M. Sc. (Semester Pattern)

I Semester		Hours		Mark	
		Theory	**Practical**	**Theory**	**Practical**
Course I	Cell Biology of plant	25	60	40	40
Course II	Molecular Biology of plants	25	60	40	40
Course III	Biology and Diversity of Viruses, Bacteria and Fungi	25	60	40	40
Course IV	Biology and Diversity of Algae, Bryophyte and Pteridophyte	25	60	40	40
Course V	Cytology and Genetics	25	60	40	40
Total		125	300	200	200

Theory : 125 Hours
Practical : 300 Hours
Tutorials/Seminars : 55 Hours
Total : 480 Hours

II Semester		Hours		Mark	
		Theory	**Practical**	**Theory**	**Practical**
Course VI	Genetics and Cytogenetics	25	60	40	40
Course VII	Biology and Diversity of Gymnosperm	25	60	40	40
Course VIII	Taxonomy of Angiosperm	25	60	40	40
Course IX	Plant Physiology	25	60	40	40
Course X	Metabolism	25	60	40	40
Total		125	300	200	200

Theory : 125 Hours
Practical : 300 Hours
Tutorials/Seminars : 55 Hours
Total : 480 Hours

III Semester		Hours		Mark	
		Theory	**Practical**	**Theory**	**Practical**
Course XI	Plant Development	25	60	40	40
Course XII	Plant Reproduction	25	60	40	40
Course XII	Plant Ecology I	25	60	40	40
Course XIV	Plant Ecology II	25	60	40	40
Course XV	Plant Resource Utilization	25	60	40	40
Total		125	300	200	200

Theory : 125 Hours
Practical : 300 Hours
Tutorials/Seminars : 55 Hours
Total : 480 Hours

IV Semester		Hours		Mark	
		Theory	**Practical**	**Theory**	**Practical**
Course XVI	Plant Resource conservation	25	60	40	40
Course XVII	Biotechnology I or Plant Cell Tissue and Organ culture	25	60	40	40
Course XVIII	Biotechnology and Genetic Engineering II or Genetic Engineering of plants and Microbes	25	60	40	40
Course XIX	Elective – I/ Project Work	25	60	40	40
Course XX	Elective – II/ Project Work	25	60	40	40
Total		125	300	200	200

Theory : 125 Hours
Practical : 300 Hours
Tutorials/Seminars : 55 Hours
Total : 480 Hours

Total Marks

Semester	**Theory**	**Practical**	
I	**200**		**Total = 1200**
II	**200**	**200**	
III	**200**		
IV	**200**	**200**	
	800	**400**	

Course I: Cell Biology of plants

* The dynamic cell: Structural organization of the plant cell, specialized plant cell types; chemical foundation; biochemical energetic.
* Cell Wall: Structure and functions; biogenesis; growth
* Plasma membrane: Structure, models, and function; sites for AT Pases, ion carriers, channels and pumps; receptors.
* Plasmodemata: Structure; role in movement of molecules and macromolecules; comparison with gap junctions.
* Chloroplast: Structure; genome organization; gene expression RNA editing; nucleo-chloroplastic interactions.
* Mitochondria: Structure; genome Organization; biogenesis.
* Plant Vacuole: Tonoplast membrane; AT Pases; transporters; as storage organelle.
* Nucleus: Structure: nuclear Pores; nucleosome organization; DNA structure; A, B and Z forms. Replication, damage and repair, transcription: plant promoters and transcription facts, splicing RNA transport; nucleous; RNA biosynthesis.

Course II Molecular Biology of Plants

* Ribosomes: Structure; site of protein synthesis; mechanism of translation initiation elevation and termination; structure and role of RNA
* Protein sorting: Targeting of proteins to organelles. Cell shape and motility; the cytoskelton; organization and role of microtubules and microfilaments; motor movements implications in flagellate and other movements.
* Cell cycle and apoptosis: control mechanisms; Role of cycline and cyciln dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plat e formation; mechanisms of programmed cell death.
* Other cellular organelles: Structure and functions of microbodies, golgi apparatus, lysosomes, endoplasmic reticulum.
* Techniques in cell biology: Immuno techniques; in situ hybridization to locate transcripts in cell types; FISH, GISH: confocal microcopy.

Suggested Readings: (For course I and II)

* Levvin, B. 2000, Genes VII. Oxford University press, New York.
* Alberts, B. Bray. D. Lewis, J. Raff. M. Roberts., K. and Waston. J.D. 1999 Molecular Biology of the Cell. Garland Publishing Inc. New York.
* Wolfe, S.L. 1993. Molecular and Cellular Biology, wadswith publishing co., California U.S.A

* De,D.N. 2000. Plant cell Vacuoles: An Introduction CSIRO Publication Collingwood, Australia

* Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition) Harpar Collins College publishers, New York, USA.

* Lodish, H, Berk, A., Zipursky, S.L. Matsudaira, P. Baltimore, D, and Damell, J.2000 Molecular Cell Biology4th Edition) W.H. Freeman and Co. New York, USA.

- See the following review journals.

* Annual Review of plant Physiology and Molecular Biology.
* Current Advances in plant sciences.
* Trends in plant Sciences.
* Nature Reviews: Molecular and Cell Biology.

Suggested Laboratory Exercises

1. To determine the mitotic index in different plant materials.
2. Demonstration of SDS-PAGE profile and seed proteins.
3. Isolation of plant DNA and separation by feulgen as a DNA specific stain.
4. Isolation of plant DNA and its quantification by a spectrophotometric method.
5. Isolation of DNA and preparation of cot curve.
6. Restriction digestion of plant DNA, its separation by agarose gel electrophoreses and Visualization by ethidium bromide staining.
7. Isolation of RNA and quantification by a spectrophotometric method.
8. Karyotype analysis from slide/photograph.
9. Induction of mitotic abnormalities through chemical treatment.
10. Determination of chiasma frequency in plants.
11. Fluorescence staining with PDA for cell viability and Cell wall staining wtih calcoflour.
12. Demonstration of SEM and TEM (By visiting national laboratories)
13. Extraction and proportion of DNA from Bacterial Cells.
14. Determination of Base ratio in nucleic acids.
15. Determination of Amino Acid composition of proteins.
16. Separation of plant RNA by agarose gel electrophoresis and visualization by Et. Br. Staining.

Suggested Readings (for Laboratory Exercises)

1. Chick, B.R. & Thompson, J.E. 1998. Methods in plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
2. Glover, D.M. and Hames, B.D. (Eds), 1995 DNA Cloning 1: A Practical Approach; core Techniques 2nd edition TAS IRL press at Oxford University press. Oxford.
3. Gunning, B.E.S. and steer, M.W. 1996. Plant Cell Biology structure and function. Jones and Bartlett publsihers. Rostrq. Massachusetts

4. Hackett., P.B., Funchs, J.A. & Messsing, J.W. 1988. An Introductin to Recombnant DNA Techniques. Basic Experiments in Gene Manipulation. The Benjamin Cummings Publishing co. InC. memno Park, California.

5. Hall, J.L. and Moor, A.L. 1983. Isolation of Membranes and organelles from plant cells. Academic Press, London,U.K.

6. Haris, N, and opataks, K.J. 1994 Plant Cell Biology A practical approach. IRL press at Oxford University Press, Oxford, U.K.

7. Shaw, C.H. (Ed) 1988. Plant Molecular Biology: A practical Approach. IRL Press. Oxford.

Course - III Biology and diversity of Bacteria and fungi.

Microbiolgoy

* Archaebacteria and eubacteia: General account, ultra structure/ nutrition and reporduction biology and economic importance cyanobacteria-salient feature and biological importance.

* Viruses: Characteristics and ultrasturcture of virsuses; isolation purification of viruses; chemical nature, replication, transmission of viruses; economic importance.

* Phytoplasma: General characteristics and role in causing plant diseases.

* Mycology: General characters of fungi: Substrate relationship in fungi, cell ultrasturcture; unicellular and multicellular organization; cell wall composition; Nutrition (saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual, sexual); heterothallism; heterokaryosis; Para sexuality; recent trends in classification.

* Phytogeny of Fungi; General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; fungi in industry, medicine and as food, fungal diseases in plant and humans; Mycorrhizas; fungi as biocontrol agents.

Course IV

Biology and Diversity of Algae, Bryophytes and pteridophytes.

* Phycology: Algae in diversified habitats (terrestrial, freshwater, marine); thallus organization Cell ultrastrcuture; reproduction (vegetative, asexual, sexula), criteria for classification of algae, pigments, reserve food, flagella, classification and salient features of protochlorophyta, Chlorophyta, Xanthophyta, Bacillariophyta, phaeophyta and Rhodophyta, algae blooms, algal, biofertilzers, algae as food, feed and uses in industry.

* Bryophyta: Morphology, structure, reproduction and life history; distribution; classification, general account of Marchantiales, Junger-maniales, anthoceratales, Sphagnales,Funariales and Polytrichales; economic and ecological Importance.

* Pteriodophyta: Morphology, anatomy and reproduction; classification; evolution of stele; heterospoy and origin of sed habit; general account of fossil pteriodophyta; Introduction to Psoiolopsiad, Lycopsida, Sphenopsida and Ptreropsida.

Suggested Readigns: (for course III and IV)

* Alexopoulus, C.J. Mims, C.W. & Blaackwel, M. 1996. Intorductory Mycology. John Wiley & sons Inc.
* Clifton, A. 1958. Introduction to the bacteria, McGraw-hill Book Co., New York.
* Kumar, H.D. 1988. Introductory Physcology. Affiliated Eastwest Press Ltd. New Delhi.
* Mandahar, C.L. 1978. Introduction to plant viruses, chand & co. Ltd., Delhi.
* Deshpande, K.B. & papdiwal P.B., 1979. A Laboratory Course in Bacteriolgoy, COSIP-ULP in Biology Pulbication, Marathwada University, Aurangabad.
* Papdiwal, P.B. 1980. Biotechniques, CONSIP-ULP in Biology Publication Marathwada University, Aurangabad.
* Mukadam, D.S., 1997. The Illustrated Kingdom of Fungi, Akshragana Prakashan, Aurangabad.
* Mehrotra, R.S. & Aneja R.s. 1998 An Introduction to Mycology, New Age Intermediate Press.
* Moris, I. 1986. An Introduction to the Algae, Cmabridge University press, U.S.
* Parihar, N.S. 1991 Bryophytes. Central Book Dept. Allahabad.
* Parihar, N.S. 1996 Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.
* Puri, P. 1980. Bryophytes, Atmaram & Sons, Delhi.
* Rangaswamy, G. & Mahadevan, A. 1999. Diseases of Crop Plants in India (4th Edition) Printed Hall of India Pvt. ltd., New Delhi.
* Round, RE. 1986. The Biology of Algae. Cambridge University press, Cambridge.
* Sporne, K.K. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd., Bombay.
* Stewatre, W. N.; and Rathwell G.W. 1993. palaeobotany and the Evolution of plants. Cambridge University press.
* Webster, J. 1985. Introduction to Fungi. Cambridge University Press.

Suggested Laboratory Exercises: For course III and IV

Morphological study of representative members of algae, fungi, bacteria, bryophytes and Pteridophytes :

* Algae - Microcystis, Aulosira, Oocystis, Pediastrum, Hydrodictyon Ulva, Pithophora, Stigeoclonium, Drapranaldiopsis. Closterium Cosmarium, Chara,Botrydiun:, Vaucheria, Ectocorpus, Batrachospermum, Polysiphonia.
* Fungi-Stemonitis, Peronospora, Albugo, Mucor, Pilobolus, Yeast, Emericella, Chaetominum, Pleospora, Morchella, Melamospora, Phallus, Polyprus, Drechslera, Phoma, Penicillium. Aspergillus, Colletotrichum, Fusarium.
* Study of Morphology, anatomy and reproductive strcuturec of bryophytes and Pteridophytes.
* Bryophyta: Marchanita, Anthocers, polytrichum.

* Preridopyta: Psilotum, Lycopodium, Selaginella, Equisetum, Gleichenia, Pteris, Ophioglossum, Isoetes.
* Plant diseases: Symptomology of some diseased specimens: with rust, downy mildew, powdery mildew, rusts smuts, ergot, groundnut leaf spot, red rot of sugarcane, wilts, paddy blast, citrus canker. Bacterial blight of bean, angular leaf spot of cotton, tobacco mosaic, little leaf of. brinjal. Seasamphyllody, mango malformation.
* Bacteriology Sterilization methods, preparation of media and stains Isolation of bacteria from infected plants, Gram staining of bacteria
* Identification of fungal cultures, Rhizophus, Mucor, Aspergillus, penicillium, Emericella, Chetomium, Drechslera, Curvularia, Fusarium, Phoma, Collectotrichum, Graplium.

Course V: Cytology and Genetics

Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere; nucleous and ribosomal RNA genes; euchromatin and heterochomatin; karyotype analysis, banding patterns; karyotype evolution specialized types of chromosomes; polytene, Lampbursh, B-Chromosomes and sex chromosomes; molecular basis of chromosome pairing.

Structural and numerical alterations in chromosomes: Origin/ meiosis and breeding behavior of duplication, deficiency, inversion and translocation heterozygotes; origin, occurrence, production and meiosis of haplodis aneuploids and euploids; origin and productionof autophyloids; chromosome and chromatic segregation; alloploylоids, types, genome constitution and analysis; evolution of mjaor crop plants; induction and characterization of trisomics and monosomics.

Genetics:

Genetics of prokaryotes and eukaryotic organelles: Mapping the bact eriophage genome. Phage Phenotypes; genetic recombination in phage; Phase genetic transformation, conjugation and transduction in bacteria; genetics of mitochondira and chloroplasts; cytoplasmic mal e sterility.

Gene structure and expression: Genetic fine structure; cis-trans test; fine structure analysis of eukaryotes; introns and their significane: RNA splicing; regulation of gene expression in prokaryotes and eukaryotes.

Genetic recombination and genetic mapping: Recombination: Independent assortment and crossing over molecular mechanism of recombination; role of RecA and RecBCD enzymes; site -specific recombination; chromosome mapping. Linkage groups, genetic markers, construction of molecular maps correlation of genetic and physical maps; somatic cell genetiecs and alterantive approach to gene mapping.

Course VI: Genetics and cytogenetics

Mutations:
Spontaneous and induced mutations: physical and chemical mutagens; molecular basis of gene mutations, transposable element in prokaryotes and eukaryotes; Mutations induced by transposons; site-directed muLagenesis, DNA damage and repair mechanism, inherited huma diseases and defects in DNA repair, initiation of cancer at cellular level; protooncogenes and oncogenes.

CYTOGENETICS:
Cytogentics of aneuploids and strucutral heterozyotes; Effect of aneu plidy on phenotype in plants; transmission of monomics and trisomics and their use in chromosome mapping of diploid and polyploid species; breeding behavior and genetics and structural heterozygotes; complex transaction heterozygotes; translocation tested sets; Robertsonian translocations; B-A transolcation.
Molecular cytogenetics:
Nuclear DNA content: c-Value paradox: cot curve and its significance; restriction mapping-concept and techniques; multigene families and their evolution; in situ hybridization-concept and techniques; physical mapping of genes on chromosomes; computer assisted chromosome analysis; chromosome microdissection andmicrocloning. Flow cytometry and confocal microscopy in karyotype analysis.
Alien gene transfer through chromosome manipulations: Transfer of whole genome, examples from wheat, Arachis and Brassica; transfer of individual chromosomes and chromosome segments; method sfor detecting alien chromati; production, characterization and utility of alien addition and substituion lines; genetic basis of inbreeding and heterosis. Exploitation of hybrid vigour.

Suggested Readings

* Alberts, B. Bray, D, Lewis, J. Raff, M, Robers, K, and watson, J.D. 1989. Molecular - Biology (Edition) Garland Publishing inc. New York.

* Atherly, A.G., Girton, J.R. & McDonald, J.F. 1999. The Science of Genetics Saunders College- USA.

* Bumham, C.R. 1962. Discussions in Cytogenetics. Burgess Publishing Co., Minnesota.

* Busch.H. & Rothblum L. 1982. Volume X. The ceil nucleus DNA part A. Academic Press.

* Hard, D.L. & Jones, E.W: 1998. Genetics: Principles and Analysis (4th Edition) Jones & Barew Publishers Massachusetts, USA.

* Khush, G.S. 1973. Ctyoenetics of Aneuploids. Academic press, New York, London.

* Karp, G. 1999. Cells and Molecular Biology: concepts and Experiments, John Wiley & Sons Inc. USA.

* Lewin, B. 2000, Genes VII. Oxford University Press, New York, USA.

Lewis, R. 1997. Human Genetics : concepts and Appications (2nd Edition) WCB McGraw Hill USA.

Malacinski, G.M. & Freifelder D. 1998. Essentials of

Molecular Biology (3rd Edition) Jones and Bartlet Publsihers Inc. London.

* Russel, PJ. 1998. Genetics (5th Edition) The Benjamin / Cummings Publishing Company Inc. USA

* Stistad, D.P. and Simons, M.J. 2000. Principles of Genetics (2nd Edition) Johan Wiley & Sons Inc. USA.

Suggested Laboratory Exercises (for Course V & VI)

* Linear differentiation of chromosomes through banding techniques, such as G-banding. C-banding and O-banding. Silver banding for staining nucleolar organizing region, where 18s and 28sr DNA are transcribed.

* Orcein and Feulgen staining of the salivary gland chromosomes of chironomus.

* Characteristics and behavior of B Chromosomes using maize or any other appropriate material.

* Working out the effect of mono-and tri-somy on plant Phenotype, fertility and meiotic behavior.

* Induction of polyloidy using colchicine: different methods of the application of colchicine.

* Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.

* Effect of transolcation heterozygosity on plant phenotype, chromosome pairing and chromosome disjunction and pollen and seed fertility.

* Meiosis of Complex transolcation heterozygotes.

* Isolation of chlorophyll mutants following irradiation and tratment with chemical mutagnes. Effect of mutagens on mitotic/meiotic chromosomal behavior, isolation of morphological mutants following mutagenic treatment. Estimation of nuclear DNA content through microdensitomety and flow cytometry.

Suggested Readings (for laboratory Exercises)

* Fikui, K. & Nakayama, S. 1996. Plant chromosomes: Laboratory Methods CRC press, Boca Ration Florida.

* Sharma, A.K. & Sharma, A. 1999. Plant chromosomes: Analysis, Manipulation and Engineering Harwooc Academic publishers, Australia.

Course VII: Biology and Diversity of Gymnosperms

Introduction: Gymnosperms, the vessel-less and fruitless seed plants varying in the structure of their sperms, pollen grains, pollen germination and the complexity of the female gametophyte; evolution of gymnosperm. Classification of gymnosperms and their distribution in India: Brief account of the families of Pteridospermales XLyginopteridacjease, Medullosaceae. Caytoniazceae and Glossopteridaceae). General account of Cycadeoidales andCordaitales. structure and reproduction in Cycadales, Ginkgoales, confierales, Ephedrales Welwitschiales and Gnetales.

Course VIII: Taxonomy of Angiospcrms

Origin of intrapopulation Variation: population and the environment: ecads and ecotypes: evolution and differentiation of species various models the Species concept: Taxonomic hierarchy, species, genus, family and other categories, principles used in assessing relationship, delimitation of taxa and attribution of rank. Salient features of the International Code of botanical Nomenclature. Taxonomic evidence: morphology, anatomy, palynology, embryolgy, cytology; phytochemistry; genome analysis and nucleic acid hybridization. Taxonomic tools; herbarium; floras; histological, cytological, phytochemical, serological, biochemical and molecular technieus, computers and GIS. Systems of angiosperm classification: phenetic versus phylogenetic systems; cladistics in taxonomy; relative merits and demerites of major system of classification; relevance of taxonomy to conservation, sustainable utilization of bio-resources and ecosystem research. Concepts of phytogeography: Endemism, hotspots and hottest hotspots; plant exploration; invasions and intrdouctions; local plant diversity and its socioeconomic importance.

Suggested Readings : (for course (VII) and (VIII))

* Bhatnagar, s-R and Moitra, A. 1996. Gymnosperms. New Age fnternationi Pvt. Ltd., New Delhi.
* Cole, A.J. 1969 Numerical Taxonomy. Academic Press, London.
* Daris, P.M. and Heywood, V.H. 1973. Principles of Angiosperms Taxonomy, robert E. Kreiger Pub. co. New York.
* Grant., V. 1971. Plant Speciation, Columbia University press, New York.
* Grant, W.F. 1984. Plant Bicosystematic, Academic Press London.
* Harrison, H.J. 1971 New concepts in Flowering Plant Taxonomy. Hieman Educational Book Ltd., London.
* Heslop-Harrison, J.I967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd., U.K.
* Heyvvood, V.H. and Moore, D.M. 1984. current concepts in Plant Taxonomy Academic press, London.
* Jones, A.D. & wilbins, A.D. 1975. Variations and Adaptations in Plant species. Hieman & co. Educational Book Ltd., London.
* Jones, S.B. Jr. & Luchsinger, A.E. 1986. Plant systematics (2nd Edition) McGraw-Hl Book Co.New York

* Nordenstam, B., El Gazaly, G. & Kassas, M. 2000. Plant systematics for 21st century. Portlant press Ltd., London.
* Radford, A.E. 1986.Fundamentals of Plant systematics. Harper & Row publications, USA.
* Singh, H. 1978. Embryology of Gymnosperms. Encyclopaedia of plant Anatomy X.Gebruder Bostraeger Berliln.
* Solbrig, O.T. 1970 Principles and Methods of plant Biosystematies. The MacMillan co. Collier MacMillan Ltd., London.
* Solbrig. O.T. & solbrig., D.J. 1979. Populatin Biology and Evolutin. Addisonwesley Publicating co. Inc. USA.
* Stebbins, G.L. 1974. Flowering Plant-Evolution Above Species Level Edward Arnold Ltd, London.
* Stace, C.A. 1989. Plant Taxonomy and Biosystematies (2nd Edition) Edward Arnold. Ltd., London.
* Takhtajan, A.L. 1997. Diversity and Gasification of Flowering Plants. Columbia University Press, New York.
* Woodland, D.W. 1991. Contemporary Plan Systematics. prentice Hall, New Jersey.

Suggested Laboratory Exercise (For Course VII and VIII)

Gymnosperms

1. Comparative study of the anatomy of Vegatative and reproductive parts of Cycas, Ginkgo, Cedrus, Abies, Picea, Cupressus, Araucaria. Cryptomeria, Taxodium, Ppducarpus, Agathis, Taxus, Ephedra and Gentum.
2. Study of important fossil gymnosperms from prepared slides and specimens.

Angiosperm

3. Description of a specimen from representative, locally available families.
4. Description of a species based on various specimens to study intraspecific variation: a collective exercise.
5. Description of various species of a geneus; location of key characters and preparation of eys at generic level.
6. Location of key characters and use of keys at family level.
7. Field trips within and around the campus; complication of ield notes and preparation of herbarium sheets of such plants wild or cultivated, as are abundant.
8. Training in using floras and herbaria for identification of specimens described in the class.
9. Demonstration of the utility for secondary metabolites in the taxonomy of some appropriate genera.

Course IX: Plant physiology

Energy flow: Principles of thermodynamics, free energy entropy and enthalpy chemical potential, redox reactions, structure and functions of ATP.

Enzymology: General aspects, structure of enzymes allosteric mechanism, regulatory adn active sites, isozymes, Kinetics of enzymatic catalysis, Michaelis-menten equation and its significance.

Translocation of water and solutes; plant water relation, mechanism of water transport through xylem, root - microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins.

Photochemistry and role of proteins in photosynthesis: General concepts and historical background, evolution of photosynthetic apparatus. Photosynthetic pigments and light harvesting complexes. Photoxidation of water, mechanisms of electron and proton transport, carbon assimilation - the Calvin cycle, photrespiration and its significance, the c4 cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.

Respiration and lipid metabolsim: Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, Pentose phosphate pathway, glyoxylate cycle, alternative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids, and their catabolism.

Course X: Plants Metabolism.

Nitrogen and sulphur metabolism: Overview, biological Nitrogen fixation, nodule formation and symbiotic N Fixation / mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate uptake transport and assimilation.

Reductive ammination and transmination sensory photobiology: History of discovery of phytochromes and its photochemical and biochemical properties, photophysiology of light-induced responses cellular localization, molecular mechanism of action of photomarphogenetic receptors.

Signaling and gene expression,

Plant growth regulators and elicitors: Physiological effects and mechanism and action of auxins, gibberellins, cytokinins ethylene, abscisic acid, brassionsteriods, polyamines jasmonic acid and salicylic acid, hormone receptors, singal trasnduction and gene expression.

Plant growth regulators and eleictors: Physiolobical effects and mechanism and action of auxins, gibberellins, cytokinins ethylene, abscisic acid, brassionsteriods, polyamines jasmonic acid and salicylic acid, hormone receptors, singal transduction and gene expression.

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development, genetic and molecular analysis, role of vernalization.

Stress physiology: plant responses to biotic and abiotic stress mechanisms of biotic and abiotic stress tolerance HR and SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and het stress, oxidative stress.

Suggested Readings: (for course IX and X)

* Buchanan, B.B., Gruissem, W. & Jones, R.L. 2000. Biochemistry and Molecular Biology of plants. American Society of plant Physiologits Maryland, USA.
* Dennis, T.D., Tupin, D.H. Lefebvre, D.D. and Layzell, D.B. (Eds.) 1997. Plant Metabolism (second edition) Longman, Essex England.
* Galston, A.W. 1989. Life Processes in Plants. Scientifica American Library, Springer - Verlag, New York.
* Hooykaas, P.J.J. Hall, M.A. and Libbenga, K.R (Eds) 1999, Biochemistry and Moleculer Biology of plants: Hormones, Elsevier, Amsterdam. The Nethclands.
* Horkins, W.G. 1995. Introduction to plant Physiology. John Wiley and sons, Inc. New York, USA.
* Lodish, H, Berk, A. Zipursky, S.L. Matsudaira, P. Baltimore, D, and Darnell J. 2000 Molecular Cell Biology (Fourth Edition) W.H. Freeman and company, New ork, USA.
* Moore, T.C. 198$, Biochemistry and Physiology of plant Hormones (Second Edition) Springer - verlag, New York, USA.
* Noble, P.S. 1999 Physiochemical and Environmental Plant Physiology (second Edition) Academic press. San Digeo USA.
* Salisbury, F.B. and Ross, C.W. 1992, Plant Physiology (Fourth Edition) Wadsworth Publishing co. California USA
* Singhal, G.S. Renger, G. Spory, S.K., Irrganp, K.D. and Govindjee 1999. Concepts in photobiology : photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
* Taiz, L. and Zeiger, E. 1998. Plant Physiology (2nd Edition) Sinauer Associates, Inc. Publishers Massachusettss USA.
* Thomas, B. & Vince- Prue D. 1997. Photoperiodism in Plants Second Edition, Academic press, san Diego, USA.
* Westhoff. P. (1998) Molecular Plant Development: from Gene to plant Oxford University,' Press, Oxford, U.K.

Suggested Laboratory Exercises (for course IX and X)

1. Effect of time and enzyme concentration on the rate of reaction of enzyme (amylase, nitrate reductase.)
2. Effect of substrate concentration on actively of any enzyme and determination of its Km value.

3. Demonstration of substrate inducibility of the enzyme nitrate reducatase.
4. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids. Isolation of intact chloroplast and estimation of chloroplast protien.
5. To determine the chlorophyll a and chlorophyll b ration in c3 and c4 plants.
6. Extraction of seed proteins depending upon the solubility.
7. Determination of succinate dehydrogenase activity, its kinetics and sensitivity to inhibitors.
8. Desalting of proteins by gel filtration chromatography employing sephadex G25.
9. Preparation of the standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by Lowry's of Burette method.
10. Fractionation of proteins using gen filtration chromatography by sephadex G100 ifr sephadex G200.
11. SDS-PAGE for soluble proteins extracted from the given plant materials and comparison of their profile by staining with comoossie Brilliant Blue of silver nitrate.
12. Separation of isozymes of esterases, peroxidases by native polyacrylamide gel electrophoresis.
13. Principles of colorimetry, spectrophotometry and fluorimetry.

Suggested Reading (for Laboratory Exercises)

* Bairacharya, D. 1999. Experiments in plant physiology: A Laboratory Manual. N osa Publishing House, New Delhi.
* Cooper, T.G., 1997. Tools in Biochemistry. John Wiley, New York, USA.
* Copeland, R.A. 1996. Enzymes : A practical introduction to structure, Mechanism and Data Analysis. VCH publishing, New York.
* Dennison, C. 1999. A Guide to protein Isolation. Kluwer Academic publishers, Dordrecht, The Netherlands.
* Devi, P. 2000. Principles and Methods of plant Molecular Biology, Biochemistry and Genetics, Agrobios, Jodhpur. India
* Dryer, R.L. & Lata, G.F. 1989. Experimental Biochemistry. Oxford University press, New York.
* Hames, B.D. (Ed.) 1998 Gel Electrophoresis of proteins: A practical Approach. 3rd Edition, PAS oxford University press oxford, UK.
* Harborne, T.C. 1981. Phytochemical Methods: A guide to Modern Techniques of plant analysis. Chapman & Hill, London.
* Moore,T.C. 1974. Research Experiences in Plant Physiology: A Laboratory Manual. Springer Verlag Berlin.
* Ninfa, A.J. and Ballou, D.P. 1998 fundamental Laboratory approaches for Biochemistry and Biotechnology. Fitzgerald Science press, Inc. Maryland USA.
* Pulmmer, D.T. 1998. An Introduction to practical Biochemistry: TAta McGraw Hill Publishing co. Ltd., New Delhi-

* Scott, R.P.W 1985 - Techniques and practice of Chromatography Marcel Dekker, Inc., New York.
* Wilson, K. & Goulding, K.H. (Eds.) 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Armold London, UK.

Course XI: Plant Development

Introduction: Unique features of plant development, differences between animal and plant development.
Seed germination and seedling growth: Metabolism of nucleic acids, proteins and mobilization of food reserves; tropisms; hormonal control of seedling growth; gene expression; use of mutants in understanding seedling development.
Shoot development: organization of the shoot apical meristem (SAM): Cytological and molecular analysis of SAM: Control of cell division and cell to cell communication: control of tissue differentiation, especially xylem and phloem; secretary ducts and laticifers: wood development in relation to environmental factors.
Leaf growth and differentiation: Determination; phyllotaxy: control °f leaf from; differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

Root development: organization of root apical meristom (RAM) cell fates and lineages; Vascular tissue differentiation, lateral root, root hairs; root - microbe interaction.
Latent life dormancy; importance and types of dormancy; seed donnan; overcoming seed dormancy; bud dormancy;
Senescence and programmed cell death (PCD): Basic concepts types of cell death, PCD in the life cycle of plants metabolic changes associated with senescence and its regulation; influence of hormones and environmental factors on senescence.

Course XII: Plant Reproduction

Reproduction: Vegetative reproduction and sexual reproduction; flower development; genetics of floral organ differentiation; sex determination.

Male gametophyte: Structure of anthers; microsporogenesis, role of tapetum; coller development and gene expression, male sterility; sperm dimorphism and hybrid seed production; pollen germination,= pollen tube growth and guidance pollen storage; pollen allergy pollen embryos.

Female gametophyte: Ovule development, megasporogenesis; organization of the embryo sac, structure of the embryo sac cells. Pollination, pollen - pistil interaction and fertilization.

Floral characteristics: Pollination mechanisms and Vectors; breeding systems; commercial consideration, structure of the pistil; pollen stigma interactions, sporophytic and gametophytic self -incompatibility (cytological. biochemical and molecular aspectsa); double fertilization; in vitro fertilization.

Seed development and fruit growth: Endosperm development during early maturation and desiccation stages; embryo genesis, ultra structure and nuclear cytology; cell lineages during later embryo development; storage protein of endosperm and embryo; polyembryony; apomixis, embryo culture; dynamics of fruit growth; biochemistry and molecular biology of fruit maturation.

Suggested Readings: (For paper XI and XII)

* Atwel, B.J., Kriendermann, P.E. & Jumbull, C.G.N. (Eds) 1999. Plants in Action: Adaptaiton in Nature. Performance in Cultivation, MacMillan Education, Sudney, Australia.
* Bewley, J.D. & Black, M 1994 Seeds: Physiology of Development and Germination. Plenum Press, New York.
* Bhojvvani, S.S. & Bhatnagar, S.P. 2000. The Embryology pf Angiosperms (4th revised and enlarged edition) Vikas publishing House, New Delhi.
* Surges, J. 1985. An Introduction to plant cell Development Cambridge University Press, Cambridge.
* Fageri, K. and Van der Fiji, L. 1979. The principles of pollination Ecology. Pergamon Press, Oxford.
* Fahn, A. 1982. Plant Anatomy (3rd Edition) Pergamon Press, Oxford.
* Fosket, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic press san Diego.
* Howell, S.H. 1998. Molecular Genetics of plant Development, Cambridge University Press. Cambridge.
* Leins, P,., Tucker, S.C. and Endfress P.K. 1988. Aspects of Floral Development. J. Cramer Germany.
* Lyndon, R.F. 1990. Plant Development. The Cellular Basis Unnin Hyman, London.
* Murphy, T.M. and Thompson, W.F. 1988 Molecular Plant Development. Prentice Hall New Jersey.
* Proctor, M. and Yeo, P. 1973. The Pollination oi lowers. William Collins Sons, London.
* Raghavan, V. 1997. Molecular Embryology of Flowering plants. Cambridge University Press, Cambridge.
* Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer Verlag, New York.
* Reven, P.H., Evert, R.F. and Eichhom, S.E. 1992. Biology of plants (5th Edition) New York.
* Salisbury, F.B. and Ross C.W. 1992. Plant Physiology (4th Edition) Wadswoth Publishing co. California.
* Steeves, T.A. and Sussex, l.M. 1989. Patterns in Plant Development (2nd Edition) Cambridge Press, Cambridge.
* Sedgely, M. and Griffin, A.R. 1989. Sexual Reproduction of Tree Crops. Academic Press, London.

* Waisel, Y. Eshel, A. & Kafkaki, U. (eds) 1996. Plant Roots: The Hidden Hall (2nd edition) Dekker New York.

* Shivanna, K.R. & Sawhney, VK. (Eds) Pollen Biotechnology for crops Production and improvement. Cambridge University, Press, Cambridge.

* Shivanna, K.R. & Rangaswamy, N.S. 1992. Pollen Biology: A Laboratory Manual, Springer - Verlag, Berlin.

* Shivanna, K.R. and Johri, B.M. 1985. The Angiosperm Pollen: Structure and Function, Willey Eastern, Ltd., New York.

* The Plant Cell special issue on Reproductive Biology of Plants Vol.5 (10) 1993. The American Society of plant physiology, Rockville, Maryland, USA.

Suggested Laboratory / Field Exercises "(For course XI and XII)

1. Effect of gravity, unilateral light and plant growth regulators on the growth of young seedlings.
2. Role of dark and red light/far-red light on the expansion of cotyledons and epicotylar hook opening in pea.
3. Study of living shoot apices by dissections using aquatic plant such as Ceratophyllum and Hydrilia.
4. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double - stained, permanent, slides of a suitable plant such as Coleus, Kalanchoe, tobacco. Examination of shoots apices in a monocotyledon in both TS. and L.S. to show the origin and arrangement of leaf primordia
5. Study of alternate and distichous, alternate and superposed, opposite and superposed; opposite decussate leaf arrangement. Examination of rosette plants (Launses, Mollugo, Raphanus, Hyoscyamus etc.) and induction of bolting under natural conditions as well as by GA treatment.
6 Microscopic examination of vertical sections of leaves such as, tobacco. Nerium, Maize and wheat to understand the internal structure of leaf tissues and trichomes, glands etc. also study the c3 and c4 leaf anatomy of plants.
7. Study of epidermal peels of leaves such as Coccinia Gaillardia, Tradescantia, Notonea etc. to study the development and fine structure of stomata and prepare stomatal index demonstration of the effect of ABA on stomatal closure.
8. Study of whole roots in monocots and dicots Examination of L.S. of root from a pe-anent preparation to understand the organization of root apical meristem and its derivatives (use maize, aerial roots of banyan, pistia etc.) Origin of lateral roots. Study of leguminous roots with different types of nodules.
9. Study of Microsporogenesis and gametogenesis in sections of anthers.
10. Examination of modes of anther dehiscenece and collection of pollen grains for microscopic examination (Maize, Grasses, Crotalaria, Tradescantia, *Brassicam, Petunia*, *Solanum melongena* etc.)
11. Tests for pollen viability using stains and in vitro germination, pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.

12. Estimating percentage and average pollen tube length in vitro.

13. The Role of transcription and translation inhibitors on pollen germination and pollen tube growth.

14. Pollen storage, pollen - pistil interaction, self-incompatibility, in vitro pollination.

15. Study of ovules in cleared preparation; study of monosporic, bisporic and tetrasporic types of embryo sacs development through examination of permanent stained serial sections.

16. Field study of several types of flower with different pollination mechanisms (wind pollination, thrips pollination, bee/ butterfly pollination, bird pollination)

17. Emasculation, bagging and hand pollination to study pollen germination, seed set and fruit development using self compatible and obligate out crossing systems. Study of-cleistogamous flowers and their adaptations.

18. Study of nuclear and cellular endosperm through dissections and staining.

19. Isolation of zygotic globular, heart-shaped torpedo stage and mature embryos from suitable seeds polyembryony in citrus, janum (*Syzygium cumin*i) etc. by dissections.

20. Study of seed dormancy and methods to breaks dormancy.

Suggested Readings (For Laboratory Exercise)

* Sivanna. K.R. and Rangaswamy, N.S. 1992 Pollen Biology: A laboratory Manual Springer Verlag. Berlin Heidelberg (and References therein)

* Chopra V. L. 2001. Plant Breeding; theory and practice oxford IBHPvt. Ltd., New Delhi.

* Chopra V.L. 2001. Plant Breeding Field crops, Oxford IBM Pvt. Ltd., New Delhi.

Course XIII-Plant Ecology -1

1. An introduction of plant Ecology and its scope.

2. Climate, soil and Vegetation Patterns of the World: Life zones; major biomes and major vegetation and soil types of the world in general and of India in particular.

3. Vegetation organization: Concepts of community and Continuum.
Analysis of communities (Analytical and Synthetic Characters): community coefficients: Interspecific association (Types of competition, Theory of Competition, interspecific competition and evolution, Commensalisms and mutualism, the evolution of competence relationship), ordination; concept of ecological niche.

4. Vegetation development: Temporal changes (Cyclic and Non Cyclic); Plant succession. Types of Succession. Mechanism of ecological successions (Relay on Floristic, and initial floristic composition; Facilitation, Tolerance and inhibition models); changes in ecosystem properties during succession.

5. Ecosystem Organization: Structure and functions; primary production methods of measurement of primary productivity, global pattern, controlling factors), Energy dynamics (food chains, food webs of trophic levels; energy flow pathway, single channel and y-shaped energy flow models, ecological efficiencies) Litter fall and decomposition (mechanism, substrate quality and climatic factors): Global

biogeochemical cycle of C, N, P, and S, meneral cycles (Pathways, processes, budgets) in terrestrial and equatic ecosystem.

Course XIV Plant Ecology - II

6. Biological diversity: meaning and measures of biodiversity, the maintenance of biodiversity (spatial Heterogeneity, the competition predation theory stability, equitability), speciation and extinction IUCN Categories of threat; distribution and global patterns; terrestrial biodiversity, hot spots; inventory.
7. Air, Water and Soil Pollution: Kinds, sources, quality parameters; effects on plants and ecosystems. Abatement measures.
8. Climate change: Greenhouse gases (CO2, CH4 N2O, CFCs: sources, trends and role); ozone layer and ozone hole, consequences of climate change (CO2 Fertilization, global warming, sea level rise UV radiation).
9. Ecosystem stability: concept (resistance and resilience): ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plants invasion; environmental impact on plants and ecosystems: ecology of plant invasion; environmental impact assessment, ecosystem restoration.
10. Ecological management: concepts: sustainable development; sustainability indicators.

Suggested Readings: (for Course XIII and XIV)

* Smith, R.L. 1996. Ecology and Field Biology. Harper Collins, New York.
* Muller- Dombis, D. & Ellenberg, H. 1974. Aims and Methods of Vegetation Ecology, Wiley, New York.
* Begon, M. Harper, J.L. & Townsend, C.R. 1996. Ecology Blackwell science, Cambridge, USA.
* Ludwing, J&Reynolds, J.F. 1988. Statistical Ecology, John wiley &sons.
* Odum, E.P. 1971. Fundamentals of Ecology, saunders, Philadelphia
* Odum, E.P. 1983. Basic Ecology, saunders, Philadelphia Merritt EmlenJ. Ecology.
* Barbour, M.G., Burk, J.H. & Pitts, W.D. 1987. Terrestrial Plant Ecology. Benjamin /cummings Publication Company, California.
* Kormundy, E.J. 1996. Concepts of ecology. Prentice - Hall of India Pvt. Ltd. New Delhi.
* Chapman, J.L. & Reiss, M.J. 1988. ecology. Principles and Applications. Cambridge University press, Cambridge, U.K.
* Moldan, B. and Billharz,S. 1997. Saustainability Indicators, John Wiley 7 & sons, New York.
* Treshovv, M. 1985. Air Pollution and plant Life Wiley Interscience.
* Heywood, V.H. and Watson, R.T. 1995. Global Biodiversity. Assessment. Cambridge University Press.
* Mason, C.F. 1991. Biology of freshwater Pollution Langman.

* Hill, M.K. 1997. Understanding Environmental Pollution. Cambridge University Press.
* Brady, N.C. 1990. The Nature and Properties of soils. Macmillan.

Suggested Laboratory Exercises: (For course XIII & XIV)

1. To calculate mean, variance, standard deviation, standard error, and coefficient of variation and to use t-test for comparing two means related to ecological data.
2. To prepare ombrothermic diagram for different sites on the basis of given data set and to comment on climate.
3. To find out relationship between two ecological variables using correlation and regression analysis.
4. To determine minimum size and number of quadrate required for reliable estimate of biomass in grasslands.
5. To find our association between important grassland species using Chi-square test.
6. To compare protected and unprotected grassland stands using community coefficients (Similarity indices)
7. To analyze plant communities using Bra-Curtis ordination method.
8. To determine diversity indices (Shannon - Wiener, concentration of dominance, species richness, equitability and Bio-diversity) for protected and unprotected grassland stands.
9. To estimate IV1 of the species in a woodland using point centered quarter method.
10. To determine gross and net phytoplankton productivity by light and dark bottle method.
11. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
12. To determine the water holding capacity of soils collected from different locations.
13. To determine percent organic carbon and organic mater in the soils of cropland, grassland and forest.
14. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of winkler's method.
15. To estimate chlorophyll content in SO2 fumigated and unfumigated plant leaves.
16. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
17. To study environmental impact of a given developmental activity-using checklist as a EIA method.

Suggested Reading (For Laboratory Exercises)

Krebs, C.J. 1989. Ecological Methodology. Harper and Row .New York, USA.

Ludwig, J.A. and Reynolds, J.F. 1988 Statistical Ecology, Wiley, NewYork.

Magurran, A.E. 1988. Ecological Diversity and its Measurement! Chapman & Hall, London.

Pielou, E.G. 1984. The Interpretation of Ecological data. Wiley, New York

Sokal, R.R. and Rohlf, F. J, 1985 Biometry, W.H. Freeman & San Francisco.

Moore, P.W. and Chapman, S.B. 1986, Methods in plant Ecology. Blackwell Scientific publications.

Mishra, R. 1968 Ecology Work Book oxford & IBH, New Delhi

APHA - Standard Methods for the examination of water and Waste water. American public Health Association Washington, D.C.

Smith, R.L. 1996. Ecology and Field Biology. Harper Collins, NewYork.

Muller- Dombois, D. and Ellenberg. H. 1974. Aims and Methods of Vegetation Ecology. Wiley, New York.

Course XV: Plant Resource Utilization.

Plant Biodiversity: Concept, status in India, utilization and concerns. Sustainable development: Basic concepts.

Origin, evolution, botany, cultivation and uses of i) Food, forage an fodder crops, ii) Fibre crops iii) Medicinal and aromatic plants, an iv) Vegetable oil - yielding crops.

Important fire- wood and timber- yielding pants and non - woo forest products (NWFPs) such as bamboos, rattans, raw materials for paper - making, gums, tannins, dyes, resins and fruits.

Green revolution: Benefits and adverse consequences. Innovations of meeting world food demands, Plants used as avenue trees for shade, Pollution control and aesthetics.

Course XVI: Plant Resource Conservation.

Principles of conservation, extinctions: Environmental status of plants based on Internationals Union for conservation of Nature.

Strategies for conservation -in situ conservation: International efforts and Indian Initiatives; protected areas in India - sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity.

Strategies for conservation - ex-situ conservation: principles and practices; botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks; general account of the activities of Botanical survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR),

Council of scientific and Industrial Research (CSIR), and the department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

Suggested Laboratory Exercises (Course XV and XVI)

The practical course is divided into three units: (1) Laboratory work (2) Field survey and (3) Scientific Visits.

Laboratory Work:

Food crops: Wheat, rice maize, chickpea (Bengal gram) potato, sweet potato, and sugarcane. Morphology, anatomy, microchemical test for stored materials.

Forage/fodder crops: study of any five important crops of the locality (For example fodder sorghum, bajra, berseem, clove, guar bean, gram, *ficus* sp.)
Plant Fibres:

(a) Textile Fibres: Cotton, jute sun hemp.

(b) Cordage Fibres: Coir

(c) Fibres for stuffing: Silk cotton or kapok Morphology anatomy, microscopic study of whole fibres using appropriate staining procedures.
Medicinal and aromatic plants: Depending on geographical location college, University selects five medicinal and aromatic plants each from a garden, crop field (or firm wild only if they are abundantly
available). '

Papaver somniferum, Catharanthus roseus; Adhatoda zeylanica (A. Vasica), Allum sativum, Withania Somnfera, phyllanthus emblica, Aloe barbadense, Mentha arvensis, Rosa sp. Origanum vulgare, Vetiveria zizaniodes, jasminum grandiflorum.

Cymbopogon sp., Pandanus odoratissimus. Study of live or herbarium specimens or other visual materials to become familiar with these resources.

1. Vegetable oils, Mustard, groundout, Soyabean, Coconut, sunflower, castor Morphology, microscopic structure of the oil -yielding tissues, test for oil and iodine number.
2. Gums, resins, tannins, dyes: perform simple tests for gums and resins, Prepare a water extract of vegetable tannins (.Acacia, Terminalia, tea, cassia Spp., Myrobalans) and dyes (turmeric, Bixa orellana, Indigo Butea, monosperma, Lawsonia inennis) and perform test to understand their chemical nature.

Course XVII – Biotechnology – I

(Plant cell tissue and organ culture)

Biotechnology basic concept, principles and scope, Plant cell and tissue culture: General introduction, history, scope, concept of cellular differentiation, totipotency.

Organogenesis and adventive embryogenesis: fundamental aspect of morphogenesis; somatic embryogenesis and androgenesis, mechanism, techniques and utility.

Somatic hybridization: protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievement and limitations of protoplast research.

Application of plant tissue culture: Clonal propagation, artificial seeds, production of hybrids and somaclones, production of secondary metabolites/natural products. Conservation and germplasm storage.

Course XVIII Biotechnology – II

(Genetic Engineering)

Recombinant DNA technology: Gene cloning, Principles and techniques, construction of genomic/cDNA libraries, choice of vectors, DNA synthesis and sequencing, Polymerase chain reaction, DNA fingerprinting.

Genetic engineering of plants: Aims, Strategies for development of transgenics (with suitable examples), Agrobacterium-the natural genetic engineer. T-DNA and transposon mediated gene tagging, chloroplast transformation and its utility. Intellectual property rights, possible ecological risks and ethical concerns.

Microbial genetic manipulation: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Genomics and proteomics: Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosomes, high throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays protein profiling and its significance.

Suggested Readings:

Bhojwani, S.S. andRazdan M.K. 1996. Plant Tissue Culture: Theory and Practice (A revised edition) Elseview Science publisher. New York, USA.

Bhojwani S.S. 1990. Plant Tissue Culture: Applications and Limitations, Elsevier Science publishers, New York, USA.

Brown, T.A. 1999, Genomes. John Wiley & Sons (Asia) Pvt. Ltd. Singapore.

Callow J.A., Ford - Lloyd B. V. & Newbury H.J. 1997. Biotechnology and plant Genetic Resources: Conservation and Use. CAB International Oxon. UK.

Chrispeels M.J. & Sadva D.E. 1994. Plants Genes and Agriculture, Johnes & Barlett publishers, Boston USA.

ClIinsH.A. and Edwards S. 1998 Plant Cell Culture, Bios Scientific publishers, Oxford U.K.

Glazer A.N. & Nikaido H. 1995, Microbial Biotechnology, W.H. Freeman & Company, New York USA.
Henry R.J. 1997 Practical Applications of plant Molecular Biology Chapmna& Hall London U.K. Jain, S.M. Sopory S.K. and Veillux.

R.E. 1996 in Vitro Haploid producation in Higher plants, Vi ;. 1-5 Fundamental Aspects and Methods, Kluwer Academic publishers Dordrcht. IheNetherlands.

Jolles O. and Jornvall H. (eds) 2000 Proteomics in Functional Genomics, Birkhauser Verlag, Basel Switzerland.

Kartha, K.K. 1985, Cryopreservation of plat cells and organs CRC press, BocaRaton, Florida, USA.

Old R. W. and Primorse S.B. 1989 - Principafes of Gene Manipulation. Backwell scientific publications Oxford UK.

Primrose S.B. 1995. PRINCIPLES of Genome Analysis, Balckwell Science Ltd. Oxford UK.

Raghavan V, 1986 Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University press, New York USA. Raghavan V. 1997. Molecular Biology of flowering plants Cambridge University Press, New York, USA.

Shantharam S & Montogomery J.F. 1999. Biotechnology, Biosafety, and Biodiversity. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi. Vasil K, & Thorpe, T.A. 1994. Plant Cell and Tissue Culture Kluwer Academic Press The Netherlands.

Suggested Laboratory Exerices (For Course XVII and XVIII)

1. Growth characterstics of E. Coli using plating and turbidimetric methods.
2. Isolation of plasmid from E. Coli by alkaline lysis method and its quantitation spectrophotomertically.
3. Restriction degestion of the plasmid and estimation of the size of various DNA fragments.
4. To detect mutant variants in a given bacterial population by replica plating technique. Isolation of protooplant from various plant tissues and testing their viability.
5. To demonstrate the gene transfer during bacterial conjugation Demonstration of DNA sequencing by sangers dideoxy method.
6. Control and expression of the genes of lac operon.
7. Effect of physical (e.g. temperature) and chemical (e.g. Osmoticum) factors on protoplast yield.
8. Demonstration of protoplast ftision employing PEG.
9. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seed.
10. Demonstration ofandrogenesis in Datura. Co-cultivation of plant material (eg. Leaf discs) with Agrobacterium and study GUS activity histochemically.

Suggested Reading (For Laboratory exercises)

Butenko R.G. 2000 plant Cell Culture, University press of pacific.

Collin H.A. and Edwards S 1998. Plant Cell culture Bios scientifica publishers, Oxford, UK.

Dixon, R. A. (Ed.) 1987. Plant Cell Culture: A Practical Approach, IRL press oxford.

Gelvin S.B. and Schilperoort R. A. (Eds) 1994. Plant Molecular Biology Manual 2nd Edition, Kluwer Academic publishers, Dordrecht, The Netherlands.

George F.E. 1993. Plant propagation by Tissue Culture. Pan 1. The Technology 2nd Edition. Exegetics Ltd. Edington UK.

Glick B.R. & Thompson J.E. 1993. Methods in plant Molecular Biology and Biotechnology. CRC press, Boca Raton, Florida,

Glover D.M. & Hames B.D. (Eds) 1995 DNA Cloning 1: A practical Approach; Core Technique and edition PAS IRL press at Oxford University press, Oxford.

Hackett P.B. Fuchs, J.A. & Messing, J. W. 1988. An Introduction to Recombinant DNA Techniques; Basic Experiments in Gene Manipulation. The Benjamin/Cummings publishing Co. inc. Menlo park. California.

Hall, R.D. (Ed.) 1999. Plant Cell culture Protocols. Humana press, Inc. New Jersey, USA.

ShawC.H. (Ed) 1988. Plant Molecular Biology: A practical Approach. IRL Press Oxford.

Smith R.H. 2000 Plant Tissue Culture: Techniques and Experiments, Academic Press New York.

Course XIX: Elective -1

Crop genetics and plant breeding -1

1. Crop genetic Resources: Improtance of genetic Conservation, global network for genetic conservation and utilization in major crops or the world. Institutes engaged in conservation and improvement of crop genetic resources.
2. Food supplies, Nutrition and crop breeding: i. World food situation, ii. Nutritional problems, iii. Nutritional objectives.
3. Methods of plant breeding: Introduction, selection, (Pure line selection, W.L. Johansons experiments on beans and their significance) Variety acclimatization, genetic significance of pollination methods, methods of breeding self and cross pollinated crops asexually and vegetatively propogated crops.
4. Incompatibility in plant breeding.

   Types, nature, charactersite genetic and biocemical basis, ii. Methods of indication and overcoming, iii. Incompatibility as a tool in breeding crops.
5. Male sterility: i. Definition and classification, ii. Male sex expression and sex Chemical induction of male sterility, v. Prespectives.

6. Back cross: i. Genetic basis, ii. Methodology in selection to character under transfer, Transfer of two or more characters, iii. Interverietal, interspeacific and intergeneric transfer.

Course XX : Elective -1

Crop generics and plant breeding - II

1. Heterosis breeding: i. Historical aspects, ii. Inbreeding depression, iii. Homozygous and heterozygous balance, iv. Genetic basis of inbreeding, v. genetic and physiological basis of heterosis, vi. heterosis and plant breeding.
2. Mutation Breeding: i. Historical perspective, ii. The nature and chemical basis of mutation, iii. Physical and chemical mutagenesis, v. Mutagenic treatment schedules, vi. Screening of mutation in population, vii. Frequency and spectrum of mutants, micro and macro mutants, viii. Mutagenetic effectiveness and efficiency, ix. Environmental mutagenesis repair mechanism, x. Role of mutationsin crop improvement programme.
3. Resistance breeding: A. Disease rasistance-nature. machanism ofresistace, methodology problems and achievements. B. Insect resistance : Nature machanism of resistance, methodology, problem and achievements. C. Drought resistance Importance, tvpes, nature of resistance methods, examples.
4. Quality breeding: A. Nature of quality B. Genetic and biochemical basis C. Genetic manipulation of quality and quantity.
5. Distant hybridizaiton: a Importance, b. Interspecific, intergeneric gene transfers, methodology, problem and remedial measures, c. Man made species.
6. Seed production and distribution: Introduction variety evaluation, variety maintenance, availability of new varieties, seed production and untore, regulation, seeds industry development.
7. Breeding crops with special reference to Marathwada region like wheat, Jowar, bajra,cotton, ground nut, safflower etc.

Practicals For Elective -1 course XlX.and XX.

1. Study of floral biology of different crop plants.
2. Demonstration of hybridization techique in self and cross pollinated crops.
3. Study of pollen germination of demonstration of incompatibility.
4. Demonstration of male sterility in Jowar.
5. Study of pollen fertility.
6. Study of pollen viability.
7. Karyotype analysis in crop plants.
8. Aneuploid analysis in crop plants.
9. Introduction of polypoidy in crop plants.
10. Study of seed protein profile by natice and SDS-PAGE.
11. Estimation of oils from edible oil crops.
12. Estimation of leaf protein, Seed proteins in diploids and polyploids.

13. Mutagenesis-

    Induction of mutations through physical /Chemical muatagenic treatments and raisin M/Mz generations. Assessin the effect of mutagens of different Ml, parameters and M2 chlorophyll viable mutant frequency and spectrum.

14. Study of mutagenens data published in different jouranls and ariving at logical conclusions by providing theoretical reasons.

15. Designing of filed experiments.

Reference Books.

1. Plant Breeding-B.D.Singh.
2. Plant Breeding - J.R. Sharma.
3. An Introduction of plant breeding - H.K. Chaudhary.
4. Evolution of crop plants - Editited by simmants N-W (1986)
5. Breeding field crops - Poehlmann and sleper.
6. Plant Breeding perspectives - Edited by sheep and Mendrikasen.
7. Crop Breeding - P.B. Vose and S.G. Blixt.
8. Genes, Choromosomes and Agriculture - Chrispecials and Sadava.
9. Principal of Genetics - Snusted and Simmants.
10. Manual of mutation breeding by FAO/IAEA.
11. Mutation Research-Aurebach.
12. Chemical mutageesis-fishbathetal.
13. Burnhan C.R. 1962 - Discussions in cytogenetics.
14. Khush G.S. 1973 - Genetics - Principles and analysis.
15. Hartt and Jones 1998 - Genetics Principles and analysis.
16. WastsonJ.D. 1989 Molecular biology of the gene. Journals

Journals

1. Cytologia
2. Caryologia
3. Nucleus
4. Nature
5. Current science.
6. Indian Journal of genetics and plant Breeding.
7. Journal of cytology and genetics.
8. Journal of genetics.
9. Genomes
10. Environmental and Experimental Botany.
11. Journal of nuclear Agriculture and Biology.
12. The Journal of the Science of food and agriculture.
13. The Journal of Indian botanical society.

Course XIX: Elective - II

Integrated pest management: Concepts and Applicaton.

1. Principles of plant pathology: History, Classification of crop diseases - viral, bacterial, fungal and nematode. Deficiency of micronutfients. Defence machanism in host, histological and chemical defence, production of phytoalexins, disease development epidemiology and forcasting seed soil and air borne palthogens Rhisosphere, seeds soild and air microflora.
2. Role of enmes and toxins in disease development cell wall degrading enzymes celluloytic, pecto.ytic, amyloytic, proteolytic and lipolytic enzymes. Toxins lycomarsmine, altemaric acid fusario acid piricularin, vicorin, aflatoxins.
3. Physiology and biochemistry of host pathogen interaction, Respiration photosynthesis, proteins nucleic acid, phenol metabolism and plant growth regulators.
4. Genetics of Host parthogen interaction, gene for gene hypothesis, protein for protein hypothesis, antigen and antibody reaction. Imminoglobulines application of immunological techniques, physiological specialization.
5. Seed pathology: Methods of detection of internal and external seed born fungi bacteria and virus, biodeterioration and myco toxins.

Suggested Reading.

Manibhoushan Rao K. and A Mahadaven Recent development in Biocontrol of plain pathogenes, Today and Tomarrovvs printers and publishers, New Delhi 110005.

Course XX: Elective-II

Integrated pest management: Concepts and applications - II

1. Methods of disease diagnosis, field observation, histo pathology, isolation and identification of pathogens.
2. Integrated management of plant disease: Definition of IPM, international approach, Quarantine laws, culture methods, avoidance of pathogen, breeding and use of disease resistant varieties, seed certification chemical methods, formation and classification, chemical methods - formulation and classification of fungicides, contact and systemic fungicides, uptake and mode of action, seed soil and plant treatment fungicides, fungicide resistance in plant pathogens and their management, antibiotics and biological control; techniques - protoplast fusion and genetics Biological control agents – VA Mycorrhiza, Trichoderma, viride, T. harzianum Pseudomonas fluorescens glomus use of botonical and other biopesticides.
3. Intergrated management of some important disease - History symptology pathogen, etiology and management: Jowar (Head and grain smut) Bajra(Green ear), Wheat (Rust, bunt) Rice (blast) Groundnut (leaf spot and rust) sunflower (downy mildew) soybean (mosaic) cotton (Angular leaf spot)sugarcane (whip smut, grassy shoot) Banana (Blight) citrus (cancer)

4. Grapes (powdery mildew anthoracnose downy, mildew) pigonpea (wilt) Bhindi (yellow view mosaic virus) potato (early and late blight), Tomato (early blight).

Suggested Laboratory Exercise for Elective II

Practice for Elective - II (Course XIX and XX)

1. Isolation, purification and culturing of plant pathogens.
2. Production of pectolytic, celluloytic, amyloytic enzymes
3. Production of toxins by plant pathogens.
4. Production of phytoalexins by host.
5. Evaluation of fungicides against plant pathogens.
6. Use of biocontrol agents against plant pathogens.
7. Use of botanical pesticides against plant pathogens.
8. Study of Rhigosphere and phyllosphere mycoflora of crop plants and microbes having antibiotic producin property.
9. Synergistic effect of fungicides on agrochemical.
10. Study of internal and external seed mycoflora.
11. Production of toxins by pathogens and seed mycoflora.
12. Protoplast fusion for improvement of Trichoderma strains for biological and integrated management.
13. Study of symptology and histo pathology mentioned in the theory.
14. Collection and preservation of plant disease.

Course XIX Elective-III

Photochemistry and pharmacognosy -1

1. Photochemistry: Definition, history and scope.
2. Biogenesis, distribution chemistry and therapeutic properties of (a) carbohydrates, (b) Glycosides, (c) Organic acids, (d) Proteins (e) Lipids, (1) Alkaloids, (g) Sterols, (h) Resins, (i) Tannins and (j) Volatile oils with related specific examples.

Course XX Elective-III

Phytochemistry and pharmacognosy - II

1. Pharmacognosy: Definition, history and scope.
2. Macroscopic and microscopic characters, biological sources, geographical distribution commercial values, chemical constituents. Chemical test for active constituents for (1) Aloe, (2) Aconitum, (3) Cinchona, (4) Cinnamomum, (5) Catharathus (6) Cannbis, (7) Myristica, (8) Nux - vomica, (9) Digitalis, (l0) Glycirrhiza, (11) Plantago,12) Adhatoda, (13) Ephedra, (14) Ergot, (15) Senna, (16) Datura, (17) Aswangandha.
3. Various systems of classification of crude drugs.
4. Cultivation, collection drying processing,-storge, marketing, detection and auutration of crude drugs.
5. Unorganised drugs: Agars, Asafoetida, ophium, gelation, peppermint, turpentine.
6. Botanical, Biochemical pharmacological and chemical evaluation and crude drugs.

Practical for Elective - III
Course XIX and XX

1. Macroscopic and microscopic Character of
   a. Root drug: Raulvolfia, Boerhavia, Glycirrhiza Acontitum, asparagus.
   b. Stem bark drugs: Scilla (Bulb) Ginger, Epedra, Turmeric, Cinnamon, Cinchona, Hoarrhena.
   c. Leaf drugs: Adhatoda, senna, Rubis, Eucalyptus
   d. Flower drugs: Clove
   e. Fruit / seed drugs: Myristica, terminalia cardmon, Nuxvomica, caster, coriandrum.
2. Phytochemistry :
   a. Extraction and qualitative tests for free sugars, free amino acide, proteins.
   b. Extraction and separation of terpenoids by TLC.
   c. Extraction qualitative tests for alkaloids,
   d. Extration and estimation of Ascorbic acid, proteins, polyphenol, pipeline, sugar, alkaloids,
   e. Phytochemical analysis of Triphala.
3. Histoichemical tests on at least one drug for each of the above categories.
4. Quantitative microscopy-Stomatal index palisade ration, veinislet and vein termination number of medicinal leaf drugs of different families available in the region.

Elective - III
Books (For course XIX and XX)

1. Jensen W.A. - Botasical histochemistry.
2. Hartone J.B. - Phytochemical Methods.
3. Johanson D.A. - Plant microtechnique.
4. Tyler V.E. and Sehuestan A.E.-Expertmental phormacognasy.
5. Wallis T.E. - Text book of pharmacognasy.
6. Youmpkar H. W. - Text book of pharmacognasy.
7. Clause E.P. Tyler V.E. Brady L.,R. Pharmacognosy.
8. Naokarhi A.K. Indian Material Medico Vol. I and II
9. Kirtikar K.R. & Basu B.P. Indian medical plants.
10. Chofrra R.N. Nayar S.L. and Chopra I.e. - Glossary on indian medicanal panls.
11. Kakate C.K. - Practical pharmacognosy.
12. Kakate C.K. purohit A.P. / S.B. Gakhale - pharmacognosy.
13. Sabris S.D. and M. David - A phytochemistry.
14. Miller L.P. phytochemistry.
15. Daniel M. - Methods in plant chemistry & econimic botany.
16. Robinson T. The organic constituents botany of higher plants.
17. Gibif R.P. - chemotaxonamy of flowering plants.
18. Bonner J.J.E. vamer-Plant phytochemistry.

Elective - IV

Paper- XIX: Advanced plant physiology and Biochemistry -1

Plant Composition: Structure and biochemical role of major plant constituents, carbohydrates and its derivatives, isomerism, mono di-and poly - peptides and proteins, structure and calssification proteins, glycoproteins, peptidoglycans, lipids and glycoproteins, peptidoglycons, lipid and triglycerides, fatty acid, vitamins nucleic acides, pigment, chorophylls, phcobiliproteins, phenalics, sterols, alkaoids, phycobiliproteins, carotenoids, phytochorme, anthocyaine, phenelics, sterols, alkaloids, porphyrins, organic acids, possibilities of isolating these chemicals for human welfare.

Principles use and application by clorametres, photometry flame photometres, chromatography spectrophotometry (ion exchange affinity thin layer high pressure liquid), gel filtration, electrophoresis and electrofocusin ultracentrifugation, application of radioactive tracers technique in biology, radio active isotopes autoradiography, scintillation. Biophysical methods X ray defraction, floursecens UV - Vis HMR and ESR Atomic absorption spectoscopy.

Growth analysis: Growth, growth curve, lag, log and senescence phase, growth rates AGR, RGR, NAR, LAP, LAI, CGR and LAD productivity potential of dwarf varieties, causes of dwarfism, morphological and physiological factors in relation to hight. Yields of dwarf plants, source to sink relationship, harvest index, response of plants to water stress and fertilizers.

Paper XX Elective-IV

Advanced plant physiology and Biochemistry- II.

1. Photosynthesis and plant productivity the C3, C4 and CAM pathways and photorespiration in relation to crop productivity, intercropping the concept of rand equivalent ratio (LER) competitive relations between component crops, soil and water conservation methods, weed biology herbicides, biological weed control, intensive cropping, zero tillage use of plant growth regulators and bio-fertilizers in agriculture, Nitrogen use efficiency, optimum economic dose of nitrogen fertilizers green manuring.

   Biomass : The concept of Biomass, Biomass, production Utilization of biomass as a energy agricultural. Residue and their management HDEF energy forests energy cropping hydro carbon, plants biomethylation biogas, bioas plants, biogas production from soils city wastes.

   The practice of green manuring and preparation of compost NADEP and other methods, Utilization of solid wastes for composting recent trends in solid waste management and productional sources.

Green crop fractionation: The GCF system and advantages of GCF. Mechanical fractionation, plants suitable for GCF Machinery recommended for machanical fractionation products, pressed crop residue (PCP) Jutice, leaf protein concentrate and deprotainized Juice (DPJ).

Use of PCR in animal nutrition preparation of silage, silage femetation, qualities of good silage, evalution of silage qualities, silage additives, use of leaf juice as a milk replacer chemical changes during storage of leaf juice of preparation of LPC, chloroplastic and cytoplasmic LPC, Nutritive valueof LPC, and its suitability in human nutrition as a sources of protein and viramin - A, preservation of LPC, use of DPJ as a sources of menare and for microbial growth and biogas production advertages in using LPC, LPC, compared with algae jrotein and SCP, the possibility of increase in protein productivity through green crop fractionation. Farm based fractionation of lucerne to produce feed and food trade products.

PRACTICALS For Elective - IV

Papers XIX and XX.

1. Estimation of B- carotene with coloumn chromatography.
2. Estimation of reducing sugars by Flin - Wutube.
3. Estimation of cellulase by cramption and Maynord Methods.
4. Estimation of free fatty acids.
5. Estimation of nitrates.
6. Thin layer chromatographic technique.
7. Techniques of flame phtometry : estimation of sodium and potassium.
8. Estimation of gross energy by chromic acid oxidation method.
9. Estimation ofN by micro - Kjelachle methods.
10. Estimation of crude protein, crude fat and crude fiber.
11. Estimation of ash, acide soluble/ insoluable ash, Nitrogen free extract and total caryhydrates.
12. Estimation of cell wall constituents, ADF, NDF, cellulose, hermicellulose, ligning, etc.
13. Estimation of calcium by titration method.
14. Estimation of phosphorus by subbaRao and Fiske Method.
15. Growth analysis : AGR, RGR, NAR, LAR, LAI, CGR And LAD.
16. The process of GCF and extractability of dry matter and Nitrogen.
17. Preparation of LPC, by heat coagulation, acid coagulation and fermentation.
18. Preparation of cytoplasmic and chloroplastic LPC by differential heat coagulation.
19. Preparation of silage and estiamtion of lactic acid in silage.
20. Estimation of volatile fatty acids in sillage.

Elective V

Paper XIX Applied Mycology -1

1. Fermentation - Concept, Types, and Fermentation of detail of the followin: Penicillin, Citric acid, alcohol, wines Beers and Enzymes (Amylase and Cellulase)
2. Fungi as food and feed: Yeast fermentation, food and feed yeast, yeast in baluing.
   Mushroom: History of mashroom cultivation, mashroom production and consumption, Nutritive value of mushrooms, edible mushroom cultivation in India, present and future prospects. Type study of mushroom cultivation of the follwoing mushrooms: Button Mushroom, paddy straw mushrooms and , pleurotus spps.
3. Screening: Screening of fungal strains of Industrial importance, primary screening and secondary screening: Definition, characters of effective screening methods, screening for: Acid production antibiotic producers, enzyme producers and organic acids producers.

Elective V

Paper XX Applied mycology - II.

Detection and Assays of the fermentation products:

Characteristics of the techniques to be employed, spectrophotometric, chromatographic partition, principle of chromatography, gel filtration, ion-exchange principle and use of TLC, HPLC and ultra centrifugation Biological principle use limitation, test - organization diffusion assya, growth assay and end - print determination.

Fungi in cheese and food fermentation: Classification and Brief consideration of fundamental processes in cheese manufacture, fungi in flavor production. Blue - veined cheese and processed cheese.

Practicals for Elective V

Papers XIX and XX Applied Mycology.

1. Principle and uses of fermentation eqipments.
2. Preparation and sterilization of media and preparation of slant, plate, and flask.
3. Techniques: 1. Crowed plate, 2. Dilution plate, 3. Enrichment technique, 4. Gaint colony technique, 5. Spectro phtometry, 6. TLC.
4. Primary Sceening: 1. Antibiotic, 2. Acid producer, 3. Amylase producer, 4. Cellulase producer.
5. Alcohol fermentation extration purification, netural alcohol. 6. Citric acid fermentation, estimation.
7. Cultivation of Mushroom - Oyster and Blition.
8. Industrial and Educational tour report.

Suggested Readings.

1. Industrial Microbiology - L.E. Casida.

2. Industrial M i robiology - Presloot Dunn
3. Fermentation fungi, Industrial mycology - Vol. I - smith.
4. Fundamental of Industrial Microbiology - Rivera.
5. Practical medical mycology - Keeney.
6. The relation of fungi human affair - Gray W.D.
7. Essay in Applied Microbiology - JP Norris and Richman.

Elective - VI

Paper - XIX seed pathology -1

Seed borne micro-organisms; A brief survey of Fungi, bacteria virus and nematodes, and their role in agricultural production, loss of germination power, Reduction in processing quality, Bio-chemical changes, biodeterioration, Production of mycotoxins plant and animal disease.

Seed born disease of major crops belonging to cereals pulses, oils, fibres, forrage, fruit vegetables, cole vegetables and ornamental plants, and their control measures.

Seed infection : Definition, concept and types of seed infection, Externally and internally seed borne pathogens. Infected or contaminated parts of the seeds, surface contamination, ovule, seed coat, pericarp, endosperm, embryonal and bract infection, concommittant seed contaminates.

Path of infection: infection from mother plant and outside stigma, ovary wall, pericarp and integuments of seed coat, flower and fruit stales as path of infection. Environment and time of seed infection. Flowering period and infection. Infection or contamination during harvest.

Transmission of seed borne pathogens: seed to plant, plant to seeds ad seed to seed transmission.

Elective - VI

Paper XX seed pathology - II

Factors affecting establishment and course of seed borne diseases.

External Factors: Influence of external factors on the predisposition of the host on the source of disease.

Internal Factors: Gene controlled pathogenicity of parasite. Gene controlled susceptibility of host.

Detection of seed borne micro - organisms : Seed health testing Objectives of seed health testing, methods-for detection of seed borne fungi, bacteria, virues and nematodes.

Seed Treatment: Development of seed dressing chemicals, a brief survey. Procedure in seeds treatment, seed treatment chemicals, mechanism of chemical seed treatment, seeds treatment. Benefit of seed treatment, hazards of chemical seed treatment. Laboratory and field testing for evalution of germicidal activity, Biological control of seed borne micro - organisms.

For casting losses from seed borne diseases and germs diseases tolerance to seed health testing.

Seed testing: A brief review of progress in seeds testing ISTA International organization for seed testing. Notified official service and state seed testing laboratories. Sampling, field / laboratory types of samples, working of seeds testing laboratories.

Elective-VI

Course-XIX and XX

PRACTICALS

1. Detection, Isolation and Identification of sec a borne microorganisms.
2. Study of seed borne diseases of major crops of the region.
3. Effect of seed leachets, extract & natural products of poison plants on the spore germination of dominent Fungi.
4. Studies on the effect of Fungi toxins on seed germination wilting of shoot cuttings, leaf necrosis of lesion, loss of plasmolysis and leakeage of electrolytes.
5. Detection of Aminoacids, sugar, Fatty acides, from the seed leachets.
6. Studies on the effect of inoculum load on seed germination.
7. Detection of activity of cellulase and pectolase enzymes.
8. Study of germicial activity of certain chemicals used in the control of seed borne micro-organisms.
8. Detection of aflatoxin by fluoresent test.
9. Submission of specimen of seed brone disease.
11. Identification of various seed treatement chemical and Instruments.

Elective-VII

Paper XIX: Biodiversity-I

Introduction: Biodiversity concept, estimates of known flora and fauna, Importance of Biodiversity, Revision of ecosystem, organization, structure, function and energetics.

Ecological Diversity: Concept of estimation qudrat methods, density, abundance, frequency concept and estimation.

Species diversity: Concept and estimation, taxonomic procedures, species concept, taxa delineation.

Character weighing: Concept of characters good VS bad characters, qualitative VS Advanced characters,

Elective-VII Paper XX
Biodiversity-II

Modern methods in taxonomy: Comparative morphology, cytological methods, dernal studies, root and stem vessels, tests topography, chemical analysis, Histo chemistry.

Numerical treatment data generation, similarity concept, matrix buildings, assesment, correlation distance calculation duster methods dendrograms, computer programmes.

Introducation to cladistic concept and methodology negetic Diversity concpet and importance gene, mappl ing DNA finger printing and its applications.

Imparts on Diversity depleting resources, threatened species and their impact, global warning impact.

Biodiversity conservation: Biodiversity its commercial value campaign, awareness conservation methods, Role of pollution control board, public. NGOs and Industries in conservation.

Practicals for Electives - VII
Biodiversity

Course XIX and XX

1. Different quadrat methods, calculation of frequency, abudnance and density (Students should collect data by different methods from at least 3 different localities of different vegetational types)
2. Preparation of keys based on comparative morphological, dermal, cytological and chemical data.
3. Comparative morphology of leaf stipules, bracts, bractioles, calyx, coralla reproductive parts (For at least 5 species of genus of 5 genera of family.)
4. Dermal studies in hairs, stomata, trichomes.
5. Vessel studies i.e. root and stem vessels.
6. Protein profiles and protease inhibitor profile by poly acrylamide gel electrophoresis. (PAGE) (at least 2 species)
7. Karyomorphology.
8. Use of computer generated keys, webs, surfing, and data analysis.

Elective VIII

Paper XIX Angiosperms taxonomy-I

1. Problems in evolutionary taxonomy of evolutionary theory on post-Darwinian systematics.

2. Concept of species, morphological, classical linnean taxonomic, typological, biological, population, modern, Darwinian two dimentional, multidimentional etc.

3. Reducing phylogenetic relationships: Primitive and advanced characters monophyletic and polyphylatic origin, convergent and parallel evolution, Homology Vs anology. cladistics Vs paristic relationship.

4. Horizontal and vertical classification, alpha Vs omega taxonomy.

5. Trends in the evolution of characters in flowering plant. Bessey's dicta, Hutchnson's principles, Thome's principles.

6. Concept of taxonomic character: Analytical an synthetic, qualitative and quantitative, genetical and environmentally controlled, good and bad characters weighting, taxonomic coefficient.

Elective - VII

Paper XX - Angiosperms Taxonomy - II

1. Sources of taxonomic characterless: Morphological, anatomy, embryology, phytochemistry, phytogeography, biosystematic.

2. Plants nomeclature: Development of the code, its principles articles, priority and its limitations, nomenclatural types, type method, efectrive and valide publication nomina, rejioiends, tranference, citation of author publication of new taxa, Interantional association of taxonomists and publications.

3. Recent post Darwinian system: Cronquiest, Takhtajan, Dehlgren, Thome, Their basic princples, broad outline, merits and demerits.

4. New trend in plant classification molecular systematics, Biochemical systemtics, DNA fingerprinting.

5. History of Botanical exploration of India : Western India, Marathwada, Floristics, studies function and organization of botanical survey of India.

6. Compartive account of floral morphology, interrelationships distribution of plant families belonging to the following orders as per Englers system: perietales Sapindales, Myrtales, Asteries, caryophyllaes, fagales Micro spermae, Lilli florae and glumi florae.

Elective - VIII

Practical for course XIX and XX Angiosperms taxonomy.

1. Detection of evolution at work by observing variations in a given plant population.

2. Assessment of taxonomic characters in different plant species; A. Analytical and synthetic, B. Qualitative and quantitative, C. Genetic and environmentally controlled.

3. Use and preparation of dichotomous keys, use punched cards keys.

4. Nomenclature problems and their interpretations.

5. Botanical excursions - Submission of report along with at least 100 per barium specimens.

6. Describe and sketch pf 'east 25 specimen belonging to different families along with their classification according Bentham and Hooker's system.

Elective IX Course-XIX

Advanced plant pathology -1

1. Enzymes in plant Diseases: Composition of cell wall and middle lamella, Cell wall degraing enzymes, Pectic enzymes - Macerating enzyme, poly-galacturonase, pectin esterase and transeleminase Celluloytic enzyms Cx and cellobiase Hemicellulases Lignolytic, proteolytic and 1 ipolytic enzymes.

2. Toxins and plant Disease: The toxins concept, toxins and root invasion, classification of toxins, lycomerasmine, altemaric acid, fusaric acid, piricularin, wildfire toxins, victorin, aflotoxins, toxins and obligate parasites:

3. Physiology and biochemistry of Defence: Pre-existing biochemical defence mechanism, phenolic substance, phytolaexin. Defence through induced synthesis of proteins and enzymes, formation of substrates resisting the enzymes of the pathogen, detoxification of pathogen toxin.

4. Physiology of host - pathogen interaction: Interference with respiration, photosynthesis, metabolism of proteins and nucleic acids, phenol metabolism, plant growth regulator.

Elective IX Paper XX

Advanced plant pathology - II

1. Management of plant Diseases: Chemical control, formulation and classification fungicides, contact and systemic fungicides, uptake and mode of action, seeds, soil and plant treatment fungicides; fungicide resistance in plant pathogens, non-targes effect of fungicides; antibiotics production, classification and mode of action.

2. Genetics of plant pathogen interaction: Genetics of host interaction, physiological specilization, production of new races, adaptation fungi to differentiation sites. Resistance and susceptibility, gene for gene hypothesis, protein for protein hypothesis, Antigen - structure and function of immunoglobins.

3. Nutrition of plant pathogens: Growth, methods of measurements, nutrition of fungal pathogen, mineral requirement of pathogenic fungi function of essential elements, carbon nutrition,-nitrogen nutrition.

4. Effect of atmospheric pollution on plants: Effect of sulphur dioxide, Hydrogen Fluoride, Hydrogen Chloride, Nitrogen oxides, photochemical oxidants.

Elective IX Courses XIX and XX

Practicals (Advanced plant pathology)

1. Production and assay of macerating enzyme.
2. Production and assay of polygalacturonase.
3. Production and assay of celluloytic enzyme.
4. Production and assay of Amylase.
5. Production and assay of toxin.
6. Production and assay of phytoalexins.
7. Evaluation of fungicides against plant pathogenic fungi
8. Evaluation of Antibiotics against plant pathogenic bacteria.
9. Extraction and estimation of pigments in healthy and diseased plants.
10. Estimation of Nucleic acids.

Suggested Readings:

1. Chandnivala M. (1955) Recent Advances in plant pathology Vol. 2, Amol publications, Pvt. Ltd. New Delhi.
2. . Nurnberg H.W. (1985) Pollutant and their ecotoxicological significance, John wiley and sons, New York.
3. Metrotra R.S. plat pathology, Tata McGraw Hill publications " Company Ltd., New Delhi.
4. Agriso G.N. plant pathology, Academic press. New York and London.
5. Bilgrami K.S. and H.C. Dube A text book of Modern plant pathology, vikas publishing house Pvt. Ltd. New Delhi 11002.
6. Nene Y.L. and P.N. Thapliyal Fungicides in plat Disease control 2nd Ed. Oxford and IBM publishing CO. New Delhi.
7. Holton C.S., Fischer C.N. Fulton, R.W. hart, H and S.E.A. Macallan, plant pathology: Problems and progress (1908-195 8). The University of Wisconsin press, USA.
8. Vyas S.C. Systemic fungicides VO1.1,11 and 111 Tata Mcgrow Hill publishing CO., Ltd. New Delhi-2.
9. Dekker J. and S.G. Georgopoulos (Eds) fingicides Resistance in plant protection, CARD Publ. Wageniangen Netherlands.
10. Gangawane LV. and Jayashree Deshpande, presticide of Crop plant in India. Ajay Prakashan, Aurangabad.

Elective X

Course XIX Biostatistics-I

Central Value and dispersion

Mode, Median, mean, range, mean deviation, standard deviation, Coefficient of variation. Frequency distribution

Frequency histogram, frequency curve, central value and dispersion inclassified data, normal curve, mean and standard deviation. Normal deviate.

Sampling

Random sampling, sample means, standard error. Test of significance, T test. Correlation and Regressions.

Positive and negative correlation, correlation coefficient. Regression. Linear and non-linear regession.

Elective X course XX Biostatistics II

Analysis of Variance

ANOVA. F test, standard error of differences, critical difference.

Probability

Mutually exclusive events. Addition rule, mutually independent events. Multiplication rule, Dependent events, Bionomial distribution Chi-square test test for goodness of fit Experimental design Replication, Randomization, Local control Randomised block design (RBD),f Latin square design (LSD) factorial experiments, Factorial RBD, split plot RBD, Use of computers for Analysis of quantitative data.

Introduction, computer organisation, Central processing unit, programming Languages, computer programming, computers for analysis ofquantitativt data.

Elective X Course XIX and XX

Biostatistics

PRATICALS

1. Visit to the Held, forest, and agricultural land.Land and studies on collection of quantitative and qualitative data
2. Tabulation of the data and Frequency distribution.
3. Calculations of mode, median, mean, range, mean deviation, standard deviation and coefficient of variation.
4. Methods of sampling : random sampling, standard error, relationship between S.E. and sample size.
5. Correlation coefficient.

6. Linear and quadratic regression equations using one and variables.

7. Analysis of variance (ANOVA) and F test.

8. Test of significance: T test, level of significance.

9. Probability and chi square test.

10. Layout of field experiments: Latin square design (LSD) randomised block design (RBD) split plot RBD. Factorial RBD.

11. Computer programming for analysis of data.

Suggested Readings:

Freund John E Modem Elementary statistics. VI Edn prentics Hail of India Pvt. Ltd. New Delhi (1984)

Goon A, Gupta M and Dasgupta, B fundementals of statistics. The world press Privant Ltd. Calcutta (1962)

Harper, W.M. Statics IV Edn. Macdonald and Evans Ltd. Estover, Plymonth(1982)

Misra, B.N. and Misra M.K Introductory' practical Biostatiscs, Naya Prokash. Calcutta (1989)

Nageswara Rao, G statistics for agricultural science oxford and IBH publishing co. Bombay (1883)

Pansc V.G. and Sukhatme P. V. Statistical Methods for Agricultural workers III Edn Indian Council of agricultural Research, New Delhi (1978)

Rangaswamy R.A. Text book of Agricultural statistics New Age International publishers Ltd. Wiley Eastern Ltd. Bombay (1995)

Trivedy R.K. Goel P.K. and Trisai C.L. practical Method in Ecology and Environmental science. EnviroMeiapublicaton s, Karad (1987)

Mungikar A.M. (1997) An Introduction to Biometry, Saraswati printing press, Aurangabad.