

**Government E. Raghvendra Rao
Postgraduate Science College
Bilaspur (C. G.)**

[AN AUTONOMOUS COLLEGE UNDER UGC SCHEME]



DEPARTMENT OF BOTANY

M. Sc. Syllabus

for

First and Second Semester

Approved for the session - 2023-24

SCHEME OF EXAMINATION AT A GLANCE

First Semester:

Papers	Title	Marks Distribution				
		Theory				Practical
		Semester Exam.**	Seminar	Internal Test *	Total	
First	Cell and Molecular Biology of Plants	80	10	10	100	Practical - I Based on theory paper I & II
Second	Biology and Diversity of Virus Bacteria & Fungi	80	10	10	100	
Third	Biology and Diversity of Algae, Bryophytes & Pteridophytes	80	10	10	100	Practical - II Based on theory paper III & IV
Fourth	Plant Physiology	80	10	10	100	
				Total	400	200

Second Semester:

Papers	Title	Marks Distribution				
		Theory				Practical
		Semester Exam.**	Seminar	Internal Test *	Total	
First	Cytology, Genetics and Cytogenetics.	80	10	10	100	Practical - I Based on theory paper I & II
Second	Biology & Diversity of Gymnosperms	80	10	10	100	
Third	Taxonomy of Angiosperms.	80	10	10	100	Practical - II Based on theory paper III & IV
Fourth	Plant Biochemistry and Bioenergetics	80	10	10	100	
				Total	400	200

* **Internal test:** Two tests shall be taken, as prescribed question pattern and average marks of both tests shall be considered.

** **Question Papers:** It shall be comprise two sections – A and B. Section A – Question no. 1 shall consist 10 objective questions of 10 marks (one mark for each) and Question no. 2 shall be consist 05 short answer type questions of 10 marks (two mark for each); all questions are compulsory. Section B shall be consist 08 descriptive type questions out of which any four shall have to solve. Each type of question shall cover the entire syllabus.

Signature of Members (BOS) -

① Dr. A.N. Bahadur
 ② Dr. D.K. Srivastava
 ③ Dr. Uttara Tiwari
 ④ Dr. V.K. Kanungo
 ⑤ Dr. Asha Khatiwala
 ⑥ Dr. M.L. Jaiswal
 ⑦ Miss. Koshimi Kaur
 ⑧ Miss. Kaur

M.Sc. Botany
First Semester
Paper -I
Cell and Molecular Biology of Plants

=====**Max. Marks - 80**=====

Cell unit:

Plant Cell: Structural organization, Specialized plant cell types, **Cell Wall:** Structure; primary, secondary and tertiary wall - Chemical nature and function; biogenesis of cell wall and growth. **Plasma Membrane:** Chemical composition, Structure (Fluid mosaic) function, sites of ATPases, ion carrier, channels and pumps, receptors. **Plasmodesmata** – structure and its role.

Cytoplasmic Organelles:

Chloroplast: Structure, genome organization, gene expression, nucleo-chloroplastic interaction. **Mitochondria:** Structure & function, Genome organization and Biogenesis. **Ribosome:** Structure site of protein synthesis, mechanism of translation - initiation, elongation and termination. **Other cell organelles:** Structure and function of microbodies, Golgi apparatus, endoplasmic reticulum and Lysosome.

Nucleus and Cell inclusion:

Nucleus: Structure, nuclear envelop & nuclear pore; DNA - structure, forms of DNA, replication, damage & repair, transcription, splicing of mRNA, mRNA transport, structure of rRNA & tRNA and its role. **Nucleolus** – Structure, chemical composition and its role. **Plant Vacuoles:** Tonoplast, function as transporters and storage organelle.

Cell shape, motility, cycle & apoptosis:

Cell shape and motility: The cytoskeleton, organization and role of microtubules and microfilament, motor movement, implications of flagellar and other movements. **Cell cycle and apoptosis:** Cell cycle – events in different phases. M-Phase - Karyokinesis- events in Mitosis and Meiosis, role of cyclins and cyclin dependent kinases, Cytokineses and cell plate formation, mechanics of programmed cell death (PDC).

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Suggested Books:

1. Lewin, B. (2005) Gene VIII Oxford University Press, New York, USA
2. Robertis, D. and Robertis, D. Cell Biology.
3. Wolfe, S. L. (1993) Molecular and Cellular Biology, Wadsworth Publishing Co, California, USA.
4. Gupta, P. K. (2007) Cell and Molecular Biology, Rastogi Publication, Meerut, India.
5. Lodish, H., Berk. A., Zipurski, S. L, Matsudarrria, P., Baltimore, D. and Darneli, J., (2000) Molecular Cell Biology, W. H. Freeman and Co., New York, USA.
6. Recognized websites.

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LABORATORY EXERCISE
(Suggested)

1. Isolation of cell from plant tissues.
2. Isolation of cell organelle from plant cells.
3. Measurement of activity of mitochondrial marker enzyme, succinate dehydrogenase.
2. Isolation of DNA from plant cells.
3. Quantitative measurement of DNA by Spectrophotometric method.
4. Techniques of differentially staining methods of cell organelles.
5. Study of differentially stained plant cell.
6. Study of different stages of mitosis in different plant.
7. Preparation of karyotype of *Alium cepa*.
8. Study of Mitotic index.
9. Study of Karyotype and karyotype analysis.

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M. Sc. Botany**First Semester****Paper -II****Biology and Diversity of Virus Bacteria & Fungi**=====*Max. Marks - 80*=====**Microbiology -I**

Viruses: Characteristics and ultrastructure of virions, viroids, prions, isolation and purification of viruses, chemical nature, replication, transmission of viruses, economic importance.
Phytoplasma: General characteristics and role in causing plant diseases. Concept of MLO.

Microbiology -II

Archaeobacteria and Eubacteria: General account, ultra structure, nutrition and reproduction, biology and economic importance, Cyanobacteria - salient features, thallus organization, Heterocyst and biological importance. General account of Actinomycetes.

Mycology -I

Fungi: General characters, substrate relationship in fungi, cell ultrastructure, unicellular and multicellular organization, cell wall component, nutrition (saprobic, biotrophic and symbiotic), reproduction (vegetative, asexual, sexual), hetrothalism, heterokaryosis, sex hormones in fungi parasexuality, recent trends in classification.

Mycology -II

Phylogeny of fungi, general account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina, fungi in industries, medicine and as food, fungal diseases in plant and humans, mycorrhizae, fungi as biocontrol agents.

=====********=====**Suggested Books:**

1. Pelczar, M. J., Chan, E. C. S. and Krieg N. R. (2005). Microbiology. Tata McGraw Hill, New Delhi.
2. Dubey, R. C. and Maheshwari, D. (2000) Microbiology S. Chand and Company Ltd., Delhi.
3. Schelegel, H.G. (1995) General Microbiology. Cambridge University Press, U. K.
4. Clifton, A. (1958) Introduction to bacteria. McGraw Hill Book Co., New York.
5. Mandahar, C. C. (1978) introduction to plant Viruses. S. Chand and Co. Ltd. Delhi.
6. Allaxopoulus, C. J. Mims. C. W. and Blackwell, M. (1996) Introductory Mycology, john willey & sons Inc. New York.
7. Mehrotra, R. S. and Aneja, R. S. (1998) An introduction to Mycology, New Age Intermediate Press, New Delhi.
8. Webster, J. (1985) Introduction to fungi Cambridge Univ. Press, U.K.
9. Recognized websites.

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LABORATORY EXERCISE
(Suggested)

Morphological studies of representatives of fungi - *Perenospora*, *Albugo*, *Mucor*, *Pilobolus*, *Yeast*, *Emericella*, *Chaetomium*, *Pleospora*, *Morchella*, *Melampsora*, *Phallus*, *Polyporus*, *Drechslera*, *Phoma*, *Penicillium*, *Aspergillus*, *Colletotrichum*. □

- Identification of fungal cultures - *Rhizopus*, *Mucor*, *Aspergillus*, *Penicillium*, *Chaetomium*, *Drechslera*, *Curvularia*, *Fusarium*, *Phoma*, *Colletotrichum*. □
- Study of different forms of bacteria, gram staining of bacteria. □
- Symptomology of some diseased specimens: white rust, downy mildew, powdery mildew, rusts, smuts, ergot, groundnut leaf spot or tikka disease, red rot of sugarcane, wilts, paddy blasts, citrus canker, bacterial blight of paddy, anular leaf spot of cotton, tobacco mosaic, little leaf of brinjal, sesame, phyllody, mango malformation. □
- **Field work:** As far practicable conveniently. □

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M. Sc. Botany**First Semester****Paper –III****Biology and Diversity of Algae, Bryophytes & Pteridophytes**=====*Max. Marks - 80*=====**Phycology:**

Algae is diversified habitats (terrestrial, fresh water, marine), thallus organization and evolutionary trends, cell structure, reproduction (vegetative, asexual), criteria for classification of algae, pigments, reserve food, flagella, classification.

Salient features of following divisions:

Prochlorophyta, Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta; role of algae in algal blooms, algal biofertilizers, algae as food, feed, fuel and use in industries.

Bryophyta:

Morphology, structure, reproduction and life history, distribution, classification, evolution of gametophytes and sterilization of sporogenous tissue. General account of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales, Polytrichales, Economic and ecological importance of bryophytes.

Pteridophytes:

Morphology, anatomy and reproduction, classification, evolution of stele, heterospory, telome theory and origin of seed habit, general account of fossil Pteridophytes, introduction of Psilopsida, Lycopsidea, Sphenopsida and Pteropsida.

=====********=====**Suggested Books:**

1. Kumar, H. D. (1988) introductory Phycology, Affiliated East-West Press Ltd., New Delhi.
2. Morris, I (1986) An Introduction to Algae, Cambridge Univ. Press, UK.
3. Puri, P. (1980) Bryophytes, Atma Ram and Sons, Delhi.
4. Sporne, K. K. (1991) The Morphology of Pteridophytes, B. I. Publishing Pvt. Ltd. Bombay.
5. Stewart, W. N. and Ruthwell, G. W. (1993) Paleobotany and the Evolution of Plants. Cambridge Univ. Press, UK.
6. Vashishtha, B. R. (2005) Pteridophytes S. Chand and Co., Delhi.
7. Vashishtha, B. R. (2005) Bryophytes S. Chand and Co., Delhi.
8. Recognized websites

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LABORATORY EXERCISE
(Suggested)

- Morphological and anatomical study of representative members of the Algae, Bryophytes and Pteridophytes.
- **Algae:** *Volvox*, *Hydrodictyon*, *Oedogonium*, *Ulva*,
Pithophora,
Stigeoclonium, *Drapranadiopsis*, *Polysiphonia*, *Sargassum*, *Chara*.
- **Bryophyta:** *Marchantia*, *Pellia*, *Anthoceros*, *Notothylus*, *Funaria*,
Polytrichum.
- **Pteridophyta:** *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum*, *Gleichenia*,
Pteris, *Ophioglossum*, *Isoetes*.
- **Field work:** As far practicable conveniently.

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M. Sc. Botany**First Semester****Paper –IV****Plant Physiology**

=====Max. Marks -

80=====

Membrane Transport and translocation of Water & Solute:

Plant - Water relations, mechanism of water transport through xylem, root-microbe interaction in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, active and passive solute transport, transpiration & guttation, membrane transport proteins.

Nitrogen & Sulphur Metabolism and Signal Transduction:

Biological nitrogen fixation: Concept, types and mechanism; Mechanism of nitrate uptake and reduction, ammonium assimilation; Sulfate uptake and assimilation. **Signal Transduction:** Concept, signaling pathway; Receptors - Extracellular - G-proteins & intracellular receptor. Lipids and cell signaling. Role of cyclin nucleotides and calcium in signaling pathway. Role of protein kinase and phosphatases cell. Sensor-regulator system in bacteria and plant. Sucrose sensing mechanism.

Photochemistry and Photosynthesis:

General concept and historical background, evolution of photosynthetic apparatus, photosynthetic pigments, photo-systems (PS I & II) and light harvesting complex, photo-oxidation of water, mechanism of electron and proton transport, carbon assimilation - the Calvin cycle, Photorespiration and its significance, the C₄ cycle, CAM pathway, biosynthesis of starch and sucrose.

Plant eco-physiology and Stress Physiology:

Concept of Plant eco-physiology. Plant perception, physiology of ecological considerations. **Stress Physiology:** Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic tolerance, HR (Hypersensitive Response) and SAR (Systemic Acquired Resistance), water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.

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Suggested Books:

1. Galston, A.W., (1989) Life Processes in Plants, Scientific American Library. Springer- Verlag, New York, USA.
2. Hopkins, W.G., (1995) Introduction to Plant Physiology, John Willey and Sons, Inc. New York, USA.
3. Salisbury, F.B. and Ross, C. W., (1992) Plant Physiology. Wadsworth Publishing Co., California, USA.
4. Denis, D.T., Turpin, D.H. Lefebvre, D.D. & Layzell, D.B. (1997) Plant Metabolism. Longman, Essex, England.
5. Taiz, L. and Zeiger, E. (1998) Plant Physiology, Sinauer Associates, Inc. Pub., Massachusetts, USA.
6. Recognized websites

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LABORATORY EXERCISE
(Suggested)

1. Demonstration of plasmolysis and deplasmolysis in plant cell.
2. Demonstration of transpiration.
3. Measurement of transpiration rate by photometer.
4. Study of interrelationship between transpiration and absorption by T/A apparatus.
5. Extraction of Chloroplast pigments from green leaves.
6. Separation of chloroplast pigments through paper chromatography.
7. Separation of chloroplast pigments through solvent method.
8. Preparation of absorption spectrum of chlorophyll a.
9. Determination of chlorophyll 'a' /chlorophyll 'b' ratio in C₃ and C₄ plants.
10. Extraction of seed proteins depending upon solubility.
11. Fractionation of proteins using gel filtration chromatography using sephadex G-100 or Sephadex G-200.
12. Principle of colorimetry, spectrophotometry and fluorimetry.

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M. Sc. Botany
Second Semester
Paper -I
Cytology, Genetics and Cytogenetics

80

Max. Marks -

Cytology:

Chromosome Organization: Chromatin structure and packaging of DNA, centromere and telomere, nucleolar organizer regions, Karyotype - analysis & evolution. Special types of chromosome - polytene, lampbrush, and sex chromosome. **Structural and Numerical Alterations in Chromosomes:** Deletion, duplication, translocation and inversion - their origin, occurrence and breeding behavior; Aneuploids and Euploids - origin, types and breeding behavior.

Genetics -I:

Genetics of Prokaryotes: Mapping the bacteriophage genome; Genetic recombination in phage; genetic transformation, conjugation & transduction in bacteria. **Gene Structure & Expression:** Genetic fine structure, cis-trans test. introns & their significance, RNA splicing, regulation of gene expression in prokaryotes & eukaryotes. Initiation of cancer at cellular level, proto-oncogene & oncogenes.

Genetics -II:

Genetic Recombination & Genetic Mapping: Recombination, independent assortment & crossing over, Role of Rec a Rec B C D enzymes in recombination, Site specific recombination, chromosomes mapping, linkage groups, and genetic markers, correlation of genetic & physical maps. **Mutation:** Spontaneous & induced mutations, molecular basis of gene mutation; transposable elements in prokaryotes & eukaryotes; mutations induced by transposons; site-directed mutagenesis; DNA damage & repair mechanism.

Cytogenetics:

Cytogenetics of Aneuploidy & Heterozygosity: Effect of aneuploidy on phenotype in plants; transmission of monosomics & trisomics and their applications. Polyploidy - breeding behavior and its role in crop evolution, complex translocation heterozygotes and its impact, Robertsonian translocation, B-A translocation. **Molecular Cytogenetics:** Nuclear DNA content; C- value paradox; Cot curve & its significance; in-situ hybridization; physical mapping of gene on chromosomes. **Alien Gene Transfer:** Transfer of whole genome, example from *Triticum* & *Brassica*; Characterization & utility of alien genetic basis of inbreeding. Heterosis and hybrid vigor.

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Suggested Books:

1. Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D. (1981) Molecular Biology of Cell. Garland Publishing Inc. New York, USA.
2. Karp, G., (1999) Cells and Molecular Biology; Concepts and Experiments. John Willey and Sons. Inc. USA.
3. Kush, G. S. (1973). Cytogenetics of Academic Press, New York, London.
4. Lewin, B. (2005) Gene VIII. Oxford Univ. Press, USA.
5. Russel, P. J. (1998) Genetic. The Benjamin Cummings Publishing Company, Inc. USA.
6. Snustand, D. P and Simons, M. J. (2000) Principles of Genetics. John Willey and Sons. Inc., USA.

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LABORATORY EXERCISE
(Suggested)

1. Study of different stages of meiosis.
2. Study of Chiasmata frequency and terminalization coefficient in *A. cepa* and *flox*.
3. Linear differentiation of chromosome through G-Banding and C-Banding.
4. Orcein and Feulgen staining of the salivary chromosome of *Chiromomonas* and *Drosophila*.
5. Characterization of B-chromosomes in maize.
6. Study of effect of monosomy and trisomy on phenotype of plants.
7. Introduction of polyploidy using colchicines.
8. Isolation of chlorophyll mutants through irradiation and chemical mutagens.
9. Isolation of DNA from prokaryotic cells.
10. Isolation of DNA from eukaryotic cells.
11. Estimation of nuclear DNA through spectrophotometric method.

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M. Sc. Botany**Second Semester****Paper –II****Biology & Diversity of Gymnosperms**

80

Max. Marks -

Fundamental concept:

Characteristics of Gymnosperms, the vessel - less & fruitless seed plants, wood, varying in the structure of their sperms, pollen grains, pollination and pollen germination, complexity of their female gametophyte, ovule and seed of Gymnosperm.

Evolution, Classification and distribution:

Origin of Gymnosperm and evolutionary trends; Classification of Gymnosperm; Polyembryony in Gymnosperms and its role; Distribution of Gymnosperm in India; Economic importance of Gymnosperm.

Fossil Gymnosperms:

Brief account of the families of Pteridospermales - Lyginopteridaceae, Medullosaceae, Caytoniaceae & Glossopteridaceae. General Account and Affinities - Cycadeoidales and Cordaitales.

Living Gymnosperms:

General account of Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales. Concepts of living fossil (Cycas & Ginkgo); Angiospermic characters of Gnetum.

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Suggested Books:

1. Bhatnagar, S. P., Moitra, A. (1996) Gymnosperms, New Age International Pvt. Ltd., New Delhi.
2. Sporne, K. K. (1991) The Morphology of Gymnosperm. B. I. Publishing Pvt. Ltd., Bombay.
3. Steward, W. N. and Ruthwell, G. W. (1993) Paleobotany and evolution of plants, Cambridge University Press, U. K.
4. Vashishta, P. C. and Sinha, A. K. (2005) Gymnosperm, S. Chand Publishing Company, Delhi.
5. Singh, H. (1978) Embryology of Gymnosperms; Encyclopedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.
6. Relevant websites

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LABORATORY EXERCISE
(Suggested)

- Comparative study of the anatomy of vegetative and reproductive parts of *Cycas*, *Ginkgo*, *Cedrus*, *Abies*, *Picea*, *Cupressus*, *Araucaria*, *Cryptomeria*, *Taxodium*, *Podocarpus*, *Agathis*, *Taxus*, *Ephedra* and *Gnetum*.
- Study of important fossil gymnosperms from prepared slides and specimens.
- Collection of various gymnospermic plant materials. Field work – as far practicable conveniently.

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M. Sc. Botany
Second Semester
Paper -III

Taxonomy of Angiosperms

=====Max. Marks -

80=====

Principles & methods of taxonomy:

Concepts of species and Taxonomic hierarchy, species, genus, family & other categories; biological nomenclature, principle used in assessing relationship, delimitations of taxa & attribution of rank, salient features of the international code of botanical nomenclature. Classical & quantitative methods of taxonomy of plants.

Taxonomic Evidence and Tools:

Taxonomic Evidence: Morphology, anatomy, embryology, Cytology, phytochemistry; genome analysis & nucleic acid hybridization. **Taxonomic Tools:** Herbarium, floras, histological phytochemical, cytological, serological, biochemical & molecular techniques, computers & GIS.

System of Angiosperm Classification:

Phenetic versus phylogenetic systems, cladistics in taxonomy; relative merits & demerits of major systems of classification. General account of locally dominant families -Magnoliaceae, Nymphaeaceae, Rutaceae, Rosaceae, Cucurbitaceae, Cactaceae, Rubiaceae, Verbinaceae, Polygonaceae, Orchidaceae, Musaceae, Zingiberaceae and Arecaceae.

Phytogeography and Bio-resources:

Population & environment; Plant diversity; Ecads & Ecotypes; Endemism, hot spots and hottest hot spots, plant exploration, invasion & introduction. Phytogeographical region in India. Local plant diversity and its socio-economic importance. Sustainable utilization of bio- resources & ecosystem research.

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Suggested Books:

1. Cole, A.J. (1969) Numerical Taxonomy. Academic Press, London.
2. Devis, P. H and Heywood, V. H (1973) Principle of Angiosperms Taxonomy, Robert E. Kreiger. Pub. Co. New York.
3. Grant, V. (1971) Plant Speciation Columbia Univ. Press, New York.
4. Grant W. F. (1984) Plant Biosystematics. Academic. Press, London.
5. Heslop-Harrison, J. (1967) Plant Taxonomy. English Language Book Assoc. and Edward Arnold Pub. Ltd. U.K.
6. Stace, C. A. (1989) Plant Taxonomy and Biosystematics, Edward Arnold Ltd. London.
7. Takhtajan A. L. (1997) Diversity and Classification of Flowering Plants. Columbia Univ. Press, New York.
8. Woodland, D. W. (1991) Contemporary Plant Systematic. Prentice Hall. New Jersey.
9. Sharma, A.K. And Sharma, R. (2007) Taxonomy, Pragati Prakashan, Meerut.
10. Relevant websites

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LABORATORY EXERCISE

(Suggested)

1. Description of a specimen from representative locally available families.
2. Description of species based on various specimens to study intraspecific variation; a collective exercise.
3. Fields trips within and around the campus, compilation of field notes and preparation of herbarium sheets of such plant, wild or cultivated as are abundant.
4. Training in using floras and herbaria for identification of specimen described in the class.
5. Comparison of different species of genus and different genera of a family to calculate similarity coefficient and preparation of dendrograms.
6. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
7. Description of various species of a genus, study of key characters and preparation of keys at generic level.
8. Location of keys and use of keys at family level.

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M. Sc. Botany**Second Semester****Paper –IV****Plant Biochemistry and Bioenergetics**

Max. Marks -

80====

Bioenergetics and Enzymology:

Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and function of ATP. **Fundamentals of Enzymology:** General aspect, allosteric mechanism, regulatory and active sites, isoenzymes, kinetics of enzymatic catalysis, Michaelis - Menton equation and its significance.

Biological Oxidation and Lipid Metabolism:

Overview of Oxidation in plant - Glycolysis, the TCA cycle, electron transport and oxidative phosphorylation (ATP synthesis), pentose phosphate pathway, glyoxylate cycle, alternative oxidase system. **Lipids** - structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipid, structural lipids and storage lipids and their catabolism.

Sensory Photobiology and Flower Physiology:

Photobiology - History and discovery of phytochromes, cryptochromes and phototropins, photochemical and biological property, photo physiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, Receptors. **The Flowering Process:** Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development, role of vernalization.

Plant Growth Regulators:

Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action of plant hormones - Auxins, Gibberellins, Ethylene, Abscisic acid and salicylic acid. Concept of brassinosteroids, polyminors, jasmonic acid hormone receptors,

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Suggested Books:

- Galston, A. W., (1989) Life Processes in Plants. Scientific American Library, Springer- Verlag, New York, USA.
- Hopkins, W. G. (1995) Introduction to Plant Physiology John Willey and Sons, Inc. New York, USA.
- Salisbury F. B. and Ross, C. W., (1992) Plant Physiology Wadsworth Publishing Co., California, USA.
- Dennis D. T., Turpin, D. H., Lefebvre D. D. and Layzell, D. B. (1997) Plant Metabolism. Longman, Essex, England.
- Taiz, L. and Zeiger, E., (1989) Plant Physiology. Sinauer Associates, Inc. Publishers, Massachusetts, USA.
- Moore, T. C. (1989) Biochemistry and Physiology of Plant Hormone. Springer Verlag, New York.
- Nobel, P. S. (1999) Physicochemical and Environmental Plant Physiology. Academic Press, San Diego, USA.
- Thomas, B. and Vince-Prue (1997) Photoperiodism in Plants. Academic Press, San Diego, USA.

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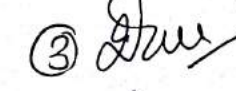

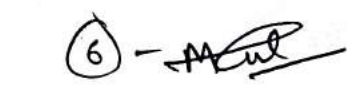
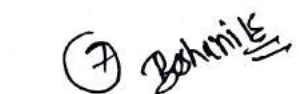
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LABORATORY EXERCISE

(Suggested)

1. Measurement of catalytic activity of catalase and diastase in germinating seeds.
2. Effect of time and enzyme concentration on the rate of reaction of enzyme action.
3. Study of R. Q. value for different respiratory substrates-carbohydrate, proteins, and fats through respirometer.
4. Study of Cassulacean Acid Metabolism (CAM) in succulants.
5. Separation of protein by PAGE.
6. Separation of iso-enzyme of esterases and peroxidases by PAGE.
7. Study of effect of auxins on apical dominance.
8. Study of seed dormancy in *Lathyrus* seeds.
9. Effect of external factors on seed dormancy.
10. Effect of different measures for removal of seed dormancy.
11. Study of phototropic and geotropic movement in plants.

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**Government E. Raghvendra Rao
Postgraduate Science College
Bilaspur (C. G.)**

[AN AUTONOMOUS COLLEGE UNDER UGC SCHEME]



DEPARTMENT OF BOTANY

M. Sc. Syllabus

for

Third and Fourth Semester

Approved for the session - 2023-24

SCHEME OF EXAMINATION AT A GLANCE

Third Semester

Papers	Title	Marks Distribution				
		Theory				Practical
		Semester Exam.**	Seminar	Internal Test *	Total	
First	Plant Development	80	10	10	100	Practical - I Based on theory paper I & II
Second	Plant Reproduction	80	10	10	100	
Third	Plant Cell, Tissue and Organ Culture	80	10	10	100	Practical - II Based on theory paper III & IV
Fourth	Elective -1(A): Plant Pathology-I or Elective -2(B): Crop Genetics & Plant Breeding-I or Elective -3(C): Plant & Society-I	80	10	10	100	
				Total	400	200

Fourth Semester

Papers	Title	Marks Distribution				
		Theory				Practical
		Semester Exam. **	Seminar	Internal Test *	Total	
First	Plant Ecology	80	10	10	100	Practical - I Based on theory paper I & II
Second	Plant Resource Utilization and Conservation	80	10	10	100	
Third	Genetic Engineering of Plants and Microbes	80	10	10	100	Practical - II Based on theory paper III & IV
Fourth	Elective -1(A): Plant Pathology-II or Elective -2(B): Crop Genetics & Plant Breeding-II or Elective -3(C): Plant & Society-II	80	10	10	100	
				Total	400	200

* Internal test: Two tests shall be taken, as prescribed question pattern and average marks of both tests shall be considered.

** Question Papers: It shall be comprise two sections – A and B. Section A – Question no. 1 shall consist 10 objective questions of 10 marks (one mark for each) and Question no. 2 shall be consist 05 short answer type questions of 10 marks (two mark for each); all questions are compulsory. Section B shall be consist 08 descriptive type questions out of which any four shall have to solve. Each type of question shall cover the entire syllabus.

Signature of Members (BOS) -

① Dr. A. N. Baidya

② Dr. D. U. Srivastava

③ Dr. Uttara Tiwari

④ Dr. V. U. Wanjungo

⑤ Dr. Ashokbir

⑥ Dr. M. L. Jaiswal

⑦ Dr. Miss Rashmi

Wanshik

M. Sc. Botany
Third Semester
Paper –I
Plant Development

=====Max. Marks - 80=====

Basics of Plant Development:

Unique features of plant development, differences between plant and animal development. **Seed Germination and Seedling Growth** – Steps of seed germination and influencing factors; metabolism of nucleic acid, protein and mobilization of food reserve in seed germination, tropism, factors affecting seed germination, seedling growth and seedling development.

Root & Shoot Development:

Root Development - Organization of root apical meristem (RAM), cell fates and lineages, vascular tissue differentiation, lateral tissue, hairs, root-microbe interaction. **Shoot Development** - Organization of shoot apical meristem (SAM), cytological and molecular analysis of SAM, control of cell division and cell communication, control of tissue differentiation especially xylem and phloem, secretory ducts and laticifers.

Plant Tissue and Leaf Differentiation:

Plant Tissue - Meristem and permanent tissue, parenchyma, chlorenchyma, sclerenchyma - sclerids and fibers, xylem and phloem, structure, origin and differentiation. **Leaf Growth & Differentiation** - Determination, phyllotaxy, control of leaf formation, differentiation of epidermis (with reference to stomata and trichomes), mesophyll.

Secondary Growth:

Primary and Secondary growth in plant. Structure, function and origin of cambium and cork cambium, ray and fusiform cells, secondary growth in dicot stem and root, abnormal secondary growth in monocot and dicot stem in various plants. Wood development in relation to environmental factors.

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Suggested Books:

1. Atwell, B. J. Kriederman, P. E. and Jumbull, C. G. N. (1999) Plant in action: Adaption in Nature, Performance in Cultivation. Macmillan Education, Sydney, Australia.
2. Bewley, J. D. and Black, M. (1994) Seeds: Physiology of Development and Germination, Plenum Press, New York.
3. Fahn, A. (1982) Plant Anatomy, Pergamon Press, Oxford.
4. Fosket, D. E. (1994) Plant Growth and Development: A Molecular Approach. Academic Press, San Diego.
5. Howell, S. H. (1998) Molecular Genetics of Plant Development. Cambridge University Press, Cambridge, U. K.
6. Lyndon, R. F., (1990) Plant Development - The Cellular Basic. Unwin Hyman, London.
7. Raghavan, V. (1999) Development Biology of Flowering Plants. Springer- Verlag, New York.
8. Steeves, T. A. and Sussex, I. M., (1989) Patterns in Plant Development, Cambridge University Press, Cambridge, U. K.

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LABORATORY EXERCISE (Suggested)

1. Effect of gravity, unilateral light and plant growth regulators on the growth of young seedlings.
2. Effect of dark, red light and far red light on expansion of cotyledons and epicotylar hook opening in peas.
3. Study of living shoot apices by dissection of aquatic plants like *Hydrilla* and *Ceratophyllum*.
4. Study of cytohistological zonation in shoot apical meristem (SAM) in sectioned and double stained permanent slides of a suitable plant like *Coleus kalanchoe*, tobacco.
5. Study of shoot apices of monocot in T. S, and L.S to show the origin and arrangement of leaf primordial.
6. Study of different types of phyllotaxy-distichous, alternate, opposite and whorled.
7. Microscopic examination of vertical sections of leaves such as *Cannabis*, Tobacco, *Nerium*, Maize and Wheat.
8. Study of epidermal peels of leaves of *Coccinia*, *Gaillardia*, *Tradescantia*, *Notonea* ect.
9. External study of whole roots in monocots and dicots.
10. Study of L.S. of dicot and monocot root from permanent and temporary double stained slides.
11. Study of different types of plant tissue-parenchyma, colenchyama and sclerenchyma.
12. Study of normal and abnormal secondary growth in various dicot and monocot plants.

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M. Sc. Botany

Third Semester

Paper –II

Plant Reproduction

=====Max. Marks - 80=====

Basics of Plant Reproduction:

Vegetative and sexual reproduction, flower structure and development; floral organ differentiation and its genetics, sex determination in plants. **Male Gametophyte:** Anthers – structure & types, microsporogenesis, role of tapetum, pollen development and gene expression, male sterility, pollen dimorphism and hybrid seed production, pollen germination, pollen tube growth and guidance, pollen storage, pollen allergy. **Female Gametophyte:** Ovule development, megasporogenesis; Embryo sac – organization, structure and types.

Pollination and Fertilization:

Floral characteristics, pollination mechanism and vectors, breeding systems and its commercial consideration, structure of pistil, pollen-stigma interaction, pollen embryos, sporophytic and gametophytic self incompatibility (cytological, biochemical and molecular aspects), fertilization, double fertilization, *in-vitro* fertilization.

Seed and Fruit Development:

Endosperm development during early, maturation and desiccation stage, embryogenesis, ultra structure and nuclear cytology, cell lineages during late embryo development in plant, storage proteins of endosperm and embryo, polyembryony, apomixes, embryo culture, fruit development, dynamics of fruit growth, biochemistry and molecular biology of fruit maturation.

Senescence and Programmed Cell Death (PCD):

Basic concepts of senescence, types and factors of program cell death in plants, PCD in the life cycle of plants, PCD in pollen prevents inbreeding, metabolic changes associated with senescence and its regulation, influence of hormones and environmental factors on senescence.

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Suggested Books:

1. Bhojwani, S. S. and Bhatnagar, S. P. (2000) The Embryology of Angiosperms. Vikas Publishing House, New Delhi.
2. Proctor, M. and Yeo, P. (1973) The Pollination of Flowers, William Collins Sons, London.
3. Raghavan, V. (1997) Molecular Embryology of Flowering Plants. Cambridge University Press, London.
4. Sedegely, M., and Griffin, A. R. (1989) Sexual Reproduction of Tree Crops. Academic Press, London.
5. Shivanna K. R., and Sawhney, V. K. (1997) Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
6. Shivanna, K., and Johri B. M. (1985) The Angiosperm Pollen: Structure and Function. Willey Eastern Limited, New York.

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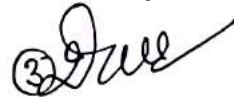
LABORATORY EXERCISE (Suggested)

1. Study of ontogeny of floral parts by cutting L. S. of buds of various size in different plants.
2. Study of microsporogenesis and gametogenesis in sections of anther.
3. Study of mode of anther dehiscence in various plants.
4. Collection and microscopic examination of microspores from various plants like- maize, grasses, *Cannabis sativa*, *Crotolaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum melangena*, *Lycopersicum esculantum* etc.
5. Test of pollen viability using stains and in-vitro germination.
6. Study of pollen germination by suspension culture and surface culture.
7. Study of pollanum in *Callotropis procera*.
8. Study of pollen tube growth in stigma of *Datura alba*.
9. Study of internal structure of ovules in permanent slides.
10. Study of monosporic, bisporic and tetrasporic embryo sac development in ovules through permanent slides.
11. Study of external structures of different types of ovules in locally available flowers.
12. Field study of different types of pollination mechanism (wind, bee/butterfly, bird pollination).
13. Study of cleistogamous flowers and their adaptations.
14. Emasculation, bagging, tagging and hand pollination.
15. Study of nuclear and cellular endosperms through dissection and staining.
16. Isolation of Zygotic embryo at globular, heart shaped, torpedo stage and mature embryos by dissection.

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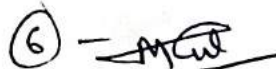
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M. Sc. Botany**Third Semester****Paper –III****Plant Cell, Tissue and Organ Culture**

=====Max. Marks - 80=====

Fundamentals of Biotechnology:

Basic concepts, principles and scope. **Plant Cell and Tissue Culture:** General concept, history, scope, totipotency, concept of cellular differentiation, tissue culture media and explants. Application of Biotechnology.

Organogenesis and Embryogenesis:

Concept of morphogenesis, organogenesis and embryogenesis; Fundamental aspects of organogenesis in plant tissue culture, factors influencing organogenesis; somatic embryogenesis and androgenesis - mechanism, techniques and utility.

Somatic Hybridization:

Concept of somatic fusion and cybridization; Protoplast isolation, fusion and culture, hybrid selection and regeneration; progress, possibilities, achievements and limitations of protoplast research.

Application of Plant Tissue Culture:

Clonal propagation, artificial seed, production of hybrids and soma clones, Somaclonal variation – cause & advantages and its application in crop improvement; production of secondary metabolites / natural products, cryopreservation and germplasm storage.

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Suggested Books:

1. Bhojwani, S. S and Razdan, N.K. (1996) Plant Tissue Culture: Theory and Practice, Elsevier Science Publishers, New York, USA.
2. Collins, H.A. and Edwards, S. (1998) Plant Cell Culture, Bios. Scientific Publisher, Oxford, U.K.
3. Kartha, K.K. (1985) Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.
4. Vasil, I. K. and Thorbe, T. A. (1994) Plant Cell and Tissue Culture. Kluwer Academic Publishers, Netherlands.
5. Smith, R. H. (2000) Plant Tissue Culture: Techniques and Experiments, Academic Press, New York.
6. Relevant websites

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LABORATORY EXERCISE (Suggested)

1. Preparation of tissue culture (ms) medium.
2. Study of techniques of tissue culture: sterilization of glass wares and plant materials, transfer of explants on culture media, incubation.
3. Isolation of plant protoplast by mechanical and enzymatic method.
4. Counting of protoplast in the suspension by haemocytometre method.
5. Effect of physical (example, temperature) and chemical (e.g somoticum). factors of protoplast yield.
6. Demonstration of protoplast fusion employing PEG.
7. Initiation of organogenesis and embryogenesis using appropriate explants.

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M. Sc. Botany
Third Semester
Paper –IV
Elective – 1(A)
Plant Pathology - I

Plant Pathology -I(Microbial Characters, Symptoms, Pathogenicity and Host Parasite Relation)

=====Max. Marks - 80=====

General Concept of Plant pathology:

Nature and concept of diseases in plants, importance of plant disease and their effect on human affairs, definition and terms in plant pathology, history and development of plant pathology, contribution of plant pathologist in India and abroad, pathology and trends in 21st century. **Causes of Plant Diseases:** Symptomatology of parasitic and non-parasitic diseases, classification of plant diseases.

Methods of Studying Plant Diseases:

Field Studies, Collection of samples. **Sterilization technique-** Methods of sterilization Physical methods, Chemical methods, Radiation methods, **Staining Technique:** Nature and Types of stains, **culture technique** – Types of culture medium, Inoculation, Pure Culture technique- Common methods, Spread methods; Cultural characters of microbes; methods of preservation of culture.

General Characteristics of Pathogens:

Fungi, bacteria and viruses, their heterotrophic behavior with emphasis on parasitism, parasitic ability and virulence. **Pathogenicity:** Distribution of plant pathogens, mode of infection, inoculum and inoculum potential, Koch's Postulates.

Host Parasite Relation:

Parturition of infection, role of enzymes and toxicity pathogenesis, defense of plant against pathogens, resistance and susceptibility by Para sensitive reaction phytoalexins, diseases syndrome. Air borne, soil borne and seed borne diseases.

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Suggested Books:

1. Agrios, G. N. (1997) Plant Pathology, Academic Press, London.
2. Bridges, P. (1998) Molecular Variability Of Fungal Pathogens. CAB
3. Bilgrami, K. S. and Dubey, H. C. (1985) Plant Pathology, Vikas Publ. House, Sahibabad U.P.
4. ali, s. s. and kulshereshta, p. (1986) plant pathology, adeeb educational, Raipur.
5. Singh, R. S. (1980) Plant Pathology, Oxford IBH Publ. Co, New Delhi.

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LABORATORY EXERCISE (Suggested)

1. Calibration of microscope.
2. Determination of dimension of pathogenic determinants bacteria, fungal spores and mycelium by micro slide and camera lucida.
3. Isolation of micro-organism from soil, water and air on artificially prepared medium.
4. Study of symptoms of various plants disease caused by viruses, bacteria and fungi.
5. Demonstration of the effect of various bio-pesticides (essential oils, neem, turmeric and garlic) against microbe/pathogens.
6. Culture of plant-pathogen like (*Fusarium*, *Colletotricum*, *Alternaria*) on culture medium/
7. Study of artificial pathogenesis induced by *Fusarium*, *Colletotricum*, *Alternaria* on specific host.

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M. Sc. Botany**Third Semester****Paper –IV****Elective – 2(B)****Crop Genetics and Plant Breeding - I**

=====Max. Marks - 80=====

Basics of plant breeding:

History of plant breeding in India and abroad, nature and objectives of plant breeding, some important achievement, undesirable consequences and future prospects. **Domestication, Plant Introduction and Acclimatization:** Evolution of crop plants, germplasm and its collection, conservation, multiplication and distribution plant introduction, procedure and merits & demerits, quarantine, centre of origin.

Reproduction and pollination in crops:

Self incompatibility gametophytic and sporophytic systems & male sterility, genetic, cytoplasmic and cytoplasmic-genetic, their utilization in plant breeding. **Breeding in Self and Cross Pollinated Control:** Hybridization, types and techniques, mass selection, pureline and pedigree selection, bulk and backcross method.

Breeding Methods for Stress Resistance:

Breeding for drought, salinity, heat, cold, disease and insect resistance, breeding for protein and oil quality. Heterosis and inbreeding depression, hybrid and synthetic varieties. Hardy-Weinberg law, systems of mating,

Biometrical Techniques in Plant Breeding:

Measures of variability, mean, mode, median, standard deviation, standard error, coefficient of variance, test of significance - chi-square, t-test, correlation and regression. Application of biostatistics in plant breeding.

Suggested Books:

1. Allard (1960) Principles of Plant Breeding. John Wiley and Sons, Inc. New York.
2. Hayes, Immer and Smith (1955) Methods of Plant Breeding, MacGraw- Hill Book Co. Inc. New York.
3. Jonossy and Lupton (1976) Heterosis in Plant Breeding. Elsevier, Amsterdam.
4. Poehlman and Borthakur (1969) Breeding Asian Field Crops With Special Reference To Crops In India. Oxford and IBH Publishing Company, New Delhi.
5. Singh and Choudhary (1985) Biometrical Methods in Quantitative Genetic Analysis, Kalyani Publisher, New Delhi.

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LABORATORY EXERCISE (Suggested)

1. Derivation of mean, mode and median of hypothetical and collected data.
2. Comparison of data by chi-square and t-test method.
3. Techniques of hybridization- Emasculation.
4. Techniques of hybridization - Bagging and tagging.
5. Collection of seeds of different varieties of locally grown crops.
6. Inter-varietal cross in an ornamental plant.
7. Bio-statistical exercise as far practicable.

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M. Sc. Botany

Third Semester

Paper –IV

Elective – 3 (C)

Plant and Society -I

=====**Max. Marks - 80**=====

Historical Background:

History of plants and development of society. Role of plants in tracing human history. Early domestication, centers of major cultivated plants viz. Cotton wheat, rice sugarcane, maize, tea, potato, tomato, groundnut. Plants in mythology, folklores. Role of ethno botany in relation of development of society

Plants and Human Health:

Usage of plants in different system of medicine allopathic, Homeopathic, Aurvedic, Herbal Medicine and concept of Herbal Cosmetic. Plants as health hazards-Allergens narcotics, opium, tobacco, cannabis, betel nut. Food spoilage. Viral, bacterial and fungal disease of human beings.

Plants in entrepreneurial areas – A:

Use of plants in earning livelihood – Such as Babboos, Rattans; Raw materials of paper makings, Gums tannins, dyes, resins and fruits. Techniques of cultivation and marketing of Aromatic Plants – Lemon grass, plasma rosa. Medicinal plants – Amla, Ashawgandha, Brahmi, Sarp Gandha, Satawar and guggul. Floriculture – rose and gladioli.

Plants in entrepreneurial areas – B:

Techniques of cultivation and marketing of Mushroom cultivation, Gardening types and layout; Nursery management, Vermiculture, Mass cultivation of few plants using tissue culture techniques. Bonsai techniques. Medicinal Cactus.

Suggested Books:

- 1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 2) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- 3) S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
- 4) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –Chichester 5) Rama Rao, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in A. P., IBSI. Howrah.
- 6) RK. Sinha, Ethnobotany. The Renaissance of Traditional Herbal Medicine – INA –SHREE Pub., Jaipur-1996 8. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
9. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH pub. Co.
10. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
11. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
12. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Niraji Prakashan,

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LABORATORY EXERCISE (Suggested)

- Survey, collection and identification of wild plants of medicinal uses.
- Preparation of herbarium category wise herbs, shrubs and tree plants.
- Study of different indigenous and improved ploughs-mould board and disc ploughs with its operation
- Study of harrows, cultivators, seed drills, planters, translators and threshers with its operation.
- Preparation of some selected agro-service and agro-processing projects according to local potentiality.
- Determination of moisture content and milling qualities of food grains and Visit to different storage structures and commercial milling plants.
- Preparation of squashes, RHS and syrups.
- Preparation of jam and jelly; Preparation of pickles, chutneys and sauces.
- Visit of food processing industries.
- Perform the technique of mushroom cultivation and process of vermiculture.
- Perform the Bonsai technique and Cactus garden.
- Perform the layout of different types of garden and nursery management.

Any other exercise planned / modified by the department based on convenience,

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M. Sc. Botany
Fourth Semester
Paper – I

Plant Ecology

(Climate, Vegetation and Ecosystem)

=====Max. Marks - 80=====

Ecological Factors and Management:

Climatic- light; temperature, air and water, topographic, edaphic, soil formation soil texture, type of soil, soil profile, classification, physio-chemical properties, soil organic matter, biotic factors, interrelationships, major soil type of the world. **Ecological management:** Concepts, sustainable development, sustainability indicators.

Ecosystem Organization:

Structure and function, primary production (methods of measurements, global pattern, controlling factors), energy dynamics, trophic organization, energy flow pathways, ecological efficiencies, litter fall and decomposition- mechanism, substrate quality and climate factors, global biogeochemical cycle of C, N, P, S, minerals cycle- pathways, processes, budgets in terrestrial and aquatic ecosystem.

Vegetation Organization & Development:

Vegetation Organization: Life zones, major biomes and vegetation of the world, concepts of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, inter-specific associations, ordination, ecological niche. **Vegetation Development:** Temporal changes, Mechanism of ecological successions (floristic composition, facilitation, tolerance and inhibition models), changes in ecosystem properties during succession.

Pollution, Climatic Changes and Eco-Stability:

Air, Water, Soil & Sound - kinds, sources, quality parameters, effect on plants and ecosystem. **Climate change:** Green house gases(CO₂, CH₄, N₂O, CFCs) sources, trends and role, ozone layer and ozone hole, consequences of climate changes, (CO₂ fertilization, global warming, sea level rise, UV radiation). **Ecological Stability:** Concept of resistance and resilience, ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystem, ecology of plant invasion, environmental impact assessment, ecosystem restoration.

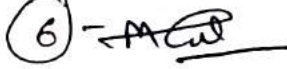
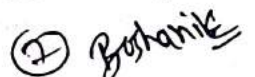
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Suggested Books:

1. Brady, N. C. (1990) The Nature and Properties of Soil Macmillan, Sydney, Australia.
2. Begon, M; Harper, J. L. And Townsend, C. R. (1996) Ecology. Blackwell Science, Cambridge, USA
3. Chapman, J. L. and Raiss, M. J. (1988) Ecology: Principles and Applications. Cambridge Univ. Press, Cambridge, U.K.
4. Kumar, H. D. (1986) Modern Concept of Ecology, Vikas Publishing House Private Ltd., New Delhi.
5. Hill, M. K. (1997) Understanding Environmental Pollution. Cambridge Univ. Press, Cambridge, U. K.
6. Odum, E. P. (1971) Fundamentals of Ecology Saunders, Philadelphhia.
7. Odum, E. P. (1983) Basic Ecology. Saunders, Philadelphia.

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LABORATORY EXERCISE
(Suggested)

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and use of t-test for comparing ecological data.
2. To determine minimum size and number of quadrates required for reliable estimate of biomass in grass land ecosystem.
3. To study the frequency, abundance and density of dominant plants in the local ecosystem by quadrat method.
4. To determine gross and net productivity by light and dark bottle method.
5. To determine soil moisture content, porosity and bulk density of soil collected from different locations.
6. To determine percent organic carbon and organic matter in soil of grass land, cropland and forests.
7. To determine the water holding capacity of various soils.

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M. Sc. Botany
Fourth Semester
Paper –II

Plant Resource Utilization and Conservation

=====**Max. Marks - 80**====

Concept of Biodiversity:

Biological Diversity: Concepts and levels, role of biodiversity in ecosystem, functions and stability, speciation and extinction, IUCN categories of threat, distribution and global pattern, terrestrial biodiversity, hot spots, inventory. **Plant diversity:** Concept, status in India, utilization and concerns. **World Centers of Primary Diversity of Domesticated Plants:** The Indo-Bermis center, plant introductions and secondary centers.

Utilization of Plant Resources:

Origin, Evolution, Cultivation and Use of: (i) food, forage and fodder crops, (ii) fiber crops (iii) medicinal and aromatic plants (iv) Vegetable and (v) Oil yielding crops. **Important Fire-wood and Timber Yielding Plants and Nonwood Forest Products (NWFPs):** Such as bamboos, rattans, raw materials for paper making, gums, tannins, dyes, resins and fruits.

Green Revolution and Conservation (in situ Conservation):

Green Revolution: Benefits and consequences. Innovations for meeting world food demands. Plants used as avenue trees for shade, pollution control and aesthetics. **Conservation:** Extinctions, environmental status of plants based on International Union for Conservation of Nature. 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:




Principle 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 Development of Biotechnology (DBT) for conservation, non formal conservation efforts.

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Suggested Books:

1. Anonymous (1997) National Gene Bank. Indian Heritage on Plant Genetic Resources (Booklet) NBPGER, New Delhi.
2. Barker, H. G. (1978) Plant and Civilization. C. A. Wadsworth, Belmont.
3. Frankel, O. H., Brown, A. H. D. and Burdon, J. J., (1995) Conservation of Plant Diversity. Cambridge Univ. Press, Cambridge, U. K.
4. Heywood, V. (1995) Global Bio-Diversity Assessment, UNEP. Cambridge Univ. Press, Cambridge, U.K.
5. Heywood, V.H. and Wyse Jackson, P. S. (1991) Tropical Botanical Garden: Their Role in Conservation and Development. Academic Press, San Digo.
6. Kochar, S. L. (1998) Economic Botany of The Tropics. McMillan India Ltd., New Delhi.
7. Kothari, A. (1997) Understanding Bio-Diversity: Life Sustainability and Equity. Orient Longam.
8. Paroda, R. S. and Arora R. K. (1991) Plant Genetic Resources and Conservation and Management IPGRI (publications). South Asia Office, c/o NBPGR, Pusa Campus, New Delhi.
9. Pinstrup- Anderson, P. Et Al (1999) World Food Prospects; Critical Issues for Early 21st Century. International Food Policy Research Institute, Washington D. C. USA.
10. Rogers, N. A. And Panwar, H. S. (1998) Planning A Wild Life Protected Area Network In India Vol. I The Report, Wildlife Institute Of India, Dehradun.
11. Scheri, R. W. (1972) Plants For Man. Englewood Cliffs, New Jersey, Prentice Hall.
12. Swaminathan, M. S. And Kocchar (1989) Plants and Society, MacMillan Publication Ltd. London.

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LABORATORY EXERCISE (Suggested)

1. Study of morphological, anatomy and microchemical tests for stored food materials present in food crops- wheat, rice, maize, chickpea, potato, sweet potato, sugarcane.
2. Study of any five important fodder/forage of the locality.
3. Morphology, anatomy and microscopic study of whole fiber of cotton, jute, linen, sun help, cannibus, cotton and kapok.
4. Study of various medicinal and aromatic plants available in the locality/college/university.
5. Study of herbarium specimen.
6. Field survey of important plant sources of firewood and timber in your locality (with their taxonomic description and properties.)
7. Scientific visit of a protected area, biosphere reserve, national park or sanctuary.

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M. Sc. Botany
Fourth Semester
Paper –III

Genetic Engineering of Plants and Microbes

=====Max. Marks - 80=====

Recombinant DNA Technology:

General idea of DNA technology – recombinant DNA; Gene cloning principle and techniques, Cloning vectors, construction of genomic / cDNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction (PCR), DNA finger printing.

Genetic Engineering of Plants:

Aims, strategies for development of transgenic (with suitable example), *Agrobacterium*- the natural genetic engineer, T-DNA and transposon mediated gene tagging, chloroplast transformation and its utility, Intellectual Property Right –Objective, Policy, Act/Law, Component and management, possible ecological risk and ethical concerns.

Microbial Genetic Manipulation:

Concept of genetic manipulation in microbes; Bacterial transformation, Transduction and sexduction; Selection of recombinants and transformants; Genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Genomic 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, micro-arrays, protein profiling and its significance.

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Suggested Books:

1. Brown, T. A. (1999) Genomes. John Willey and Sons Asia Pvt. Ltd., Singapore.
2. Callow, J. A. Ford-Loyd, B. V. and Newbury, H. J. (1997) Biotechnology and Genetic Resources: Conservation and Use. Cab International, Oxon, UK.
3. Glazer, A. N. and Nikaido, H. (1995) Microbial Biotechnology. Freeman and Company, New York, USA.
4. Hennery, R. J. (1997) Practical Applications of Plant Molecular Biology. Chapman and Hall, London UK.
5. Jolles, O. And Jornvali, H. (2000) Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
6. Old, R. W. Primerose, S. B. (1989) Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford UK.
7. Primrose, S. B. (1995) Principles of Genome Analysis, Blackwell Scientific Publications, Oxford, UK. 8.Raghvan, V. (1997) Molecular Biology of Flowering Plants, Cambridge Univ. Press, New York, USA.

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LABORATORY EXERCISE (Suggested)

1. Preparation of liquid and solid culture media for bacterial culture.
2. Study of growth characteristic of *E. coli* using plating and turbidometric method.
3. Isolation of total DNA from *E. coli* by lysozyme lysis method and its quantification by spectrophotometric method.
4. Isolation of plasmid DNA from *e. coli* by alkaline lysis method and its quantification by spectrophotometric method.
5. Restriction digestion of plasmid and genomic DNA and estimation of size of various DNA fragments.
6. Isolation of *Rhizobium* from root nodules of leguminous plants.
7. Isolation of *Agrobacterium tumifaciens* from tumours of dicot plants.
8. Any other concern the course contents and convenient.

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M. Sc. Botany**Fourth Semester****Paper –IV****Elective I (A)****Plant Pathology – II****(Effect of Environment, Control & Plant Disease Cycle)**

=====Max. Marks - 80=====

Disease Development and Control:

Disease Development: Predisposition and stress epidemiology and disease forecasting, sources of infection i.e. seed, soil, water and air born disease of plants, significance of phyllosphere and rhizosphere studies, recurrence of disease. **Control of Plant Diseases:** Principles of plant disease control, method of control eg regulatory, chemical, biological and breeding for disease resistant varieties of host, plant quarantine.

Fungal Diseases in Crop Fields - I:

Studies of different diseases in crop fields and there managements - **Disease caused by Mastigomycotina** – Wart of Potatos, Late blight of Potatos, Green ear disease of Bajra, Downey mildew of Pea, Downey mildew of Cucurbits; **Disease caused by basidiomycotina** - Rust Diseases- Rust of Wheat, Rust of linseed, Rust of pea and lentil, Rust of Gram; Smut diseases- Loose smut of wheat, Covered smut of Barley, Smut of Maize, Smut of Sugarcane, Bunt of Wheat, Bunt of Rice.

Fungal Diseases in Crop Fields - II:

Disease caused by Ascomycotina – Stem gall of coriander, Powdery mildew of Pea, Powdery mildew of Cucurbit, Ergot disease of Bajra, False smut of Rice. **Disease of Deuteromycotina** – Early Blight of Potato, Leaf Blight of Wheat, Tikka Disease of Groundnut, Brown spot of Rice, Blast of Rice, Red rot of Sugarcane, Ripe fruit rot & die back of Chilli, Anthracnose of Bean, Wilt of Arhar, Fusariumwilt of Banana (Panama disease).

Viral, Bacterial and Nematode Diseases:

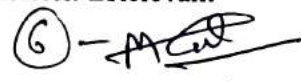

Disease caused by Virus – Tobacco mosaic, Potato mosaic, Potato leaf roll, Yellow Vein mosaic of Bhindi, Rice tungro, Sugarcane mosaic, Leaf roll of Papaya, Bunchy top of Banana. **Disease caused by Bacteria and Molecutes** – Citrus canker, Angular leaf spots of Cotton, Bacterial leaf blight of Rice, Moko diseases of Banana, Soft rot of Potato, Tundu of Wheat, Scab of potato, Citrus Greening, Grassy Shoot of Sugarcane, Little leaf of Brinjal, Witches broom of Potato. **Disease caused by Nematodes**- Root Knot of Vegetable, Molya diseases of Wheat and Barley, Ear cockle of Wheat, **Disease caused by Flowering plants**- Dodder, Giant or True or Leafy Mistletoes (Banda), Witch weed, Orobanche. **Non-Parasitic diseases** –Tip burn of Paddy, Black tip of Mango, Black heart of Potato, Khaira of Rice.

Suggested Books:

□Described for paper IV Elective I (A), Plant Pathology _ I of Third Semester. □Relevant websites

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LABORATORY EXERCISE
(Suggested)

1. Study of various bacterial/fungal plant pathogens of various crop plants.
2. Study of life cycle of bacteria- *Xanthomonas citri*, *X. oryzae* etc. and fungi causing white rust, black rust, loose and covered smut on various crop plants.
3. Demonstration of antibiosis using a bacterial culture and known antibiotics.
Isolation of cellulose from diseased plants.
4. Study of antagonism between isolated antagonists and plant pathogens.

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M. Sc. Botany
Fourth Semester
Paper –IV
Elective 2 (B)

Crop Genetics and Plant Breeding – II

=====Max. Marks - 80=====

Crop Genetics:

Concept of Mendelian inheritance, aneuploidy, euploidy, cytology and genetics of various types of aneuploids and euploids evolution of wheat, *Brassica* and *Gossipium*, sexual polyploidization. Chromosomal aberration, deletion, duplication, translocation and inversion, their meiotic behavior and role in plant breeding.

Mutation & Polyploidy in crop improvement:

Mutation - Spontaneous and induced mutations, molecular basis of gene mutation, transition, transversion, frame shift, mutagens-physical and chemical, procedure of mutation breeding for oligogenic and polygenic traits, application and limitation of mutation breeding. **Polyploidy** – Induction and role in evolution & crop improvement; limitation, distant hybridization in plant breeding, alien-addition lines, alien-substitution lines, limitations of distant hybridization.

Biotechnology in Crop Improvement:

Scope and importance of biotechnology, plant tissue culture, embryo culture, meristem culture, anther of pollen culture, cell and protoplast culture- their application in crop improvement, somatic hybridization, genetic engineering in plants; transgenic plants; general account of genetically modified crops.

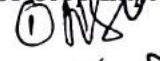

Seed Technology:

Principle & Concept of Seed Technology. Quality seeds, Indian seed act. Classes of quality seeds - breeder, foundation, registered and certified seeds, operations essential for seed production, seed processing, certification and maintenance storage of improved seeds, seed productions organizations- national and state seed corporations and private seed companies.

Suggested Books:

1. Auerbach (1976) Mutation Research Chapman and Hall, London.
2. Elliot (1958) Plant Breeding and Cytogenetics. McGraw Hill Book Co. Inc., New York.
3. IAEA (1970) Manual of Mutation Breeding. International Atomic Energy Agency, Viena.
4. Singh (1990) Plant Breeding: Principles and Methods. Kalyani Publisher Ludhiana.
5. Singh (1963) what is a Good Quality Seed? Indian Farm 13:8.
6. USDA (1961) Year Book of Agricultural Washington D.C. U. S. Government Printing Office.
7. Simmonds (1979) Principles of Crop Improvement. Longman London and New York.

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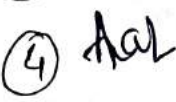


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LABORATORY EXERCISE
(Suggested)

1. Hybridization/breeding experiments in a locally grown crop.
2. Measurement of heterosis.
3. Study of breeding behavior of triploids auto and allotetraploids.
4. Induction of mutation in crop seeds,.
5. Study of effects of U. V. induced mutations in wheat, pea and mustard.
6. Study of effect of chemically induced mutations in wheat, pea and mustard.
7. Seed testing for germinability.
8. Effect of storage period on seed germination of *oryza*.

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M. Sc. Botany**Fourth Semester****Paper –IV
Elective 3 (C)****Plant and Society -II**

=====Max. Marks - 80=====

Concept of Ethno botany:

Definition and scope of Ethno-botany; Historical review and online idea of archaeoethno-botany. General idea of Ethno-ecology, Ethromedicines, Ethnogynecology, Ethnomusicology, Ethnomycology, Ethnonocotics, Ethnopharmacology, Ethnotaxonomy, Ethnotoxicology, Ethnocosmotics, Ethnolinguistics and Ethnopaediatrics.

Plants and Human society:

Indigenous culture; Plants in mythology; Taboos and Totems in relation to plants; Folklore and folk tales; Plants in similes and metaphors; Wildlife protection and tribal; plant domestication by the tribal. Women and tree motifs; Floral motifs based on legends. Role of Ethnobotany in the development of society.

Plant and other uses:

Agriculture: Organic farming - Organic fertilizers and biofertilizers. Viral, bacterial and fungal disease of important crop plants, symptoms, appraisal disease forecasting and several methods of control.
Horticulture: Common methods of horticultural practices. Green house Layout of kitchen garden, ornamental garden and fruit trees, floral calendar.

Plants as Medicines:

Preservation of genetic diversity, Plants used in various systems of medicines – Ayurvedic, Unani, Homoeopathic and Allopathic systems. Plants used for treatment of common diseases by villagers/tribal people – Skin diseases, Rheumatism, Jaundice, piles, Malaria, Asthma and Blood purifier.

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Suggested Books:

- 1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 2) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- 3) S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
- 4) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –Chichester 5) Rama Rao, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in A. P., IBSI. Howrah.
- 6) RK. Sinha, Ethnobotany. The Renaissance of Traditional Herbal Medicine – INA –SHREE Pub., Jaipur-1996 8. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
9. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH pub.Co.
10. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
11. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
12. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

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LABORATORY EXERCISE (Suggested)

- To study the vegetative and floral characters of ethno-medicinal plant species especially modern medicine mentioned in syllabus.
- To study the vegetative and floral characters of folk medicinal plant species especially modern medicine mentioned in syllabus.
- To study the vegetative and floral characters of herbal medicinal plant species especially modern medicine mentioned in syllabus.
- Biological testing of herbal drugs.
- Phytochemical screening test for secondary metabolite / alkaloids, phenolic compound, flavonoids, steroids, triterpenoids.
- Determine the layout of different types of garden and develop the herbal/medicinal garden with locally collected plants
- Perform the techniques of vegetative propagation for Ethno medicinal plants.
- Survey, collection and identification of wild plants of medicinal uses.
- Preparation of herbarium category wise herbs, shrubs and tree plants.
- Study of different indigenous and improved ploughs-mould board and disc ploughs with its operation
- Preparation of squashes, RHS and syrups.
- Preparation of jam and jelly; Preparation of pickles, chutneys and sauces. Preparation of layout for green house.

Any other exercise planned / modified by the department based on convenience,

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