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

Syllabus

VSC 502: Production of Warm 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 502	Production of Warm 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 warm 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, intercultural 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.

Unit I

Fruit vegetables—Tomato, brinjal, hot pepper, sweet pepper and okra.

Unit II

Beans—French bean, Indian bean (Sem), cluster bean and cowpea.

Unit III

Cucurbits—Cucumber, melons, gourds, pumpkin and squashes.

Unit IV

Tuber crops—Sweet potato, elephant foot yam, tapioca, taro and yam.

Unit V

Leafy vegetables—Amaranth and drumstick.

Practical

• Scientific raising of nursery and seed treatment;

• Sowing, transplanting, vegetable grafting;

• 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 warm 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.
Gopalakrishanan TR. 2007. *Vegetable crops*. New India publ. agency.
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*. 2ndedn, 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.
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 506: Breeding of Cross 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 506	Breeding of Cross 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 cross pollinated vegetable crops breeding.

Theory

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

Unit I

Cucurbitaceous crops—Gourds, melons, cucumber, pumpkin and squashes.

Unit II

Cole crops—Cauliflower, cabbage, kohlrabi, broccoli and brussels sprouts.

Unit III

Root and bulb crops—Carrot, radish, turnip, beet root and onion.

Unit IV

Tuber crops—Sweet potato, tapioca, taro and yam.

Unit V

Leafy vegetables—Beet leaf, spinach, amaranth and coriander.

Practical

Floral mechanisms favouring cross pollination;

Development of inbred lines;

Selection of desirable plants from breeding population;

Observations and analysis of various quantitative and qualitative traits in germplasm, hybrids and segregating generations;

Induction of flowering, 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;

Demonstration of sib-mating and mixed population;

Molecular marker techniques to identify useful traits in vegetable crops and special breeding techniques;

Visit to breeding blocks.

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

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

Kalloo G. 1998. *Vegetable breeding*. Vols. I-III (Combined Ed.). Panima Edu. 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 and III.Studium press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 509 p.
Prohens J and Nuez F. 2007. *Handbook of Plant Breeding- Vegetables* (Vol I and II), Springer, USA.

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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VSC 508: Seed Production 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 508	Seed Production 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 impart a comprehensive knowledge and skills on quality seed production of vegetable crops

Theory

Unit I

Introduction, history, propagation and reproduction—Introduction, definition of seed and its quality, seed morphology, development and maturation; Apomixis and fertilization; Modes of propagation and reproductive behaviour; Pollination mechanisms and sex forms in vegetables; History of vegetable seed production; Status and share of vegetable seeds in seed industry.

Unit II

Agro-climate and methods of seed production—Agro-climate and its influence on quality seed production; Deterioration of crop varieties, genetical and agronomic principles of vegetable seed production; Methods of seed production, hybrid seeds and techniques of large scale hybrid seed production; Seed village concept

Unit III

Seed multiplication and its quality maintenance—Seed multiplication ratios and replacement rates in vegetables; Generation system of seed multiplication; Maintenance and production of nucleus, breeder, foundation, certified/ truthful label seeds; Seed quality and mechanisms of genetic purity testing

Unit IV

Seed harvesting, extraction and its processing—Maturity standards; Seed harvesting, curing and extraction; Seed processing, viz., cleaning, drying and treatment of seeds, seed health and quality enhancement, packaging and marketing; Principles of seed storage; Orthodox and recalcitrant seeds; Seed dormancy

Unit V

Improved agro-techniques and field and seed standards—Improved agro-techniques; Field and seed standards in important solanaceous, leguminous and cucurbitaceous vegetables, cole crops, leafy vegetables, bulbous and root crops and okra; clonal propagation and multiplication in vegetative propagated crops; Seed plot technique and true potato seed production in potato

Practical

Study of floral biology and pollination mechanisms in vegetables;

Determination of modes of pollination;

Field and seed standards;

Use of pollination control mechanisms in hybrid seed production of important vegetables;

Maturity standards and seed extraction methods;

Seed sampling and testing;

Visit to commercial seed production areas;

Visit to seed processing plant;

Visit to seed testing laboratories.

Suggested Reading

Agarwaal PK and Anuradha V. 2018. *Fundamentals of seed science and technology*. Brilliant publications, New Delhi.

Agrawal PK and Dadlani M. (Eds.). 1992. *Techniques in seed science and technology*. South asian Publ.

Agrawal RL. (Ed.). 1997. *Seed technology*. Oxford and IBH.

Basra AS. 2000. *Hybrid seed production in vegetables*. CRC press, Florida, USA.

Bench ALR and Sanchez RA. 2004. *Handbook of seed physiology*. Food products press, NY/ London.

Bendell PE. (Eds.). 1998. *Seed science and technology: Indian forestry species*. Allied Publ.

Chakraborty SK, Prakash S, Sharma SP and Dadlani M. 2002. *Testing of distinctiveness, uniformity and stability for plant variety protection*. IARI, New Delhi

Copland LO and McDonald MB. 2004. *Seed science and technology*, Kluwer Academic Press.

Fageria MS, Arya PS and Choudhary AK. 2000. *Vegetable crops: breeding and seed production*. Vol. I. Kalyani Publishers, New Delhi.

George RAT. 1999. *Vegetable seed production* (2nd Edition). CAB International.

Kalloo G, Jain SK, Vari AK and Srivastava U. 2006. *Seed: A global perspective*. Associated publishing company, New Delhi.

Hazra P and Som HG. 2015. *Seed production and hybrid technology of vegetable crops*. Kalyani publishers, Ludhiana.

Kumar JC and Dhaliwal MS. 1990. *Techniques of developing hybrids in vegetable crops*. Agro botanical publ.

More TA, Kale PB and Khule BW. 1996. *Vegetable seed production technology*. Maharashtra state seed corp.

Rajan S and Markose BL. 2007. *Propagation of horticultural crops*. New India publ. agency.

Singh NP, Singh DK, Singh YK and Kumar V. 2006. *Vegetable seed production technology*. International book distributing Co.

Singh SP. 2001. *Seed production of commercial vegetables*. Agrotech publ. academy. Singhal

NC. 2003. *Hybrid seed production*. Kalyani publishers, New Delhi.

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OF 501: Concepts and Principles of Organic Farming (2+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	Teacher's Assessment*			
OF 501	Concepts and Principles of Organic Farming	50	40	10	00	00	2	0	2

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

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

Objective

To impart knowledge on the basic concept of organic farming.

Theory

Unit I:
Concepts and principles of organic farming History and evolution of organic farming in the world and India. Scenario of organic farming in India and world, global market for organic products, IFOAM's Guiding principles of organic farming, conversion to organic agriculture, advantages and
limitations.

Unit II:
Definitions and types of organic farming Definitions of organic farming, types of organic farming such as natural farming, zero chemical natural farming, bio dynamic farming, biological farming, compost farming, Natueco culture, integrated farming, homa farming, permaculture etc, traditional farming systems in India and evolving indigenous knowledge systems.

Unit III:
Conventional *vs* Organic farming Philosophy of two farming systems, fundamental differences, productivity issues, management protocols, food quality, nutritional differences and impact of conventional practices on soil fertility, natural resources, environment and overall social perception. Myths and realities about organic farming in addressing nutritional security and food safety need *vis-à-vis* national food security.

Unit IV:
Advocacy, Ethics, health and social issues in organic farming Advocacy for organic farming with sustainability, resource conservation and food safety issues. Advocacy through overall farm productivity under diversified cropping systems. Spirituality values and ethics in organic farming. Socio economic importance of organic farming: concept measurements and

issues. Need for ethical practices and values across the organic agriculture value chain including trading and reaching to consumers.

Unit V:

Organic farming for sustainability, resource conservation, climate change issues and safe and healthy food General concerns on sustainability, climate change issues threatening sustainability, potential of organic farming practices in addressing sustainability and climate change. Resource conservation through organic farming, rainwater conservation and preservation of native seeds and germplasm an essential component of organic farming, Consumers concerns on food quality and safety, organic farming for safe and healthy food, ITKs potential and role in sustainability of modern organic farming practices.

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STAT 502: STATISTICAL METHODS FOR APPLIED SCIENCES (3+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*			
STAT 502	Statistical methods for Applied sciences	50	30	0	15	5	3	1	4

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 who do not have sufficient background of Statistical Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Theory

UNIT I

Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation

UNIT II

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

UNIT III

Introduction to theory of estimation and confidence-intervals, Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination, Fitting of quadratic models.

UNIT IV

Non-parametric tests – sign, Wilcoxon, Mann-Whitney U-test, Run test for the randomness of a sequence. Median test

UNIT V

Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data.

Practical

• Exploratory data analysis, fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal.

• Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F.

• Confidence interval estimation and Correlation and regression analysis, fitting of Linear and Quadratic Model.

• Non-parametric tests. ANOVA: One way, Two Way, SRS

Suggested Readings

- Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
- Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
- Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley.
- Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan.
- Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill.
- Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition.
- Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.
- Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed . John Wiley
- http://freestatistics.altervista.org/en/learning.php.
- http://www.statsoft.com/textbook/stathome.html

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PGS 504: BASIC CONCEPTS IN LABORATORY TECHNIQUES (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 504	Basic Concepts in Laboratory Techniques	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 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, sandbath, waterbath, oilbath; 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 Hand Book of Laboratory Safety. CRC Press.
- Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

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PGS 505: AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (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 505	Agricultural Research, Research Ethics and Rural Development Programmes	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.

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.

UNIT IV

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme.

UNIT V

Integrated Rural Development Programme (IRDP), Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla G S & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
- Punia M S. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.
- Rao B S V. 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.