onion, garlic and potato.

Unit II

Cole crops—Cabbage, cauliflower, kohlrabi, broccoli, Brussels sprouts and kale.

Unit III

Root crops—Carrot, radish, turnip and beetroot.

UNIT IV

Peas and beans—Garden peas and broad bean.

UNIT V

Leafy vegetables—Beet leaf, fenugreek, coriander and lettuce.

Practical

- Scientific raising of nursery and seed treatment.
- Sowing and transplanting.
- Description of commercial varieties and hybrids.
- Demonstration on methods of irrigation, fertilizers and micronutrients application.
- Mulching practices, weed management.
- Use of plant growth substances in cool season vegetable crops.
- Study of nutritional and physiological disorders.
- Studies on hydroponics, aeroponics and other soilless culture.
- Identification of important pest and diseases and their control.
- Preparation of cropping scheme for commercial farms.
- Visit to commercial farm, greenhouse/ polyhouses.
- Visit to vegetable market.
- Analysis of benefit to cost ratio.

Suggested Readings

- Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. Vegetable crops. Vols. I-III. Naya udyog.
- Bose TK, Som MG and Kabir J. (Eds.). 1993. Vegetable crops. Naya prokash.
- Chadha KL and Kalloo G. (Eds.). 1993-94. Advances in horticulture Vols. V-X. Malhotra publ. house.
- Chadha KL. (Ed.). 2002. Hand book of horticulture. ICAR.
- Chauhan DVS. (Ed.). 1986. Vegetable production in India. Ram prasad and sons.
- Fageria MS, Choudhary BR and Dhaka RS. 2000. Vegetable crops: production technology. Vol.II. Kalyani publishers.
- Gopalakrishanan TR. 2007. Vegetable crops. New India publ. agency. Singhal NC. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.



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- Vanangamudi K, Prabhu M, Kalaivani S, Bhaskaran M and Manonmani V. 2010. Vegetable Hybrid seed Production and Management. Agrobios., Jodhpur, India.
- Hazra P and Banerjee MK and Chattopadhyay A. 2012. Varieties of vegetable crops in India, (Second edition), Kalyani publishers, Ludhiana, 199 p.
- Hazra P. 2016. Vegetable Science. 2nd edn, Kalyani publishers, Ludhiana.
- Hazra P. 2019. Vegetable production and technology. New India publishing agency, New Delhi.
- Hazra P, Chattopadhyay A, Karmakar K and Dutta S. 2011. Modern technology for vegetable production, New India publishing agency, New Delhi, 413p
- Rana MK. 2008. Olericulture in India. Kalyani publishers, New Delhi.
- Rana MK. 2008. Scientific cultivation of vegetables. Kalyani publishers, New Delhi.
- Rana MK. 2014. Technology for vegetable production. Kalyani publishers, New Delhi.
- Rubatzky VE and Yamaguchi M. (Eds.). 1997. World vegetables: principles, production and nutritive values. Chapman and Hall.
- Saini GS. 2001. A text book of oleri and flori culture. Aman publishing house.
- Salunkhe DK and Kadam SS. (Ed.). 1998. Hand book of vegetable science and technology: production, composition, storage and processing. Marcel dekker.
- Shanmugavelu KG. 1989. Production technology of vegetable crops. Oxford and IBH.
- Singh DK. 2007. Modern vegetable varieties and production technology. International book distributing Co.
- Singh SP. (Ed.). 1989. Production technology of vegetable crops. Agril. comm. res. centre. Thamburaj S and Singh N. (Eds.), 2004. Vegetables, tuber crops and spices. ICAR. Thompson HC and Kelly WC. (Eds.). 1978. Vegetable crops. Tata McGraw-Hill.



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Syllabus

VSC 503: Growth and Development of Vegetable Crops (2+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
VSC 503	Growth and Development of Vegetable Crops	50	30	00	15	05	2	1	3

Legends: L - Lecture; P – Practical

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

Objective

To teach the physiology of growth and development of vegetable crops.

Theory

Unit I

Introduction and phytohormones—Definition of growth and development; Cellular structures and their functions; Physiology of phyto-hormones functioning/ biosynthesis and mode of action; Growth analysis and its importance in vegetable production.

Unit II

Physiology of dormancy and germination—Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellins, cytokinins and abscisic acid; Application of synthetic PGRs including plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production.

Unit III



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Abiotic factors—Impact of light, temperature, photoperiod, carbon dioxide, oxygen and other gases on growth, development of underground parts, flowering and sex expression in vegetable crops; Apical dominance.

Unit IV

Fruit physiology—Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening.

Unit V

Morphogenesis and tissue culture—Morphogenesis and tissue culture techniques in vegetable crops; Grafting techniques in different vegetable crops.

Practical

Preparation of plant growth regulator's solutions and their application.

Experiments in breaking and induction of dormancy by chemicals.

Induction of parthenocarpy and fruit ripening.

Application of plant growth substances for improving flower initiation, changing sex expression in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables.

Growth analysis techniques in vegetable crops.

Grafting techniques in tomato, brinjal, cucumber and sweet pepper.

Suggested Readings

- Bleasdale JKA. 1984. *Plant physiology in relation to horticulture* (2nd Edition) MacMillan. Gupta US. Eds. 1978. *Crop physiology*. Oxford and IBH, New Delhi.
- Kalloo G. 2017. *Vegetable grafting: Principles and practices*. CAB International Krishnamoorti HN. 1981. *Application growth substances and their uses in agriculture*. Tata McGraw Hill, New Delhi.
- Leopold AC and Kriedemann PE. 1981. *Plant growth and development*, Tata McGraw-Hill, New Delhi.
- Peter KV and Hazra P. (Eds). 2012. *Hand book of vegetables*. Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.
- Peter KV. (Eds). 2008. *Basics of horticulture*. New India publication agency, New Delhi. Rana MK. 2011. *Physio-biochemistry and Biotechnology of Vegetables*. New India Publishing Agency, Pritam Pura, New Delhi.
- Saini *et al.* (Eds.). 2001. *Laboratory manual of analytical techniques in horticulture*. Agrobios, Jodhpur.
- Wien HC. (Eds.). 1997. *The physiology of vegetable crops*. CAB International.



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Syllabus

VSC 504: Principles of Vegetable Breeding (2+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
VSC 504	Principles of Vegetable Breeding	50	30	00	15	05	2	1	3

Legends: L - Lecture; P – Practical

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

Objective

To teach basic principles and practices of vegetable breeding.

Theory

Unit I

Importance and history- Importance, history and evolutionary aspects of vegetable breeding and its variation from cereal crop breeding.

Unit II

Selection procedures- Techniques of selfing and crossing; Breeding systems and methods; Selection procedures and hybridization; Genetic architecture; Breeding for biotic stress (diseases, insect pests and nematode), abiotic stress (temperature, moisture and salt) resistance and quality improvement; Breeding for water use efficiency (WUE) and nutrients use efficiency (NUE).

Unit III



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Heterosis breeding- Types, mechanisms and basis of heterosis, facilitating mechanisms like male sterility, self-incompatibility and sex forms.

Unit IV

Mutation and Polyploidy breeding; Improvement of asexually propagated vegetable crops and vegetables suitable for protected environment.

Unit V

Ideotype breeding- Ideotype breeding; varietal release procedure; DUS testing in vegetable crops; Application of In-vitro and molecular techniques in vegetable improvement.

Practical

- Floral biology and pollination behaviour of different vegetables.
- Techniques of selfing and crossing of different vegetables, viz., Cole crops, okra, cucurbits, tomato, eggplant, hot pepper, etc.
- Breeding system and handling of filial generations of different vegetables.
- Exposure to biotechnological lab practices.
- Visit to breeding farms.

Suggested Reading

Allard RW. 1960. *Principle of plant breeding*. John Willey and Sons, USA. Kallou G. 1988. *Vegetable breeding* (Vol. I, II, III). CRC Press, Fl, USA.

Kole CR. 2007. *Genome mapping and molecular breeding in plants-vegetables*. Springer, USA. Peter KV and Pradeep Kumar T. 1998. *Genetics and breeding of vegetables*. ICAR, New Delhi, p. 488.

Prohens J and Nuez F. 2007. *Handbook of plant breeding-vegetables* (Vol I and II). Springer, USA.

Singh BD. 2007. *Plant breeding- principles and methods* (8th edn.). Kalyani Publishers, New Delhi.

Singh Ram J. 2007. *Genetic resources, chromosome engineering, and crop improvement-vegetable crops* (Vol. 3). CRC Press, Fl, USA.



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Syllabus

VSC 505: Breeding of Self Pollinated Vegetable Crops (2+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
VSC 505	Breeding of Self Pollinated Vegetable Crops	50	30	00	15	05	2	1	3

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

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

Objective

To impart comprehensive knowledge about principles and practices of breeding of self pollinated vegetable crops.

Theory

Origin, botany, taxonomy, wild relatives, cytogenetics and genetics, types of pollination and fertilization mechanism, sterility, breeding objectives, breeding methods (introduction, selection, hybridization, mutation and polyploidy), varieties and varietal characterization, resistance breeding for biotic and abiotic stresses, breeding for protected environment and quality improvement, molecular markers and marker's assisted breeding; QTLs, PPV and FR Act.

Unit I

Tuber crops: Potato.



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Unit II

Fruit vegetables- Tomato, eggplant, hot pepper, sweet pepper and okra.

Unit III

Leguminous vegetables- Garden peas and cowpea.

Unit IV

Leguminous vegetables: French bean, Indian bean, cluster bean and broad bean.

Unit V

Leafy vegetables- Lettuce and fenugreek.

Practical

- Floral mechanisms favouring self and often cross pollination.
- Progeny testing and development of inbred lines.
- Selection of desirable plants from breeding population, observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations.
- Palynological studies, selfing and crossing techniques.
- Hybrid seed production of vegetable crops in bulk.
- Screening techniques for biotic and abiotic stress resistance in above mentioned crops.
- Molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques.
- Visit to breeding farms.

Suggested Reading

Allard RW. 1999. Principles of plant breeding. John Wiley and Sons.

Basset MJ. (Ed.). 1986. *Breeding vegetable crops*. AVI Publ.

Dhillon BS, Tyagi RK, Saxena S and Randhawa GJ. 2005, Plant genetic resources: horticultural crops. Narosa Publ. House.

Fageria MS, Arya PS and Choudhary AK. 2000, *Vegetable crops: Breeding and seed production*. Vol. I. Kalyani.

Gardner EJ. 1975. *Principles of genetics*. John Wiley and Sons.

Hayes HK, Immer FR and Smith DC. 1955. *Methods of plant breeding*. McGraw-Hill.

Hayward MD, Bosemark NO and Romagosa I. (Eds.). 1993. *Plant Breeding-principles and prospects*. Chapman and Hall.

Hazra P and Som MG. 2015. Vegetable science (Second revised edition), Kalyani publishers, Ludhiana, 598 p.

Hazra P and Som MG. 2016. *Vegetable seed production and hybrid technology* (Second revised edition), Kalyani Publishers, Ludhiana, 459 p

Kaloo G. 1988. *Vegetable breeding*. Vols. I-III. CRC Press.

Kaloo G. 1998. *Vegetable breeding*. Vols. I-III (Combined Ed.). Panima Edu.



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Book Agency. Kumar JC and Dhaliwal MS. 1990. *Techniques of developing hybrids in vegetable crops*. Agro Botanical Publ.

Paroda RS and Kalloo G. (Eds.). 1995. *Vegetable research with special reference to hybrid technology in Asia-Pacific Region*. FAO.

Peter KV and Pradeepkumar T. 2008. *Genetics and breeding of vegetables*. Revised, ICAR. Peter KV and Hazra P. (Eds). 2012. *Hand book of vegetables*. Studium press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.

Peter KV and Hazra P (Eds). 2015. *Hand book of vegetables Volume II*. Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 509 p.

Peter KV and Hazra P. (Eds). 2015. *Hand book of vegetables Volume III*. Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 634 p.

Rai N and Rai M. 2006. *Heterosis breeding in vegetable crops*. New India Publ. Agency.

Ram HH. 1998. *Vegetable breeding: principles and practices*. Kalyani Publishers, New Delhi. Simmonds NW. 1978. *Principles of crop improvement*. Longman. Singh BD. 1983. *Plant Breeding*. Kalyani Publishers, New Delhi.

Singh PK, Dasgupta SK and Tripathi SK. 2004. *Hybrid vegetable development*. International Book Distributing Co.

Swarup V. 1976. *Breeding procedure for cross-pollinated vegetable crops*. ICAR.



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Syllabus

PSM 502: Production of Spice Crops (2+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
PSM 502	Production of Spice Crops	50	30	00	15	05	2	1	3

Legends: L - Lecture; P – Practical

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

Objective

The course is designed to provide both basic and applied knowledge on various aspects of production technology of spice crops grown in India.

Unit I

Role of Spice crops: Introduction, importance of spice crops, pharmaceutical significance, historical accent, present status – national and international, prospects, role of Spices board and other development agencies. Classification of spice crops: Major spices, minor spices, seed spices, tree spices, herbal spices.

Unit II

Varietal wealth: Botany and taxonomy, species, cultivars, commercial varieties/ hybrids in spice crops. Propagation and nursery management: Seed, vegetative and micropropagation methods, nursery techniques and nursery management practices.

Unit III



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Agro techniques: Climatic and soil requirements, site selection, layout, sowing/ planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercropping, mixed cropping, intercultural operations, weed control, mulching, plant protection, precision farming, physiological disorders, protected cultivation.

Unit IV

Maturity indices and harvest: Maturity indices, harvesting methods, harvesting seasons, mechanized harvesting.

Unit V

Post harvest management: Post harvest management including primary processing, grading, packaging and storage, GMP in major spice crops.

Practical

- GAP in spice crops;
- GMP in spice crops;
- Short term experiments on spice crops;
- Exposure visits to spice farms, research institutes.

Suggested Reading

Agarwal S, Sastry EVD and Sharma RK. 2001. Seed Spices: Production, Quality, Export. Pointer Publ.

Arya PS. 2003. Spice Crops of India. Kalyani.

Bose TK, Mitra SK, Farooqi SK and Sadhu MK. Eds. 1999. Tropical Horticulture. Vol.I. Naya Prokash.

Chadha KL and Rethinam P. Eds. 1993. Advances in Horticulture. Vols. IX-X. Plantation Crops and Spices. Malhotra Publ. House.

Gupta S. Ed. Hand Book of Spices and Packaging with Formulae. Engineers India Research Institute, New Delhi.

Kumar NA, Khader P, Rangaswami and Irulappan I. 2000. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants. Oxford and IBH.

Nybe EV, Miniraj N and Peter KV. 2007. Spices. New India Publ. Agency.

Parthasarthy VA, Kandiannan V and Srinivasan V. 2008. Organic Spices. New India Publ. Agency.

Peter KV. 2001. Handbook of Herbs and Spices. Vols. I-III. Woodhead Publ. Co. UK and CRC USA.

Ponnuswami V et al. 2018. Medicinal Herbs and Herbal Cure. Narendra Publishing House, New Delhi.

Pruthi JS. Ed. 1998. Spices and Condiments. National Book Trust.

Pruthi JS. 2001. Minor Spices and Condiments- Crop Management and Post Harvest Technology. ICAR.

Purseglove JW, Brown EG, Green CL and Robbins SRJ. Eds. 1981. Spices. Vols. I, II. Longman.



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- Ramachandra et al. 2018. Breeding of Spices and Plantation crops. Narendra Publishing House, New Delhi.
- Ravindran PN. 2000. Black pepper, Piper nigrum. CRC press.
- Ravindran PN. 2002. Cardamom, the genus Elettaria. CRC press
- Ravindran PN. 2003. Cinnamon and cassia. CRC press
- Ravindran PN. 2004. Ginger, the genus Zingiber. CRC press
- Ravindran PN. 2007. Turmeric, the genus curcuma. CRC press
- Ravindran PN. 2017. The Encyclopedia of Herbs and Spices. CABI
- Shanmugavelu KG, Kumar N and Peter KV. 2002. Production Technology of Spices and Plantation Crops. Agrobios.
- Sharangi AB, Datta S and Deb P. 2018. Spices “Agrotechniques for quality produce”. Apple Academic Press (Tylor and Francis Groups), New Jersey, USA.
- Sharangi AB. 2018. Indian Spices “The legacy, production and processing of India’s treasured export.” Springer International publishing AG, Part of Springer Nature 2018, Cham, Switzerland.
- Restructured and Revised Syllabi of Post-graduate Programmes Vol. 1 428
- Sharangi AB and Datta S. 2015. Value Addition of Horticultural crops: Recent trends and Future directions. SPRINGER; ISBN: 978-81-322-2261-3.
- Sharangi AB and Acharya SK. 2008. Quality Management of Horticultural crops. Agrotech Publishing House, Udaipur; ISBN: 81-8321-090-2.
- Thamburaj S and Singh N. Eds. 2004. Vegetables, Tuber Crops and Spices, ICAR.
- Tiwari RS and Agarwal A. 2004. Production Technology of Spices. International Book Distr.



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Syllabus

FSC 503: Propagation and Nursery Management in Fruit Crops (2+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
FSC 503	Propagation and Nursery Management in Fruit Crops	50	30	00	15	05	2	1	3

Legends: L - Lecture; P – Practical

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

Objective

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

Unit I

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.



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Unit II

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. Layering – principle and methods.

Unit III

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

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.
- Anatomical studies in rooting of cutting and graft union.
- Hands on practices on various methods of budding and grafting.
- Propagation by layering and stooling.
- Micropropagation- explant preparation, media preparation, culturing – meristem tip culture, axillary bud culture, micro-grafting, hardening.
- Visit to commercial tissue culture laboratories and accredited nurseries.

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/ PrenticeHall 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.

Love et al. 2017. Tropical Fruit Tree Propagation Guide. UH-CTAHR F_N_49. College of Tropical

Agriculture and Human Resources University of Hawaii at Manwa, USA.

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



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Co., Lucknow.

Singh SP. 1989. Mist Propagation. Metropolitan Book Co.

Singh RS. 2014. Propagation of Horticultural Plants: Arid and Semi-Arid Regions. NIPA, New Delhi.

Tyagi S. 2019. Hi-Tech Horticulture. Vol I: Crop Improvement, Nursery and Rootstock Management. NIPA, New Delhi.

PGS 501: LIBRARY AND INFORMATION SERVICES (0+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
PGS 501	Library and Information Services	00	00	00	60	40	0	1	1

Legends: L - Lecture; P – Practical;

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

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



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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.

PGS 502: TECHNICAL WRITING AND COMMUNICATIONS SKILLS (0+1)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
PGS 502	Technical Writing & Communications Skills	0	0	0	60	40	0	1	1

Legends: L - Lecture; P – Practical;

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

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

- Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;



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- 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

- Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
- Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
- Collins' Cobuild English Dictionary. 1995.
- Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
- Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
- James HS. 1994. Handbook for Technical Writing. NTC Business Books.
- Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
- Mohan K. 2005. Speaking English Effectively. MacMillan India.
- Richard WS. 1969. Technical Writing.
- Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
- Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.



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PGS 503: INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (1+0)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
PGS 503	Intellectual Property and Its Management in Agriculture	50	40	10	0	0	1	0	1

Legends: L - Lecture; P – Practical;

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

Objectives

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



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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 etc.

UNIT IV

Protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection;

UNIT V

National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch F H & 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 Diversity Act, 2003.*



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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
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.



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- 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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