DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO. SU/Sci./B.Sc. Syll./38/2015

It is hereby inform to all concerned that, on the recommendation of the various Board of Studies, Ad-hoc Boards & Committees, the Hon'ble Vice-Chancellor has accepted the revised semester-wise syllabi on behalf of the Academic Council under Section-14[7] of the Maharashtra Universities Act, 1994 in the Faculty of Science as under :-

Sr. No.	Name of the Subject	Semester
[1]	B.Sc. Polymer Chemistry IIInd Year, [Optional]	V & VI
[2]	B.Sc. Networking and Multimedia IIInd Year, Three Year Degree Course	V & VI
[3]	B.Sc. Dry Land Agriculture IInd Year, [Optional]	III & IV
[4]	B.Sc. Sericulture IInd Year, [Optional]	III & IV
[5]	B.Sc. Workshop Technology IInd Year, Three Year Degree Course	III & IV
[6]	M.Sc. Botany IInd Year [at college level]	III & IV

This is effective from the Academic Year 2015-16 & onwards as appended herewith.

All concerned are requested to note the contents of the circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF. NO. ACAD/ SU / SCI./
2015/
Date:- 28-07-2015.

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Director,
Board of College and
University Development.

Copy forwarded with compliments to:-

1] The Principals, affiliated concerned colleges,
Dr. Babasaheb Ambedkar Marathwada University

Copy to :-

1] The Controller of Examinations,
2] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,
Dr. Babasaheb Ambedkar Marathwada University,
3] The Superintendent, [B.Sc. Unit],
4] The Superintendent, [M.Sc. Unit],
5] The Superintendent, [B.C.S. Unit],
6] The Programmer [Computer Unit-1] Examinations,
7] The Programmer [Computer Unit-2] Examinations,
8] The Record Keeper.
Dr. Babasaheb Ambedkar Marathwada University.

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S*/-030815/-

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

AURANGABAD.

REVISED SYLLABUS

FOR

M.Sc. III AND IV SEMESTER

BOTANY

FOR AFFILIATED POST GRADUATE COLLEGES OF

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

AURANGABAD.

EFFECTIVE FROM JUNE 2015

SEMESTER - III
COURSE NO XIII
BIOINFORMATICS & INSTRUMENTATION

Unit – I Bioinformatics and its applications

Databases, types, pairwise and multiple alignments. Structure-function relationship. Sequence assembling using computers. Computer applications in molecular biology, Protein domains and human genome analysis program (BLAST, FASTA, GCC etc.) Search and retrieval of biological information and databases sequence, databank. (PDB and gene bank), accessing information (Network expasy, EMB Net, ICGEB Net).

Unit–II

(a) Microscopy: Introduction, Magnification, Resolution, and Contrast Light (Bright Field), Microscopy, Dark Field Microscope, Phase Contrast, Microscope, Interference Microscope, UV and Fluorescence Microscopes, Electron Microscopy, Tunneling Electron Microscopy, Confocal Microscopy.

(b) Micrometry : Introduction, Structure of an Ocular Micrometer,Conjugate Image-Forming Focal Planes, Eyepiece Designs Stage Micrometer, Filar Eyepiece Micrometer, Principle of Filar Eyepiece Micrometer Working

Unit – III Separation Techniques

(a) Electrochemical Techniques: Introduction, Structure of a pH Meter, Principles Factors Limiting the Accuracy of pH Measurements, Measurement of pH, Working Procedure for Measuring pH Using a pH Meter, Cleaning and Troubleshooting of Glass Probes Application of pH Measurements, Oxygen Electrode. Conductivity Meter: Introduction, Principles, Common Definitions Conductivity Meter, Conductivity Cells, Factors Influencing the Measurement, Measuring Techniques, Reliable Measurements Maintenance and Storage, Applications.

(b) Chromatography: Introduction, General Principles Column Chromatography, Paper Chromatography and Thin-Layer Chromatography, Sample Collection, Preservation, and Preparation, Adsorption Chromatography, Partition Chromatography, High-Performance Liquid Chromatography, Fast Protein Liquid Chromatography, Gas–Liquid Chromatography, Ion-Exchange Chromatography, Exclusion Chromatography, Affinity Chromatography,

(c) Centrifugation: Introduction, Principle of Centrifugation, Types of Centrifuges, Types of Centrifugal Separations, Rotor Categories, Selection of Centrifuge Tubes, Common Centrifugation Vocabulary and Formulas, Analytical Ultracentrifuge

(d) Electrophoresis: Introduction, Principles of GE, Working with the electrophoresis Apparatus, Denaturing Gradient GE, Temperature Gradient GE, Pulsed-Field GE, Capillary Electrophoresis.

Unit – IV Spectroscopy: Introduction, UV–Visible Spectroscopy, IR (Vibration) Spectroscopy, Flame/ Atomic Absorption Spectroscopy, Fluorescence Spectroscopy
ESR Spectroscopy, NMR Spectroscopy, MALDI-TOF Mass Spectrometry, Circular Dichroism (CD) Spectroscopy,

Unit – V Techniques with Radioisotopes: Introduction, Isotopes and Radioactivity, Ionization Effects, Measurement Units, Measurement Techniques Autoradiography, Counting Statistics, Biological Uses of Radioisotopes Tracer Dilution Technique, Radioimmunoassay, Miscellaneous Uses of Radioisotopes.

Suggested readings:

1. Instrumental Methods of Analysis. 6th Edition by H.H. Willard, L.L. Merritt Jr. and others, 1986. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.
4. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.
5. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.
6. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons. Inc., New York.
7. Analytical Biochemistry by Holme.
8. Introduction to High Performance Liquid Chromatography by R. J. Hamilton and P. A. Sewell.
9. Spectroscopy by B.P. Straughan and S. Walker.
10. Practical aspects of Gas Chromatography and Mass Spectrometry 1984 by Gordon M. Message, John Wiley and Sons, New York.
11. Gel Chromatography by Tibor Kremmery. Wiley Publications.
12. Isotopes and radiations in Biology by C.C. Thornburn, Butterworth and Co. Ltd., London.
13. The use of radioactive isotopes in the life sciences by J.M.Chapman and G.Ayrey, George Allen and Unwin Ltd., London.
14. Analytical biotechnology edited by Thomas G M Schalkhammer.
15. Principles and techniques of biochemistry and molecular biology by Keith Wilson and Walker.

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COURSE XIV

PLANT RESOURCE UTILIZATION& CONSERVATION.

Unit – I Plant Biodiversity: Concept, status in India,Sustainable development: Origin,and evolution with its botanical importance

Unit II- Cultivation and Uses of -

i) Food, forage an fodder crops,

ii) Fibre crops

iii) Medicinal and aromatic plants; *Atropa belladona, Catheranthus roseus, Adhatoda vasica, Allium sativum, Rauvolffia serpentina, Papaver somniferum, Phyllanthus amaaratus, Aloe barbadense*

iv) Dyes (*Turmeric, Indigo, Butea monosperma, Lowsonia alba)*

v) Vegetable oil - yielding crops oils groundnut, sunflower, Safflower, Soyabean.

v) Important fire-wood and timber yielding plants: *Acacia nilotica, Tectona grandis, Dalbergia sissoo,Terminalia Arjuna (Arjun sadar), Mangifera indica*. and non - wood forest products (NWFPs) eg. Bamboos, Rattans, Raw materials for paper - making, gums, resins and fruits.

vi) Rubber: Introduction, chemical composition of rubber, *hevea rubber*, plantation and production of rubber in the world and India, processing. Uses of rubber and synthetic rubber.

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

Unit – IV Principles of conservation: 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.

Ex-situ conservation: principles and practices; Botanical gardens, Field gene banks, Seed banks, *in vitro* repositories, Cryobanks;

Unit – V General Account of Plant Conservation - 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 Department of Biotechnology (DBT) conservation, non-formal conservation efforts.

Suggested Readings:

1. Baker, H.G. 1978. Plants and Civilization (3rd Edition) C.A. Wadsworth, Belmont Chrispeels, M.J. and Sadava, D. 1977. Plants, Food and People. W.H. Freeman and Co., San Francisco
2. Cinway, G. 1999. The Doubly Green Revolution. Food for All in the 21st Century, Penguin Books.
3. Council of Scientific & Industrial Research 1986. The useful plants of India. Publications and Information Directorate. CSIR, New Delhi. Council of Scientific & Industrial Research (1948-1976).
4. The Wealth of India. A Dictionary of Indian Raw materials and Industrial products, New Delhi, Raw materials I - XII Revised Vol. I-III (1985-1992) supplement (2000).
5. Frankel, OH. Brown, A.H.D. & Burdon, J.J. 1995. The conservation of Plant Diversity, Cambridge University Press, Cambridge, UK
6. Kocchar, S.L. 1998. Economic Botany of the Tropics, 2nd Edition. Mac Millan India Ltd., Delhi.
7. Paroda, R.S. and Arora, R.K. 1991. Plant Genetic Resources Conservation and Management. IPGRI (Publication) South Asia Office, C/o. NBPGR Pusa Campus, New Delhi.
8. Pinstrup – Anderson, P. et al. 1999. World Food Prospects: Critical Issues for the Early 21st Century.
9. International Food Policy Research Institute, Washington, D.C., USA.' Plant Wealth of India 1997. Special Issue of Proceedings Indian National Science Academy B-63.
10. Sambamurthy, AVSS and Subramanyam, N.S. 2000. Economic Botany of Crop Plants. Asiatech Publishers, Inc., New Delhi.
11. Schery, R.W. 1972. Plants for Man. 2nd Edition. Englewood Cliffs, New Jersey, Prentice Hall.
12. Sharma, O.P. 1996. Hills Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharms). Tata McGraw Hill Co., Ltd., New Delhi.
13. Swaminathan, M.S. and Kocchar, S.L. (Eds.) 1989. Plants and Society. Mac Millan Publication Ltd., London.
14. Thakur, R.S. Puri, H.S. and Hussain, A. 1989. Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants, CSIR, Lucknow.

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COURSE XV

ELECTIVE – I
PLANT PATHOLOGY-I

Unit I. **Plant disease diagnosis:**

Field observations, laboratory investigations, isolation of plant pathogen and purification, Koch's postulates; identification of plant pathogens.

Unit II **Classification of Plant diseases:**

Based on crop plants, symptoms, causal organisms.

Unit III. Symptoms, etiology and disease cycle of diseases caused by:

a) **Mastigomycotina:** Damping off of seedlings, Rhizome rots of ginger, early blight of potato, white rust of crucifers, Downy mildew of Bajra, Downy mildew of grapes.

b) **Ascomycotina:** Stem galls of coriander, leaf spot of turmeric, powdery mildew of grapes, Ergot of bajra.

Unit IV. Symptoms, etiology and disease cycle of diseases caused by

a) **Basidiomycotina :** Loose smut of wheat, Bunt of wheat, kernel bunt of Rice, Head smut of Jowar, grain smut of Jowar, whip smut of sugarcane. Rust: Rust of wheat, Rust of Bajra, Rust of groundnut

Unit V. **Symptoms, etiology and disease cycle of diseases caused by Deuteriomycotina:** Early blight of potato and tomato leaf spot caused by *Alternaria* on brinjal, crucifers, Tikka disease of groundnut, Helminthosporiurn leaf spot on Rice; Blast of Rice, Red rot of sugarcane Die back of chili, Wilt of Pigeaon pea, Panama disease of Banana, Blight of gram, *Rhizoctonia* stem rot of crops.

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COURSE XVI – (ELECTIVE – II)

PLANT PATHOLOGY-II

Unit I. **i. Agents of infections and diseases:** Biotic agents - bacteria, viruses, fungi, mycoplasma, nematodes.

ii Abiotic agents: Air pollution; mineral elements, temperature, toxic effects of improperly used chemicals.

Unit II. **Phytoplasma diseases:** Symptoms and disease cycle of little leaf of brinjal; Sesamum phylody, witches broom diseases, Grassy shoot of sugarcane.

Unit III. **Viral diseases:** Symptoms produced by viruses on plants, study of plant virus disease; Tobacco moisac, leaf curl of tomato, papaya moisac, yellow vein moisac of bhendi, Bunchy top of Banana, Tristeza of citrus.

Unit IV. **Bacterial diseases:** symptoms of bacterial diseases on plants. Study of bacterial diseases: Angular leaf spot of cotton, citrus canker, Gummosis,, of sugarcane, Bacterial wilt of solanecious vegetables. Halo blight of bean, Soft rots of fruits.

Unit V. **Non parasitic diseases:** Non infectious diseases of plants, Nutritional deficiencies, Blossom rot of tomato, mango black tip, zinc deficiency of citrus.

Suggested readings Bot 521 and 522(Elective B)

1. Agrios, G.N. (1969) Plant Pathology, Academic Press, New York.
2. Rangaswami, G. and A. Mahadevan (2001) Disease of crop plants in India, Printic Hall of India, Pvt. Ltd., New Delhi.
3. Gupta, V.K. and V.S. Paul (2001) Disease of vegetable crops. Kalyani Publ.Ludhiana,
4. Gupta, V.K. and S.K. Sharma (2000) Disease of fruit crops, Malyani Publ. Ludhiana.
5. Raychaudhari, S.P. and T.K. Nariani (1977), Virus and Mycoplasma disease of plants in India. Oxford and IBK Publ. Corp., New Delhi.
6. Bos L. (1999), Plant viruses, unique and intriguing pathogens. Backhugs Publ, Leiden.
7. Rangaswami, G. and S. Rajagopalan (1973), Bacterial plant pathology, T.N. Agri. Uni. Coimbatore.

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COURSE XV

ELECTIVE – I

TAXONOMY OF ANGIOSPERMS-I

UNIT-I: **Characteristic features of angiosperms;** aims and objectives of taxonomy, functions and phases of taxonomy; taxonomy as synthetic discipline (passing remarks)

UNIT-II: **Phylogeny of angiosperms:** monophyletic and polyphyletic origin of angiosperms, herbaceous origin hypothesis, origin of monocotyledons; molecular evidence to angiosperm origin, cradle of angiosperms.

UNIT-III: **Taxonomic hierarchy:** it's major, minor and intraspecific categories and ranks A brief history of Pre-Darwinian and post Darwinian systems of classification with special emphasis on Thorne and Cronquist's systems of classification

UNIT-IV: **Concept of taxonomic character:** analytical and synthetic, qualitative and quantitative, genetically and environmentally controlled, good and bad character, character weighing, taxonomic coefficient

UNIT-V: **Phylogenetic relationship:** Primitive and advanced characters, monophyletic, paraphyletic and polyphyletic, homology and analogy, parallel and convergent evolution, plesiomorphic and apomorphic characters.

Unit - VI: Cladistics: Operational Taxonomic Units (OTU), characters and coding, measuring of similarity, cladograms.

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COURSE XVI

Elective – II

TAXONOMY OF ANGIOSPERMS-II

UNIT-I: **The concepts of species;** plant speciation: allopatric/ abrupt/ sympatric/ hybrid/ apomictic speciation and isolation mechanism. Types of speciation: quantum, myrean, catastrophic, local, geographic and phyletic. Causes of variation in population, ecotypes and ecads, evolution and differentiation of species, adaptive radiations.

UNIT-II: **Botanical Nomenclature:** Scientific names: legitimate name, illegitimate name, autonym, homonym, synonym, basionym, tautonym, alternative name, ambiguous name, superfluous name, naked name, conserved name, rejected name; procedure to describe new taxon; Latin diagnosis and description, effective and valid publication, coining of generic names and specific epithets; citation of names(s) of author(s); Scientific Journals in plant taxonomy.

UNIT-III: **Taxonomic evidences:** Morphology, micro-morphology, ultrastructure systematics-SEM and TEM studies, anatomy, embryology, palynology, cytology, ecology, population biology, phyto-chemistry, molecular biology and numerical taxonomy.

UNIT-IV: **Herbarium:** History, Objectives and function of a herbarium, Types of herbaria, role of herbarium in Systematics, Floristics, Teaching, Research, Assessment and documentation of phyto diversity and Public Education, pests in herbarium and its control.

UNIT-V: Comparative account on distribution, floral morphology, interrelationships of families belonging to the following order as per Engler's system of classification:

a) Ranales, b) Rhoedales, c) Centrospermae, d) Malvales,
e) Geraniales, f) Contortae and g) Tubiflorae

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COURSE XV– (Elective – I)

ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY -1

Unit I. **Plant Composition :** Structure and biochemical role of major plant constituents, carbohydrates and its derivatives, structure and classification of proteins, glycoproteins, peptidoglycans, lipids and glycoproteins, lipid and triglycerides, fatty acid, vitamins nucleic acids.

Unit II. **Pigments:** chlorophylls, phycobiliproteins, phenolics, sterols, alkaloids, carotenoids, phytochorme, anthocyanine, phenolics, sterols, alkaloids, porphyrins, organic acids, possibilities of isolating these chemicals for human welfare.

Unit III. **Principles use and application** of colorimeters, photometry flame photometers, spectrophotometry, chromatography (ion exchange, affinity, thin layer, high pressure liquid), gel filtration, electrophoresis, electro focusing and ultracentrifugation,

Unit IV. **Application of radioactive tracer technique** in biology, radioactive isotopes Autoradiography, Biophysical methods X ray diffraction, fluorescence UV, NMR and ESR Atomic absorption spectroscopy

Unit V. **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 height. Yields of dwarf plants.

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COURSE XVI

Elective – II

ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY - II.

Unit I **Photosynthesis and plant productivity** C3, C4 and CAM pathways and photorespiration in relation to crop productivity, 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.

Unit II **Biomass :** The concept of Biomass, Biomass production, Utilization of biomass as a energy agricultural. Residue and their management HDEF energy forests energy crapping hydro carbon, plants biomathylation biogas, biogas plants, biogas production from soils city wastes.

Unit III. **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 production sources.

Unit IV. **Green crop formation:** The GGF system and advantages of GCF. Mechanical fractionation, plants suitable for GCF, Machinery recommended for mechanical fractionation, products, pressed crop residue (PCR) Juice, leaf protein concentrate and deproteinized Juice (DPJ).

Unit V. **Green Crop Fractionation:** Use of PCR in animal nutrition preparation of silage, silage fermentation, use of leaf juice as a milk replacer, Preparation of LPC, chloroplastic and cytoplasmic LPC, Nutritive value of LPC, and its suitability in human nutrition as a sources of protein and vitamin - A, preservation of LPC, DPJ as a replacer of tissue culture media, LPC compared with algal protein SCP, the possibility of increasing protein productivity through green crop fractionation. Bidkin Process

Suggested Readings

1) Hess, D. Plant Physiology, Narosa Publishing House, New Delhi.

2) Mukharji, S. and Ghosh, A.K. Plant Physiology. New Central Book Agencies, Kolkatta.

3) Noggle, G.R. and Fritz, G.S. Introductory plant physiology, Prentice Hall, U.S.A.

4) Vaidya, V.G., Sahasrabuddhe, K.R. and Khupse, V.S. Crop production and field experimentation, Continental Prakashan, Pune - 30.

5) ICAR Handbook of Agriculture^ ICAR, New Delhi.

6) Mungikar, A.M. Bibliography of leaf protein in Marathwada University.

7) Pine, N.W. (1971), Leaf protein, its preparation, quality and use, Blackwell Scientific Publ. U.K.

8) Telek, H. and Graham, LT. (1983), Leaf protein concentrates, AVI, Publishing Co., USA

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COURSE XV

ELECTIVE I

BIODIVERSITY I

Unit 1 Introduction: Biodiversity concept, Origin and evolution of diversity, Types of biodiversity, Estimation of known floras and faunas, Importance of Biodiversity, Revision of ecosystem: organization, structure, function and energetics.

Unit 2 Genetic Diversity: Definition, Concept and importance, Nuclear centre and regional centres of origin, Germ-plasm,

Unit 3 Species diversity: Species concept and definition, estimation and plant global status and with India, taxonomic procedure, taxa delimitation.

Unit 4 Ecological Diversity: Types ecosystem diversity (Terrestrial and aquatic), Forest ecosystem types (Tropical, Subtropical, temperate and alpine)

Unit 5 Agricultural and cropland diversity: Agricultural and cropland diversity concept, Crop domestication, India's status for primary and secondary agricultural crops.

COURSE XVI

ELECTIVE II

BIODIVERSITY II

Unit 1: Diversity Distribution: Mega diversity regions, Endemism concept and its types, World Hots spots, Western Ghats and Eastern Himalayas.

Unit 2: Modern methods in taxonomy: Comparative morphology, Cytological methods, dermal studies, root and stem anatomy, vessel study, Chemotaxonomy, Embryology and Palynology.

Unit 3:Numertical Taxonomy: Numerical treatment data generation: Similarity concept, matrix building, assessment, correlation, distance calculation duster method, dendrograms, computer programs.

Unit 4: Cladistics and Phenetics: Introduction, definition of Cladistics and phenetics, methodology of genetics, diversity concept and importance of gene mapping, DNA finger printing and its applications.

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COURSE XV

ELECTIVE-I (CROP GENETICS AND PLANT BREEDING - I

PAPER I: PLANT BREEDING

Unit I: Food supplies and Nutrition: i) World food situation ii) Nutritional problems iii) Nutritional objectives.

Unit II: Plant Breeding: Historical milestones in plant breeding(19th century on wards); aims and objectives of plant breeding; its applications and significance in crop development.

Unit III: Methods of Plant Breeding: Concepts of introduction, acclimatization, selection (pureline theory-W.L.Johansen's experiments on bean; its significance); reproductive systems of plants, floral biology, flower parts; self and cross pollinated plants- differences between them, various methods of breeding in them; asexual and vegetative propagation in crops.

Unit IV: Incompatibility in plant breeding: types, nature, characteristics, genetic and biochemical basis of incompatibility; methods of induction and overcoming it; incompatibility as a tool in breeding crops.

Unit V: Male sterility: concept, classification; methods of chemical induction of male sterility; its exploitation in plant breeding.

Unit VI: Back cross: genetic basis of back cross; methodology in selection of character under transfer; transfer of two or more characters; inter-varietal, inter-specific and inter-generic transfer.

Unit VII: Heterosis: historical aspects; concept of inbreeding depression; homozygous and heterozygous balance; genetic and physiological basis of heterosis; applications of heterosis in plant breeding.

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COURSE XVI
ELECTIVE II (CROP GENETICS AND PLANT BREEDING)
PAPER II- MOLECULAR BIOLOGY AND PLANT BREEDING

Unit I: Mutation breeding: Historical perspectives; types of mutations-spontaneous and induced; mutagens- physical and chemical; mutagenic treatment schedules; screening of mutation in population; mutagenic effectiveness and efficiency; environmental interactions; repair mechanism; role of mutation in crop improvement programmes.

Unit II: Polyploidy in plant breeding: history; utilization of aneuploidy, euploidy, autoploidy, alloploidy in crop improvement and limitations of each.

Unit III: Resistance breeding: A) disease resistance: nature and mechanism of resistance; methodology, problems and achievements. B) insect resistance: nature and mechanism of resistance; methodology, problems and achievements C) Drought resistance: nature and mechanism of resistance; methodology, problems and achievements; D) Use of rDNA technology in each of these (A-C).

Unit IV: Distant hybridization: importance; interspecific and intergeneric gene transfers-methodology, problems and remedial measures; concept of GMO's with suitable examples.

Unit V: Molecular markers in plant breeding: types of molecular markers with their strength, weaknesses and application of each in plant breeding especially in varietal identification, germplasm divergence analysis; phylogenetic relationship in cereal crops

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COURSE XV
ELECTIVE PAPER - I
APPLIED MYCOLOGY I

Unit I- Screening - Primary and Secondary Screening of industrially important fungal strains, Definition and characteristics of effective screening, methods for acid producers, antibiotic producers , organic acid producers and Enzyme Producers.

Unit II- Fermentation Technology – Definition, Scope and Limitation, Types of Fermentation. Penicillin Fermentation Citric acid fermentation, Wine and Beer fermentation.

Unit III – Enzyme Technology – -Fungal Enzymes of Commercial Importance, Production of Fungal enzymes free and Immobilized cells and enzymes.

Unit IV- Fungi as Food and beverages-alcoholic beverages mushroom & other macro fungi, edible biomass from yeast & moulds, single cell protein (SCP).

Unit V- Fungi in Food- Processing Bread- soybean products, cheese & fermented foods.

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COURSE XVI
ELECTIVE PAPER - II
APPLIED MYCOLOGY II

Unit I- Yeast and Its Uses- Introduction ,Production of Brewers and Baker's yeast, Production of Food and Fodder Yeast , Yeast and yeast Products.

Unit II-Fungal Metabolites:-Primary metabolites of Economic importance, Secondary metabolites in medicine & agriculture

Unit III- Bio-deterioration and Biodegradation by fungi: - Textiles, Leather, Plastic Hydrocarbons, metals &Pesticides.

Unit IV– Fungi Toxins –Myco-toxicoses -Fungi in Dermatomycosis, Aspergillosis & fungi allergenic to man and Animals.

Unit V- Cultures Maintenance - Slants and broths, Freezing-Liquid Nitrogen, Importance of Culture Maintenance with reference to R & D Laboratories.

SEMISTER - IV

COURSE XVII
PLANT BIOTECHNOLOGY

Unit – I. Biotechnology basic concept: Principles and scope, Plant cell and tissue culture: General introduction, history, scope, concept of cellular differentiation, totipotency.

Unit – II. Organogenesis and adventive embryogenesis: Fundamental aspect of morphogenesis; somatic embryogenesis and androgenesis, mechanism, techniques and utility.

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

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

Unit – V. 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.

Unit – VI. 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.

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

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COURSE NO XVIII
APPLIED BOTANY

Unit 1. Seed Technology: Impact of green revolution, notified varieties, seed act. International organizations – ISTA, OECD, UPOV, Seed production strategies - classes of seeds and maintenance, seed production requirements. Seed drying, processing, storage and marketing. Concept and testing of Seed quality; Seed certification, . Seed health: , quarantine, phyto-sanitary certificates, seed borne diseases, seed health testing for fungi, bacteria, viruses and nematodes.

Unit 2 Crop improvement : Basic concepts and scope of plant breeding, principles and methods of plant breeding in-self, cross and asexually propagated plants; male sterility, breeding for disease resistance, polyploidy, Marker assisted selection. Transgenic technology - Scope of plant transgenics, plant transformation techniques, Agro-bacterium - mediated genetic transformation, Ti and Ri plasmids; viral vectors; direct gene transfer methods; selection of transformants. Transgenic traits – herbicide resistance, against biotic and abiotic stress, nutritional quality, male sterility; Concerns and constraints of transgenic technology, ethical issues; Molecular farming. Intellectual Property Rights –WTO, WIPO, GATT, TRIPS, Plant breeders' Rights.

Unit 3. Molecular markers : DNA Polymorphism in plants and microbes, molecular taxonomy, DNA fingerprinting, Genetic markers –RAPD, RFLP, AFLP, SSR, ISSR, ; cDNA library, PCR techniques, quantitative PCR; genome sequencing techniques and applications

Unit 4 Molecular medicine: Natural products as modern drug targets, ethno-botanical approach and screening, plants and microbes as sources of natural metabolites; extraction, purification and characterization of natural metabolites, establishing bioactive potential and screening against different targets, Assay- guided fractionation, high throughput screening, clinical trials; use of softwares in drug development.

Unit 5. Biodiversity : Introduction to basic concepts, agricultural ecology, centres of origin/diversity, domestication of species, Agro-ecosystem characteristics, sustainable agriculture, agricultural biodiversity; conservation of genetic resources for food and

agriculture, Gene flow – vertical and horizontal, gene transfer; ecology of GM crops, environmental effects, potential risks and benefits of GMOs.

Unit 6. Applied Phycology – a) Seaweeds and its applications, sea farming-necessity, principles and methodology. b) Algal biotechnology – BGA and its commercial applications, *Spirulina* – mass production technology and nutritive value. c) Algae sewage treatment, Algae causing nuissance, algal blooms, algae as indicators of water quality.

Unit 7. Applied Mycology – a) Metabolic diversity among fungi, role of fungi in biotechnology. b) Industrial mycology i) Fermentation technology (Submerged, shallow and substrate fermentation) ii) Fungal production of biochemical's – organic acids, enzymes, vitamins, antibiotics, growth regulators, alcohol, Brewing and wine industry, Ergot alkaloid and its applications. c) Fungal biotechnology – Fungi in mineral biotechnology, applications of fungi in agriculture.

Suggested Readings:

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COURSE NO XIX

ELECTIVE- III

PLANT PATHOLOGY

Unit I. History: Beginning of modern plant pathology; Contribution of Anton De Bary; Benedict Prevost; J.C. Kuhn; M.S. Woromin; B.C. Stakman; Paul Neergaard, P.H. Gergory, K.C. Mehta. History of the development of plant pathology in India; plant disease clinics.

Unit II. Dispersal of plant pathogens: Direct transmission; Indirect transmission; Plant disease epidemiology; Some important epiphytotics; Methods used in plant disease forecasting.

Unit III. Seed Pathology: Scope and importance; seed health testing; methods and procedures; Detection of seed borne-fungi, Bacteria and viruses. Seed bio deterioration: Biochemical

changes, Morphological abnormalities, loss in germinability. Mycotoxins, fusarium toxin and aflatoxins. Control of Post-harvest spoilage of grains.

Unit IV. Enzymes of plant pathogens: Cell wall degrading enzymes; Proeolytic enzymes - Macerating enzyme, Polygalacturonase, Pectin esterase; trans-aminase and their role in disease development. Cellulolylic enzymes and their role in disease development.

Unit V. Disease Management: Cultural Methods- Avoidance of pathogen, exclusion of inoculum, eradication of pathogen, Chemical methods- sulphur fungicides, Copper fungicides, Mercury fungicides, Quinone fungicides, Systemic fungicides, Antibiotics, Breeding for disease resistance, Integrated Pest Management, Biopesticides and bioagents; *Trichoderma* and VA mycorrhiza. Application of Biotechnology in disease management.

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COURSE NO -XX ELECTIVE- IV
PLANT PATHOLOGY

Unit I. Nature, origin and evolution of parasitism: Interrelationship of parasitism and pathogenecity; physiology of pathogenecity; Natural process of pathogenesis, evolution of parasitism and pathogenecity. Effect of environment on different classes of parasitism; law of host - parasite balance, host genetics in relation to type of pathogenicity; search for effective disease control.

Unit II. Pathogenesis: Penetration and entry by plant pathogen; Pre-penetratkm; Entry through natural opening, Direct penetration, Entry through wounds, root hairs and buds,

Unit III Toxins of Plant pathogens: Phytotoxins ; Classifications of toxins, Fusaxic acid, Lycomarasmin, Pirieularin, Alteraaric acid, Tabtoxin, Phaseolotoxin, Victorin

Unit IV Physiological imbalances in disease plants: Photosynthesis, respiration, protein

metabolism, phenol metabolism, plant growth regulators.

Unit V. i. Disease Resistance in Plants: Primary infection resistance, Structural and Chemical defences; Post infection resistance : Production and activities of phytotoxins. Histological accumulation of phenols, hypersensitive substances and enzymes, detoxification.

ii. Genetics of host Pathogen interaction: Resistance and susceptibility, Vertical and horizontal resistance, Gene for Gene hypothesis, PR-Proteins, physiological specialization, mutation, heterokaryosis.

Suggested readings

1. Chandnivala, M. (1955). Recent advances in plant pathology, Amol Publication, Pvt. Ltd.,
2. Nurenburg, H.W. (1985) Pollution and their ecotoxicological significance, John Wiley and Sons, New York.
3. Mehrotra, R.S. Plant Pathology, Tata McGraw Hill Publication Co., Ltd., New Delhi.
4. Agriso, G.N. Plant Pathology, Academic Press, New York and London.
5. Bilgrami, K.S. and H.C. Dubey, A text book of Modem plant pathology, Vikas Publishing House, New Delhi.
6. Nene, Y. and P.N. Thaphyal Fungicides in plant disease control II lidiv Oxford and IBH Publishing Co., New Delhi.
7. Vyas, S.C. Systemic fungicides, Vol. 1 - 3, Tata Mc(Jrnw Hill Publishing Co., Ltd., New Delhi.
8. Dekker, J. and S.G. Georgopoulos (Ed), Fungicides Resistance in plnnl Protection, CARD Publications,
9. Gangawane, L.V. and Jayashree Deshpande. Pesticides and crop plnntn in India, Ajay Prakashan, Aurangabad.
10. Holton, C.S., Fischr, C.N. Fulton, R.W., Hart, H. and S.K.A.Macallan. Plant Pathology: Problems and progess (1908 - 1958), The University of Wisconsin, USA.

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COURSE NO XIX ELECTIVE- III

TAXONOMY OF ANGIOSPERMS

UNIT-I: Phylogeny of Angiosperms: Isoetes-monocotyledone theory, Coniferales-amentiferae theory, Gnetales-angiosperms theory, anthostrobilus theory, Bennettitalean theory, Caytonialean theory, Stachyspory-phyllospermae theory, pteridosperm theory, Pentoxylales theory and Durian theory; Co-evolution of insect and plants.

UNIT-II: Study of fossil angiosperms: Malvaceae: Sahniocarpon; Myrtaceae: Sahnipushpam; Soneratiaceae: Sahnianthus, Enigmocarpon; Palmae: Palmoxylon.

UNIT-III: Taxonomic tools: Serological and molecular techniques, GIS, GPS, Use of computers in angiosperms taxonomy (Use of computer and data bases for identification of plants with the help of website). Taxonomic keys: suggestions for construction and use of keys: types of keys.

UNIT-IV: Recent system of classification: Angiosperm Phylogeny Group (APG) system.

UNIT-V: Phyto-geography: World vegetation, theories of plant distribution, vicarious areas, centers of origin, theory of tolerance.

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COURSE NO XX ELECTIVE- IV
TAXONOMY OF ANGIOSPERMS

UNIT-I: Trends in evolution of characters in flowering plants in habit and habitat, phyllotaxy, stomatal apparatus, nodal anatomy, xylem, phloem, cambium, vascular cambium, inflorescence, flower, androecium gynoecium, pollination, fertilization, placentation, fruit, seed and seedling.

UNIT-II: **Numerical Taxonomy:** Principles of taxometrics, operational taxonomic units, taxonomic characters, measuring resemblances, cluster analysis, classification. **Biosystematics:** Aims, objectives and steps in biosystematic studies, biosystematic categories, importance of biosystematic studies.

UNIT-III: **Molecular Biology:** Acquisition of Molecular Data, sources of DNA sequence data, Plant genomes, Polymerase Chain Reaction (PCR) analysis, DNA Sequencing Reaction, Types of DNA Sequence Data, Generation and analysis of DNA Sequence Data, Restriction Fragment Length Polymorphism analysis (RFLP), allozymes, micro-satellite DNA, Random Amplified Polymorphic DNA (RAPDs), Amplified Fragment Length Polymorphism (AFLPs).

UNIT-IV: **Botanic Gardens:** Definition, criteria, history and role of botanic gardens, special types of botanic gardens: Arboretum, Pineatum, Orchidarium, Bambusetum, Fernary. Important Botanic Gardens in India and World.

UNIT-V: History of Botanical explorations in Maharashtra and Marathwada.regions. Importance of Botanical Survey of India.

Suggested Readings:

1. AHMEDULLAH, M., AND M.P. NAYAR. 1987. Endemic Plants of the Indian Region. Vol. I. Botanical Survey of India. Howrah.
2. BENSON, L.D. 1962. Plant Taxonomy: Methods and Principles. Ronald Press, New York.
3. BHOJWANI, S. S. AND BHATNAGAR, S. P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Dehli.
4. BILGRAMI, K.S. AND J.V. DOGRA. 1990. Phyto Chemistry and Plant Taxonomy. New Delhi, CBS Publishers
5. CRONQUIST, A. 1968. The Evolution and Classification of Flowering Plants. Houghton Mifflin. Boston.
6. CRONQUIST, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
7. CRONQUIST, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
8. DANIEL, M. 2009. Taxonomy: Evolution at work. Narosa Publishing House Pvt. Ltd. New Delhi.
9. DAVIS, P.H., AND V.H. HEYWOOD. 1965. Principles of Angiosperm Taxonomy. Oliver & Boyd. Edinburgh
10. DAVIS, P.H., AND V.H. HEYWOOD. 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delh
11. DOBSON, A.P.1996. Conservation and Biodiversity. Scientific American Library. New York, U.S.A.
12. ERDTMAN, G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. Almquist and Wiksell. Stockholm.
13. ERDTMAN, G. 1986. Pollen Morphology and Plant Taxonomy : Angiosperms An Introduction to Palynology. Netherland, E.J.Brill, Leiden.
14. FORMAN, L. AND D. BRIDSON. 1989. The Herbarium Handbook. Royal Botanic Gardens, Kew, U.K
15. GRAHAM, L.E. 1993. Origin of Land Plants. John Wiley & Sons. Inc. New York.
16. GREUTER, W, (Ed.). 2007. International Code of Botanical Nomenclature. (VIENNA CODE). Koeltz Vesentific Books. Germany.
17. GROOMBRIDGE, B, (Ed.). 1992. Global Biodiversity: Status of The Earth's Living Resources. Chapman and Hall. London.
18. HENRY, A.N., M.CHANDRABOSE. 1980. An Aid to International Code of Botanical Nomenclature. Today & Tomorrow's Printers and Publishers. New Delhi.
19. HESLOP-HARRISON, J. 1953. New Concepts in Flowering Plant Taxonomy. Heinemann Ltd. London.
20. HEYWOOD, V.H. 1967. Plant Taxonomy. Edward Arnold Ltd. Great Britain.
21. HEYWOOD, V.H. 1995. Global Biodiversity Assessment. Cambridge University Press, Cambridge, U.K.
22. HUTCHINSON, J. 1973. The Families of Flowering Plants. 3rd Edition. Oxford University Press. Oxford.
23. JAIN, S.K. and R.R. RAO. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.

24. JOHRI, B.M. 1994. Botany in India: History and Progress. Vol-I. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
25. JONES, S.B., AND A.E. LUCHSINGER. 1987. Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York.
26. JUDD, W. S, C. S. CAMPBELL, E. A, KELLOG, P. F. STEVENS AND N. J. DONOGHUE. 2008. Plant Systematics. Sinauer Associates, INC,Publishers.Sunderland, Massachusetts, USA.
27. LAWRENCE, G.H.M. 1951. Taxonomy of Vascular Plants. The Macmillan Company. New York.
28. MABBERLEY, D.J. 2005. The Plant-Book, A portable dictionary of the vascular plants. Cambridge University Press, United Kingdom
29. MANILAL, K. S. AND M. S. MUKTESH KUMAR [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.
30. MINELLI, A. 1993. Biological Systematics: The State of the Art. London, Chapman & Hall.
31. MONDAL, A.K. 2005. Advanced Plant Taxonomy. New Central Book. Agency Pvt. Ltd. Kolkata.
32. MOORE, R., W.D. CLARK, K.R. STERN AND D. VODOPICH. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers. London.
33. NAIK, V. N. 2000. Taxonomy of Angiosperms. Tata McGraw – Hill Publishing Company Limited, New Delhi.
34. Nair, P. K. K. 1966. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.
35. NAYAR, M.P., 1996. "Hot Spots" of Endemic plants of India, Nepal and Bhutan. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, India.
36. NAYAR, M.P., AND R.K. SASTRY. 1987-1990. Red Data Book on Indian Plants. Vols. I - III. Botanical Survey of India. Howrah.
37. QUICKE, D.L.J. 1993. Principles and Techniques of Contemporary Taxonomy. Chapman and Hall. London.
38. RADFORD, A.E., W.C. DICKISON, J.R. MASSEY, AND C.R. BELL. 1974. Vascular Plant Systematics. Harper & Row. New York
39. RAVEN, P.H., R.F. EVERT, AND S.E. EICHHON. 1992. Biology of Plants. 5th Edition. Worth Publishers. New York.
40. SANTAPAU, H. 1955. Botanical Collector's Manual. Botanical Survey of India.
41. SANTAPAU, H. AND H.A. HENRY. 1994. A dictionary of the flowering plants in India, CSRI, New Delhi.
42. SHARMA A. AND A. SHARMA. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.
43. SHIVANNA, K. R. AND N. S. RANGASWAMY. 1992. Pollen Biology- A Laboratory Manual. Springer-Verla
44. SIMPSON, M. G. 2006. Plant Systematics. Elsevier Academic Press, California, USA.
45. SIMPSON, M.G. Plant Systematics. Elsevier Academic Press. Burlington, U.S.A.
46. SINGH, G. 2005. Plant Systematics – Theory and Practice. Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi.
47. SIVARAJAN, V.V. 1989. Introduction to Principles of Plant Taxono¬my. Oxford and IBH

Publishing Co. New Delhi.
48. SOLTIS, D. E., P. S. SOLTIS, P. K. ENDRESS AND M. W. CHASE. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc, Massachusetts, USA.
49. STACE, C.A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
50. STUESSY, T. F. 2002. Plant Taxonomy. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
51. SUBRAMANIAM, N.S. 1995. Modern Plant Taxonomy. Vikas Publishing House. New Delhi.
52. TAKHTAJAN, A. 1997.Diversity and Classification of Flowering Plants. Bishen Singh and Mahendra pal Singh, Dehra Dun, India.
53. TAYLOR, D. V. AND L. J. HICKEY. 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi
54. WILEY, E.O. 1981. Phylogenetics : The Theory and Practice of Phylogenetic Systematics. New York, John Wiley & Sons.

COURSE NO XIX ELECTIVE- III
PLANT PHYSIOLOGY

Unit I. Plant water relations: Molecular structure of. water, water potential, Absorption of water -by plants, transpiration and anti-transpirants with its significance, physiology of stomatal movements,.

Unit II Stress physiology: Biotic and Abiotic , environmental stresses, effect on plant metabolism and growth, high temperature stress, water stress, chilling stress, thermo genesis, salinity and salt stress, salt respiration, salinity and agriculture.

Unit III Seed Germination: seedling growth, seed dormancy, light and temperature sensitive seeds, Biochemical changes associated with seed germination, Hormonal regulation, and conditions for seed germination, Mobilization of reserve food material, longevity of seed and seed viability.

Unit IV Organic farming: Mixed fanning, crop rotation and inter-cropping, weed management and control, Herbicides, weed biomass as green manure, organic matter recycling and preparation of compost / vermin-compost, Production of crop plants under organic and conventional fanning system, Bio-fertilizers, Bio-methylation

Unit V Biostatistics: Collection and tabulation of data, Frequency distribution, normal curve, location, dispersion, normal distribution, tests of significance, t test, F test, chi square test, correlation and regression. Experimental designs, Analysis of data: RBD, LSD, Factorial and split plot RBD.

COURSE NO XX ELECTIVE- IV
ADVANCED PLANT PHYSIOLOGY

Unit I: Cell Physiology :-Role of nucleic acids as carriers of genetic Information, transformation and transduction. Auto catalytic function of DNA-replication, Hetero catalytic functions -Transcription and translation, toti-potency, differential gene activity and its regulation., Recombinant DNA, GM plants, Application of Gene technology in agriculture

Unit II: Cell Senescence: Senescence and aging, cellular, tissue, organ and organism senescence, physiological changes associated with senescence, Biological significance.

Unit-III: Microbial physiology: Carbohydrate metabolism, energy production, substrate metabolism, utilization of sugar, starch, cellulose, pectin, hydro carbons, aromatic hydrocarbons and other compound, microbial biomass production, production of useful microbial metabolites -enzymes, organic acids, single cell protein, toxins, antibiotics, alcohol etc..

Unit IV: Enzyme technology:- Enzyme production, sources and uses of enzymes, microbial enzyme, Production, Isolation and purification of enzymes, Applications of enzymes in various industrial processes, Immobilization of enzymes - techniques and advantages, Bio-catalysis, Enzyme production and application.

Unit V: Productivity of crop plants, integrated fertilizer management, bio-fertilizers, productivity potential and cultural practices for fiber plants (e.g. cotton), cereals (rice, wheat), millets (Sorghum, pearl millet), pulses (gram), oil seed crops (safflower, groundnut), commercial crops (sugarcane), vegetables, fodder crops (lucerne, hybrid Napier, maize),

Suggested Reading:

1. Mukharji S and A.K. Ghosh. Plant Physiology - New Central Book Agency, Kolkatta.
2. Mertz, E.T. Elements Biochemistry Vakils, Fe Her and Simson Pvt Ltd, Bombay.
3. Fains, J.L. and Kilgour, G.L. Essentials of Biological Chemistry, Affiliated East - West Press, Pvt. Ltd., New Delhi.
4. Moat, A.G., Foster, J.W. and Spectok, M.P. Microbial Physiology, Wilesy Liss, A. John Wiley and Sons, Inc., Singapore.
5. Trevan, M.D., Botey, S., Goulding, K.H. and Stanburn, P. Biotechnology. The Biological Principles. Tata Mc Graw Hill Publishing Company Limited, New Delhi.
6. Salisbury. I'.B. an<! Ross. C.W., Plant Physiology CBS Publishers andDistributors, Ncw Delhi.
7. NoggIe, G.R. and Fritz, G.S. Introductory Plant Physiology. Printice Hall, USA.
8. Styter, R.O. Plant water relationship, Academic Press, New York
9. Hess, D. Plant Physiology, Narosa Publishing House, New Delhi
10. Devlin, R.M. and Hostan, F.H. Plant Physiology, CBS publishers and Distributors, New Delhi
11. Mukhcrji, S. and Ghosh A.K. Plant Physiology, Tata Me Graw Hill Publishing Company Ltd., New Delhi
12. Datta, C.S. Plant Physiology, Wiley Eastern Limited, New Age International Ltd., New Delhi.
13. Vaidya, V.G., Sahasrabuddhe, K.R. and Khupse, V.S. Crop production and field experimentation, Continental Prakashan, Pune – 30
14. Mungikar, A.M. An Introduction for Biometry, Saraswati Printing Press, Aurangabad.

COURSE NO XIX
ELECTIVE III
(BIODIVERSITY III)

Unit I: Introduction of Angiosperms: Definition, scope, salient features of Angiosperms, Comparative study with Gymnosperms. Concept of Taxonomy, Origin and evolution in relation to Geological time scale

UNIT- II: Plant Systematics: Concept of Artificial, Natural and Phylogenetic systems of classifications. Systems of Classifications A.P.de Candolle, Hutchinson and Cronquests's and its merits and demerits

UNIT- III: Study of Families: Ranunculaceae, Papavaraceae, Malvaceae, Fabaceae, Rubiaceae, Asteraceae, Solanaceae, Verbenaceae, Euphorbiace, Liliaceae and Orchicaceae.

UNIT-IV: Taxonomic tools in Angiosperms: Keys, Plant inventory and exploration, Herbarium techniques, Cryo preservation, Botanical Garden , Major herbaria of the World and India.

COURSE XX
ELECTIVE IV (BIODIVERSITY IV)

UNIT- I: Ecological Aspects: Role of Ecological parameters, Concept of estimation of quadrat methods, density, abundance, frequency concept and estimation.

UNIT-II : Analysis of Characters: Characters weighing: Concept and definition, primitive and advanced characters, good vs bad characters, qualitative vs quantitative characters.

UNIT- III : RET categorisation: Impacts on Diversity depleting resources: RET, Threatened species and their impacts, global warming impact, Red data book IUCN and Species extinction.

UNIT- IV: Biodiversity Conservations: Causes and consequences of loss of Biodiversity, Biodiversity its commercial value campaign, awareness, conservation methods, role of

pollution control board, Public awareness, NGOs and Industries in conservation.

Suggested Readings:

1. Cole, A.J. 1969 Numerical Taxonomy. Academic Press. London.
2. Daris, P.H, and Heywood,V.H. 1-973. Principles of Angiosperms' Taxonomy. Robert E.Krieger Pub.Co. New York.
3. Grant, V. 1971 Plant Speciation, Columbia, University Press, New York.
4. Grant, W.F. 1984. Plant Biosystematic , Academic Press, London.
5. Harrison, H.J. 1971 New concepts in Flowering Plant Taxonomy. Hieman Educational Book Ltd., London.
6. Heslop-Harrison, J. 1967 Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd. U.K.
7. Heywood, V.H. and Moore , D.M. 1984 Current concepts in Plant Taxonomy, Academic Press, London.
8. Jones, A.D. and wilbins, A.D. 1971 Variations and Adaptions in Plant species. Hieman& co. Educational Ltd. London.
9. Jones S.B. Jr. &Luchsinger,A.E. 1986 Plant systematics, (2nd Edition) McGraw-Hill Book Co. New York.
10. Radford, A.E. 1986 Fundamentals of Plant systematics. Harper & Raw Publicaations, U.S.A.
11. Soibrig. O.T.& Solbrig D.J. 1979. Population Biology and Evolution. Addison wesley Publication Co. Inc. U.S.A. Stebbins, G.L. 1974 Flowering Plant- Evolution Above Species Level Edward Arnold Ltd,.'London.
12. Stace,C.A. 1989. Plant Taxonomy and Biosystamatics (2nd Edition) Edward Arnold,, London.
13. Takhtajan A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
14. Woodland D.W. 1991. Contemporary Plant Systematies, Prentice Hall, New Jersey.
15. Choudhary H.J., S.K.Murthy Plant Diversity and Conservation in India. Bishen Singh Mahendra Pal Singh Publishers, Dehradun.

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SEMESTER IV
COURSE XIX: ELECTIVE III (CROP GENETICS AND PLANT BREEDING)
PAPER III: AGRONOMY AND PLANT PATHOLOGY

Unit I: Climatic zones of Maharashtra and India in relation to cereals and pulses.

Unit II: Agronomy: meaning and scope; manures and fertilizers-types and applications, agronomic practices for improvement of crops such as cotton, soyabean, oats, rice and groundnut. Applications of biofertilizers such as cyanobacteria, bacteria and fungi.

Unit III: Plant protection measures: principles and methods of plant disease management of Marathwada region with special reference to cereals and pulses. Role of Bio-pesticides in controlling plant diseases;

Unit IV: Harvesting, yield, storage and preservation of cereals and pulses.

Unit V: Seed production: introduction (nucleus, breeder, foundation, certified); maintenance of genetic purity during seed production; operations in a seed industry; seed processing; production of certified and hybrid seeds; seed certification.

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COURSE XX: ELECTIVE IV (CROP GENETICS AND PLANT BREEDING)
PAPER: IV NUTRITION AND GENETIC ENGINEERING

Unit I: Malnutrition: concept, consequences, causes, prevention and control

Uniy II: Nutrition: classification, chemical composition and nutritional values of food-grains-i.cereals including millets ii.pulses (pigeon pea, chick pea, black gram and green pea)

Unit III: Quality breeding: nature of quality; genetic and biochemical basis of breeding for quality; genetic manipulation of quality and quantity.

Unit IV: Enrichment of food-grains: methods and need of fortification of food-grains; genetic engineering for value addition from economic view as well as nutritional composition of oil/starch /amino-acids/vitamins/anti-nutrients with their sources; golden rice, high quality protein maize, wheat gluten modification.

Unit V: Shade nets: types of shade nets; components; importance and use in production of commercial horticultural crops (vegetables, ornamentals, exotics).

Unit VI: Crop genetic resources: importance of genetic conservation; global network for genetic conservation and utilization in major crops of the world; institutes engaged in conservation and improvement of crop genetic resources-abroad and in India.

Suggested Reading:

1. Genes I-IX, Lewin,B., Oxford University Press, Oxford.
2. Fundamentals of Genetics, Singh B.D., Kalyani Publishers.
3. Agronomy, Panda S.C., 2006, Agribios Publication, New Delhi.
4. Weed Management: Principles and Practices, Gupta O.P., Agribios, New Delhi.
5. Crop Production and Management, Morchan Y.B., Oxford and IBH Publishing Co. Ltd., Bangalore.
6. Principles of Agronomy, Reddy S.R., Kalyani Publishers, Ludhiyana.
7. Biotechnology, Singh B.D., Kalyani Publishers, New Delhi.
8. Elements of Biotechnology, Gupta P.K., Rastogi Publication, Meerut, India.
9. Introductory Plant Pathology, Dube, H.C.
10. Introductory Mycology, Alexopolous, Mims and Blachwel, 2004, Wiley Eastern Ltd. New Delhi.
11. Disease of Crop Plants in India, Rangaswami G and Mahadevan, 2006.
12. Principles of Plant Breeding, Singh B.D., 1983, Kalyani Publishers, New Delhi.
13. Plant Tissue Culture Theory and Practices, Bhojwani and Ramzan, 2008, Elsevier, India.
14. Statistics (Theory, Methods and application) Sancheti D.C., Kapoor V.K., 1985, Sultan Chand and Sons, New Delhi.
15. Manual of mutation breeding by FAO/IAEA.

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COURSE XIX
ELECTIVE III
APPLIED MYCOLOGY –III

Unit I- Production Media -Introduction, Raw Materials and Detection of Fermentation products.

Unit II- Assay-Assay of fermentation Products- Physico-chemical assay growth turbidity assay, Cell yielding determination assay Spectrophotometric assay.

Unit III-Chromatographic assays- Paper Chromatography, Thin Layer chromatography (TLC),High Performance Liquid Chromatography (HPLC), Gas Chromatography –Mass Spectroscopy (GC-MS),Gel- Electrophoresis and Ultra centrifuge assay.

Unit IV-Biological assay-Exchange Principles of Biological assay, Biological assay and End point determination assay.

Unit V- Stock Cultures- Working stock culture and Primary stock cultures.

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COURSE XX
ELECTIVE IV
APPLIED MYCOLOGY-IV

Unit I- Fermentation Media – Media composition, growth factors, precursors, antifoaming agents, inoculum media, and media economics.

Unit II-Scale Up-off fermentation – Fermentation Tanks, Laboratory fomenters, pilot plant fermentors and its design.

Unit III - Industrial Effluents –Application of Industrial Waste, Management of Industrial Waste and its disposals.

Unit IV - Sewage and Sewage Disposal – Introduction, objectives of Sewage Treatment, Collection of Sewage, Sewage Treatment Methods, Govt. Approved policies.

Suggested Readings.

1. Industrial Microbiology - L.E. Casida.

2. Industrial M icrobiology - Presloot Dunn

3.Industrial Microbiology By Peppler Vol.I and Vol.II

4. Fermentation fungi, Industrial mycology - Vol. I - smith.

5. Fundamental of Industrial Microbiology - Rivera.

6. Practical medical mycology - Keeney.

7. The relation of fungi human affair - Gray W.D.

8. Essay in Applied Microbiology - JP Norris and Richman.

9.Industrial Micribiology by A.H.Patel

Student Assignments: 20 Marks

a) One compulsory long tour in Sem- III or IV be conducted, a report of the tour be submitted during the final practical examination.

b)) The PG Student of M. Sc. Sem - IV should carry out Project Assignments related with Elective papers -III & IV. A bound project needs to submit at the time of practical examination which will be evaluated for 20 Marks.

PRACTICALS

COURSSE NO XXI :

PRACTICALS BASED ON COURSE NO XIII and COURSE NO XVII

Bio-informatics and Instrumentation (XIII)

1. Studies on pH titration curves of amino acids/ acetic acid and determination of pK a values and Handerson-Hasselbach equation.
2. Separation of lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography.
3. Separation of seed protein by horizontal submerged gel electrophoresis.
4. Study of UV absorption spectra of macromolecules (protein, nucleic acid, pigments).
5. Quantitative estimation of hydrocarbons/pesticides/by Gas/HPLC chromatography.
6. Demonstration of PCR, DNA sequencer.
7. Microscopy - (Demonstration/ Working on) Fluorescence, confocal, Dark field, Bright field, Inverted. Microscope.
8. Demonstration of SEM and TEM.
9. Micrometry techniques
10. Separation of chlorophyll and Carotene, Phycocyanin, Xanthophyll pigments.
11. Paper electrophoresis technniques.
12. Density gradient centrifugation.
13. Interpretation / microanalysis of X ray film
14. Database search, NCBI, DDBJ, EMBL, BRENDA, KEGG, UniProt.
15. Pair wise Sequence Alignment-FASTA, BLAST.
16. Websites for Bioinformatics.
17. To prepare the inventory of websites.
18. To develop a phylogeny tree of at least 5 plant species.
19. To search allergic fragments of proteins in fruits / pollen grains.
20. To study Protein characteristics by using different boinformatic tools.
21. Blast analysis of DNA sequence.
22. Blast analysis of Protein sequence
23. Genome analysis (Prokaryotes)
24. Genome analysis (Eukaryotes)

Plant Biotechnology (XVII)

1. Isolation and fusion of plant protoplasts.
2. Preparation of synthetic seeds.
3. Preparation of selective medium for drought or salinity resistance. Preparation of MS soild medium from stock solutions containing auxin and cytokinin, NaCl or PEG, and inoculation.
4. Cell immobilization Application of immobilized yeast cells for ethanol production.
5. Isolation of microbes producing organic acids.
6. Find out the uninucleate stage of anther and anther culture.
7. Dissect out an embryo from any seed and culture it on a suitable solid medium.
8. Isolation of explant, induction of callus, establishment and maintenance of callus.
9. Organogenesis and plant regeneration through clonal propagation.
10. Embryogenesis in cultured cell from different explants.
11. Micropropagation of banana, citrus, papaya, sugarcane etc.
12. Cell suspension culture from different tissues.
13. Embryo culture and embryo rescue of different plant species.
14. Effect of various growth hormones on cell divisions and cell proliferation.

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PRACTICALS

COURSE NO XXII

PRACTICALS BASED ON COURSE NO XIV AND COURSE NO XVIII

PLANT RESOURCE UTILIZATION AND CONSERVATION (XIV)

1. **Food crops**: Wheat, rice maize, chickpea (Bengal gram) potato, sweet potato, and sugarcane. Morphology, anatomy, microchemical test for stored materials.
2. **Forage/fodder crops:** study of any five important crops of the locality (For example - fodder sorghum, bajra, berseem, clove, guar bean, gram, *ficus* sp.)

3. **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.
4. **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). Eg. *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.
5. **Vegetable oils**, Mustard, groundout, Soyabean, Coconut, sunflower, castor

   Morphology, microscopic structure of the oil -yielding tissues, test for oil and iodine number.
6. 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 inermiss*) and perform test to understand their chemical nature.

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APPLIED BOTANY (XVIII)

1. Study of various seed testing tests.
2. Study of seed borne diseases- fungi, bacteria, viruses and nematodes.
3. Demonstration of methods of plant breeding - self, cross and asexually propagated plants.
4. Demonstration of various nursery techniques – Layering, Budding, Grafting, Cutting
5. Demonstration of Molecular markers for molecular taxonomy, DNA fingerprinting, Genetic markers –RAPD, RFLP, AFLP, SSR, ISSR, ; cDNA library,
6. Demonstration of PCR techniques,
7. Study of various primary and secondary natural metabolites
8. Extraction, purification and characterization of natural metabolites,
9. Survey of plant biodiversity of College campus/ University/ Botanical garden/National park/ field of botanical interest.
10. Demonstration of *Spirulina/* BGA – mass production technology.

11. Estimation of protein, Amino acids, Carbohydrate, Vitamins, Pigments from algae
12. Study of Algal blooms, for water quality analysis.
13. Estimation of Ergotin from fungal source
14. Production of organic acids /enzymes/ vitamins/ antibiotics/ growth regulators/ alcohol, from fungi.

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PRACTICALS

COURSE NO XXIII

PRACTICALS BASED ON COURSE NO XV AND COURSE NO XIX

PLANT PATHOLOGY-I AND III

ELECTIVE - I (XV)

1. Collection and preservation of diseases specimens.
2. Symptomology, histopathology of disease (Phytoplasma diseases, Viral diseases, Bacterial diseases fungi, nematodes) minimum three from each causal organism.
3. Production and assay of macerating enzymes.
4. Production and assay of polygalactiironase, cellulolytic enzymes, ainylase, toxins, phytoalexines etc.
5. Evaluation of fungicide against plant pathogenic fungi.

ELECTIVE - III (XIX)

1. Non parasitic diseases
2. Virulence test for pathogens.
3. Effect of pollutants/ Toxic chemicals/ Insecticides/ Pesticides on crop plants.
4. Evaluation of antibiotics again pathogenic bacteria.
5. Extraction and estimation of pigments in healthy and diseased plants.
6. Estimation of Nucleic acids.
7. Visits to fields for study of diseases.

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COURSE NO XXIV

PRACTICALS BASED ON COURSE NO XVI AND COURSE NO XX

PLANT PATHOLOGY-II AND IV

1. Collection and Identification of Phytoplasmal disease material (PPLO) at least foru types.
2. Collection and identification of viral diseases with special reference to Tobacco, Papaya, Bhendi ,Banana citrus ,Rice etc.
3. Collection and identification of Bacterial diseases with special reference to Cotton and Citrus.
4. Pathogenicity Test for plant Diseases with remedial measures
5. Isolation of Toxins from different plant pathogens (Crop plants, oil yielding plants ,pulses and vegetables)
6. Use of Plant growth regulator for controlling the plant diseases (Crop plants, oil yielding plants ,pulses and vegetables).
7. Collection and Submission of at-least **20** Plant diseases at the time of final practical examination

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COURSE XXIII

PRACTICALS BASED ON ELECTIVE COURSE XV & XIX

TAXONOMY OF ANGIOSPERMS I & III

1. Description of species based on many specimens to study intraspecific variation
2. Study of morphology and general evolutionary trends in flowers, stamens and carpels of primitive families viz. Magnoliaceae, Papaveraceae, Nymphaeaceae, Lauraceae
3. Study of different types of ovules, placentation and evolutionary trends therein
4. Exercises on nomenclature problems: Author citation, principle of priority, transfer of taxa, effective and valid publication.
5. Describing new taxon, deposition of type, Latin diagnosis and abbreviations used in citations.

6. Assessment of taxonomic characters (a) analytical and synthetic characters, (b) qualitative and quantitative characters
7. Study of different taxonomic features (a) stomata, (b) trichomes, (c) crystals, (d) pollen grains.
8. Describing new taxon, deposition of type, Latin diagnosis and abbreviations used in citations.
9. Detection of taxonomically important chemical compounds by various tests.
10. Detection of variations in a given population.
11. Exercises on nomenclature problems: Author citation, principle of priority, transfer of taxa, effective and valid publication etc.

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COURSE XXIV

PRACTICALS BASED ON ELECTIVE COURSE XVI & XX

TAXONOMY OF ANGIOSPERMS II & IV

1. Semi-permanent pollen preparations by acetolysis method and study of different pollen morphotypes.
2. Taxonomic distribution of special units of pollen dispersal- bi celled pollen, tetrads, polyads and pollinia and pollen types.
3. Study of plant surface attributes with the help of SEM photographs.
4. Descriptions, sketching, classification and identification of at least 30 families represented in local flora.
5. Classification and identification of at least 5 species of some of the genera like *Alysicarpus, Amaranthus, Cassia, Chlorophytum, Commelina, Cyperus, Euphorbia, Indigofera, Leucas, Sida, Solanum.*
6. Practicals based on numerical taxonomy/ cluster analysis.
7. Study of different types of ovules, placentations and evolutionary trends therein.
8. Study of following fossil angiosperm specimens: Palmoxylon, Enigmocarpon, Sahnianthus, Glossopteris with the help of slides/ specimens.

9. To identify family with the help of computerized Key.
10. Preparation and standardization of some simple Ayurvedic Drugs.
11. One-day botanical excursions to botanically rich locations
12. Botanical excursion of about one week to any botanically rich location preferable outside the State.

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COURSE XXIII

PRACTICALS BASED ON ELECTIVE COURSE XV & XIX
Elective – I
ADVANCED PLANT PHYSIOLOGY

1. Estimation of B - carotene with column chromatography.
2. Estimation of reducing sugars by Folin – Wu tube.
3. Estimation of cellulose by cramption and Maynord Method.
4. Estimation of free fatty acids.
5. Estimation of nitrates.
6. Thin layer chromatographic technique.
7. Techniques of flame photometry: estimation of sodium and potassium.
8. Estimation of gross energy by chromic acid oxidation method.
9. Estimation of N by micro – K jeldhal methods.
10. Estimation of crude protein, crude fat and crude fiber.
11. Estimation of ash acid soluble / insoluble ash, Nitrogen free extracts and total carbohydrates.
12. Estimation of cell wall constituents, ADF, NDF, cellulose, hemicellulose, lignin etc.
13 Estimation of calcium by titration method.
14. Estimation of phosphorus by Subba Rao and Fiske Method,

Elective -III

1. Determination of water potential.
2. Determination of relative water content (RWC).
3. Effect of growth regulators on seed germination.
4. Estimation of starch in fresh, germinating and germinated seed.
5. Estimation of glucose at various stage of seed germination.
6. Estimation of protein content during seed germination – Lawry's method, burette method
7. Estimation of non-protein nitrogen (NPN) content in germinating seeds,
8. Estimation of vitamin C in germinating seeds.
9. Accumulation of praline in normal and stressed plants.
10. Determination of seed viability.
11. Seed dormancy and breaking of seed dormancy by using physical, scanning, hot water, acid and PGRs.
12. Studies on effect of 2,4 - D on seed germination.
13. Measures of central value - mode, median, mean, range, standard deviation, mean deviation and coefficient of co-relation.
14. Frequency distribution - Graphic representation, frequency curve and Histogram.
15. Calculation of central value of dispersion in classified data,
16. Statistics in agricultural science - ANOVA for various field experimentation,
17. Correlation, regression and calculation of optimum economic use for fertilizers.

COURSE XXIV

PRACTICALS BASED ON ELECTIVE COURSE XVI & XX

Advanced Plant Physiology

Elective - II

1. Isolation and estimation of nucleic acids
2. Study of leaf senescence.
3. Changes in chlorophyll content in leaf discs during senescence
4. Biochemical changes during leaf senescence - sugars, protein -nitrogen, non-protein nitrogen, etc
5. Effect of PGRs on senescence.
6. Chemical changes associated with fruit ripening.
7. Growth of microbes (yeast, bacteria and fungi) on synthetic and biological media,
8. Assay and chemical tests for enzymes, organic acids, antibiotics, toxins etc.
9. Estimation of the activities of hydrolytic enzymes - amylase, lipase, protease, cellulose etc
10. Estimation of alcohol content in fermented plant material.
11. Immobilization of enzymes with wax
12. Activity of enzyme a - amylase, cellulose and protease under the influence of substrate concentrate
13. Activity of enzyme a - amylase, cellulose and protease under the iniiueiv.ee of substrate Concentrate of enzymes.
14. Activity of enzyme - amylase, cellulos^1 and protease under the influence of substrate concentrate pH values,
15. Visit to the fields for studies on crop plants.

Elective -IV

1. Estimation of protein in pulse seeds
2. Estimation of starch in seeds.
3. Estimation of fat content in seeds,
4. Chlorophyll content in crop plants*
5. Growth of crop plants, growth curve and growth analysis.
6. Growth analysis: AGR, RGR, NAR, LAR, LAI, CGR and LAD
7. The process of GCF and extractability of dry matter and Nitrogen.
8. Preparation of LPC, by heat coagulation, acid coagulation and fermentation.
9. Preparation of cytoplasmic and chloroplastic LPC by differential heat coagulation.
10. Preparation of TCM using DPJ and Inoculation of explant.

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COURSE XXIII

PRACTICALS BASED ON ELECTIVE COURSE XV & XIX

Biodiversity –I & III

Practical's: Study of family upto floral formula & diagram

1. Ranunculaceae,
2. Papavaraceae,
3. Malvaceae,
4. Fabaceae,
5. Rubiaceae,
6. Asteraceae,
7. Solanaceae,
8. Verbenaceae,
9. Euphorbiace,

10. Liliaceae.
11. Orchicaceae.
12. Submission of Herbarium Sheath, Excursion report and Project.

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COURSE XXIV

PRACTICALS BASED ON ELECTIVE COURSE XVI & XX

Biodiversity –II & IV

1. Different quadrat methods , calculation of frequency, abundance and density(Student should collect data by different methods from at least 3 different localities of different vegetation types).
2. Preparation of keys based on comparative morphological study.
3. Starch test,
4. Cellulose Test
5. Legnin Test
6. Comparative morphology of leaf, stipules, bracts, bracteoles, Floral, calyx, corolla, reproductive parts.(For atleast 5 Species of a genus of in a family).
7. Dermal Studies such as hairs/ Trichomes types, Stomata types etc.
8. Stomatal Index
9. Vessels studies i.e. Root and Stem Vessels.
10. Karyomorphology.
11. Use of computer generated keys, webs, surfing , data analysis etc.
12. Pollen study: Morphology, Pollen types, and pollen germination activity.

Course XXIII

Practical Paper based on course XV and XIX.
CROP GENETICES AND PLANT BREEDING I & III

1. Plant breeder's kit
2. Study of anthesis and dehiscence in flowers of crop plants.
3. Study of floral biology and hybridization techniques of cereals- maize, wheat, Sorghum, bajra,
4. Study of floral biology and hybridization techniques of pulses- Bengal gram, cowpea, blackgram,
5. Study of floral biology and hybridization techniques of vegetables- brinjal, tomato, bottlegourd.
6. Study of floral biology and hybridization techniques of oil crops- groundnut, soyabean
7. Study of floral biology and hybridization techniques of cash crop such as cotton.
8. Demonstration of male sterility in jowar.
9. Study of pollen fertility.
10. Study of pollen viability.
11. Study of agricultural implements.
12. Comparative of effect of chemical fertilizers and organic manure on crops- tomato, spinach.
13. Effect of different doses of chemical fertilizers on crops- tomato.
14. Study of germination percentage by towel paper method.
15. Identification, classification and control measures of atleast five common weeds.
16. Preparation of seed certification tag.
17. Field visits; visit to seed company.

Course XXIV

Practical Paper based on course XVI and XX.
CROP GENETICES AND PLANT BREEDING II & IV

1. Karyotype analysis in crop plants.
2. Aneuploid analysis in crop plants.
3. Introduction of polyploidy in crop plants.
4. PCR amplification reaction with detail role of each component.
5. Designing of field experiments, analysis of variance of CRD and RBD.
6. Interpretation of 't' test, 'F' test and C_2 test.
7. Induction of mutations through physical mutagenic treatment and raising M /M_z generations.
8. Induction of mutations through chemical mutagenic treatment and raising M /M_z generations
9. Assessing the effect of mutagens on different M_1 agronomic parameters
10. Study of seed protein profile by natice and SDS-PAGE.
11. Estimation of protein by Lowry's method from edible crops- tur, chana.
12. Estimation of oil from edible crops- soyabean, sunflower.
13. Estimation of starch from edible crops- maize, bajra.

14. Study of shade nets and their utility.
15. Cultivation of commercial horticultural crops- vegetables such as brinjal, tomato, chillies, okra
16. Visit to fields and micropropagation laboratory.

Course XXIII
APPLIED MYCOLOGY
Practical Paper Based on XV and XIX
&
Course XXIV
APPLIED MYCOLOGY
Practical paper based on XVI and XX

1.Preparation of different media and broth

2. sterilization of media and preparation of slant, plate, and flask.

3.Isolation and Identification of fungal strains used for fermentation

4. Principle and uses of fermentation equipment.

5. Techniques: 1. Crowed plate, 2. Dilution plate, 3. Enrichment technique, 4. Gaint colony technique, 5. Spectrophtometry, 6. TLC.

6. Primary Sceening: 1. Antibiotic, 2. Acid producer, 3. Amylase producer, 4. Cellulose producer.

7 Alcohol fermentation extration purification, netural alcohol.

8. Citric acid Fermentation and its estimation .

9. Cultivation of Mushroom - Oyster and Button.

10 Bio-degradation of Wood .

11.Isolation and Identification of Industrial effluents.

12.Isolation and Identification of Yeast from different sources.

13.Industrial Visit and Educational tour report.

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Important Note :- a) One compulsory long tour in Sem- III or IV to be conducted and a detailed tour a report of the tour should be submitted at the time of final practical examination. The Student of M. Sc Sem - IV must carry out Project Assignments related to Elective papers -III & IV. A bound project needs to submitted at the time of practical examination which has the weightage of **20 Marks** (Course no. XXIV)