

**UNIVERSITY OF KOTA,  
KOTA**

**SYLLABUS  
2012-2013**

**M.Sc. (BOTANY)**

**PREVIOUS**

**UNIVERSITY OF KOTA, KOTA**  
**M.Sc. (BOTANY)- Examination - 2013**  
(M.Sc. Previous)

**Scheme of Examination**

There will be six papers in theory, each of three hours duration, 100 marks each and two practicals carrying 150 marks each (10% marks are reserved for viva-voce and 15% for records and 20 marks for seminars in each examination). Each practical examination will be of 6 hours duration to be completed in one day.

Paper I	Plant Ecology
Paper II	Cytogenetics
Paper III	Biology & Diversity of Lower Plants : Cryptogams
Paper IV	Taxonomy & Diversity of Seed Plants
Paper V	Plant Physiology and Metabolism
Paper VI	Microbiology and Plant Pathology

**Paper I – Plant Ecology**

**Duration : 3 hours**

**Max. Marks : 100**

**Note :** The question paper will contain three sections as under –

**Section A :** One compulsory question with 10 parts, having 2 parts from each unit, short answer in 20 words for each part. Total Marks : 10

**Section B :** 10 question, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer approximately in 250 words. Total Marks : 50

**Section C :** 4 questions (question may have sub division) covering all units descriptive type, answer in about 500 words, 2 questions to be attempted. Total Marks : 40

**UNIT – I**

**Climate, soil and vegetation patterns of the world :** Life zones, major biomes, and major vegetation and soil types of the world. Environment – Holistic environment, factors and their interactions, animals and man.

**UNIT - II**

**Vegetation organization :** Concepts of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, interspecific associations, ordination, concept of ecological niche.

**Vegetation development :** Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic composition, facilitation, tolerance and inhibition models), changes in ecosystem, properties during succession.

**UNIT – III**

**Ecosystem organization :** Structure and functions, primary production (methods of measurement, global pattern, controlling factors), energy dynamics (trophic organization, energy flow pathways, ecological efficiencies), litter fall and decomposition (mechanism, substrate quality and climatic factors), global biogeochemical cycles of C, N, P and S, mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.

**Biological diversity :** Concept and levels, role of biodiversity in ecosystem functions and stability, speciation and extinction, IUCN categories of threat, distribution and global patterns, terrestrial biodiversity hot spots, inventory.

**UNIT – IV**

**Air, water and soil pollution :** Kinds, sources, quality parameters, effects on plants and ecosystems.

**Climate change** : Greenhouse gases ( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ , CFCs : sources, trends and role), ozone layer and ozone hole, consequence of climate change ( $\text{CO}_2$  utilization, global warming, sea level rise, UV radiation), carbon sequestration.

#### UNIT – V

**Ecosystem stability** : Concept (resistance and resilience), ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems, ecology of plant invasion, environmental impact assessment, ecosystem restoration.

**Ecological management** : Concepts, sustainable development, sustainability indicators, role of International Union for Conservation of Nature & Natural Resources (IUCN), World Wide Fund for Nature (WWF), UNEP, UNESCO, IGBP etc.

#### Suggested Readings:

1. Smith, R.L. 1996. Ecology and Field Biology, Harper Collins, New York
2. Muller-Dombois, D. and Ellenberg, H., 1974. Aims and Methods of Vegetation Ecology, Wiley, New York.
3. Begon, M. Harper, J.L. and Townsend, C.R. 1996. Ecology, Blackwell Science, Cambridge, U.S.A.
4. Ludwig, J. and Reynolds, J.F. 1988, Statistical Ecology. John Wiley & Sons.
5. Odum, E.P. 1971. Fundamentals of Ecology, Saunders, Philadelphia.
6. Odum, E.P. 1983. Basic Ecology, Saunders, Philadelphia.
7. Barbour, M.G., Burk, J.H. and Pitts, W.D. 1987. Terrestrial Plant Ecology, Benjamin / Cummings Publication Company, California.
8. Kormondy, E.J., 1996 Concepts of ecology, Prentice- Hall of India Pvt. Ltd., New Delhi.
9. Chapman, E.J. and Reiss, M.J. 1988. Ecology, Principles and Applications, Cambridge University Press, Cambridge, U.K.
10. Molan, B. and Billharz, S. 1997, Sustainability Indicators, John Wiley Sons, New York.
11. Treshow, M. 1985. Air Pollution and Plant Life, Wiley Interscience.
12. Heywood V.H. and Watson, R.T. 1985. Global Biodiversity Assessment, Cambridge University Press.
13. Mason, C.F. 1991 Biology of Freshwater Pollution, Longman.
14. Hill, M.K. 1997 Understanding Environmental Pollution, Cambridge University Press.
15. Brady, N.C. 1990 The Nature and Properties of Soils, Macmillan

#### Suggested Laboratory Exercises :

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use t-test for comparing two means related to ecological data.
2. To prepare ombrothermic diagram for different sites on the basis of given data set and to comment on climate.
3. To find out the relationship between two ecological variables using correlation and regression analysis.
4. To determine minimum size and number of quadrats required for community study.
5. To find out association between important grassland species using chi-square test.
6. To compare protected and unprotected grassland stand using community coefficients (similarity indices).
7. To analyse plant communities using Bra-Curtis ordination method.
8. To determine diversity indices (Shannon – Wiener, concentration of dominance, species richness, equitability and biodiversity) for protected and unprotected grassland stands.
9. To estimate IVI of the species in a woodland using point centered quarter method.
10. To determine gross and net phytoplankton productivity by light and dark bottle method.
11. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
12. To determine the Water holding capacity of soils collected from different locations.

13. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
14. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Wrinkler's method.
15. To estimate chlorophyll content in SO<sub>2</sub> fumigated and unfumigated plants leaves.
16. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
17. To study environmental impact of a given developmental activity using checklist as a EIA method.

## Paper-II- Cytogenetics

Scheme of Examination

Duration 3 Hrs.

Max. Marks: 100

**Note : The question paper will contain three sections as under –**

**Section-A :** One compulsory question with 10 parts, having 2 parts from each unit short answer in 20 words for each part Total Marks : 10

**Section – B :** 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer approximately in 250 words. Total Marks : 50

**Section-C :** 4 questions (question may have sub division) covering all units descriptive type, answer in about 500 words, 2 question to be attempted Total Marks : 40

### Unit-I

**Chromatin organization :** Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, karyotypes of chromosomes, polytene, lampbrush, B-chromosomes and sex chromosome, molecular basis of chromosome pairing.

**Structural and numerical alterations in chromosomes :** Origin, meiosis and breeding behaviour of duplication, deficiency, in version and translocation heterozygotes, Origin, occurrence, production and meiosis of haploids, aneuploids and euploids, origin and production of autopolyploids, chromosome and chromatid segregation, allopolyploids, types, genome constitution and analysis, evolution of major crop plants, induction and characterization of trisomics and monosomics.

### Unit-II

**Genetics of prokaryotes and eukaryotic organelles:** Mapping the bacteriophage genome, phage phenotypes, genetic recombination in phage, genetic transformation, conjugation and transduction in bacteria, genetics transformation, conjugation and transduction in bacteria, genetics of mitochondria and chloroplasts, cytoplasmic male sterility.

### Unit-III

**Gene Structure and expression:** Genetic fine structure, cis trans test, fine structure analysis of eukaryotes, introns and their significance, RNA splicing, regulation of gene expression in prokaryotes and eukaryotes, Panoply of operon, catabolite repression, attenuation and antitermination.

**Genetic recombination and genetic mapping :** Recombination independent assortment and crossing over, molecular mechanism recombination, role of RecA and RecBCD

enzymes, site-specific recombination, chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps, somatic cell genetics – an alternative approach to gene mapping.

**Mutations** : Spontaneous and induced mutations, physical and chemical mutagens, molecular basis of gene mutation.

#### Unit-IV

Transposable elements in prokaryotes and eukaryotes, mutation induced by transposons, site-directed mutagenesis, DNA damage and repair mechanisms, inherited diseases and defects in DNA repair, initiation of cancer at cellular level, protooncogenes and oncogenes.

Sex determination, sex linked inheritance, sex limited characters and sex reversal, multiple allele's and blood groups in man.

**Cytogenetics of aneuploids and structural heterozygotes** : Effect of aneuploidy on phenotype in plants, transmission of monosomics and trisomics and their use in chromosome mapping in diploid and polyploid species, breeding behaviour and genetics of structural heterozygotes, complex translocation heterozygotes, translocation tester sets, Robertsonian translocations, B-A translocations.

#### Unit – V

**Molecular cytogenetics** : Nuclear DNA content, C-value paradox, cot curve and its significance, restriction mapping-concept and techniques, multigene families and their evolution, in situ hybridization-concept and techniques, physical mapping of genes of chromosomes, computer assisted chromosome analysis, chromosome microdissection and microcloning, flow cytometry and confocal microscopy in karyotype analysis.

**Alien gene transfer through chromosome manipulations** : Transfer of whole genome, examples from wheat, *Arachis* and *Brassica*, transfer of individual chromosomes and chromosome segments, methods for detecting alien chromatin, production, characterization and utility of alien addition and substitution lines, genetic basis of inbreeding and heterosis, exploitation of hybrid vigour.

#### Suggested Readings :

1. Albert B. Bray, D., Lewis, J., Raff, M., Robert, K. and Watson, J.D. 1989., Molecular Biology of the Cell (2<sup>nd</sup> edition), Garland Publishing Inc., New York.
2. Atherly, A.G., Girton, J.R. and McDonald, J.F. 199. The Science of Genetics. Saunders College Publishing, For Worth, USA.
3. Burnham, C.R. 1962. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
4. Busch, H. and Rothblum, J. 1982. Volume X. The Cell Nucleus rDNA Part. A. Academic Press.
5. Hartl, D.L. and Jones, E.W. 1998. Genetics : Principles and Analysis (4<sup>th</sup> edition). Jones & Bartlett Publishers, Massachusetts. USA.
6. Khush, G.S. 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.
7. Karp, G. 1999. Cell and Molecular Biology : Concepts and Experiments. John Wiley & Sons, Inc., USA.
8. Lewin. B. 2000. Gene VII. Oxford University Press, New York, USA.
9. Lewis, R. 1997. Human Genetics : Concepts and Applications (2<sup>nd</sup> edition). WCB McGraw Hill, USA.
10. Malacinski, G.M. and Freifeldo, D. 1998 : Essentials of Molecular Bilogy (3<sup>rd</sup> edition). Jones and B Artlet Publishers Inc. London.

11. Russel, P.J. 1998. Genetics (5<sup>th</sup> edition). The Benjamin Cummings Publishing Company INd., USA.
12. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetic (2<sup>nd</sup> eddition). John Wiley & Sons Inc., USA.

### **Suggested Laboratory Exercises**

1. Linear differentiation of chromosomes through banding techniques, such as G-banding, C-banding and Q-banding.
2. Silver banding for staining nucleolus-organizing region, where 18S and 28srDNA are transcribed.
3. Orcein and Feulgen. Staining of the salivary gland chromosomes of chironomas and Drosophila.
4. Characteristics and behaviour of B chromosomes using maize any other appropriate material.
5. Working out the effect of mono-and tri-somy on plant type, fertility and meiotic behaviour.
6. Induction of polyploidy using colchicines, different methods of the application of Colchicines.
7. Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.
8. Effect of translocation heterozygosity on plant phenotype. Chromosome pairing and chromosome disjunction and pollen and seed fertility.
9. Meiosis of complex translocation heterozygotes.
10. Isolation of chlorophyll mutants, following irradiation and treatment with chemical mutagens.
11. Estimation of nuclear DNA content through microdensitometry and flow cytometry.
12. Fractionation and estimation of repetitive and unique DNA sequences in nuclear DNA.

### **Suggested Readings :**

1. Fukui K. and Nakayama, S, 1996. Plant chromosomes : Laboratory methods. CRC Press, Boca rattan, Florida.
2. Sharma, A.K. and Sharma, A. 1999. Plant chromosome Analysis. Manipulation and Engineering. Hoarwood Academic publisher. Australia.

## **Paper-III : Biology and Diversity of Lower Plants: Cryptogams**

### **Scheme of Examination**

Duration 3 Hrs.

Max. Marks: 100

**Note :** The question paper will contain three sections as under –

**Section-A :** One compulsory question with 10 parts, having 2 parts from each unit, short answer in 20 words for each part.

Total marks : 10

**Section-B :** 10 questions. 2 questions from each unit. 5 questions to be attempted, taking one from each unit, answer approximately in 250 words.

Total marks : 50

**Section-C :** 04 questions (question may have sub division) covering all units descriptive type, answer in about 500 words, 2 questions to be attempted.

Total marks : 40

### **Unit -I**

**Phycology :** Algae in diversified habitats (terrestrial, freshwater, marine) thallus organization, cell ultrastructure, reproduction (vegetative, asexual, sexual) criteria for classification of algae; pigments, reserve food, flagellar, modern classification, salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta. Phaeophyta and Rhodophyta, with special reference to Microcystis, Hydrodictyon, Drapernaldiopsis, Cosmarium, algal blooms, algal biofertilizers: algae as food, feed and use in industry.

### **Unit-II**

**Mycology :** General character of fungi, substrate relationship in fungi, cell ultrastructure, unicellular and multicellular organization, cell wall compoition, nutrition (sapropili, biotrophic, symbiotic), heterothallism, heterokaryosis, parasexuality, recent trends in classification, phylogeny of fungi.

### Unit-III

General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina, with special reference to Pilobolus, Chaetomium, Morchella, Melampsora, Polyporus, Drechslera & Phoma, fungi in industry medicine and as food, fungal diseases in plants and humans, Mycorrhizae, fungi as biocontrol agents.

### Unit-IV

**Bryophyta** : Morphology, structure, reproduction and life history, distribution, classification, general account of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales and Polytrichales, with special reference to Plagiochasma, Notothylus and *Polytrichum*, economic and ecological importance.

### Unit-V

**Pteridophyta** : Morphology, anatomy and reproduction classification; evolution of stele; heterospory and origin of seed habit; general account of fossil pteridophyta; introduction to Psiloposida, Lycopsida, Sphenopsida and Pteropsida; with special reference to *Lycopodium*, *Gleichenia*, *Pteris*, *Isoetes* & *Ophioglossum*.

#### Suggested Reading

- Alexopoulos, C.J., Mims. C.W. and Blackwel, M. 1996. Introductory Mycology, John Wiley & Sons Ind.  
Cliffron, A. 1958. Introduction to the Bacteria. McGiaw-Hill Book Co., New York.  
Kumar, H.D; 1988. Introductory to Plant Viruses. Chand & Co. Ltd., Delhi  
Mandahar, C.L. 1978. Introduction to Plant Viruses. Chand & Co. Ltd. Delhi.  
Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology, New Age Intermediate Press.  
Morris, I.1986. An Introduction to the Algae. Cambridge University Press, U.K.  
Parihar, N.S. 1991. Bryophyta. Central Book Depot, Allahabad  
Parihar, N.S. 1996. Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.  
Puri, P. 1980, Bryophytes. Atma Ram & Sons, Delhi.  
Rangaswamy, G. and Mahadevn, A. 1999. Diseases of Crop Plants in India (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi.  
Round, F.E. 1986. The Biology of Algae. Cambridge University Press, Cambridge.  
Sporne, K.K. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd. Mumbai.  
Stewart, W.N. and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants, Cambridge University Press.

#### Suggested Laboratory Exercises

Morphological study of representative members of algae, fungi, bacteria, bryophytes and peridophytes : *Microcystis*, *Aulosira*, *Oocysits*, *Pediastrum*, *Hydrodictyon*, *Ulva*, *Pithophora*, *Stigeoclonium*, *Draparnaldiopsis*, *Closterium*, *Cosmarium*, *Chara*, *Stemonitis*, *Peronospora*, *Albugo*, *Mucor*, *Pilobolus*, *Yeast*, *Emericella*, *Chaetomium*, *Pleospora*, *Morchella*, *Melampsora*, *Phallus*, *Polyporus*, *Drechsiera*, *Phoma*, *Penicillium*, *Aspergillus*, *Colletotrichum*, *Marchantia*, *Anthoceros*, *Polytrichum*, *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum*, *Gleichenia*, *Pteris*, *Ophioglossum*, *Isoetes*.

**Symptomology of some diseased specimens:** White rust, downy mildew, powdery mildew, rusts, smuts, ergot, groundnut leaf spot, red rot of sugarcane, wilts, paddy blast, citrus canker, bacterial blight of paddy, angular leaf spot of cotton, tobacco mosaic, little leaf brinjal, sesame phyllody, mango malformation.

Study of morphology, anatomy and reproductive structures of bryophytes and pteridophytes.

Gram staining of bacteria.

**Identification of fungal cultures** : *Rhizopus*, *Mucor*, *Aspergillus*, *Penicillium*, *Emericella*, *Chaetomium*, *Drechslera*, *Curvularia*, *Fusarium*, *Phoma*, *Colletotrichum*, *Graphium*.

## Paper-IV : Taxonomy and Diversity of Seed Plants

### Scheme of Examination

Duration 3 Hrs.

Max. Marks: 100

**Note** : The question paper will contain three sections as under –

**Section-A** : One compulsory question with 10 parts, having 2 parts from each unit, short answer in 20 words for each part. Total marks : 10

**Section-B** : 10 questions. 2 questions from each unit. 5 questions to be attempted, taking one from each unit, answer approximately in 250 words. Total marks : 50

**Section-C** : 04 questions (question may have sub division) covering all units descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

### Unit-I

**Introduction** : Gymnosperms, the vesselless and fruitless seed plants varying in the structure of their sperms, pollen grains, pollen germination and the complexity of their female gametophyte, evolution of gymnosperms. Classification of Gymnosperms and their Distribution in India. Economic Importance of Gymnosperms.

**Brief account of the families of Pteridospermales** (Lyginopteridaceae, Meudullosaceae, Caytoniaceae and Glossopteridaceae)

General Account of Cycadeoidales and Cordaitales.

Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.

### Unit-II

**Origin of intrapopulation variation** : Population and the environment, ecads and ecotypes, evolution and differentiation of species, various models.

**The species concept** : Taxonomic hierarchy, species, genus, family and other categories, principles used in assessing relationship, delimitation of taxa and attribution of rank. Salient features of the International Code of Botanical nomenclature.

### Unit-III

**Taxonomic evidence** : Morphology, anatomy, palynology, embryology, cytology, phytochemistry, genome analysis and nucleic acid hybridization.

**Taxonomic tools** : Herbarium, floras, histological, cytological, phytochemical, serological, biochemical and molecular techniques computers and GIS.

**Systems of angiosperm classification** : Phenetic versus phylogenetic systems, cladistics in taxonomy, relative merits and demerits of major systems of classification, relevance of taxonomy to conservation.

### Unit-IV

**Concepts of phytogeography**: Endemism, hotspots and hottest hotspots, plant explorations, invasions and introductions, local plant diversity and its socio-economic importance. Sustainable utilization of bioresources.

### Unit-V

**Phylogeny of Angiosperms** : Ancestors of Angiosperms, time and place of origin of Angiosperms, Habit of Angiosperm, Primitive living Angiosperms, Interrelationship among the major groups of Angiosperms.

### Suggested Reading

1. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms. New Age International Pvt. Ltd., New Delhi.
2. Cole, A.J. 1969. Numerical Taxonomy, Academic Press, London.
3. Devis, P.H. and Heywood, V.H. 1973, Principles of Angiosperms Taxonomy, Robert E. Kreiger Publ Co., New York.
4. Grant, V. 1971. Plant Speciation. Columbia University Press, New York.
5. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.
6. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.



7. Heslop-Harrison, J. 1967. *Plant Taxonomy*, English Language Book Soc. & Edward Arnold Pub. Ltd. U.K.
8. Heywood, V.H. and Moore, D.M. 1984. *Current Concepts in Plant Taxonomy*. Academic Press, London.
9. Jones, A.D. and Wilbins, A.D. 1971. *Variations and Adaptations in Plant Species*. Hiemand & Co. Educational Books Ltd. London.
10. Jones, S.B. Jr. and Luchsinger, A.E. 1986. *Plant Systematics* (2<sup>nd</sup> edition). McGraw-Hill Book Co., New York.
11. Nordenstam, B., El Gazaly, G., and Kassas, M. 2000. *Plant Systematics for 21<sup>st</sup> Century*. Portland Press Ltd. London.
12. Radford, A.H. 1986, *Fundamentals of Plant Systematics*. Harper & Row Publications, USA.
13. Singh, M. 1978, *Embryology of Gymnosperms*, Encyclopaedia of Plant Anatomy X. Gebruder Borntraeger, Berlin.
14. Solbrig, O.T. 1970. *Principals and Methods of Plant Biosystematics*. The Macmillan Co-collier-MacMillan Ltd. London.
15. Solbrig, O.T. and Solbrig, D.J. 1979. *Population Biology and Evolution*, Addison-Wesley Publishing Co. Ind. USA.
16. Stebbings, G.L. 1974, *Flowering Plant-Evolution Above Species Level*. Edward Arnold Ltd. London.
17. Stace, C.A. 1989. *Plant Taxonomy and Biosystematics* (2<sup>nd</sup> edition) Edward, Arnold Ltd. London.
18. Takhtajan, A.L. 1997. *Diversity and Classification of Flowering Plants*. Columbia University Press, New York.
19. Woodland, D.W. 1991, *Contemporary Plant Systematics*. Prentice Hall. New Jersey.

### **Suggested Laboratory Exercises**

1. Comparative study of the anatomy of vegetative and reproductive parts of *Cycas*, *Ginkgo*, *Cedrus*, *Abies*, *Picea*, *Cupressus*, *Araucaria*, *Cryptomeria*, *Taxodium*; *Pedocarpus*, *Agathis*, *Taxus*, *Ephedra* and *Gnetum*.
2. Study of important fossil gymnosperms from prepared slide and specimens, Angiosperms.
3. Description of a specimen from representative, locally available families.

### **List of Locally Available Families :**

- (1) Ranunculaceae, (2) Capparidaceae, (3) Portulacaceae, (4) Caryophyllaceae, (5) Malvaceae, (6) Tiliaceae, (7) Streculiaceae, (8) Zygophyllaceae, (9) Rhamnaceae, (10) Sapindaceae, (11) Leguminosae, (12) Combretaceae, (13) Myrtaceae, (14) Cucurbitaceae, (15) Umbelliferae-Apiaceae, (16) Rubiaceae, (17) Asteraceae, (18) Primulaceae, (19) Plumbaginaceae, (20) Asclepiadaceae, (21) Convolvulaceae, (22) Solanaceae, (23) Boraginaceae, (24) Polemoniaceae, (25) Acanthaceae, (26) Pedaliaceae, (27) Martyniaceae, (28) Bignoniaceae, (29) Lamiaceae, (20) Nyctaginaceae, (31) Polygonaceae, (32) Chenopodiaceae, (33) Amaranthaceae, (34) Aizoaceae, (35) Mollugmaceae, (36) Euphorbiaceae, (37) Commelinaceae, and (38) Cyperaceae.
4. Description of species based on various specimens to study intraspecific variation : a collective exercise.
5. Description of various species of a genus, location of key characters and preparation of keys at generic level.
6. Location of key characters and use of key at family level.
7. Field trips within and around the campus, compilation of field notes and preparation of herbarium sheets of such plants, natural or cultivated as are abundant.
8. Training in using floras and herbaria for identification of specimens described in the class.
9. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
10. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

## Paper-V : Plant Physiology and Metabolism

Scheme of Examination

Duration 3 Hrs.

Max. Marks: 100

**Note :** The question paper will contain three sections as under –

**Section-A :** One compulsory question with 10 parts, having 2 parts from each unit, short answer in 20 words for each part. Total marks : 10

**Section-B :** 10 questions. 2 questions from each unit. 5 questions to be attempted, taking one from each unit, answer approximately in 250 words. Total marks : 50

**Section-C :** 04 questions (question may have sub division) covering all units descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

### Unit -I

**Water relation of plants :** Unique physico chemical properties of water, chemical potential, water potential, apparent free space, bulk movement of water, soil plant Atmosphere continuum (SPAC), stomatal regulation of transpiration, signal transduction in guard cell.

**Membrane Transport :** Passive-non-mediated transport and Ernst equation, Passive-mediated transport, ATP-driven active transport, Uniport, Symport, Antiport, Ion channels.

**Amino acids, Proteins and Enzymes :** Nod factor, root nodulation and nitrogen fixation, structure of amino acids, stereo-monomers, Amphoteric properties, synthesis of amino acids by reductive amination, GS-GOGAT system and transamination.

### Unit-II

**Structure of proteins :** Primary, secondary, tertiary, quaternary domain structure, reverse turn and Ramchandran Plot. Protein ability : electrostatic forces, hydrogen bonding, disulfide bonding hydrophobic interaction.

**Enzymes :** Structure and properties, substrate specificity, classification and mechanism of enzyme action.

**Carbohydrates :** Classification, structure and function of monosaccharides, polysaccharides and glycoproteins including starch, cellulose and pectins.

### Unit-III

**Photosynthesis :** Photosynthetic pigments, absorption and transformation of radiant energy, photo-oxidation, four complexes of thylakoid membranes :photosystem I, cytochrome b-f complex photosystem II and coupling factors, photolysis of water and  $C_4$  evolution, non-cyclic and cyclic transportation of electrons, water cycle, proton gradient and photophosphorylation, Calvin cycle regulation of RUBISCO activity, control of Calvin cycles,  $C^4$  pathway and its adaptive significance, CAM pathway, differences between  $C^3$  and  $C^4$  plants, glycolate pathway and photorespiration chlororespiration and  $CO_2$  concentrating mechanism in micro-organism.

### Unit-IV

**Respiration :** Anaerobic and aerobic respiration, amphibolic nature of TCA cycle, pentose phosphate pathway, glyoxylate pathway, oxidative phosphorylation, gluconeogenesis, high energy compounds : their synthesis and utilization.

**Fat metabolism :** Synthesis of long chain fatty acids, lipid biosynthesis, and oxidation.

**Secondary metabolites :** Biosynthesis and function of secondary metabolites with special reference to tannins, alkaloids and steroids.

### Unit-V

**Plant growth regulators :** Auxins-chemical nature, bioassay physiological effects and mode of action.

**Gibberellins :** chemical nature, bioassay, physiological effect and mode of action.

**Cytokinins-**chemical nature, bioassay, physiological effects and mode of action.

**Abscisic acid :** chemical nature, bioassay, physiological effect and mode of action.

**Physiology of flowering :** Photoperiodism and vernalization.

**Suggested Reading :**

1. Bachanan, B.B. Gruissem, W. a2nd lones, R.L. 2000, Biochemistry and Molecular Biology of Plants. American Society Plant physiologists, Maryland, USA.
2. Dennis, D.T. Turpin, D.H. Lefebvre, D.D. and Layzell, D. (Eds) 1997. Plant Metabolism (second edition). Longman sex, England.
3. Galston, A.W. 1989. Life Processes in Plants. Scientific American, Springer-Verlag. New York, USA.
4. Hooykaas, P.J.J., Hall M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Lodish, II., Berk, A., Zipursky, S.L., Matsudaira P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology (fourth edition). W.M. Freeman and Company, New York USA.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. (second edition). Springer-Verlag, New York, USA
8. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.
9. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4<sup>th</sup> edition). Wadsworth Publishing Co., California, USA.
10. Singhal, G.S. Renger, G., Sopory. S.K., Irrgang, K.D. and Govindjle 1999., Concepts in Photobiology : Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
11. Taiz. I., and Zeiger, E., 1998. Plant Physiology (2<sup>nd</sup> edition) Sinaucr Associates, Inc., Publishers, Massachusetts, USA.
12. Thomas, B. and Vince-Preu, D. (1997) Photoperiodism in Plants (second edition). Academic Press, San Diego, USA.
13. Westhoff, P. (1998) Molecular Plant Development from Gent to Plant, Oxford University Press, Oxford, U.K.

**Suggested Laboratory Exercises :**

1. Effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. acid phosphatase nitrate reductase)
2. Effect of substrate concentration on activity on any enzyme and determination of its Km value.
3. Demonstration of the substrate inducibility of the enzyme nitrate reductase.
4. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids.
5. To determine the chlorophyll a. chlorophyll b. ratio in C<sub>3</sub> and C<sub>4</sub> Plants.
6. Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.
7. To demonstrate photophosphorylation in intact chloroplasts, resolve the phosphoproteins by SDS-PAGE and perform autoradiography.
8. Extraction of seed proteins depending upon the solubility.
9. Determination of succinate dehydrogenase activity, its kinetics and sensitivity to inmcitors.
10. Desalting of proteins by gel filtration chromatography employing Sepnadex.
11. Preparation of the standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by Lowry or Bradford's method.
12. Fractionation of proteins using gel filtration chromatography by Sephadex G100 or Sephadex G200.
13. SDS-PAGE for soluble proteins extracted from the given plant materials and comparison of their profile by staining with Coomassie Briliant Blue or silver nitrate.
14. Separation of isozymes of esterases, peroxidases by native polyacrylamide gel electrophoresis.
15. Radioisotope methodology, autoradiography, instrumentation (GM count and Scintillation counter) and principles involve.
16. Principles of colorimetry, spectrophotometry and fluorimetry.

### **Suggested Reading (for laboratory exercise)**

1. Bajracharya, D. 1999. Experiments in Plant Physiology Laboratory Manual, Narosa Publishing House, New York, USA.
2. Cooper, T.G. 1977. Tools in Biochemistry. John W. New York, USA
3. Copeland, R.A. 1996. Enzymes : A Practical intr Structure, Mechanism and Data Analysis. VCH Publishing House, New York, USA.
4. Dennison, C. 1999. A Guide to Protein Isolation. Demic Publishers, Dordrecht. The Netherlands.
5. Devi, P. 2000. Principles and Methods of Plant Molecular Biology. Biochemistry and Genetics. Agrobolors, Jodhpur, India.
6. Dryer. R.L. and Lata, G.F. 1989. Experimental Biochemistry Oxford University Press, U.K.
7. Haines B.D. (Ed.) 1998. Gel Electrophoresis of Proteins, Practical Approach, 3<sup>rd</sup> edition. PAS, Oxford University Press, U.K.
8. Harbome, T.C. 1981. Phytochemical Methods : A Guide Modern Techniques of Plant Analysis. Chapman & Hall, don.
9. Moore, T.C. 1974. Research Experiences in Plant Physiology : A Laboratory Manual, Springer-Verlag, Berlin.
10. Ninfa, A.J. and Ballou, D.P. 1998 Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc. Maryland, USA.
11. Piummer, D.T. 1998. An Introduction to Practical Biochemistry. Tata MCGraw-Hill-Publishing Co. Ltd, New Delhi.
12. Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel DcKkker, Inc. New Delhi.
13. Wilson, K. and Goulding, K.H. (Eds) 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, UK.
14. Wilson, K and Walker, J. 1994. Practical Biochemistry : Principles and Techniques. 4<sup>th</sup> edition, Combridge University Press Cambridge, U.K.

## **Paper-VI : Microbiology and Plant Pathology**

### **Scheme of Examination**

Duration 3 Hrs.

Max. Marks: 100

**Note** : The question paper will contain three sections as under –

**Section-A** : One compulsory question with 10 parts, having 2 parts from each unit, short answer in 20 words for each part. Total marks : 10

**Section-B** : 10 questions. 2 questions from each unit. 5 questions to be attempted, taking one from each unit, answer approximately in 250 words. Total marks : 50

**Section-C** : 04 questions (question may have sub division) covering all units descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

### **Unit-I**

**Important landmarks in the history of microbiology arch-aebacteria and eubacteria** : General account, ultrastructure, nutrition and reproduction, biology and economic importance, cyanobacteria-salient features and biological importance.

**Viruses** : Classification, characteristics and ultrastructure of isolation and purification of viruses, chemical nature, replication, transmission of viruses, cyanophages, economic importance.

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

### **Unit-II**

Scope and application of microbes in agriculture, industry, pollution and biological control of pests.

General account of immunity, allergy, properties of antigens antibodies. Antibody structure and function, affinity and anti body specificity. Monoclonal antibodies and their uses, antibody

engineering, serology, types of vaccines. Preliminary account of Biofilms, biochips, biosensors and biosurfactants.

### **Unit-III**

**History and scope of plant pathology** : General account of diseases caused by plant pathogens. Pathogen attack and defense mechanisms Physical, physiological, biochemical and molecular aspects.

**Plant disease management** : Chemical, biological, IPM systems, development of transgenics, biopesticides, plant disease clinics.

### **Unit-IV**

Symptomology, identification and management of following plant diseases.

**Fungal diseases** : Wheat (Rust, Smut, Bunt), Bajra (Greenear, ergot and smut), crucifer (rust). Paddy (Paddy blast), Cotton (Wilt), Grapes (Downy mildew and powdery mildew).

### **Unit-V**

Preliminary account of application of Biotechnology in plant pathology.

**Bacterial disease** : Wheat (Tundu), Soft rot of vegetables.

**Viral disease** : Tobacco mosaic, Bhindi yellow mosaic.

**Phytoplasma disease** : Little leaf of brinjal.

**Nematode disease** : Root-knot of vegetables.

### **Suggested Reading**

1. Alexopoulos, C.J., Minis, C.W. and Blackwel, M. 1996 Introductory Mycology. John Wiley & Sons Inc.
2. Agrios, G.N. 1997. Plant Pathology. Academic Press, London.
3. Albajes, R., Cullino, M.L., Van Lenteren, J.C. and Elad, 2000 Integrated Pest and Disease Management in Greenhot Crops. Kluwer Academic Publishers.
4. Bridge, P. Moore, D.R. & Scott, P.R. 1998. Information Technology. Plant Pathology and Biodiversity. CAB International, U.K.
5. Clifton, A. 1958. Introduction to the Bacteria. McGraw Book Co., New York.
6. Mandahar, C.I. 1978. Introduction to plant viruses. Chan Co. Ltd. Delhi.
7. Mehrotar R.S. Plant Pathology. Tata McGraw Hill.
8. Rangaswamy, G. & Mahadevan, A. 1999. Diseases of crop plants in India (4<sup>th</sup> edition) Prentice Hall of India, Pvt. New Delhi. Horsfall, J.G. & A.L. Dimond. Plant Pathology Vols. 1, 2 & 3. Academic Press, New York, USA.
9. Trivedi, P.C. 1998. Nematode Diseases in Plants, CBS Publisher & Distributor, New Dehli.

### **Suggested Laboratory Exercises (Microbiology)**

1. Calibration of microscope : determination of dimensions of micro-organisms (suggested model organisms : yeast, lactobacilli, cyanobacteria)
2. Cultivation media of autotrophic and heterotrophic micro-organisms (cleaning of glasswares, mineral media, complex media, solid media, sterilization)
3. Isolation of microorganisms, streaking on agar plates/pour plate method, isolation of clones, preservation
4. Determination of growth of a microorganism (model organism : Escherichia coli, effects of nutrients, e.g. glucose, fructose, sucrose, principle of colorimetry/spectrocolorimeter)
5. Determination of microbial population size (suggested model organism yeast, use of haemocytometer, serial dilution techniques, relationship between dilution and cell count, determination of standard error, reliability in cell counts)
6. Preparation of Winogradsky column using pond bottom mud. Observations on temporal sequence of appearance of microbes (visual appearance, microscopic, observations)
7. Observation on virus infected plants (symptoms)
8. Fermentation by yeast (inverted tube method, use of different substrates, e.g. glucose, fructose, cane sugar, starch)

**M.Sc. (Previous) – Botany  
Skeleton Paper -I**

**Time : 4 hrs**

**M.Marks: 150**

- Q1. a. Calculate the Frequency /Density/Species Cover of the plant species in the plot allotted by quadrat method and compare your results with Raunkiers frequency diagram. **12**
- b. Investigate the moisture content of soil/pH/CO<sub>2</sub> content of water sample given to you. **08**
- Q2. Identify the various stages of cell division / measure the pollen size through micrometry. **10**
- Q3. Identify the material present in the mixture A, draw a labeled diagram and comment upon their significant characteristics and systematics. **10**
- Q4. Make a suitable preparation of material B so as to show reproductive part of the given plant. **10**
- Q5. Make a suitable preparation of vegetative and reproductive part of material C, draw labeled sketches, write features of special interest and identify with reasons. **16**
- Q6. Make a suitable preparation of vegetative and reproductive part of material D, draw labeled sketches, write features of special interest and identify with reasons. **16**
- Q7. Identify the spots. (3x6) = **18**
- Q8. Record **25**
- Q9. Sessional **10**
- Q10. Viva-Voce **15**

**M.Sc. (Previous) – Botany  
Skeleton Paper-II**

**Time : 4 hrs**

**M.Marks: 150**

- Q1. a. Describe the given material in semi-technical language, assign it to the relevant family with reasons, draw floral diagram. (A) **15**
- b. Prepare an artificial key of given plant materials (B,C) / Determine % similarity coefficient among different plant species and prepare phanogram. **07**
- Q2. a. Make a suitable preparation of material D(veg. Part only), draw labeled diagram and identify with reasons. Also write points of special interest. **10**

<b>b.</b> Make a suitable preparation of material E (reproductive parts only), draw labeled diagram and identify with reasons.	<b>10</b>
Q3. Perform the Physiological experiment, describe the methodology, record your observations and conclusion. (i) Exercise A (major)                      (ii) Exercise B (minor)	<b>20</b>
Q4. (i) Perform the microbiological exercise F. Draw suitable diagram, describe methodology and record observations.	
a. Gram staining	<b>10</b>
b. Isolation of bacteria / Yeast fermentation	<b>10</b>
(ii) Prepare a suitable slide of given material G. For histological study – draw labeled diagram and identify the pathogen giving reasons.	<b>10</b>
Q5. Spotting	6x3= <b>18</b>
Q6. Herbarium & Record	<b>15</b>
Q7. Sessional Marks	<b>10</b>
Q8. Viva-Voce	<b>15</b>