



**Department of Horticulture
Mahatma Phule Krishi Vidyapeeth
Rahuri-413 722, Dist. Ahmednagar (MS)**



Doctoral Programme in Vegetable Science

Course Layout

Minimum Credit Requirements

Sr. No.	Subject	Minimum credit(s)
1.	Major	18
2.	Minor	08
3.	Supporting	05
4.	Seminar	02
5.	Research	45
	Total Credits	78
6.	Compulsory Non Credit Courses	04

Sr. No.	Course Number	Course Title	Credits
A) Major subjects (Min. 18 credits)			
1	VSC -601	Advances in Vegetable Production	2+1=3
2	VSC -602	Advances in Breeding of Vegetable Crops	2+1=3
3	VSC -603	Protected Cultivation of Vegetable Crops	2+1=3
4	VSC -604	Biotechnology of Vegetable Crops	2+1=3
5	VSC -605	Seed Certification, Processing and Storage of Vegetable Crops	2+1=3
6	VSC-606	Abiotic Stress Management in Vegetable Crops	2+1=3
B) Minor Subjects (Min. 08 credits)			
1	FSC -505	Propagation and Nursery Management for Fruit Crops	2+1=3

2	PP-605	Climate Change and Crop Growth	2+0=2
3	BIOCHEM-603	Biochemisty of Biotic and Abiotic Stress	3+0=3
C) Supporting Subjects (Min. 05 credits)			
1	STAT-601	Advanced Statistical Methods	2+1=3
2	AGRON-606	Advances in Weed Management	2+0=2
D) Seminar (02 credits)			
1	VSC 691	Doctoral Seminar I	1+0=1
2	VSC 692	Doctoral Seminar II	1+0=1
E) Doctoral Research (45 credits)			
		Doctoral Research	0+45=45
F) Non Credit Compulsory Courses			
1	PGS-501	Library and Information Services	0+1
2	PGS-504	Basic Concepts in Laboratory Techniques	0+1
3	PGS-502	Technical Writing and Communication Skills	0+1
4	PGS-503	Intellectual Property and its Management in Agriculture	0+1

Course Contents

Major Subjects

Course No.	: VSC 601
Title	: ADVANCES IN VEGETABLE PRODUCTION
Credits	: 2+1=3

Theory:

<p>Present status and prospects of vegetable cultivation. Nutritional and medicinal values of vegetable crops. Climate and soil as critical factors in vegetable production; choice of varieties; nursery management; modern concepts in water and weed management; physiological basis of growth, yield and quality as influenced by chemicals and growth regulators; role of organic manures, inorganic fertilizers, micronutrients and biofertilizers; response of genotypes to low and high nutrient management, nutritional deficiencies, disorders and correction methods of following crops :</p>	
Unit-I	: Tomato, Brinjal, Chilli, Sweet pepper, Potato
Unit-II	: Cucurbits, Cabbage, Cauliflower, Knolkhol
Unit-III	: Bhendi, Onion, Peas, Beans, Amaranthus, Drumstick
Unit-IV	: Carrot, Beet root, Radish
Unit-V	: Turnip, Sweet potato, Tapioca, Elephant foot, Yam, Taro
<p>Cropping systems, mulching in vegetable crops, Containerized culture for year round vegetable, production Low cost polyhouse; and net house production in vegetable crops, Crop modeling, organic gardening, Vegetable production for pigments, Export and processing of vegetable crops</p>	

Practical:

<p>Seed hardening treatments; practices in indeterminate and determinate vegetable growing and organic gardening. Portrays and ball culture; diagnosis of nutritional and physiological disorders. Analysis of physiological factors; photosynthesis; light intensity indifferent cropping situation. Assessing nutrient status, use of plant growth regulators; practices in herbicide application; estimating water requirements in relation to crop growth stages, maturity indices; dryland techniques for rainfed vegetable production; production constraints; analysis of different cropping system in various situation like cold and hotset. Vegetable waste recycling management; quality analysis; marketing survey of the above crops; visit to vegetable and fruit molls and packing houses.</p>	
Practical No.	Topic
1-2	Seed hardening treatments; practices in indeterminate and determinate

	vegetable growing and organic gardening
3-5	Portrays and ball culture; diagnosis of nutritional and physiological disorders
6-8	Analysis of physiological factors; photosynthesis; light intensity indifferent cropping situation
9-11	Assessing nutrient status, use of plant growth regulators; practices in herbicide application; estimating water requirements in relation to crop growth stages,
12-13	maturity indices; dryland techniques for rainfed vegetable production; production constraints; analysis of different cropping system in various situation like cold and hotset
14-16	Vegetable waste recycling management; quality analysis; marketing survey of the above crops; visit to vegetable and fruit molls and packing houses.

Reference Books:

Bose TK & Som NG. 1986. *Vegetable Crops of India*. Naya Prokash.

Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. *Vegetable Crops*. Vols. I-III. Naya Udyog.

Brewster JL. 1994. *Onions and other Vegetable Alliums*. CABI.FFTC. *Improved Vegetable Production in Asia*. Book Series No. 36.

Ghosh SP, Ramanujam T, Jos JS, Moorthy SN & Nair RG. 1988. *Tuber Crops*. Oxford & IBH.

Gopalakrishnan TR. 2007. *Vegetable Crops*. New India Publishing Agency.

Kallo G & Singh K. (Ed.). 2001. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publ. House.

Kurup GT, Palanisami MS, Potty VP, Padmaja G, Kabeerathuma S & Pallai SV. 1996. *Tropical Tuber Crops, Problems, Prospects and Future Strategies*. Oxford & IBH.

Sin MT & Onwueme IC. 1978. *The Tropical Tuber Crops*. John Wiley & Sons.

Singh NP, Bhardwaj AK, Kumar A & Singh KM. 2004. *Modern Technology on Vegetable Production*. International Book Distr. Co.

Singh PK, Dasgupta SK & Tripathi SK. 2006. *Hybrid Vegetable Development*. International Book Distr. Co.

Course No.	: VSC 602
Title	: ADVANCES IN BREEDING OF VEGETABLE CROPS
Credits	: 2+1=3

Theory:

<p>Evolution, distribution, cytogenetics, genetic resources, genetic divergence, types of pollination and fertilization mechanisms, sterility and incompatibility, anthesis and pollination, hybridization, inter-varietal, interspecific and inter-generic hybridization, heterosis breeding, inheritance pattern of traits, qualitative and quantitative, plant type concept and selection indices, genetics of spontaneous and induced mutations, problems and achievements of mutation breeding, ploidy breeding and its achievements, in vitro breeding; breeding techniques for improving quality and processing characters; breeding for stresses, mechanism and genetics of resistance, breeding for salt, drought; low and high temperature; toxicity and water logging resistance, breeding for pest, disease, nematode and multiple resistance of :</p>	
Unit-I	: Tomato, brinjal, chilli, sweet pepper and potato
Unit-II	: Cucurbits, Cabbage, cauliflower, knoll-khol and broccoli
Unit-III	: Bhendi, onion, peas and beans, amaranthus and drumstick
Unit-IV	: Carrot, beet root and radish
Unit-V	: Sweet potato

Practical:

<p>Designing of breeding experiments. Screening techniques for abiotic stresses. Screening and rating for pest, disease and nematode resistance. Estimation of quality and processing characters. Screening for-quality improvement. Estimation of heterosis and combining ability. Induction and identification of mutants and polyploids. Distant hybridization and embryo rescue techniques.</p>	
Practical No.	Topics
1-2	Designing of breeding experiments
3	Screening techniques for abiotic stresses
4	Screening and rating for pest, disease and nematode resistance
5-6	Estimation of quality and processing characters
7-8	Screening for-quality improvement
9-10	Estimation of heterosis and combining ability
11-12	Induction and identification of mutants and polyploids
13-16	Distant hybridization and embryo rescue techniques.

Reference Books:

Acta Horticulture. Conference on Recent Advance in Vegetable Crops. Vol. 127.

Chadha KL, Ravindran PN & Sahijram L. 2000. *Biotechnology in Horticultural and Plantation Crops*. Malhotra Publ. House.

Chadha KL. 2001. *Hand Book of Horticulture*. ICAR.

Dhillon BS, Tyagi RK, Saxena S & Randhawa GJ. 2005. *Plant Genetic Resources: Horticultural Crops*. Narosa Publ. House.

Janick JJ. 1986. *Horticultural Science*. 4th Ed. WH Freeman & Co.

Kaloo G & Singh K. 2001. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals and Book Publ. House.

Kaloo G. 1994. *Vegetable Breeding*. Vols. I-III. Vedams eBooks.

Peter KV & Pradeep Kumar T. 2008. *Genetics and Breeding of Vegetables*. (Revised Ed.). ICAR.

Ram HH. 2001. *Vegetable Breeding*. Kalyani.

Course No. : VSC 603
Title : PROTECTED CULTIVATION OF VEGETABLE CROPS
Credits : 2+1=3

Theory:

Unit-I	:	Importance and scope of protected cultivation of vegetable crops; principles used in protected cultivation, energy management, low cost structures; engineering aspects.
Unit-II	:	Regulatory structures used in protected structures; types of greenhouse/polyhouse/net house, cold frames, effect of environmental factors, viz. temperature, light, CO ₂ and humidity on growth of different vegetables, manipulation of CO ₂ , light and temperature for vegetable production, fertigation.
Unit-III	:	Nursery raising in protected structures like poly-tunnels, types of benches and containers, different media for growing nursery under cover.
Unit-IV	:	Regulation of flowering and fruiting in vegetable crops, technology for raising tomato, sweet pepper, cucumber and other vegetables in protected structures, training and staking in protected crops, varieties and hybrids for growing vegetables in protected structures.
Unit-V	:	Problem of growing vegetables in protected structures and their remedies, insect and disease management in protected structures; use of protected structures for seed production.

Practical:

Study of various types of structures. Study of different methods to control temperature, CO ₂ and light. Study of soil and soil less media. Study of training and pruning in vegetable crops. Study of fertigation and nutrient management under protected structure. Study of insect pests and diseases in greenhouse and its control. Study of hybrid seed production of vegetables. Economics of protected cultivation (Any one crop). Visit to established green/polyhouse/ shade net house in the region.	
Practical No.	Topic
1-2	Study of various types of structures
3-4	Study of different methods to control temperature, CO ₂ and light
5	Study of soil and soil less media
6	Study of training and pruning in vegetable crops
7-8	Study of fertigation and nutrient management under protected structure
9-10	Study of insect pests and diseases in greenhouse and its control
11-12	Study of hybrid seed production of vegetables
13-14	Economics of protected cultivation (Any one crop)
15-16	Visit to established green/polyhouse/ shade net house in the region

Reference Books:

<p>Anonymous (2003). Proc. All India Seminar on Potential and Prospects for Protective Cultivation. Organised by Institute of Engineers, Ahmednagar. Dec.12-13, 2003.</p> <p>Chandra S & SomV. (2000). Cultivating Vegetables in Green House. Indian Horticulture 45: 17-18.</p> <p>Prasad S & Kumar U. (2005). Greenhouse Management for Horticultural Crops. 2nd Ed. Agrobios.</p> <p>Tiwari GN. (2003). Green House Technology for Controlled Environment. Narosa Publ. House.</p> <p>Chadha KL & Kalloo G. (Eds.). (1993-94). Advances in horticulture. Malhotra Pub I. House.</p> <p>Kalloor G & Singh K (Ed.). (2000). Emerging Scenario in Vegetable Research and Development. Research Periodicals & Book Publ. House.</p>

Course No. : VSC-604
Title : BIOTECHNOLOGY IN VEGETABLE CROPS
Credit : 2 +1=3

Theory:

Crops: Tomato, eggplant, hot and sweet pepper, potato, cabbage, cauliflower, tapioca, onion, cucurbits.	
Unit-I	: In vitro culture methods and molecular approaches for crop improvement in vegetables, production of haploids, disease elimination in horticultural crops, micro grafting, somoclones and identification of somaclonal variants, in vitro techniques to overcome fertilization barriers, in vitro production of secondary metabolites.
Unit-II	: Protoplast culture and fusion; construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species, in vitro conservation.
Unit-III	: In vitro mutation for biotic and abiotic stresses recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology.
Unit-IV	: Quality improvement, improvement for biotic and abiotic stresses transgenic plants.
Unit-V	: Role of molecular markers in characterization of transgenic crops, fingerprinting of cultivars etc., achievements, problems and future thrusts in horticultural biotechnology.

Practical:

Establishment of axenic explants. Study of organogenesis. Production of suspension culture. Protoplast isolation, fusion. Regeneration and identification of somatic hybrids and cybrids. Identification of embryonic and non-embryonic calli. In vitro mutant selection for biotic and abiotic stresses. In vitro production and characterization of secondary metabolites. DNA isolation and quantification. PCR based DNA amplification and polymorphism. Methods of gene transformation. Molecular characterization of transgenic vegetable plants.	
Practical No.	Topic
1	Establishment of axenic explants
2	Study of organogenesis
3	Production of suspension culture

4	Protoplast isolation, fusion
5	Regeneration and identification of somatic hybrids and cybrids
6	Identification of embryonic and non-embryonic calli
7	In vitro mutant selection for biotic and abiotic stresses.
8-9	In vitro production and characterization of secondary metabolites.
10-11	DNA isolation and quantification.
12-13	PCR based DNA amplification and polymorphism.
14-15	Methods of gene transformation.
16	Molecular characterization of transgenic vegetable plants.

Reference Books:

- Chawla H.S. 2004. Introduction to Plant Biotechnology Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi. 110 001.
- Bajaj YPS. (Ed.) 1987. Biotechnology in Agriculture and Forestry. Vol. XIX. Hitech and Micropropagation. Springer. Chadha KL, Ravindran PN & Sahijram L. (Ed.) 2000. Biotechnology of Horticulture and plantain Crops. Malhotra Publ. House.
- Debnath M. 2005. Tools and Techniques of Biotechnology. Pointer Publ.
- Glover MD. 1984. Gene Cloning. The Mechanics of DNA Manipulation. Chapman & Hall.
- Gorden H & Rubsell S. 1960. Hormones and Cell Culture. AB Book publ.
- Pathasarathy V A, Bose TK, Deka PC, Das P, Mitra SK & Mohanadas S. 2001. Biotechnology fo Horticultural Crops. Vols, I-III. Naya Prokash.
- Pierik RLM. 1987. In Vitro Culture of Higher Plants. Martinus Nijhoffpubl.
- Prasad S. 199. Impact of Plant Biotechnology on Horticulture. 2 nd Ed. Agro Botanica.
- Sharma R. 2000. Plant Tissue Culture. Campus Books.
- Singh BD. 2001. Biotechnology. Kalyani.
- Skoog Y. & Miller CO. 1957. Chemical Regulation of Growth and Formation in Plant Tissue Cultured in vitro.
- Attidel. III Symp. on Biotechnology Action of Growth Substance.
- Vasil TK, Vasi M, While DNR & Bery HR. 1979. Somatic Hybridization and Genetic Manipulation in plants. plant Regulation and Workd Agriculture. Planum Press.
- Williamson R. 1981-86. Genetic Engineering Vols. I.V.

Course No.	: VSC 605
Title	: SEED CERTIFICATION, PROCESSING AND STORAGE OF VEGETABLE CROPS
Credits	: 3 (2+1)

Theory:

Unit-I	:	Seed certification, objectives, organization of seed certification, minimum seed certification standards of vegetable crops, field inspection, specifications for certification.
Unit-II	:	Seed processing, study of seed processing equipments, seed cleaning and upgrading, Seed packing and handling, equipments used for packaging of seeds, procedures for allocating lot number.
Unit-III	:	Pre-conditioning, seed treatment, benefits, types and products, general principles of seed storage, advances in methods of storage, quality controlling storage, storage containers, seed longevity and deterioration, sanitation, temperature and relative humidity control.
Unit-IV	:	Seed testing; ISTA rules for testing, moisture, purity germination, vigor test, seed sampling, determination of genuineness of varieties, seed viability, seed health testing; seed dormancy and types of dormancy, factors responsible for dormancy.
Unit-V	:	Seed marketing, demand forecast, marketing organization, economics of seed production; farmers' rights, seed law enforcement, seed act and seed policy.

Practical:

Management of isolation distance in seed production. Seed viability and seed vigor tests of vegetable seeds. Seed sampling, purity, moisture testing. Quick test of germination. Practices in rouging in seed plot. Handling of seed testing equipment and processing machines. Field and seed inspection. Seed treatment methods. Seed priming and pelleting, mixing and dividing instruments. Seed cleaning, grading and packaging and storage of vegetable seeds. Visit to seed testing laboratories and processing plants. Visit to seed processing unit and warehouse and to know about sanitation standards.

Practical No.	Topic
1	Management of isolation distance in seed production
2-3	Seed viability and seed vigor tests of vegetable seeds
4-5	Seed sampling, purity, moisture testing
6	Quick test of germination
7	Practices in rouging in seed plot
8-9	Handling of seed testing equipment and processing machines
10	Field and seed inspection
11	Seed treatment methods

12	Seed priming and pelleting, mixing and dividing instruments
13-14	Seed cleaning, grading and packaging and storage of vegetable seeds
15	Visit to seed testing laboratories and processing plants
16	Visit to seed processing unit and warehouse and to know about sanitation standards.

Reference Books:

<p>Agrawal PK & Oadlani M. 1992. Techniques in Seed Science and Technology. South Asian Publication.</p> <p>Singh N, Singh OK, Singh YK & Kumar Y. 2006. Vegetable Seed Production Technology. International Book Oistr. Co.</p> <p>Singh SP. 2001. Seed Production of Commercial Vegetables. Agrotech Pub!. Academy.</p> <p>Tanwar NS & Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, GOI, New Delhi.</p>

Course No.	: VSC- 606
Title	: ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS
Credits	: 2+1=3

Theory:

Unit-I	:	Environmental stress and its types, soil parameters including pH, classification of vegetable crops based on susceptibility and tolerance to various types of stress; root stock, use of wild species, use of anti-transpirants.
Unit-II	:	Mechanism and measurements of tolerance to drought, water logging, soil salinity, frost and heat stress in vegetable crops.
Unit-III	:	Soil-plant-water relations under different stress conditions in vegetable crops production and their management practices.
Unit-IV	:	Techniques of vegetable growing under water deficit, water logging, salinity and sodicity.
Unit-V	:	Techniques of vegetable growing under high and low temperature conditions, use of chemicals in alleviation of different stresses.

Practical:

Identification of susceptibility and tolerance symptoms to various types of stress in vegetable crops. Measurements of tolerance to various stresses in vegetable crops. Short term experiments on growing vegetable under water deficit, water logging, salinity and sodicity, high and low temperature conditions. Use of chemicals for alleviation of different stresses.	
Practical No.	Topic
1-5	Identification of susceptibility and tolerance symptoms to various types of stress in vegetable crops.
6-10	Measurements of tolerance to various stresses in vegetable crops.
11-14	Short term experiments on growing vegetable under water deficit, water logging, salinity and sodicity, high and low temperature conditions.
15-16	Use of chemicals for alleviation of different stresses.

Reference Books:

Dwivedi P. and Dwivedi, R. S. 2005. Physiology of Abiotic Stress in Plants. Agrobios.
Lerner H. R. (Ed.). 1999. Plant Responses to Environmental Stresses. Marcel Decker.
Maloo S. R. 2003. Abiotic Stresses and Crop Productivity. Agrotech Publ., Academy.

Minor Subject

Course No.	: FSC 505
Course title	: PROPAGATION AND NURSERY MANAGEMENT FOR FRUIT CROPS
Credits	: 2+1

Theory:

Unit-I	:	Introduction, life cycles in plants, cellular basis for propagation. Sexual propagation, apomixis, poly-embryony, chimeras. Principle factors influencing seed germination of horticultural crops, dormancy. Hormonal regulation of germination and seedling growth.
Unit-II	:	Seed quality, treatment, packing, storage, certification, testing. Asexual propagation-rooting of soft and hard wood cutting under mist by growth regulators. Rooting of cuttings in hotbeds Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering – principle and methods
Unit-III	:	Budding and grafting – selection of elite mother plants, methods. Establishment of bud wood bank, stock, scion and inter stock, relationship –Incompatibility.

		Rejuvenation through top working. Progeny orchard and scion bank.
Unit-IV	:	Micro-propagation-principles and concepts, commercial exploitation in horticultural crops. Techniques - in vitro clonal propagation, direct organogenesis, embryogenesis, micro-grafting, meristem culture. Hardening, packing and transport of micro-propagules.
Unit-V	:	Nursery-types, structures, components, planning and layout. Nursery management practices for healthy propagule production. Nursery act.

Practical:

Anatomical studies in rooting of cutting and graft union. Construction of propagation structures, study of media and PGR. Hardening – case studies, micro-propagation, explant preparation. Media preparation, culturing – *in vitro* clonal propagation. Meristem culture, shoot tip culture, axillary bud culture. Direct organogenesis, direct and indirect embryogenesis, micro grafting and hardening. Visit to TC labs and nurseries.

Practical No.	Topic
1-2	Anatomical studies in rooting of cutting and graft union
3-4	Construction of propagation structures, study of media and PGR
5-6	Hardening – case studies, micro-propagation, explant preparation
7-8	Media preparation, culturing – <i>in vitro</i> clonal propagation
9-10	Meristem culture, shoot tip culture, axillary bud culture.
11-13	Direct organogenesis, direct and indirect embryogenesis, micro grafting, hardening
14-16	Visit to TC labs and nurseries

Reference Books:

Hartmann HT & Kester DE. 1989. Plant Propagation – Principles and Practices. Prentice Hall of India.

Bose TK, Mitra SK & Sadhu MK. 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prokash.

Peter KV. (Ed.). 2008. Basics of Horticulture. New India Publ. Agency.

Singh SP. 1989 Mist Propagation. Metropolitan Book Co.

Rajan S & Baby LM. 2007. Propagation of Horticultural Crops. New India Publ. Agency.

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

PP-605	Climate Change and Crop Growth	2+0=2
BIOCHEM-603	Biochemistry of Biotic and Abiotic Stress	3+0=3

Supporting Subjects (Min. 05 credits)		
STAT-601	Advanced Statistical Methods	2+1=3
AGRON-606	Advances in Weed Management	2+0=2
Seminar (02 credits)		
VSC 691	Doctoral Seminar I	1+0=1
VSC 692	Doctoral Seminar II	1+0=1
Doctoral Research (45 credits)		
	Doctoral Research	0+45=45

Non Credit Compulsory Courses		
PGS 501	Library and Information Services	1 (0+1)

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

PGS 504

Basic Concepts in Laboratory Techniques

1 (0+1)

Practical:

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets; 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 Books:

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
2. Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

PGS 502

Technical Writing and Communications Skills

1 (0+1)

Practical:

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

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

Suggested Books:

1. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
2. Collins' Cobuild English Dictionary. 1995. Harper Collins.
3. Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
4. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
5. James HS. 1994. Handbook for Technical Writing. NTC Business Books.

6. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
7. Mohan K. 2005. Speaking English Effectively. MacMillan India.
8. Richard WS. 1969. Technical Writing. Barnes & Noble.
9. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.
10. Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
11. Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

PGS 503 (e-Course) Intellectual Property and its Management in Agriculture 1 (1+0)

Theory:

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; 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 Books:

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