COURSE STRUCTURE AND SYLLABI

of

M.Sc.Agriculture

in

(Genetic & Plant Breeding)

2020-21 Batch

Centurion UNIVERSITY

Shaping Lives... Empowering Communities...

M.S.SWAMINATHAN SCHOOL OF AGRICULTURE
CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT
Odisha-761211, INDIA

Web Site: - www.cutm.ac.in

Master's programme : M.Sc. Agriculture(**Genetics and Plant Breeding)**

Course structure

Course code	Course title	Credits
MAGP 1101*	Principles of genetics	2+1
MAGP 1102*	Principles of cytogenetic	2+1
MAGP 1103*	Principles of plant breeding	2+1
MAGP 1204*	Principles of quantitative genetics	2+1
MAGP2107	Heterosis breeding	2+1
MAGP1205*	Cell biology and molecular Genetics	2+1
MAGP 1206*	Biotechnology for crop improvement	2+1
MAGP 2191*	Master's Seminar	1+0
MAGP 2199*& MAGP2299*	Master's Thesis	0+20

***Compulsory**

Minor Departments: Plant Molecular biology and bio technology; Biochemistry; Statistics and Mathematics, Entomology, Plant pathology, Plant physiology

Supporting departments: Statistics and Mathematics, Entomology, Plant pathology, Plant physiology

Code	Course Title	Credits
MAMB1101	Principles of biotechnology	2+1
MAMB 1102	Fundamentals of molecular biology	3+0
MAMB1205	Techniques in molecular biology I	0+3
MAST2102	Statistical methods for applied sciences	2+1
MAMB 2110	Genomics and proteomics	2+0

Non credit compulsory courses: 6 credits (Compulsory for Master's programme in all disciplines)

Course code	Course title	Credits
MALI1101	Library and information services	0+1
MACS1101	Technical writing and communication Skills	0+1
MAIP 1201 (e-Course)	Intellectual property and its management in agriculture	1+0
MALT1201	Basic concepts in laboratory techniques	0+1
MAAR2101 (e-Course)	Agricultural research, research ethics and rural development programmes	1+0
MADM2101 (e-Course)	Disaster management	1+0

Semester- wise distribution of courses

First Semester

Course No	Course Title	Credits (T+P)
MAGP 1101	Principles of Genetics	2+1
MAGP1102	Principles of cytogenetics	2+1
MAGP1103	Principles of plant breeding	2+1
MAMB 1101	Principles of biotechnology	2+1
MAMB 1102	Fundamentals of molecular biology	3+0
MALI1101	Library and information services	0+1
MACS1101	Technical writing and communications Skills	0+1

Second Semester

MAGP1204	Principles of quantitative genetics	2+1
MAGP 1205	Cell biology and molecular Genetics	2+1
MAPB 1206	Biotechnology for crop improvement	2+1
MAMB1205	Techniques in molecular biology I	0+3
MAST2102	Statistical methods for applied sciences	2+1
MAGP2191	Masters seminar	1+0
MAIP 1201 (e-Course)	Intellectual property and its management in agriculture	1+0
MALT1201	Basic concepts in laboratory techniques	0+1

Third Semester

MAGP 2107	Heterosis breeding	1+1
MAMB 2110	Genomics and proteomics	2+0
MAGP2199	Masters research	0+10
MAAR2101 (e-Course)	Agricultural research, research ethics and rural development programmes	1+0
MADM2101 (e-Course)	Disaster management	1+0

Fourth Semester

MAGP2299	Masters research	0+10

SEMESTER – I

MAGP 1101 PRINCIPLES OF GENETICS 2+1

Objective

This course is aimed at understanding the basic concepts of genetics, helping students to developtheir analytical, quantitative and problem solving skills from classical to molecular genetics.

Outcomes: On completion of this course, the successful students should be able to: Practical skills and concepts leading to research to generate high yielding varieties.-Employability

Theory

UNIT I

Beginning of genetics; Cell structure and cell division; Early concepts of inheritance, Mendel's laws; Discussion on Mendel's paper, Chromosomal theory of inheritance.

UNIT II

Multiple alleles, Gene interactions. Sex determination, differentiation and sex-linkage, Sex influenced and sex-limited traits; Linkage-detection, estimation; Recombination and genetic mapping in eukaryotes, Chiasmata and the time of crossing over,

UNIT Ill

Somatic cell genetics,

UNIT IV

Structural and numerical changes in chromosomes; Variation in chromosome number; Nature, structure and replication of the genetic material; Basic features of DNA replication *in vivo*; DNA modification and restriction; Organization of DNA in chromosomes; Genetic code; Protein biosynthesis; Split genes; Translation and Genetic code.

UNITV

Regulation of gene activity in prokaryotes; Molecular chaperones and gene expression .Gene regulation in eukaryotes, RNA editing. Gene silencing, Anti-sense RNA and ribozymes; Micro-RNAs (miRNAs)

UNITVI

Genetic fine structure analysis, Allelic complementation; Transposable genetic elements, overlapping genes, Pseudogenes, Oncogenes, Gene families and clusters.

UNITVII

Molecular mechanism of mutation, repair and suppression -reverse mutations and suppressor mutations.

UNlVVIII

Extra chromosomal inheritance **-**Genetics of mitochondria and chloroplasts

UNIT IX

Population - Mendelian population - Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium.

UNIT X

Gene isolation, synthesis and Cloning, genomic and cDNA libraries, PCR based cloning, positional cloning; Nucleic acid hybridization and immunochemical detection;

UNIT XI

Genomics and proteomics; Functional and pharmacogenomics; Metagenomics.

UNITXII

Concepts of Eugenics, Epigenetics, Genetic disorders and Behavioural genetics.

Practical

Laboratory exercises in probability and chi-square, Demonstration of genetic principles using laboratory organisms, Chromosome mapping using three point test cross, Tetrad analysis, induction and detection of mutations through genetic tests, DNA extraction and PCR amplification, Electrophoresis - basic principles and running of amplified **DNA,** Extraction of proteins and isozymes- use of Agrobacterium mediated method, Biolistic gun; practical demonstrations, Detection of transgenes in the exposed plant material, Visit to transgenic glasshouse and learning the practical considerations.

Suggested Readings

Gardner EJ **&**Snustad DP. 1991. *Principles of Genetics*. John Wiley *&*Sons.
Klug WS & Cummings MR. *2003.Concepts of Genetics*. Peterson Edu.
Lewin 8.2008.*Genes IX*. Jones & Bartlett Publ.
Russell PJ. 1998. *Genetics*. The Benzamin/Cummings Publ. Co.
Snustad DP & Simmons MJ. 2006. *Genetics*. 4th Ed. John Wiley & Sons.
Strickberger MW. 2005. *Genetics* (lll Ed). Prentice Hall, New Delhi, lndia
Tamarin RH. 1999. *Principles of Genetics*. Wm. C. Brown Publs.
Uppal S, YadavFl, Subhadra**&**Saharan RP. 2005. *Practical Manual on Basic and Applied Genetics.* Dept. of Genetics, CCS HAU Hisar.

MAGP 1102 PRINCIPLES OF CYTOGENETICS 2+1

Objective

To provide insight into structure and functions of chromosomes, chromosome mapping, polyploidy and cytogenetic aspects of crop evolution.

Outcomes: On completion of this course, the successful students should be able to: Practical skills and concepts leading to entrepreneurship and research to generate high yielding and disease resistant varieties.-Employability

Theory

UNIT l

Architecture of chromosome in prokaryotes and eukaryotes - Terminology. Euchromatin and heterochromatin; karyotype and techniques for karyotyping; Banding patterns for identification of

chromosomes **-** C value paradox - DNA content (genome size) and adaptability, Split gene; Special types of chromosomes - lamp brush chromosomes, polytene chromosomes **B** chromosomes and sex chromosomes.

UNIT ll

Mitosis cell cycle-significance of mitosis; Meiosis cell cycle- -significance of meiosis, Difference between mitosis and meiosis- significance; Crossing over-mechanisms and theories of crossing over.

UNIT III

Recombination models and cytological basis of crossing over; Structural chromosomal aberrations, Deletions- types of deletions, origin and occurrence_- meiosis and breeding behaviour of deletion heterozygote, genetics of deletions; Duplications -_ origin, types of duplications_ chromosome pairing and crossing over at meiosis in duplicate heterozygotes, phenotypic effects of duplications; Bridge-breakage _- fusion cycle in corn. Role of duplications in plant breeding and evolution; lnversions: origin, types of inversions – meiotic pairing in inversions-detection and uses of pericentric and paracentric inversions; Breeding behaviour of inversion heterozygotes, Role of inversions in evolution and karyotype; Breeding behaviours of translocation heterozygote-Permanent hybrids in *Oenothera*– Robertsonian translocations, detection and uses; Numerical chromosomal aberrations: classification; Euploidy; Haploidy – Terminology and classification of haploids; Origin, occurrence and production of haploids Detection of haploids Phenotypic effects of haploids - Meiosis and Breeding behaviour of haploids. Use of haploids in plant breeding.

UNIT IV

Polyploidy- autopolyploidy, Origin and types of autopolyploids, Meiotic behaviour in autopolyploids- Autotriploids and autotetraloids; Allopolypioidy- segmental allopolyploidy Genome analysis of allopolyploids - Evolution of important polyploid crops _ Wheat, Tobacco, Brassica and Cotton; Aneuploidy _ hyperploids - trisomics and tetrasomics; primary trisomics and secondary trisomics, Meiotic behaviour in trisomics and uses; Balanced tertiary trisomics in hybrid seed production - Trisomics in polyploids; tetrasomics; Aneuploidy - hypoploidy-Monosomics and nullisomics - Method of production of monosomics- Meiotic behaviours of monosomics - Monosomics in maize; Production of nullisomics - Meiotic behaviour of nullisomics, nullisomic analysis, use of nullisomics in locating genes on chromosomes; Aliengene transfer through chromosome manipulations- transfer of genome to 4x and 6x wheat - transfer of genome in the genus Arachis.

UNIT V

Transfer of individual whole chromosome- alien addition lines - alien substitution lines; Apomixis- Evolutionary and genetic problems in crops with apomixis; Chromosome painting, chromosome walking and chromosome jumping; Artificial chromosome construction and its uses; Reversion of autopolyploids to diploids; Genome mapping in polyploids.

UNIT VI

Fertilization barriers in crop plants at pre-and post-fertilization levels- *In vitro* techniques to overcome the fertilization barriers in crops; chromosome manipulations in wide hybridization; case studies- Production and use of haploids, dihaploids and doubled haploids in genetics and breeding.

Practical

Learning the cytogenetics laboratory, various chemicals to be used for fixation, dehydration, embedding, staining, cleaning etc. - Microscopy: various types of microscopes- Observing sections of specimen using Electron microscope; Preparing specimen for observation- Fixative preparation and fixing specimen for light microscopy studies in cereals - Studies on the courseof mitosis in wheat, pearl millet - Studies on the course of mitosis in onion and Aloe vera ~Studies on the course of meiosis in cereals, millets and pulses - Studies on the course of meiosis in oilseeds and forage crops- Using micrometers and studying the pollengrain size in various crops: Various methods of staining and preparation of temporary and permanent slides- Pollen germination *in vivo* and *in vitro*; Microtomy and steps in microtomy; Agents employed for the induction of various ploidy levels; Solution preparation and application at seed, seedlinglevel- Identification of polyploids in different crops- Induction and identification of haploids;Anther culture and Ovule culture- Morphological observations on synthesized autopolyploids- Observations on C-mitosis, learning on the dynamics of spindle fibre assembly- Morphologicalobservations on alloployploids- Morphological observations on aneuploids- Cytogenetic analysisof interspecific and intergeneric crosses- Maintenance of Cytogenetic stocks and theirimportance in crop breeding. Various ploidy levels due to somaclonal variation; Polyploidy inornamental crops-Fluorescence in situ hybridization (FISH)- Genome in situ hybridization (GISH).

Suggested Readings

Becker K **&**Hardin. 2004. *The World of Cell*. 5th Ed. Pearson Edu.
Carroll M. 1989. *Organelles*. The Guilford Press.
Charles B . 1993. *DiscussioinsinCytogenetics*. prentice Hall.14
Darlington CD **&**La Cour LF. 1969. *The Handling of Chromosomes*. Georger Allen **&**Unwin**-** Ltd.
Elgin SCR. 1995. *Chromatin Structure and Gene Expression*. IRL Press.
Gray P. 1954. *The Mirotomist's_Formulatory Guide*. The Blakiston C o.
Gupta PK **&**Tsuchiya T. 1991. *Chromosome Engineering in plants: Genetics, Breeding and Evolution.* Part A. Elsevier.
Gupta PK. 2000. *Cytogenetics*. Rastogi Publ.
Johannson DA. 1975. *Plant Microtechnique*. McGraw Hill.
Karp G 1996. *Cell and Molecular Biology: Concepts and Experiments*. John Wiley *&*Sons.
Khush GS. 1973. *Cytogenetics of Aneuploids*. Academic Press.
Sharma AK *&*Sharma A.198.8 *Chromosome Techniques: Theory and practice*. Butterworth.
Sumner AT. 1982. *Chromosome Banding*. Unwin Hyman Publ.
Swanson CP. 1960. *Cytology and Cytogenetics*. Macmillan **&**Co.
Singh B D2006. *Genetics*. KalyaniPubnlishers, New Delhi.
Singh B D 2006. *Plant Biotechnology*, Kalyani Publishers New Delhi
Strickberger, M. W. *Genetics*.

MAGP 1103 PRINCIPLES OF PLANT BREEDING 2+1

Objective

To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement.

Outcomes: On completion of this course, the successful students should be able to: Technical skills leading to research-Employability

Theory

UNIT I

History of Plant Breeding (Pre and post- Mendelian era); Objectives of plant breeding characters improved by plant breeding; Domestication- Changes in plant species under domestication, patterns of evolution in crop plants; Centres of Origin biodiversity and its significance. Genetic basis of breeding self and cross pollinated crops; Mating systems significance in plant breeding.

UNIT II

Selection in self and cross pollinated crops-basic principles and implications; Nature of Variability-components of variation-heritability and genetic advance-response to selectionImplications in plant breeding; General and specific combining ability-types of gene actionsand implications in plant breeding; Plant introduction-types procedure-merits and demerits-germplasm components of genetic resources-genebanks-role in plant breeding; Mechanism0f pollination control in plants-self incompatibility classification-mechanisms significance inCrop improvement. Genotype-environment interaction-significance in plant breeding**.**

UNIT III

Male sterility classification-GMS, CMS, C-GMS and chemically induced male sterility- utilization in plant breeding limitations; Mass selection-procedure merits and demerits-applications and achievements; Pedigree method - procedure - modifications of pedigreemethod, bulk method-procedure-modifications of bulk method-merits and demerits achievements-comparison between bulk and pedigree methods; Back cross method requirements- procedures of back cross method-applications-merits and demerits achievements-comparison between back cross, pedigree and bulk methods.

UNIT IV

Multiline breeding- differences between multiline and pure lines- procedure – merits and demerits-achievements- population breeding approaches (diallel selective mating scheme)merits and demerits; Breeding methods in cross-pollinated crops-classification of breeding methods-mass selection-ear-to-row method - St and 32 progeny testing – progeny selection schemes; Recurrent selection schemes-comparison among different recurrent selection schemes- merits and demerits- achievements; Hybrid breeding- steps /operations in production of hybrid varieties- genetical and physiological basis of heterosis and inbreeding -production of inbreds procedures; Genetic improvement of inbred lines breeding approaches – diversification- improvement of CMS lines- approaches- merits and demerits-prediction of hybrid performance seed production of hybrid and their parent varieties/ inbreds.

UNIT V

Synthetic and composite varieties-steps-merits and demerits-factors determining the performance of synthetic varieties-achievements; Breeding methods for asexually/ clonally propagated crops- clonal selection- procedure-merits and demerits-achievements-Apomixis classification- merits and demerits-utilization in plant breeding. Concept of plant ldeotype- types of ideotypes - steps in ideotype .development. Role in crop improvement transgressive breeding - approaches - merits and demerits.

UNIT VI

Special breeding techniques- Mutation breeding- procedures for oligogenic and polygenic traits-somatic mutations in vegetatively propagated crops merits and demerits- achievements; Breeding for abiotic stresses- classification of abiotic stresses mechanisms of drought, salt tolerance, flooding tolerance, cold tolerance crop plants-screening techniques- problems in breeding for abiotic stresses-achievements; Breeding for biotic stresses- disease resistance- mechanisms of disease resistance-genetics of disease resistance, breeding methods for disease resistance-screening techniques-achievements; Breeding for insect resistance- mechanisms- genetics of insect resistance sources breeding approaches-screening techniques-problems in breeding for insect resistance achievements.

UNITVII

Cultivar development-testing procedures-release and notification of cultivars- All India Coordinated, Research Projects-impact on cultivar development in various crops; Maintenance breeding classical maintenance breeding - New forms of maintenance breeding- Maintenance procedure of crop varieties; Participatory Plant Breeding approaches-steps implications; Plant breeders- rights-genesis-benefits and drawbacks of PBR system-Plant variety protection and farmers rights-salient features-implications on Indian Agriculture.

Practical

Floral biology, selfing and crossing techniques in Rice, Floral biology, selfing and crossing techniques in Sorghum, Floral biology, selfing and crossing techniques in Maize, Floral biology, selfing and crossing techniques in Bajra, Floral biology, selfing and crossing techniques in Cotton, Floral biology, selfing and crossing techniques in Pulses, Floral biology, selfing and crossing techniques in Oilseeds, Floral biology, selfing and crossing techniques in asexually propagated crops, Selection methods in segregating populations, Pedigree method, Bulk method and Backcross methods, Evaluation of breeding material, Analysis of variance (ANOVA), Estimation of heritability and genetic advance, Maintenance of experimental records, Learning techniques in hybrid seed production using male-sterility in field crops, Production of hybrids in Rice, Sorghum, Maize, Bajra etc., Production of hybrids in oil seed and pulse crops.

Suggested Readings

Allard RW. 1981. *Principles of Plant Breeding*. John Wiley &Sons.
Chopra VL. 2001. *Breeding Field Crops*. Oxford **&**lBH.
Chopra VL. 2004. *Plant Breeding*. Oxford &lBH.
Gupta SK. 2005. *Practical Plant Breeding*. Agribios.
Pohlman JM **&**Bothakur DN. 1972. *Breeding Asian Field Crops*. Oxford **&**lBH.
Roy D. 2003. *Plant Breeding*, *Analysis and Exploitation of Variation*. NarosaPubl; House.
Sharma JR. 2001. *Principles and Practice of Plant Breeding*. Tata McG raw-Hill.
Simmonds N W. 1990. *Principles of Crop Improvement* English Language Book Society.
Singh BD. 2006. *Plant Breeding*. Kalyani Publishers. _
Singh P. 2002. *Objective Genetics and Plant Breeding*. Kalyani Publishers.
Singh P. 2006. *Essentials of Plant Breeding*. Kalyani Publishers.
Singh S &Pawar IS. 2006. *Genetic Bases and Methods of Plant Breeding*. CBS.

MAMB 1101 PRINCIPLES OF BIOTECHNOLOGY 2+1

Objective

To familiarized the students with fundamental principle of Biotechnology, various developments in Biotechnology and its potential applications.

Course Outcomes: On completion of this course, the successful students should be able to:

Skill: Students learn the techniques of molecular biology and further carry out research and also serve as entrepreneurs

Theory

Unit I

History, scope and importance: DNA structure, function and metabolism, C values and plant genomes, Respective and coding sequences.

Unit II

Restriction enzymes, DNA modifying enzymes, Vectors, Methods of recombinant DNA technology, Nucleic acid hybridization, Gene libraries, DNA cloning, Application of rDNA technology

Unit III

Introduction of molecular markers, Nucleic acid hybridization and RFLP marker, CR based marker (RAPDS, ISSR, SCAR, SSR), AFLP, Single Nucleotide polymorphism (SNPs), DNA sequencing-methods, Automatic sequencing methods, Genetic engineering and transgenic, Genomics, transcriptomics and proteomics

Unit IV

General application of Biotechnology in Agriculture, Medicine, Animal Husbandry, Environmental remediation, Energy production and Forensics.

Practical

Isolation of genomic and plasmid DNA, Gel electrophoresis technique, Restriction enzyme digestion, ligation, transformation and screening of transformants, PCR and molecular analysis.

Suggested Reading:

Becker JM, Coldwell GA &Zachgo EA. 2007.Biotechnology- a Laboratory Course. Academic press
Brown CM, Campbell I & Priest FG. 2055. Introduction of Biotechnology. Panima pub.
Brown TA. Gene Cloning and DNA Analysis.5th Ed. Blackwell Publication.
Dale JW & von Schantz M. 2002.From Gene to Genomes; Concept and Applications of DNA technology.Jhone Wiley & Sons.
Gupta PK. 2004. Biotechnology and Genomic.Rastogi Publication.
Sambrock J, Fritsch T &Maniatis T. 2001.Molecular cloning-a
Laboratory Manual 2nd Ed Cold Spring Harbour Laboratory Press.

MAMB 1102 FUNDAMENTAL OF MOLECULAR BIOLOGY 3+0

Objective

To familiarize the student with the basic cellular processes at molecular level

Course Outcomes: On completion of this course, the successful students should be able to:

Skill: Students learn the techniques of molecular biology and further carry out research and also serve as entrepreneurs

Theory

Unit I

Historical development of molecular biology; Nucleic acids as genetic material; chemistry, structure and properties of DNA and RNA.

Unit II

Genome organization in prokaryotes and eukaryotes; Chromatin structure and function; DNA replication; DNA polymerases, topoisomerases, DNA ligase, etc; Molecular basis of mutation; DNA repair mechanisms.

Unit III

Transcription process; RNA processing; Reveres transcription; RNA editing; Ribosome's structure and function; Organization of ribosomal proteins and RNA genes; Genetic code; Aminoacy It RNA syntheses.

Unit IV

Translation and post-translational modifications; Operon concept; Attenuation of trp operon; important feature of gene regulation in eukaryotes.

Suggested Reading:

Lewin B. 2008. *Gene IX*. Peterson Publications/ Panima.
Malacinski GM & Freifelder D. 1998.*Essentials of Molecular Biology*. 3rd Ed. Jones & Bartlett Publishers.
Nelson DL & Cox MM. 2007.*Lehninger's Principles of Biochemistry*. W.H. Freeman & Co.
Primrose SB. 2001.*Molecular Biotechnology*.Panima.
Watson JD, Bakee TA, Bell SP, Gann A, Levine M &Losick R. 2008. *Molecular Biology of the Gene*.6th Ed. Pearson Education International.

MALI1101 LIBRARY AND INFORMATION SERVICES 0+1

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 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.

MACS1101 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 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 communication; 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 Writng. NTC Business Books
Joseph G. 2000. MLA Handbook for Writers of Research Papers.5th Ed.
Affliated 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 Labguage. Abhishek.
Sethi J &Dhamija PV. 2004. Course in Phonetics and Spoken English 2nd Ed. Prentice Hall of India
Wren PC & Martin H 2006.High School English Grammar and Composition.S Chand & Co.

SEMESTER – II

MAGP 1204 PRINCIPLES OF QUANTITATIVE GENETICS 2+1

Objective

To impart theoretical knowledge and computation skills regarding components of variation and variances, scales, mating designs and gene effects.

Outcomes: On completion of this course, the successful students should be able to:

Technical Skills leading to research in quantitative genetics-Employability

Theory

UNIT I

Mendelian traits *vs* polygenic traits **-**nature of quantitative traits and its inheritance – Multiple factor hypothesis **-** analysis of continuous variation; Variations associated with polygenic traits-phenotypic, genotypic and environmental– non allelic interactions; Nature of gene action **-** additive, dominance, epistatic and linkage effects.

UNIT II

Principles of Analysis of Variance (ANOVA) **-** Expected variance components, random and fixed models; ANOVA, biplot analysis; Comparison of means and variances for significance.

UNIT III

Designs for plant breeding experiments **-** principles and applications; Genetic diversity analysis-metroglyph, cluster and D2 analysis **-** Association analysis **-** phenotypic and genotypic correlations; Path analysis and Parent **-** progeny regression analysis; Discriminant function and principal component analyses; Selection indices-selection of parents; Simultaneous selection models- concepts of selection **-** heritability and genetic advance.

UNIT IV

Generation mean analysis; Mating designs- Diallel, partial diallel, line x tester analysis, NCDs and TTC', Concepts of combining ability and gene action; Analysis of genotype x environment interaction **-** adaptability and stability; Models for GxE analysis and stability parameters; AMMl analysis _ principles and interpretation.

UNITV

QTL mapping; Strategies for QTL mapping- desired populations for QTL mapping– statistical methods in QTL mapping- QTL mapping in Genetic analysis; Marker assisted selection (MAS)- Approaches to apply MAS in Plant breeding- selection based on marker-simultaneous selection based on marker and phenotype **-** factors influencing MAS.

Practical

Problems on multiple factors inheritance **-** Partitioning of variance **-** Estimation of heritability and genetic advance **-** Covariance analysis, Metroglyph analysis, D2 analysis-Grouping of clusters and interpretation- Cluster analysis- Construction of cluster diagrams and dendrograms_lnterpretation,

Correlation analysis - Path analysis- Parent-progeny regression analysis, Diallel analysis: Griffing's methods I and II, Diallel analysis: Hayman's graphical approach– Diallel analysis: interpretation of results, NCD and their interpretations, Line x tester analysis and interpretation of results- Estimation of heterosis: standard, mid-parental and better-parental heterosis- Estimation of inbreeding depression, Generation mean analysis: Analytical part and interpretation- Estimation of different types of gene actions, Partitioning of phenotypic variance and co-variance into components due to genotypes, environment and genotype x environment interactions, Construction of saturated linkage maps and QTL mapping - Strategies for QTL mapping; statistical methods in QTL mapping; Phenotype and Marker linkage studies– Working out efficiency of selection methods in different populations and interpretation, Biparental mating, Triallel analysis, Quadriallel analysis and Triple Test Cross (TTC), Use of softwares in analysis and result interpretation, Advanced biometrical models for combining ability analysis, Models in stability analysis-Additive Main Effect and Multiplicative Interaction (AMMl) model– Principal Component Analysis model - Additive and multiplicative model - Shifted multiplicative model, Analysis and selection of genotypes -Methods and steps to select the best model, Selection systems- Biplots and mapping genotypes.

Suggested Readings

Bos I &Caligari P. 1995. *Selection Methods in Plant Breeding.* Chapman **&**Hal.

Falconer DS & M ckay J. 1998. *Introduction to Quantitative Genetics.* Longman

Mather K &Jinks JL. 1971. *Biometrical Genetics.* Chapman *&*Hall.

Mather K & Jinks JL. 1983. *Introduction to Biometrical Genetics*. Chapman & Hall.

Nadarajan N **&**Gunasekaran M. 2005. *Quantitative Genetics and Biometrical Techniques in Plant Breeding.* Kalyani Publishers.

Naryanan SS & Singh P. 2007.*Biometrical Techniques in Plant Breeding*. Kalyani Publishers.

Singh P & Narayanan SS.1993. *Biometrical Techniques in Plant Breeding.* Kalyani Publishers.

Singh R K &Choudhary B D. 1987. *Biometrical Methods in Quantitative Genetics.* Kalyani Publishers.

Weir D S. 1990. *Genetic Data Analysis. Methods for Discrete Pepulation Genetic Data.* Sinauer Associates.

Wricke G **&**Weber WE. 1986. *Quantitative Genetics and Selection in Plant Breeding.* Waiter de Gruyter.

MAGP 1205 CELL BIOLOGY AND MOLECULAR GENETICS 2+1

Objective

To impart knowledge in theory and practice about cell structure, organelles and their functions, molecules like proteins and nucleic acids.

Course Outcomes: On completion of this course, the successful students should be able to:

Skill: Students learn the techniques of molecular biology and further carry out research and also serve as entrepreneurs

Theory

UNIT I

Introduction- Definition of cell biology and molecular genetics- History of cell biology. Ultra structure of the cell- Differences between eukaryotic and prokaryotic cells and examples. Structure and function of cell wall- Origin and growth of cell wall, plasma membrane structure, evolution and

experimental evidence in support of Fluid– Mosaic model of plasma membrane- Functions of plasma membrane, Cellular Organelles- Structure and functions of Nucleus. lnterphase nucleus- Structure chemical composition and Hammerlings experiment- Plastids- Structure, types of plastids- Chloroplast– Chromoplast and other photosynthetic organelles and their functions.

UNIT II

Mitochondria Ultra structure and function. Endoplasmic reticulum Structure, types of endoplasmic reticulum- Smooth and rough endoplasmic reticulum and functions of endoplasmic reticulum- Golgi complex, lysosomes, peroxisomes, structure and function and macro molecules Cell division- Mitosis general events of lnterphase. prophase. metaphase, telophase- Cytokinesis- Physiology of cell cycle- significance of mitosis. Cell division- Meiosis and its significance- Comparison of mitosis and meiosis– Historical background of Molecular genetics.

UNIT III

Genetic material in organisms- Evidence for Griffith-s DNA as the genetic material experiment by Griffiths- Avery, McLeod and Mc Carty-Hershey and Chase to prove DNA as genetic material- Evidences for RNA as the genetic material Cornat and Singer's experiment- Structure and properties of nucleic acid, DNA- Watson and clicks model- Different forms of DNA- RNA- Types of RNA- DNA transcription and its regulation- Mechanisms of Transcription in prokaryotes -and eukaryotes- DNA regulation- Regulation of Transcription- Promoters- Enhancers- Silencers- Terminators- Transcription teeters and their role.

UNIT lV

Processing of RNA Genetic code- Cracking of genetic code-properties of genetic code, Exceptions to genetic code- Regulation of protein synthesis in prokaryotes– Translation-Components of translation- mRNA, tRNA Ribosomes- Amino acids- Translation factors- Translation in prokaryotes. Regulation of protein synthesis in eukaryotes– differences between protein synthesis in prokaryotes and eukaryotes. Transposable elements-Characteristics of Transposable elements-Types of Transposable elements and example Ac- Ds system in maize.

UNIT V

Mechanisms of recombination in prokaryote (bacteria and viruses) DNA organization in eukaryotic chromosomes - models of chromosome- Nucleosome and solenoid model. DNA content variation- C value paradox Types of DNA sequences- Unique and repetitive sequences Organelle genomes- Chloroplast DNA, Mitochondrial DNA Gene amplification and its significance Proteomics and protein-protein interaction Signal transduction– Genes in development - Cancer and cell ageing.

Practical

Morphological and Gram staining of natural bacteria, Cultivation of bacteria in synthetic medium, Determination of growth rate and doubling time of bacterial cells in culture, Demonstration of bacteriophage by plaque assay method, Determination of soluble protein content in a bacterial culture, lsolation, purification and raising clonal population of a bacterium, Biological assay of bacteriophage, Determination of phage population in lysate, Study of lytic cycle of bacteriophage by one step growth experiment, Determination of latent period and burst size of phages per cell, Quantitative estimation of DNA, Quantitative estimation of RNA, Quantitative estimation of protein in an organism, Numericals: problems and assignments

Suggested Readings

Bruce A. 2004. *Essential Cell Biology*. Garland.
Karp 6. 2004. *Cell and Molecular Biology: Concepts and Experiments*. John Wiley.
Klug WS &Cummings MR 2003. *Concepts of Genetics.* Scot, Foreman **&**Co.
Lewin B. 2008. *IX Genes*. John Wiley & Sons
Lodish H, Berk A &Zipursky SL. 2004. *Molecular Cell Biology*. 5th Ed. WH Freeman.
Nelson DL **&**Cox MM. 2005. *Lehninger's Principles of Biochemistry*. WH Freeman & Co.
Russell PJ. 1996. *Essential Genetics*. Blackwell Scientific Publ.
Schleit PM 986. *Genetics and Molecular Biology*. Addison-Wesley Publ. Co.
Singh B D. 2006 *Genetics*Kalyant Publishers. New Delhi
Verma PS. and Agarwal V.K. 2005. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S Chand and company limited New Delhi

MAPB 1206 BIOTECHNOLOGY FOR CROP IMPROVEMENT 2+1

Objective

To impart knowledge and practical skill, to use biotechnological tools in crop improvement.

Course Outcomes: On completion of this course, the successful students should be able to:

Skill: Students learn the techniques of biotechnology,molecular biology and further carry out research and also serve as entrepreneurs

Theory

UNIT I

Biotechnology and its relevance in agriculture; Definition, terminologies and scope in plant breeding.

UNIT III

Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biotechnological and molecular markers: morphological, biochemical and DNA based markers (RFLP, RAPD, AFLP, SSR, SNPs, Ests etc.); mapping populations (F_2s, back cross, RILs and DH).

UNIT IV

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker Assisted Selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding.

UNIT V

Marker Assisted Selection and molecular breeding; Genomics and geoinformatics for crop improvement; integrating functional genomics information on agronomically/ economically important traits in plant breeding; Marker assisted backcross breeding for rapid introgression; Generation of EDVs.

UNIT VI

Recombinant DNA technology, transgenes, methods of transformation, selectable markers and clean transformation techniques, vector- mediated gene transfer, physical methods of gene transfer. Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases.

UNIT VII

Biotechnology applications in male sterility/ hybrid breeding, molecular farming.

UNIT VIII

MOs and related issues (risk and regulation); GMO; International regulations, biosefty issue of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; intellectual property rights.

UNIT IX

Bioinformatics and Bioinformatics tools.

UNIT X

Nanotechnology and its applications in crop improvement programmes**.**

Practical

Requirements for plant tissue culture laboratory, techniques in plant tissue culture, media composition and media preparation- Aseptic manipulation in of various explants; Callus induction and plant regeneration- plant regeneration; Standardizing the protocols for regeneration; Hardening of regenerated plants; Establishment a greenhouse and hardening procedures. Visit to commercial micro-propagation unit. Transformation using *Agrobacterium* strains, GUS assay in transformed cell/ tissues. DNA isolation, DNA purity and quantification test, gel electrophoresis of protein and isozymes, PCR based DNA markers, gel scoring and data analysis for tagging and phylogenetic relationship, construction of genetic linkage maps using computer software.

Suggested Readings

Singh B D. 2005. *Biotechnology, Expending Horizons*. Kalyant Publishers. Ludhina.

Chawla H.S.2003. *Introduction to Plant Biotechnology*. Oxford & IBH Publishing Co. New Delhi.

Gupta PK. 1997. *Elements of Biotechnology*. Rastogi Publ.

Chopra VL &Nasim A. 1990. *Genetic Engineering and Biotechnology : Concept, Methods and Applications.* Oxford & IBH.

Hackett PB, Fuchs JA and Messing JW. 1988. *An introduction to recombinant DNA technology- Basic experiments in gene manipulation*. 2nd Ed. Benjamin Publ. Co.

Sambrook J &Russel D. 2001. *Molecular Clonong- a Laboratory manual*. 3rdEd.Cold Spring Harbor Lab. Press.

0+3

MAMB 1205 TECHNIQUES IN MOLECULAR BIOLOGY - I

OBJECTIVE

To provide hand on training on basic molecular biology techniques

Course Outcomes: On completion of this course, the successful students should be able to:

Skill: Students learn the techniques of molecular biology and further carry out research and also serve as entrepreneurs

Practical unit I

Good lab practices, Biochemical techniques, Preparation of Buffers and reagents, Principle of centrifugation, autoclave, LAF, hot air oven, incubators, etc. Isolation of DNA; Polymerase chain reaction (PCR) and optimization of factors affecting PCR; Gel electrophoresis - agarose and PAGE (nucleic acids and proteins), Demonstration of gene expression studies.

Practical unit II

Growth of bacterial culture and prearation of growth curve; isolation of plasmid DNA from bacteria; Growth of lambda phage and isolation of phage DNA, Restriction digestion of plasmid and phage DNA, Gene cloning – Recombinant DNA construction, transformation and selection of transformants; Southern blotting, Northern blotting and Western blotting. Radiation safety and non-radio isotopic procedure.

Practical unit III

Chromatographic techniques - Gel filtration chromatography, Ion exchange chromatography, paper chromatography and affinity chromatography.

Reference books

1. Introduction to Plant Biotechnology – H.S. Chawala
2. Plant Biotechnology – A. Slater et al.
3. Handbook of Plant tissue culture – ICAR
4. Plant tissue Culture : Theory and Practice – S.S. Bhojwani and M.K. Razdan

MAST2102 STATISTICAL METHODS FOR APPLIED SCIENCES 2+1

Theory

UNIT I

Classification, tabulation and graphical representation of data. 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.Large sample theory.

UNIT III

Introduction to theory of estimation and confidence-intervals.Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination.Polynomial regression models and their fitting.Probit regression

analysis by least squares and maximum likelihood methods, confidence interval for sensitivity; Testing for heterogeneity.

UNIT IV

Non-parametric tests - sign, Wilcoxon, Mann-Whitney U-test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.

Practical

Exploratory data analysis, Box-Cox plots; 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 point estimation of parameters of binomial, Poisson and Normal distribution, Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis; Nonparametric tests.

Suggested Readings

Goon AM, Gupta MK &Dasgupta B. 1983. *Fundamentals of Statistics*. Vol. I.The World Press.
Hoel PG. 1971. *Introduction to Mathematical Statistics*.John Wiley.
Hogg RV & Craig TT. 1978. *Introduction to Mathematical Statistics*. Macmillan.
Morrison DF. 1976. *Multivariate Statistical Methods*. McGraw Hill.
Siegel S, Johan N &Casellan Jr. 1956.*Non-parametric Tests for Behavior Sciences*. John Wiley.
Learning Statistics: http://freestatistics.altervista.org/en/learning.php.
Electronic Statistics Text Book:
http://www.statsoft.com/textbook/stathome.html

MAIP1201 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE 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.C. 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 Countires: A Compendium on Law and Policies. Daya Publ. House.

The Indian Acts- Patents Act, 1970 and amendments; 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.

MALT1201 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

Objective

To acquaint the students about the basic 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 application; 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.

SEMESTER – III

MAGP2107 HETEROSIS BREEDING 1+1

Objective

To provide understanding about mechanisms of heterosis and its exploitation for yield improvement through conventional and biotechnological approaches.

On completion of this course, the successful students should be able to gain expertise leading to research in breeding-Employability

Theory

UNIT I

Historical aspect of heterosis - Nomenclature and definitions of heterosis - Heterosis in natural population and inbred population; Evolutionary aspects - Genetic consequences of selfing and crossing in self-and cross-pollinated and asexually propagated crops.

UNIT II

Pre-Mendelian and Post-Mendelian ideas - Genetic theories of heterosis – Physiological, Biochemical and molecular factors underlining heterosis; theories and their estimation; - Evolutionary concepts of heterosis.

UNIT III

Prediction of heterosis from various crosses- Inbreeding depression, frequency of inbreeding and residual heterosis in F2 and segregating populations, importance of inbreeding in exploitation of heterosis – case studies. - Relationship between genetic distance and expression of heterosis – case studies; Divergence and Genetic Distance analyses morphological and molecular genetic distance in predicting heterosis, Development of heterotic pools in germplasm/ genetic stocks and inbreds, their improvement for increasing heterosis.

UNIT IV

Types of male sterility and use in heterosis breeding; Maintenance, transfer and restoration of different types of male sterility; Use of selfincompatibility in development of hybrids; Hybrid seed production system: 3-line, 2-line and 1-line system; Development of inbreds and parental lines- A, B and R lines – functional male sterility; Commercial exploitation of heterosis- maintenance breeding of parental lines in hybrids.

UNIT V

Fixation of heterosis in self, cross and often cross pollinated crops, asexually/clonally propagated crops; Male sterile line creation and diversification in self pollinated, cross pollinated and asexually propagated 21 crops; problems and prospects; Apomixis in fixing heterosis-concept of single line hybrid.

UNIT VI

Organellarheterosis and complementation - Creation of male sterility through genetic engineering and its exploitation in heterosis.

UNIT VII

Heterosis breeding in wheat, rice, cotton, maize, pearl millet, sorghum and oilseed crops.

Practical

Selection indices and selection differential – Calculations and interpretations - Male sterile line characterization in millets; Using morphological descriptors; Restorer line identification and diversification of male sterile sources - Male sterile line creation in dicots comprising oilseeds, pulses and cotton ; problems in creation of CGMS system; Ways of overcoming them - Male sterile line creation, diversification and restoration in forage crops; Understanding the difficulties in breeding apomicts; Estimation of heterotic parameters in self, cross and asexually propagated crops - Estimation from the various models for heterosis parameters -Hybrid seed production in field crops – an account on the released hybrids; their potential; Problems and ways of overcoming it; hybrid breeding at National and International level; Opportunities ahead.

Suggested Readings

Proceedings of *Genetics and Exploitation of Heterosis in Crops* – An International Symposium CIMMYT, 1998.
Akin E. 1979.*The Geometry of Population Genetics*.Springer-Verlag.
Ben Hiu Lin. 1998. *Statistical Genomics – Linkage, Mapping and QTL Analysis*.CRC Press.
De Joung G. 1988. *Population Genetics and Evolution*.Springer-Verlag.
Hartl DL. 2000. *A Primer of Population Genetics*. 3rd Ed. Sinauer Assoc.
Mettler LE & Gregg TG. 1969. *Population Genetics and Evolution*. Prentice-Hall.
Montgomery DC. 2001. *Design and Analysis of Experiments*. 5th Ed. Wiley & Sons.
Richards AJ. 1986. *Plant Breeding Systems*. George Allen &Unwin.
Srivastava S &Tyagi R. 1997.*Selected Problems in Genetics*.Vols.I, II.AnmolPubl

MAMB2110 GENOMICS AND PROTEOMICS 2+0

Objective

To familiarize the students with recent tools used for genome analysis and their applications.

Outcomes:

Skill: Students learn the techniques of molecular biology and further carry out research and also serve as entrepreneurs

Theory

UNIT I

Structural genomics: Classical ways of genome analysis, large fragment, genomic libraries; Physical mapping of genomes; Genome sequencing, sequence assembly and annotation; Comparative genomics, etc.

UNIT II

Functional genomics: DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics; Metabolomics and ionomics for elucidating metabolic pathways, etc.

UNIT III

Proteomics - Protein structure, function and purification; Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis, etc.

UNIT IV

Applications of genomics and proteomics in agriculture, human health and industry.

Suggested Readings

Azuaje F &Dopazo J. 2005.*Data Analysis and Visualization in Genomics and Proteomics*. John Wiley & Sons.
Brown TA. 2007. *Genome III*. Garland Science Publ.
Campbell AM &Heyer L. 2004.*Discovery Genomics, Proteomics and Bioinformatics*. Pearson Education.
Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.
Jollès P &Jörnvall H. 2000.*Proteomics in Functional Genomics: Protein Structure Analysis*. Birkhäuser.
Kamp RM. 2004.*Methods in Proteome and Protein Analysis*.Springer.
Primrose SB &Twyman RM. 2007.*Principles of Genome Analysis and Genomics*. Blackwell.
Sensen CW. 2005. *Handbook of Genome Research*.Vols.I, II.Wiley CVH.

MAAR2101 (e-Course)	**AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES**	**0+1**

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunitites; 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 Organizations. Critical evaluation of rural development policies and programmes.Constraints in implementation of rural policies and programmes.

Suggested Readings

Bhalla GS & Singh G. 2001.Indian Agriculture- Four Decades of Development.Sage Publ.

Punia MS. Manual on International Research and Research Ethics.CCS, Haryana Agricultural University, Hisar.

Rao BSV. 2007. Rural Development Strategies and Role of Institutions- Issues, Innovations and Initiatives. Mittal Publ.

Singh K.. 1998. Rural Development – Principles, Policies and Management. Sage Publ.

MADM2101 DISASTER MANAGEMENT 1+0
(e-Course)

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 vuinerability; and capacity building.

Outcome:

Students understand about the key concepts and practices of natural disaster management.

Students know to conduct thorough assessment of hazards, and risks vuinerability; 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 NGSs, Community-based organiztions, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2002. Disaster Management. Indian National Science Academy.OrientBlackswan.

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.