

# Biotechnology Centre

## Ph.D. programme

### Courses offer

Group	Number	Title of Course	Credit	
<b>Major</b>	1	MBB 601	Advances in plant molecular biology	3(3+0)
	2	MBB 602	Advances in genetic engineering	3(3+0)
	3	MBB 603	Advances in microbial biotechnology	3(3+0)
	4	MBB 604	Advances in crop biotechnology	3(3+0)
	5	MBB 605	Advances in functional genomics and proteomics	2(2+0)
	6	MBB 606	Commercial plant tissue culture	2(2+0)
<b>Total</b>			<b>16(16+0)</b>	
<b>Seminar</b>	MBB 691	Doctoral Seminar I	<b>2(0+2 )</b>	
<b>Thesis research</b>	MBB 699	Research	<b>45(0+45)</b>	
<b>Minor</b>	FSC 604	Genomics and bioinformatics in horticulture	3(2+1)	
	PP 601	Functional genomics and genes associated with a few physiological processes	2(2+0)	
	PP 603	Molecular approaches for improving physiological traits	3(2+1)	
	VSC 604	Biotechnology in vegetable crops	3(2+1)	
<b>Total</b>			<b>9/8</b>	
<b>Supporting</b>	1	MBB 552	General biochemistry	3(2+1)
	2	MBB 554	Principles of microbiology	3(2+1)
<b>Total</b>			<b>6 (4+2)</b>	
<b>Non-Credit Compulsory Course</b>	1.	PGS 501	Library and Information Services	0+1
	2.	PGS 502	Technical Writing and Communications Skills	0+1
	3.	PGS 503	Intellectual Property and its Management in Agriculture	1+0
	4	PGS 504	Basic Concepts in Laboratory Techniques	0+1
	5	PGS 505	Agril Res. Ethics and Rural Dev. Programs	1+0
	6	PGS 506	Disaster Management	1+0
	7		Human value and Professional Ethics	1+1
<b>Total</b>			<b>8(4+4)</b>	
<b>Grand total</b>			<b>86</b>	

**Name of the Programme**

**Doctorate degree in Molecular Biology and Biotechnology**

<b>Subject</b>	<b>Doctorate</b>
<b>Major</b>	15
<b>Minor</b>	08
<b>Supporting</b>	05
<b>Seminar</b>	02
<b>Thesis research</b>	45
<b>Total</b>	75

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### Ph.D. programme

#### Semester wise distribution of courses

Course	Course Title	Course No	Credits
<b>Semester-I</b>			
Major	Advances in plant molecular biology	MBB 601	3(3+0)
	Advances in microbial biotechnology	MBB 603	3(3+0)
	Commercial plant tissue culture	MBB 606	2(2+0)
Minor (any one)	Genomics and bioinformatics in horticulture	FSC 604	3(2+1)
	Molecular approaches for improving physiological traits	PP 603	3(2+1)
Supporting (any one)	Immunology and molecular diagnostics	MBB 512	3(2+1)
	General biochemistry	MBB 552	3(2+1)
	Biostatistics and computers	MBB 553	3(2+1)
Compulsory NC	Library and information services	PGS 501	1(0+1)
	Intellectual property and its managements in agriculture	PGS 503	1(1+0)
	Basic concept in laboratory techniques	PGS 504	1(0+1)
	Human value and professional ethics	HEV	2(1+1)
<b>Semester-II</b>			
Major	Advances in genetic engineering	MBB 602	3(3+0)
	Advances in crop biotechnology	MBB 604	3(3+0)
	Advances in functional genomics and proteomics	MBB 605	2(2+0)
Minor	Biotechnology in vegetable crops	VSC 604	3(2+1)
	Functional genomics and genes associated with a few physiological processes	PP 601	2(2+0)
Supporting (any one)	Biosafety, IPR and bioethics	MBB 510	2(2+0)
	Nano biotechnology	MBB 513	3(3+0)
	Principles of microbiology	MBB 554	3(2+1)

Compulsory NC	Technical writing and communications skills	PGS 502	1(0+1)
	Agriculture research, research ethics and rural development programme	PGS 505	1(1+0)
	Disaster management	PGS 506	1(1+0)
<b>Semester-III</b>			
<i>Written comprehensive exam</i>			
Major	Doctoral seminar I	MBB 691	2(0+2)
	Doctoral research	MBB 699	10(0+10)
<b>Semester-IV</b>	Doctoral research	MBB 699	15(0+15)
<b>Semester-V</b>	Doctoral research	MBB 699	10(0+10)
<b>Semester-VI</b>	Doctoral research	MBB 699	10(0+10)

*Agricultural Statistics not offered*

**Objective**

To discuss the specialized topics and recent advances in the field of plant molecular biology.

**Theory**

**UNIT I**            Arabidopsis in molecular biology, Forward and Reverse Genetic Approaches, Transcriptional and post-transcriptional regulation of gene expression, isolation of promoters and other regulatory elements.

**UNIT II**            RNA interference, Transcriptional gene silencing, Transcript and protein analysis, use of transcript profiling to study biological systems.

**UNIT III**            Hormone regulatory pathways Ethylene, Cytokinin, Auxin and ABA, SA and JA; ABC Model of Floral Development, Molecular basis of self incompatibility, Regulation of flowering photoperiod, vernalization, circadian rhythms.

**UNIT IV**            Molecular biology of abiotic stress responses Cold, high temperature, submergence, salinity and drought; Molecular Biology of plant-pathogen interactions, molecular biology of Agrobacterium Infection, Molecular biology of Rhizobium infection (molecular mechanisms in symbiosis), Programmed cell death in development and defense.

**Suggested Readings**

Buchanan B, Gruissen W & Jones R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, USA.

Lewin B. 2008. Gene IX. Peterson Publications/ Panima. Malacinski GM & Freifelder D. 1998. Essentials of Molecular Biology. 3<sup>rd</sup> Ed. Jones & Bartlett Publ.

Nelson DL & Cox MM. 2007. Lehninger's Principles of Biochemistry. WH Freeman & Co.

Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. Molecular Biology of the Gene. 6th Ed. Pearson Education.

**Objective** To discuss the specialized topics and advances in field of genetic engineering and their application in plant improvement.

**Theory**

**UNIT I** General overview of transgenic plants; Case studies Genetic engineering of herbicide resistance, Transgenic plants resistant to insects/pests, Genetic engineering of abiotic stress tolerance, Engineering food crops for quality, Genetically engineered pollination control, Induction of male sterility in plants.

**UNIT II** Molecular farming of plants for applications in veterinary and human medicine systems Boosting heterologous protein production in transgenics, Rapid production of specific vaccines, High-yield production of therapeutic proteins in chloroplasts.

**UNIT III** Recent developments in plant transformation strategies; Role of antisense and RNAi-based gene silencing in crop improvement; Regulated and tissue-specific expression of transgenes for crop improvement; Gene stacking; Pathway engineering; Marker-free transgenic development strategies; High throughput phenotyping of transgenic plants.

**UNIT IV** Field studies with transgenic crops; Environmental issues associated with transgenic crops; Food and feed safety issues associated with transgenic crops; Risk assessment of transgenic food crops.

**Suggested Readings**

Christou P & Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.

Nichol DST An Introduction to Genetic Engineering Third Edition 2002. Cambridge University Press.

Old RW & Primrose SB 1980 Principles of gene manipulation 1980 University of California Press



**MBB 604**                    **Advances in Crop Biotechnology**                    **3+0**

**Objective**                    To discuss specialized topics on the application of molecular tools in breeding of specific crops.

**Theory**

**UNIT I**                    Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement.

**UNIT II**                    Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc) and biotic (insect pests, fungal, viral and bacterial diseases, weeds, etc) stresses; Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc); edible vaccines, etc.

**UNIT III**                    Molecular breeding constructing molecular maps; integrating genetic, physical and molecular maps; diversity assessment and phylogenetic analysis; molecular tagging of genes/traits; selected examples on marker assisted selection of qualitative and quantitative traits.

**UNIT IV**                    Discussion on application of molecular, transformation and genomic tools for the genetic enhancement in some major field crops such as rice, wheat, cotton, maize, soybean, oilseeds, sugarcane etc.

**Suggested Readings**

Ruplal and Sukanya Lal 1993, Genetic Engineering of Plants for Crop Improvement. CRC Press

Harikumar, VS 2003 Advances in Agricultural Biotechnology. DK Publishers



**MBB 605**                      **Advances in Functional Genomics and Proteomics**                      **2+0**

**Objective**                      To discuss recent advances and applications of functional genomics and proteomics in agriculture, medicine and industry.

**Theory**

**UNIT I**                      Genome sequencing and functional genomics; Human, animal, plant, bacterial and yeast genome projects; genome annotation; *ab initio* gene discovery; functional annotation and gene family clusters; etc.

**UNIT II**                      Functional analysis of genes; RNA-mediated interference; gene knockoffs; Gene traps/ T-DNA insertion lines; homologous recombination; microarray profiling; SAGE; SNPs/variation; yeast-two hybrid screening; gene expression and transcript profiling; EST contigs; EcoTILLING; allele/gene mining; synteny and comparative genomics; Genome evolution, speciation and domestication etc.

**UNIT III**                      Proteomics protein annotation; protein separation and 2D PAGE; mass spectroscopy; protein microarrays; protein interactive maps; structural proteomics protein structure determination, prediction and threading, software and data analysis/ management, etc.

**UNIT IV**                      Discussion on selected papers on functional genomics, proteomics, integrative genomics etc.

### **Suggested Readings**

Specific journals and published references.



<b>FSC 604</b>	<b>Genomics and Bioinformatics in Horticulture</b>	<b>2+1</b>
<b>Objective</b>	Studies on the fundamentals and application of genomics and bioinformatics in horticulture	
<b>Theory</b>		
<b>UNIT I</b>	Primer on bioinformatics and computational genomics, database fundamentals – biological databases, horticultural genome and protein databases, functional genomics.	
<b>UNIT II</b>	Dynamic Programming Sequence Alignment, BLAST search engine, FASTA search engine, Microarrays- Microarray Clustering and Classification, Terminologies and Ontologies - EcoCYC knowledge base of E. Coli metabolism - Description of UMLS Semantic Network.	
<b>UNIT III</b>	Multiple Sequence Alignment, MSA algorithm descriptions, ClustalW, 1D Motifs, Algorithms and Databases, methods for sequence weighting, BLOCKS database, Making BLOCK motifs, PROSITE database, 3D structure alignment, SCOP, DALI, LOCK, MUSTA algorithm for geometric hashing and multiple alignment.	
<b>UNIT IV</b>	Hidden Markov models , Molecular energetics and dynamics , Protein structure prediction, Genetic networks - Modeling and Simulation of Genetic Regulatory Systems- KEGG database of genes and gene pathways/networks - EcoCYC database of metabolic pathways in E. Coli - EGF-signal pathway modeling, Gene finding algorithms – Genome Annotation Assessment Project for Arabidopsis, Comparative genomics algorithms, Genome Alignment.	
<b>UNIT V</b>	3D structure computations, NMR, Xtallography, NMR Structure Determination, X-ray Crystallography Structure Determination, Distance Geometry Description, RNA secondary structure, Molecular Modeling and Drug discovery programs.	
<b>UNIT VI</b>	Phylogenetic algorithms - Treebase database of phylogenetic information for plants mostly, Tree of Life Page, Samples from the Tree of Life, Ribosomal Database Project, Natural Language Processing , Proteomics, 3D Motifs, Applications and Integration with Horticulture, Final Thoughts.	
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Computers, Operating systems and Programming languages, Internet Resources, Horticultural Genome and Protein Databases, BLAST/RNA Structure, Sequence Alignment, Microarray Data Analysis, Ontology, MSA, HMMs, Identification of Functional Sites in Structures, Protein Structure Prediction - Phylogenetics - Gene Finding - Molecular Modeling and Drug Discovery Software – Assignments.</li> </ul>	

### Suggested Readings

- Attwood TK & Parry Smith DJ. 2006. Introduction to Bioinformatics. Pearson Edu.
- Baxevaris AD. 2005. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd Ed. Wiley.
- Bourne PE & Weissig H. (Eds.). 2004. Structural Bioinformatics. John Wiley & Sons.
- Durbin R, Eddy SR, Krogh A & Mitchison G. 1999. Biological Sequence Analysis: Probabilistic Model of Proteins and Nucleic Acids. Cambridge Univ. Press.
- Keshavachandran R, Nazeem PA, Girija D, John PS & Peter KV. 2007. Recent Trends in Biotechnology of Horticultural Crops. Vols. I, II. New India Publ. Agency.
- Kohane IS, Kho A & Butte AJ. 2002. Microarrays for an Integrative Genomics. MIT Press.
- Mount DW. 2001. Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbour Laboratory Press.

**VSC 604      Biotechnology in Vegetable Crops      2+1****Objective**      To teach advances in biotechnology for improvement of vegetable crops.**Theory**      Crops: Tomato, eggplant, hot and sweet pepper, potato, cabbage, cauliflower, tapioca, onion and 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, somaclones 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, callus initiation and multiplication, production of suspension culture, cell and protoplast culture, fusion, regeneration and identification of somatic hybrids and cybrids; Identification of embryonic and non-embryonic calli, development of cell lines; in vitro mutant selection for biotic and abiotic stresses, In vitro production and characterization of secondary metabolites, isolated microspore culture, isolation and amplification of DNA, gene transfer methods, molecular characterization of transgenic plants.

**Suggested Readings**

Bajaj YPS. 1987. Biotechnology in Agriculture and Forestry. Vol.XIX.Springer.

Chadha KL, Ravindran PN & Sahijram L (Eds.). 2000. Biotechnology of Horticulture and Plantation 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.

Keshavachandran R & Peter KV. 2008. Plant Biotechnology: Tissue Culture and Gene Transfer. Longman

Keshavachandran R et al. 2007. Recent Trends in Biotechnology of Horticultural Crops. New India Publ..

Panopoulos NJ. (Ed.). 1981. Genetic Engineering in Plant Sciences. Praeger Publ.

Parthasarathy VA, Bose TK, Deka PC, Das P, Mitra SK & Mohanadas S. 2001. Biotechnology of Horticultural Crops. Vols. I-III. Naya Prokash.

Pierik RLM. 1987. In vitro Culture of Higher Plants. Martinus Nijhoff Publ.

Prasad S. 1999. Impact of Plant Biotechnology on Horticulture. 2 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. II 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 World Agriculture. Planum Press.

Williamson R. 1981-86. Genetic Engineering. Vols. I-V.



**PP 603                      Molecular Approaches for Physiological Traits Improvement                      3(2+1)**

**Objective**                      To impart knowledge to improve the physiological traits using molecular approaches.

**Theory**

**UNIT I**                      importance of Molecular Breeding for complex multi-gene controlled physiological traits and its relevance in augmenting trait based breeding. Physiological traits with relevance to growth, development, abiotic stress tolerance, nutrient acquisition, Accurate phenotyping of germplasm accession and mapping populations.

**UNIT II**                      The advantages of "Trait based" breeding approaches. Concept of segregation, independent assortment and linkage. The concept of molecular markers, various types of Dominant and Co-dominant marker systems.

**UNIT III**                      Relevance and development of mapping populations and genetic analysis using marker systems. Advantages of association mapping and the concept of linkage, LD decay and population structure.

**UNIT IV**                      Statistical analysis to assess the variance in phenotypic traits and molecular data. Assessment of genetic parameters such as heritability, genetic advance etc.

**UNIT V**                      Strategies for QTL introgression and Marker Assisted Selection (MAS). Map based cloning of novel genes and alleles. Allele mining

**UNIT VI**                      Transgenic approach in improving physiological processes-Introduction to GMOs and application in crop improvement; gene mining, sequence structure & function analysis using bioinformatics tools, identification of candidate genes for various physiological process associated with specific traits (such as stress tolerance) and their potential benefits in transgenic crops.

**UNIT VII**                      Cloning full-length candidate genes, stress inducible promoters, strategies to clone and characterize and make constructs for specific crop, gene stacking strategies, tissue specific expression and functional validation of genes.

**UNIT VIII**                      Transformation of crop plants-Agrobacterium and use of other organisms for transformation-particle gun transformation and other methods.

**UNIT IX**                      Selection of transformants-molecular analysis on the basis of qRT-PCR, Southern, Northern analysis and immunoassays; estimation of copy number, Concept of desirable number of independent events.

**UNIT X**                      Evaluation of transgenics based on empirical/physiological. Biochemical process under specific conditions on the basis of gene function. Generation of T1 populations, event characterization and generation of molecular data as per the regulatory requirements.

**UNIT XI**                      Issues related to Biosafety and Registration of Transgenic Agricultural Organisms, methods to detect GMOs from agricultural products.

## Practical

- Phenotyping approaches for the different physiological traits.
- Genotyping options using gene-scan systems.
- Development of SSR, SNP and SCAR markers
- Resolution of polymorphism on agarose gels and PAGE
- Genotyping using a DNA sequencing machine
- Scoring of gels and assessment of polymorphism
- Statistical approaches to assess genetic variability, heritability and other parameters
- Phylogenic analysis
- Principal component analysis and construction of dendrograms.
- Construction of Linkage map, QTL maps, population structure, LD decay etc. leading to identification of QTLs
- Bioinformatics –
  - Sequence analysis
  - Structure analysis
- Molecular biology –
  - Genomic/plasmid dna isolation
  - Rna isolation.
  - Full-length gene cloning
  - Vector construction with specific promoter
  - Gene stacking
  - Transient assays
  - Transformation in model system
- Crop transformation –
  - Agro bacterium mediated transformation (in-planta & invitro)
  - particle-gun transformation
  - Evaluation of transgenics - semi quantitative & quantitative
  - RT-PCR, southern blot, northern blot, western blot and ELISA, biochemical/physiological assay based on the function of gene & testing LOD.

## Suggested Readings

Selected articles from various journals



**MBB 552**      **General Biochemistry**      **2+1**

**Objective**      To provide elementary knowledge/overview of structure, functions and metabolism of biomolecules.

**Theory**

**UNIT I**      Scope and importance of biochemistry in agriculture; Fundamental principles governing life; structure of water; acid base concept and buffers; pH; hydrogen bonding; hydrophobic, electrostatic and Van der Waals forces; General introduction to physical techniques for determination of structure of biopolymers.

**UNIT II**      Classification, structure and function of carbohydrates, lipids and biomembranes, amino acids, proteins, and nucleic acids.

**UNIT III**      Structure and biological functions of vitamins, enzymes classification and mechanism of action; regulation, factors affecting enzyme action. Fundamentals of thermodynamic principles applicable to biological processes, Bioenergetics.

**UNIT IV**      Metabolism of carbohydrates, photosynthesis and respiration, oxidative phosphorylation, lipids, proteins and nucleic acids. DNA replication, transcription and translation; recombinant DNA technology, Nutritional aspects of carbohydrates, lipids, proteins and minerals.

**Practical**

- Preparation of standard and buffer solutions.
- Extraction and estimation of sugars and amino acids.
- Estimation of proteins by Lowry's method.
- Estimation of DNA and RNA by Diphenylamine and orcinol methods.
- Estimation of ascorbic acid.
- Separation of biomolecules by TLC and paper chromatography

**Suggested Readings**

Conn EE & Stumpf PK. 1987. Outlines of Biochemistry. John Wiley.

Metzler DE. Biochemistry. Vols. I, II. Wiley International.

Nelson DL & Cox MM. 2004. Lehninger's Principles of Biochemistry. MacMillan.

Voet D & Voet JG. Biochemistry. 3rd Ed. Wiley International.



<b>PGS 501</b>	<b>Library and Information Services</b>	<b>1(0+1)</b>
<b>Objective</b>	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.	
<b>Practical</b>	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; ere sources access methods.	
<b>PGS 504</b>	<b>Basic Concepts in Laboratory Techniques</b>	<b>1(0+1)</b>
<b>Objective</b>	To acquaint the students about the basics of commonly used techniques in laboratory.	
<b>Practical</b>	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; Neutralization 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 Hand Book of Laboratory Safety*. CRC Press.

Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

**PGS505      Agriculture Research, Research Ethics and Rural Development Program's**  
**(e-Course)    1(1+0)**

**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; 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 II**        Research ethics research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

**UNIT III**        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, 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 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.  
Singh K.. 1998. Rural Development Principles, Policies and Management. Sage Publ.

**PGS 506      Disaster Management      (e-Course) 1(1+0)**

**Objective** To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

**Theory**

**UNIT I** Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change Global warming, Sea Level rise, Ozone Depletion

**UNIT II** Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

**UNIT III** Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response Police and other organizations.

**Suggested Readings**

Gupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. Coping with Catastrophe A Handbook of Disaster Management. Routledge.

Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.

**PGS 502      Technical Writing and Communications Skills      1(0+1)**

**Objective**

To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

**Practical**

- **Technical Writing** - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.
- **Communication Skills** - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern Weak forms in connected speech Participation in group discussion Facing an interview, presentation of scientific papers.

## Suggested Readings

Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India. Collins' Cobuild English Dictionary. 1995. Harper Collins. Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & 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. Barnes & Noble. Robert C. (Ed.). 2005. Spoken English Flourish Your Language. Abhishek. Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2<sup>nd</sup>Ed. Prentice Hall of India. 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)**

### Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

### Theory

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 Readings

Erbisch FH & 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.