UNIVERSITY OF KOTA

SEMESTER SCHEME

(w.e.f. 2020-21)

M.Sc. (Botany)

MBS Marg, Near Kabir Circle, KOTA (Rajasthan)-324 005

Syllabus of M.Sc. Botany

Semester-I

Paper I . Biology and Diversity of Lower Plants

II. Pteridophyta, Gymnosperms and Paleobotany

III. Plant Physiology

IV. Microbiology and Plant Pathology

V. Practical

Semester-II

Paper VI . Plant Ecology

VII. Plant Resource Utilization & Conservation

VIII. Cell and Molecular Biology

IX. Biochemistry

X. Practical

Semester-III

Paper XI. Plant Development and Reproduction

XII. Cytogenetics

XIII. Taxonomy of Angiosperms

XIV. Elective Paper-(a) Adv. Plant Pathology -I (b) Adv.Plant Ecology-I.

(Environment Biology)

XV. Practical

Semester-IV

Paper XVI . Biotechnology and Biometrics

XVII. Plant Morphology and Anatomy

XVIII. Seed Biology and Plant Breeding

XIX. Elective paper-(a) Adv. Plant Pathology-II (b) Adv. Plant Ecology-II (Arid Zone Ecology)

XX. Practical

M.Sc. Botany

Semester-I

Paper I . Biology and Diversity of Lower Plant

II. Pteridophyta, Gymnosperm and Paleobotany

III. Plant Physiology

IV. Microbiology and Plant Pathology

V. Practicals

Paper I-Biology and Diversity of Lower Plants

Duration of Examination: 3 Hours

Maximum Marks : 100 Marks

Semester Assessment : 70 Marks

Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Phycology: Algae in diversified habitats (terrestrial, fresh water, marine), thallus organization, cell ultrastructure, reproduction (vegetative, asexual, sexual), criteria for classification of algae: pigments, reserve food, flagella, modern classification.

Unit-II

Salient features of protochlorophyta, chlorophyta, charophyta, xanthophyta, Bacillariophyta, phaeophyta and Rhodophyta with special reference to *Microcystis, Hydrodictyon, Chara, Drapernaldiopsis, Sargassum, Dictyota, Batrachospermum.* Algal blooms, algal biofertilizers; algae as food, feed and use in industry.

Unit-III

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

Unit-IV

General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomy cotina, Deuteromycotina with special reference to *Pilobolus, Chaetomium, Morchella, Melampsora, Polyporus, Drechslera and Phoma*. Fungi in industry, medicine and as food, mycorrhizae, fungi as biocontrol agents.

Unit-V

Bryophyta: morphology, structure, reproduction and life history, distribution, classification, general account of Sphaerocarpales-*Sphaerocarpos,* Jungermaniales-*Porella,*Calobryales-*Calobryum,*Anthocerotales-*Notothylus,*Sphagnales-*Sphagnum,* Polytrichales-*Pogonatum.* Economic and ecological importance.

Suggested Reading

1. Alexopoulus, C.J., Mims. C.W. and Blackwel, M. 1996. Introductory Mycology, John Wiley & Sons Ind.
2. Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology, New Age Intermediate Press.
3. Morris, I.1986. An Introduction to the Algae. Cambridge University Press, U.K.
4. Parihar, N.S. 1991. Bryophyta. Central Book Depot, Allahabad.
5. Puri, P. 1980, Bryophytes. Atma Ram & Sons, Delhi.

6. Round, F.E. 1986. The Biology of Algae. Cambridge University Press, Cambridge.

Suggested Laboratory Exercises

Morphological study of representative members of algae, fungi and bryophytes:- *Microcystis, Aulosira, Oocysits, Pediastrum, Hydrodictyon, Ulva, Pithophora, Stigeoclonium, Draparnaldiopsis. Closterium, Cosmarium Batrachospermum Chara, Stemonitis, Peronospora, Albugo, Mucor, Pilobolus, Yeast, Emericella, Chaetomium, Pleospora, Morchella, Melampsora, Phallus, Polyporus, Drechsiera, Phoma, Penicillium, Aspergillus, Colletotrichum, Plagiochasma, Asterella, Notothylus, Polytrichum, Shaerocarpos, Porella, Calobryum, Sphagnum, Pogonatum.*

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.

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

Paper II-Pteridophyta, Gymnosperm and Paleobotany

	Maximum Marks	: 100 Marks
Duration of Examination: 3 Hours	Semester Assessment	: 70 Marks
	Continuous (Internal) Assessment	: 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

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- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

General characters and classification of pteridophyta, Stelar system, Telome theory, Heterospory and origin of seed habit. Introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Unit-II

Life history of *Psilotum*, *Lycopodium*, *Gleichenia*, *Isoetes*, *Botrychium* and *Pteris.*

Unit-III

General characters, classification and economic importance of Gymnosperm, Evolution of Gymnosperm, Distribution in India, Life History of *Ginkgo*, *Taxus* and *Gnetum.*

Unit-IV

General Characters and life history of *Lyginopteris*, *Medullosa*, *Caytonia, Glossopteris, Cycadeoidea, Pentoxylon,* and *Cordaites.*

Unit-V

General introduction of Paleobotany, fossilization, types of fossils, Techniques of fossil study, Geological time scale, General characters of fossil members of pteridophyta with special reference to *Horneophyton, Asteroxylon* and *Cladoxylon.* Paleobotany and evolution of vascular plants.

Suggested Reading;

1. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperm New Age International pvt. Ltd., NewDelhi.

2. Parihar, N.S. 1996. Biology and Morphology of Pteridophytes, Central Book Depot, Allahabad.

3. Singh, M. 1978, Embryology of Gymnosperms, Encyclopaedia of Plant Anatomy. X. Gebruder Bortraeger, Berlin.
4. Sporne, K.K. 1991. The morphology of pteridophytes. B.I. publishing Pvt. Ltd. Mumbai.
5. Stewart, W.N and Rathwell, G.W.1993. Paleobotany and the evolution of plants, Cambridge University press.
6. Sunderrajan, S.2007. Introduction to pteridophyta, New Age International Publishers, New Delhi.

Suggested Laboratory Exercises

Morphology and anatomy of vegetative and reproductive part of *Psilotum, Lycopodium, Selaginella, Equisetum, Gleichenia, Isoetes, Ophioglossum, Botrychium, Pteris, Cycas, Ginkgo, Cedrus, Abies, Picea, Cupressus, Araucaria, Cryptomeria, Taxodium, Pedocarpus, Agathis, Taxus, Ephedra and Gnetum* and the members in their natural habitat found in your locality.

Study of important fossil of Pteridophytes and Gymnosperms from specimens.

Paper III-Plant Physiology

Duration of Examination: 3 Hours

Maximum Marks : 100 Marks
Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

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Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Water relation of plants:- Unique physicochemical 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.

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.

Unit-III

Photosynthesis:- Photosynthetic pigments, absorption and transformation of radiant energy, photooxidation, four complexes of thylakoid membranes: photo system I, cytochromeb-f complex, photosystem II and coupling factors, photolysis of water and C_4 evolution, noncyclic and cyclic transportation of electrons, water cycle, proton gradient and photophosphorylation, calvin cycle regulation of RUBISCO activity. Control of calvin cycle. 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 cycles, pentose phosphate pathway, glyoxylate pathway, oxidative phosphorylation, gluconeogenesis, high energy compounds: their synthesis and utilization.

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 effect and mode of action.

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

N_2 fixation, Abiological, Biological, mechanism of N_2 fixation.

Suggested Reading :

1 Bachanan, B.B. Gruissim, W. and 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, Elservier, 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^{th} 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^{nd} 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_3 and C_4 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 succenate 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.

Paper IV-Microbiology and Plant Pathology

Duration of Examination: 3 Hours

Maximum Marks : 100 Marks
Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

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Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

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

General account of immunity, allergy, properties of antigens antibodies. Antibody structure and function, affinity and antibody 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. Alexopoulus, 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. Kiluwel Academic Publishers.
4. Bridge, P. Moore, D.R. & Scotf, P.R. 1998. Information Technology. Plant Pathology and Biodiversity. CAB International, U.K.
5. Clifiton, 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 (4th 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 colorimerty/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.–(Botany) 2020-21
Semester–I
Paper V- Practical
Skeleton Paper

Time : 6 hrs **Max. Marks: 100**

Q1. Identify the material present in the mixture A, draw a labeled diagram and comment upon their Significant characteristics and systematic. **8**

Q2. Make a suitable preparation of material B so as to show vegetative or reproductive part of the given plant. **8**

Q3. Make a suitable preparation of vegetative and or reproductive part of material C, draw labeled sketches, write features of special interest and identify with reasons. **8**

Q4. Make a suitable preparation of vegetative and or reproductive part of material D, draw labeled sketches, write features of special interest and identify with reasons. **8**

Q.5. make a suitable preparation of vegetative/reproductive part of material 'E', draw labelled sketches, write feature of special interest. **8**

Q.6. Perform the Physiological, experiment, describe the methodology, record your observation and conclusions (i) Exercise A (major) (ii) Exercise B (minor). **8+4= 12**

Q.7. Perform the microbiological exercise 'F'. **4**

Q8. Prepare a suitable preparation of material 'G'. **4**

Q9. Spots. **(2x6) = 12**

Q10. Record **12**

Q11. Sessional **8**

Q12. Viva-Voce **8**

M.Sc. Botany

Semester-II

Paper VI Plant Ecology

Paper VII Plant Resource Utilization and Conservation

Paper VIII Cell and Molecular Biology

Paper IX Biochemistry

Paper X Practical

Paper VI- Plant Ecology

Duration of Examination: 3 Hours

Maximum Marks : 100 Marks

Semester Assessment : 70 Marks

Continuous (Internal) Assessment : 30 Marks

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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), Concept of global biogeochemical cycles.

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 (CO_2, CH_4, N_2O, CFCs : sources, trends and role), ozone layer and ozone hole, consequence of climate change (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, Harpr 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 Wily 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 chisquare test.
6. To compare protected and unprotected grassland stand using community coefficients (similarity indices).
7. To analyze plant communities using Bra-Curtis ordination method.
8. To determine diversity indices (Shannon – Wiener, concentration of dominance, species richness, equitability and 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_2 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 VII-Plant Resource Utilization and Conservation

Duration of Examination: 3 Hours

Maximum Marks : 100 Marks
Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

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Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

UNIT – I

Plant Diversity: Concept, status in India, utilization and concerns.

Sustainable Development: Basic Concepts, origin of agriculture.

World Centers of primary diversity of domesticated plants: The Indo-Burmese center, plant introduction and secondary centers.

UNIT – II

Cultivation and uses-: Fodder, Fiber, medicinal and vegetable oil yielding crops of Rajasthan.

Important firewood and timber yielding plants and non wood forest products (NWFPs) such as bamboos, rattans, raw materials for paper making, gums, dyes, and fruits.

UNIT – III

Green revolution: Benefits and adverse consequences, innovations for meeting world food demands.

Plants used as avenue trees for shade, pollution control and aesthetics: Principles of conservation, environmental status of plants based on IUCN.

UNIT – IV

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

UNIT – V

Strategies for conservation – ex situ conservation: Principles and practices, botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks, general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources [NBPGR], Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT) for conservation.

1. Anonymous 1997. National Gene Bank : Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.
2. Arora, R.K. and Nayar, E.R. 1984. Wild Relatives of Crop Plants in India. NBPGR Science Monograph No.-7.
3. Baker, H.G. 1978. Plants and Civilization (3rd edn.) C.A. Wadsworth, Belmont.
4. Bole, P.V. and Vaghani, Y. 1986. Field Guide to Common Indian Trees. Oxford University Press, Mumbai.
5. Chandel, K.P.S., Shukla, G. and Sharma, N. 1996. Biodiversity in Medicinal and Aromatic Plans in India : Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.
6. Chrispeels, M.J. and Sadava, D. 1977. Plants, Food and People, W.H. Freeman and Co., San Francisco.
7. Cristi, B.R. (ed.) 1999. CRC Handbook of Plant Sciences and Agriculture. Vol. I. In-situ conservation. CRC Press, Boca Raton, Florida, USA.
8. Conway, G. 1999. The Doubly Green Revolution : Food for All in the 21st Century. Penguin Books.
9. Conway, G. and Barbier, E. 1990. After the Green Revolution. Earthscan Press, London.
10. Conway, G.and Barbief, E. 1994. Plant. Genes and Agriculture. Jones and Bartlett Publishers, Boston.
11. Council of Scienfific and Industrial Research 1986. The Useful Plants of India. Publications and Information Directorate, CSIR, New Delhi.
12. Council of Scientific and Industrial Research (1948 - 1976). The Wealth of India. A Dictionary of Indian Raw Materials and Industrial Products. New Delhi. Raw Materials I-XII, Revised Vol. I-III (1985-1992) Supplement (200).
13. Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York, USA.

14. Directory of Indian Wetlands, 1993. WWF INDIA, New Delhi and AWB, Kuala Lumpur.
15. Falk, D.A., Olwel, M. and Millan C. 1996. Restoring Diversity, Island Press. Columbia, USA.
16. FAO/IBPGR 1989. Technical Guidelines for the Safe Movement of Germp1asm. FAO/IBPGR, Rome.
17. Frankel, O.H., Brown, A.H.D. and Burdon, J.J. 1995. The Conservation of Plant Diversity. Cambridge University Press, Cambridge, U.K.
18. Gadgil, M. and Guha, R. 1996. Ecology and Equity : Use and Abuse of Nature in Contemporary India. Penguin, New Delhi.
19. Gaston, K.J. (Ed.) Biodiversity : a Biology of Numbers and Differences. Blackwell Science Ltd., Oxford, U.K.
20. Heywood, V. (Ed). 1995 Global Biodiversity Assessment. United Nations Environment Programme. Cambridge University Press, Cambridge, U.K.
21. Heywood, V.H, and Wyse lackn, P.S. (Eds) 1991. Tropical Botanical Gardens. Their Role in Conservation and Development. Academic Press, San Diego.
22. Kocchar, S.L. 1998. Economic Botany of the Tropics, 2nd edition. Macmillian India Ltd., Deihi.
23. Kothari, A. 1997. Understanding Biodiversity : Life Sustainability and Equity. Orient Longman.
24. Kohli, R., Arya, K.S., Singh, P.H. and Dhillon, H.S. 1994. Tree Directory of Chandigarh. Lovdale Educational, New Delhi.
25. Nair, M.N.B. et. al. (Eds.) 1988. Sustainable Management of Nonwood Forest Products. Faculty of Forestry, University Putra Malaysia. 43004 PM Serdong. Selangor, Malaysia.
26. Paroda, R.S. and Arora, R.K. 1991. Plant Genetic Resources Conservation and Management. IPGRI (Pubiication) South Asia Office, C/o NBPGR. Pusa Campus, New Delhi.

27. Pimentel, D. and Hall, C.W. (Eds.) 1989. Food and Natural Resources, Academic Press, London, New York.
28. Pinstrup-Anderson, P. et. al. 1999. World Food Prospects :Critical Issues for the Early 21st Century. International Food Policy Research Institute. Washington, D.C., USA.
29. Plant Wealth of India 1997. Special Issue of Proceedings Indian National Science Academy B-63.
30. Plucknett, D.L., Smith, N.J.H., William, J.T. and Murti Annishetty, N. 1987. Gene Banks and Worlds Food. Princeton Univrersity Press, Princeton, New Jersey, USA.
31. Rodgrs, N.A. and Panwar, H.S. 1988. Planning a Wildlife Protected Area Network in India. Vol. I. The Report. Wildlife Institute of India, Dehradun.
32. Sahni, K.C. 2900. The Book of Indian Trees. 2nd edition. Oxford University Press, Mumbai.
33. Schery, R.W. 1972. Plants for Man. 2nd ed. Englewood Cliffs, New Jersey. Prentice Hall.
34. Sharma, O.P. 1996. Hill's Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharma). Tata McGraw Hill Co. Ltd., New Delhi.
35. Swaminathan, M.S. and Kocchar, S.L. (Eds.) 1989. Plants and Society. Macmillan Publication Ltd., London.
36. Thakur, R.S., Puri, H.S.and Husain, A. 1989. Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants, CSIR, Lucknow.
37. Thomas, P. 2000. Trees: Their National History. Cambridge University Press, Cambridge.
38. Wanger, H., Hikino, H. and Farnswarth, N. 1989. Economic and Medicinal Plant Research. Vols. 1-3. Academic Press, London.
39. Walter, K.S. and Gillett, H.J. 1998. 1997 IUCN Red List of Threatened Plants. IUCN, the World Conservation Union. IUCN, Gland, Switzerland and Cambridge,U.K.

Suggested Laboratory Exercises The Practical course is divided into three units : (1) Laboratory work, (2) Field survey and (3) Scientific visits.

Laboratory Work

1. Forge/fodder crops : Study of any five important crops of the locality (for example fodder sorghum, bajra, berseem, clove, guar bean, gram, *Ficus* sp.)
2. Plant fibers :
   (a) Textile fibres : cotton, jute, linen, sunn hemp, *Cannabis.*
   (b) Cordage fibres : coir
   (c) Fibres for stuffing : silk cotton or kapok.

   Morphology, anatomy, (microscopic) study of whole fibres using- appropriate staining procedures.

3. Medicinal and aromatic plants : Depending on the geographical location college/university select five medicinal and aromatic plants each from a garden crop field (or from the wild only if they are abundantly available).

   Papaver somniferum, Atropa belladonna, Catharanthus roseus. Adhatoda zeylanica, (syn A. vasaca) Allium sativum, Rauwolfia serpentina, Withania somnifera, Phyllanthus amarus, (P. fraternus), Andrographis paniculata, Aloe barbadens, Mentha arvensis. Rosa sp., Pogostemon cablin, Origanum vulgare, Vetiveria zizanioides. Jasminum grandiflorum, Cymbopogon sp., Pandanus odoratissimus.
   Study of live or herbarium specimens or other visual materials, to become familiar with these resources.
4. Vegetaible oils : Mustard, groundnut, soyabean, coconut, sunflower, castor, Morphology, microscopic structure of the oil-yielding tissues, tests for oil and iodine number.

5. Gums, resins, tannins, dyes : Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins *(Acacia, Terminalia, mangroves, tea, Cassia spp., Myrobalans)* and *dyes (Curcuma longa, Bixa orellana, Indigofera sps., Butea monosperma, Lawsonia inermis)* and perform tests to understand their chemical nature.

Field Survey

6. **Firewood and timber yielding plants and NWF's :**
   a. Prepare a short of 10 most important sources of firewood and timber in your locality. Give their local names, scientific names, and families to which they belong. Mention, their properties.
   b. Prepare an inventory of the bamboos and rattans of your area giving their scientific and local names and their various uses with appropriate illustrations.
   c. A survey of a part of the town or city should be carried out by the entire class, In batches, Individual students will select one avenue/road and locate the trees planted on a graph paper. They will identify the trees, mention their size, canopy shape, blossoming and fruiting period and their status (healthy, diseased, infested, mutilated, misused or dying) and report whether or not the conditions in which they are surviving are satisfactory. The individual reports will be combined to prepare a larger map of the area, which can be used for subsequent monitoring either by the next batch of students/teachers/local communities/NGOs/or civic authorities. The purpose of exercise in item C above is to make the students aware of the kinds of trees and value in urban ecosystems and ecological services.

Scientific Visits*

The students should be taken to one of the following :

i. A protected area (biosphere reserve, national park, or a sanctuary)
ii. A wetland
iii. A mangrove
iv. National Bureau of Plant Genetic Resources, New Delhi-110012 or one of its field stations.
v. Head Quarters of the Botanical Survey of India or one of its Regional Circles.
vi. A CSIR Laboratory doing research on plants and their utilization.
vii. An ICAR Research Institute or a field station dealing with one major crop or crops.
viii. A recognised botnical graden or a museum (such as those at the Forest Research Institute, dehradun, National Botanical Institute, Lucknow, Tropical Botanical Garden and Reaserch Institute, Trivendram), which has collection of planrt products.

Note : The students are expected to prepare a brief illustrated narrative of the field survey and scientific Visits. After evaluation, the grades awarded to the students by the teachers should be added to the field assessment of the practical examination.

Paper VIII-Cell and Molecular Biology

Duration of Examination: 3 Hours

Maximum Marks : 100 Marks
Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

The dynamic cell : Structural organization of the plant cell, specialized plant cell types, chemical foundation, biochemical energetics.

Cell wall : Structure and functions, biogenesis, growth.

Plasma membrane : Structure, models and functions, sites for ATPases, ion carriers, channels and pumps, receptors.

Plasmodesmata : Structure, role in movement of molecules.

Unit-II

Chloroplast : Structure, genome organization, gene expression, RNA editing, nucleochloroplastic interactions.

Mitochondria : Structure, genome organisation, biogenesis.

Plant vacuole : Tonoplast membrane, ATPase, transporters as storage organelle.

Nucleus : Structure, nuclear pores, nucleosome organization, DNA structure- A, B and Z forms, DNA replication, damage and repair, transcription, plant promoters and transcription factors, mRNA transport nucleolus,rRNA biosynthesis.

Unit-III

Restriction enzymes : Cleavage of DNA into specific fragments, construction of a restriction map from the fragments, restriction sites as genetic markers, RFLP and their use in plant breeding.

Ribosomes : Structure, Protein synthesis, mechanism of translation, initiation, elongation and termination, structure and role of tRNA.

Unit-IV

Protein sorting : Targeting of proteins to organelles.

Cell shape and motility :The cytoskeleton, organization and role of microtubules and microfilaments, motor movements, implications in flagellar and other movements.

Cell cycle and apoptosis: Control mechanisms, role of cyclins and cyclin-dependent kinases, retinoblastoma and E2F proteins. Cytokinesis and cell plate formation, mechanisms of programmed cell.

Unit-V

Other Cellular organelles : Structure and functions of microbodies, Golgi apparatus, Lysosomes, Endoplasmic Reticulum:

Techniques in cell biology : Immunotechniques, in situ hybridization to locate transcripts in cell types, (FISH, GISH), confocal microscopy.

Suggested Readings :

1. Lewis, B. 2000 Genes VII. Oxford University Press, New York.
2. Alberts, B., Bray, D. Lewis, J., Raff, M., Roberts, K and Watson, J., 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.

3. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing USA.

4. Rost, T, etal. 1998. Plant Biology. Wadsworth Publishing Co., California USA.

5. Krishnamurthy, K.V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.

6. Buchanan, B.B., Gruissem, W., and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists. Maryland, USA.

7. De, D.N. : 2000. Plant Cell Vacuoles : An Introduction. CSIRO Publication Collingwood, Australia.

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

9. Lodish, H., Berk, A. Zipursky, S.L. Matsudaira, P., Baltimore D. and Darnell, J. 2000. Molecular Cell Biology (4th Edition) W.H. Freeman and Co., New York, USA.

See the following Review Journals

Annual Review of Plant Physiology and Molecular Biology.

Current Advances in Plant Sciences.

Trends in Plant Sciences.

Nature Reviews : Molecular and Cell Biology.

Suggested laboratory Exercises

1. Isolation of mitochondria and the activity of its marker enzyme succinate dehydrogenase (SDH).

2. Isolation of chloroplasts and SDS-PAGE profile, of proteins demarcate the two subunits of Rubisco.

3. Isolation of nuclei and identification of histones by SDS-PAGE.
4. Isolation of plant DNA and its quantitation by spectrophotometric method.
5. Isolation of DNA. And preparation of 'cot' curve.
6. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
7. Isolation of RNA and quantitation by a spectrophotometric method.
8. Separation of plant RNA by agarose gel electrophoresis and visualization by EtBr staining.
9. Southern blot analysis using a gene specific probe.
10. Northern bolt analysis using a gene specific probe.
11. Immunological techniques : Ouchterlony method, ELISA and western blotting.
12. Fluorescence staining with FDA for cell viability and cell well staining with calcolflour.
13. Demonstration of SEM and TEM.

Note : Chemicals and kits for conducting some of the above molecular biology experiments are available in India, for example from M/s Bangalore Genei and Centre for Biotechnology (CSTR) Mall 'Road, Delhi.'

Suggested Reading (For laboratory exercises)

1. Glick, B.R. and Thompson, J.E. 1993, Methods in Plant Molecular, Biology and Biotechnology, CRC Press, Boca Raton, Florida.
2. Glover, D.M. and Hames, B.D. (Eds.), 1995. DNA Cloning 1: A Practical Approach, Core techniques. 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
3. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology : Structure and Function Jones and Bartlett Publishers, Boston, Massachusetts.

4. Hackett, P.B., Fuchs, J.A.and Messing, J.W. 1988. An Introduction to Recombinant DNA Techniques : Basic Experiments in Gene Manipulation. The Benjamin Cummings Publishing Co.Inc. Menlo Park, California.

5. Hall, J.E. and Moore, A.L. 1983. Isolation of Membranes md Organelles from Plant Cells. Academic Press, London, U.K.

6. Harris, N and Oparka, K.J. 1994, Plant Cell Biology : A Practical Approach, IRL Press, at Oxford University Press, Oxford, U.K.

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

Paper IX-Biochemistry

Maximum Marks : 100 Marks

Duration of Examination: 3 Hours

- Semester Assessment : 70 Marks
- Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

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

Enzyme: Discovery and nomenclature, characteristics of enzyme, concept of holozymes, apozymes, coenzyme, ribozyme, abzyme and artificial enzyme, regulation of enzyme activity, mechanism of enzyme action and Michaelis-Menten equation.

Unit-II

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

Unit-III

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

Unit-IV

Lipid metabolism: Structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids storage and their catabolism.
Sulphur metabolism : sulphur uptake, transport and assimilation.

Unit-V

Biomolecules: General structure, classification properties, distribution biosynthesis and function of primary metabolites (carbohydrates, proteins, amino acids, lipids) and secondary metabolites (flavonoids, alkaloids, steroids etc).

Suggested Reading :

1 Dennis, D.T. Turpin, D.H. Lefebvre, D.D. and Layzell, D. (Eds) 1997. Plant Metabolism (second edition). Longman sex, England.
2 Hooykaas, P.J.J., Hall M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones, Elservier, Amsterdam, The Netherlands.
3 Westhoff, P. 1998 Molecular Plant Development from Gent to Plant, Oxford University Press, Oxford, U.K.
4 Taiz. L and Zeiger, E. 2006. Plant Physiology, 4th Edition, Sinauer Associates, Inc., Publishers, Massachusetts, USA.

5 Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology. Asia Ltd. Singapore.
6 Devlin, R.M. and Witham, F.H. 1986. Plant Physiology, 4th Ed. CBS Pub. Delhi
7 Voet, D and Voet J.G. 1995. Plant Biochemistry, John wiley, New York.
8 Lehnenger, A.L. 1982. Principles of biochemistry, CBS Publication.

Suggested Laboratory Exercises :

1. Effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. acid phosphatase nitrate reductase)
2. Determination of succenate dehydrogenase activity, its kinetics and sensitivity to inmcitors.
3. Principles of colorimetry, spectrophotometry and fluorimetry.
4. Estimation of Lipids
5. Separation of chlorophyll by paper chromatography.
6. Separation of amino acids by paper chromatography.
7. Separation of chlorophyll by liquid chromatography.
8. Test of phenols, alkaloids and terpenoids.
9. Isolation of VAM fungi.
10. Determination of amylase activity
11. Separation of aliphatic wax components by thin layer chromatography (TLC)
12. Isolation of root nodule bacteria from roots of legume plant.
13. Quantification of protein in given plant sample.
14. Quantification of carbohydrates in given sample.
15. The effect of temperature on enzyme activity.
16. The effect of pH on enzyme action.
17. To determine total soluble carbohydrates in given plant material.
18. To determine proline in given plant material.

M.Sc. (Botany)
2020-21
Semester-II
Skeleton Paper

Time: 6hrs M. Marks 100

1. (a) Calculate the quantitative characters of the plant community by quadrat method in college campus. 10

   (b) To investigate the water content/air content/soil particles in given various samples. 5

   OR

   Investigate the pH/ chloride content/oxygen content in given water sample.

2. (a) Identify any…. materials from the given samples. Give economic importance with special reference to origin, cultivation, part used and processing,if any. 10

   (b) Mark the highest yield… producing areas in the map (Rajasthan / India) provided to you. 5

   OR

   Mark the area of centre of origin of cultivated plants according to Vavilov.

3. (a) Perform the given cell biology exercise. 10

   (b) Perform the given molecular biology exercise. 5

4. Perform exercise of biochemistry in the given sample.

   (a) Estimation 10

   (b) Biochemical test 5

5. Spots (2X6)=12

6. Record 12

7. Sessional/Project/Seminar 8

8. Viva-Voce 8

M.Sc. (Botany) Semester-III

Scheme of Examination

Paper XI: Plant Development and Reproduction

Paper XII: Cytogenetics

Paper XIII: Taxonomy of Angiosperms

Paper XIV: Elective Paper (a) Advanced Plant Pathology-I

(b) Advanced Plant Ecology-I
(Environmental Biology)

Paper XV: Practical

Paper XI: Plant Development and Reproduction

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

Maximum Marks : 100 Marks
Duration of Examination: 3 Hours
Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

UNIT-I

Unique features of plant development.

Root development: Organization of root apical meristem (RAM), cell fates and lineages, vascular tissue differentiation, lateral roots, root hairs.

UNIT- II

Shoot development: Organization of the shoot apical meristem (SAM), cytological and molecular analysis of SAM, control of cell division and cell to cell communication, control of tissue differentiation, especially xylem and phloem, secretory ducts and laticifers, wood development in relation to environmental factors.

Leaf growth and differentiation: Determination, phyllotaxy, control of leaf form, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

UNIT-III

Reproduction: Vegetative and sexual reproduction, flower development, genetics of floral organ differentiation, homeotic mutants in *Arabidopsis* and *Antirrhinum*.

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

Female gametophyte: Ovule development,megasporogeneis, organization of the embryo sac, structure of the embryo sac cells.

UNIT-IV

Pollination, Pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms and vectors, breeding systems, commercial considerations, structure of the pistil, pollen-stigma interactions, sporophytic and gametophyticself incompatibility (cytological, biochemical and molecular aspects), double fertilization, *in-vitro* fertilization.

UNIT-V

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

Suggested Readings:

1. Atwll, B.J. Kriedcrmann, P.E. and Jumbull, C.G.N. (eds). 1999. Plant in Action: Adaption in Nature Performance, in Cultivation, MacMillan Education, Sydney, Australia.
2. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4^{th} revised and enlarged edition). Vikas Publishing House, New Delhi
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Combridge University Press, Cambridage .
4. Fageri, K. and Van der Pijl, L. 1979. The Principle of Pollination Ecology. Pergamon Press, Oxford.
5. Fahn, A. 1982. Plant Anatomy. (3^{rd} edition). Pergamon Press. Oxford.
6. Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Dieo.
7. Howell, S.H. 1998. Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
8. Leins, P., Tucker, S.C. and Endress, P.K. 1998. Aspects of Floral Development. J. Cramer, Germany.
9. Lyndon, R.F. 1990. Plant Development. The Cellular Basis, UnninByman, London.
10. Murphy, T.M. and Thompson, W.E., 1988. Molecular Plant Development. Prenitice Hall, New Jersey.

11. Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins, London.
12. Raghavan, V. 1997. Molccular Embryology of Flowering Plant. Cambridge University Press, Cambridge.
13. Raghavan, V. 1999. Development Biology of Flowering Plants. Springer-Verlag, New York.
14. Raven, P.H., Evrt, R.F. and Eichhorn, S. 19992. Biology of Plant (5^{th} edition). Worth, New York.
15. Steeves, T.A. and Sussex, I.M., 1989. Patterns in Plant Development (2^{nd} edition). Cambridge University Press, Cambridge.
16. Sdgely, M. and Griffin, A.R. 1989. Sexual Reproduction to Tree Crops. Academic Press, London.
17. Waisel, Y., Eshel, A. and Kafkaki, U. (eds.) 1996. Plant Roots: The Hidden Hall (2^{nd} edition), Marcel Dekker, New York.
18. Shivanna, K.R. and Sawhney, VK. (eds.) 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
19. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology: A Laboratory Manual. Springer-Verlag. Berlin.
20. Shivanna, K.R. and Johri, B.M. 1995. The Angiosperm Pollen: Structure and Function. Wiley Eastern Ltd. New York.

Suggested Laboratory/Field Exercises:

1. Effect of gravity, unilateral light and growth regulators on the growth of young seedlings.
2. Study of tracheary elements by elements by maceration technique.
3. L.S. of shoot tip to study the organization of meristem and origin of leaf primordial.
4. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum*and *Hydrilla.*
5. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as *Coleus, Kalanchoe, Tobacco.* Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordial.
6. Study of alternate and distichous, alternate and superposed, opposite and superposed, opposite and decussate leaf arrangement, Examination of rosette plants *(Launaea, Mollugo, Raphanus, Hyoscyamus*etc.) and induction of bolting under natural conditions as well as by GA treatment.
7. Microscopic examination of vertical sections of leaves such as *Cannabis, Tobacco, Nerium,* maize and wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the C_3 and C_4 leaf anatomy of plants.
8. Study of epidermal peels of leaves such as *Coccinia, Gaillardia, Tradescantia, Notonea*etc. Study the development and final structure of stomata and prepare stomatal index. Demonstration of the effect of ABA on stomatal closure.
9. Study of whole roots in monocots and dicots. Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives (use

maize, aerial roots of banyan, *Pistia, Jussiaea* etc.). Origin of lateral roots. Study of leguminous roots with different types of nodules.

10. Study of microsporogenesis in sections of anthers.
11. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Crotolaria, Tradescantia, Brassica, Petunia,Solanummelongena* etc.)
12. Tests for pollen viability using stains and in vitro germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
13. Estimating percentage and average pollen tube length *in vitro*.
14. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.
15. Pollen storage, pollen-pistil interaction, self-incompatibility, *in vitro* pollination.
16. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryo sac development thorough examination of permanent, stained serial sections.
17. Field study of several types of flower with different pollination, mechanisms (Wind pollination, bee/butterfly pollination, bird pollination).
18. Emasculation, bagging and hand pollination to study pollen germination, seed set and fruit development using self compatible and obligate outcrossing systems. Study ofcleistogamous flowers and their adaptations.

Paper XII: Cytogenetics

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

Maximum Marks : 100 Marks

Duration of Examination: 3 Hours

- Semester Assessment : 70 Marks
- Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

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.

UNIT-II

Structural and numerical alterations in chromosomes: Origin, meiosis and breeding behaviour of duplication, deficiency, inversion 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-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.

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

UNIT-IV

Somaticcell genetics:an alternative approach to gene mapping. 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.

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, physical mapping of genes of chromosomes, computer assisted chromosome analysis, chromosome microdissection and microcloning, flow cytometry and confocal microscopy in karyotype analysis.

Suggested Readings:

1. Albert B. Bray, D., Lewis, J., Raff, M., Robert, K. and Watson, J.D. 1989., Molecular Biology of the Cell (2nd edition), Garland Publishing Inc., New York.
2. Burnham, C.R. 1962. Discussions in Cytogenetics. Burgess Publishiong Co. Minnesota.
3. Busch, H. and Rothblum, J. 1982. Volume X. The Cell Nucleus rDNA Part. A. Academic Press.
4. Hartl, D.L. and Jones, E.W. 1998. Genetics : Principles and Analysis (4th edition). Jones & Bartlett Publishers, Massachusetts. USA.

5. Khush, G.S. 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Karp, G. 1999. Cell and Molecular Biology : Concepts and Experiments. John Wiley & Sons, Inc., USA.
7. Lewin. B. 2000. Gene VII. Oxford University Press, New York, USA.
8. Lewis, R. 1997. Human Genetics : Concepts and Applications (2nd edition). WCB McGraw Hill, USA.
9. Malacinski, G.M. and Freifeldo, D. 1998 : Essentials of Molecular Biology (3rd edition). Jones and B Artlet Publishers Inc. London.
10. Russel, P.J. 1998. Genetics (5th edition). The Benjamin Cummings Publishing Company Ind., USA.
11. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetic (2ndedtition). 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. Orecein 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 microdensitomerty and flow cytometry.
12. Fractionation and estimation of repetitive and unique DNA sequences in nuclear DNA.

Paper XIII: Taxonomy of Angiosperms

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

Maximum Marks : 100 Marks
Duration of Examination: 3 Hours
Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

UNIT-I

Angiosperm Taxonomy: Brief history, Aims and fundamental components, taxonomic key, Pheneticversus phylogenetic systems, Salient features of main system of classification and their relative merits and demerits.

UNIT-II

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.

Taxonomic tools: Herbarium, floras, cytological, phytochemical, serological, biochemical and molecular techniques, computers and GIS, Relevance of taxonomy to conservation.

UNIT-IV

Evolutionary tendencies and range of flower variations in following families-Asteraceae, Cucurbitaceae, Myrtaceae, Sterculiaceae, Combretaceae and Rubiaceae.

UNIT-V

Phylogeny of Angiosperms: Ancestors of Angiosperms, time and place of origin of Angiosperms, Habit of Angiosperm, Primitive living Angiosperms, Primitive families of Angiosperm.

Suggested Readings:

1. Cole, A.J. 1969. Numerical Taxonomy, Academic Press, London.
2. Devis, P.H. and Heywood, V.H. 1973, Principles of Angiosperms Taxonomy, Robert E. KreigerPubl Co., New York.
3. Grant, V. 1971. Plant Speciation. Columbia University Press, New York.
4. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.
5. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.
6. Heslop-Harrison, J. 1967. Plant Taxonomy, English Language Book Soc. & Edward Arnold Pub. Ltd. U.K.
7. Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
8. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand& Co. Educational Books Ltd. London.
9. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
10. Nordenstam, B., El Gazaly, G., and Kassas, M. 2000. Plant Systematics for 21st Century. Portland Press Ltd. London.
11. Radford. A.H. 1986, Fundamentals of Plant Systematics. Harper & Row Publications, USA.
12. Solbrig, O.T. 1970. Principals and Methods of Plant Biosystematics. The Macmillan Co-collier-MacMillan Ltd. London.
13. Solbrig, O.T. and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-WeslleyPublicatingCo. Ind. USA.
14. Stebbings, G.L. 1974, Flowering Plant-Evolution Above Species Level. Edward Arnold Ltd. London.
15. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition) Edward, Arnold Ltd. London.
16. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
17. Woodland, D.W. 1991, Contemporary Plant Systematics. Prentice Hall. New Jersey.

Suggested Laboratory Exercises:

Description of a specimen from representative, locally available families.

1. 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) 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, (30) Nyctaginaceae, (31) Polygonaceae, (32) Chenopodiaceae, (33) Amaranthaceae, (34) Aizoaceae, (35) Molluginaceae, (36) Euphorbiaceae, (37) Commelinaceae, and (38) Cyperaceae.
2. Description of species based on various specimens to study intraspecific vartation: a collective exercise.
3. Description of various species of a genus, location of key characters and preparation of keys at generic level.
4. Location of key characters and use of key at family level.
5. 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.
6. Training in using floras and herbaria for identification of specimens described in the class.
7. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
8. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

Paper XIV (a): Advanced Plant Pathology-I

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

Maximum Marks : 100 Marks

Duration of Examination: 3 Hours

- Semester Assessment : 70 Marks
- Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

UNIT-I

Phenomenon of plant infection, penetration, infection, post infection development, factors affecting infection, defense mechanisms.

Host pathogen interaction: The response of the host, pathogenecityand virulence, host specific toxins in relation to pathogenesis and disease resistance.

UNIT-II

Plant disease control: Physical control, chemical control, plant quarantines, plant disease resistance and breeding of resistance varieties.

Methods: Techniques of isolation, purification, culture and inoculation of pathogens.Technique of tissue culture and its applications in plant pathology.Raising virus free plants in culture.

UNIT-III

Fungal diseases: Symptomatology and disease identification,Some important diseases of cereals: Smuts, rusts, leaf blights, spots, mildews, karnal bunt and flag smut of wheat; covered smut and stripe disease of barley. Brown spot and blast of paddy, Brown spot, downy mildews and Drechlera (Helminthosporium) blights of Maize; ergot and smut of Bajra, leafspots and smuts of jowar, green ear disease of Bajra.

UNIT-IV

Other Diseases: Red rot and smut of sugarcane; Wilt of cotton, flax and pigeon pea; Flax rust; Blight of gram; Early blight of tomato and potato; Late blight of potato; Tikka disease of groundnut, and downy and powdery mildews of grapes.

UNIT-V

Molecular base of host-parasitic interactions,signal transductionand plant disease development,acquired immunity, SAR, role of salicylic acid in plant disease development,culture of obligate parasites.

Suggested Readings:

1. Agrios, G.N. 2005 Plant Pathology. 5th edition Academic Press. New York, USA
2. Alexopoulus, C.J, C.W. Mims and M. Blackwel, 1996. IntroductoryMycology, 4th edition, John Wiley and Sons, inc., New York, USA
3. Khan, J.A. and J. Dijkstra. 2002 Plant Virus as Molecular Pathogens. The Haworth Press Inc. USA
4. Mehrotra R.S. and A. Agarwal. 2003 Plant Pathology. 2nd Edition TATA McGraw Hill. Pub.Company Ltd. New Delhi.
5. Singh, R.S. 1982. Plant Pathogens. The Fungi. Oxford and IBH Publishing Company, New Delhi, India.
6. Singh, R.S. 1989.Plant Pathogens. The Prokaryotes.Oxford and IBH Publishing Company, New Delhi, India.
7. Trigiano, R.N., M.T. Windham and A.S. Windham. 2008. Plant Pathology: Concepts and Laboratory Exercises. 2nd edition. CRC Press.
8. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology: Food product Press and Haworth Press Inc. Binghamton.
9. Kaushik, P 1996 Introductory Microbiology Emkay Pub. New Delhi.
10. Mehrotra R.S.1987 Plant Pathology.TATA MacgrawthllPub.Company Ltd., New Delhi.

11.Purohit S.S. 2002 Microbiology-Fundamentals& applications Agrobios (India) Pub. Jodhpur.

Suggested Laboratory Exercises:

1. Culture transfer techniques
2. Techniques for isolation of pure culture
3. Isolation of discrete colonies from a mixed culture
4. Isolation of pure culture from spread plate streak plate preparation.
5. Culture characteristics of microorganisms

6. Grams staining.
7. To draw camera lucida drawings of fungal spores.
8. Calibration of Microscopes
9. Study of fungal and other disease

Paper XIV (b): Advanced Plant Ecology-I(Environmental Biology)

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

Maximum Marks : 100 Marks
Duration of Examination: 3 Hours
- Semester Assessment : 70 Marks
- Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

UNIT-I

Ecosystem: Concept, structure and function of grassland, forest, fresh water and marine ecosystems, biogeochemical cycles, evolution of ecosystem, ecological energetic and flow of energy.

UNIT-II

Natural Resources: water, soil, energy and wild life management and their remediation, biodiversity conservation, sanctuaries, national parks, non-conventional energy resources, solar, wind, tidal and geothermal energy sources, 3 R's (Reduction, Recycle & Reuse).

UNIT – III

Noise, Land, Radiation and Thermal Pollution: Sources and characteristics. Global Warming, ozone depletion and acid rains. Ganga Action Plan, Ecolabeling and Environmental Auditing, water pollution (Prevention and control of Pollution Act 1974). Air Pollution Act.

UNIT-IV

Plant community characters (Analytic and synthetic), IVI, Consequences of growing human population on environment. Ecosystems: Manmade ecosystems–Urban and rural. Environmental Impact Assessment (EIA), Social Impact Assessment (SIA) and sustainable development. Solid Waste Management.

UNIT V

Environmental Education and Awareness: Environmental laws & Ethics: Wild Life Protection Act 1972. Poaching and killing of wild life. Forest conservation Act 1980, ecofeminism, Social forestry and role of tribals in conservation, environmental economics – issues in perspective global economy, ecopolitics and green policies.

Suggested Readings:

1. Smith, R.L. 1996. Ecology and Field Biology, Harpr Collins, New York
2. Muller-Dombois, D. and Ellenberg, H., 1974. Aims and Methods of VegetationEcology, Wiley, New York.
3. Begon, M. Harper, J.L. and Townsend, C.R. 1996. Ecology, Blackwell Science, Cambridge, U.S.A.
4. Ludwig. J. nad Reynolds, J.F. 1988. Statistical Ecology. John Wiley & Sons.
5. Odum, E.P. 2005. Fundamentals of Ecology, Saunders, Philadelphia.
6. Odum, E.P. 2005. Basic of 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, J.L. 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 Wily Sons, New York.
11. Pandey, S.C., G.S. Furl and J.Singh 1967. Research methods in plant ecology Asia, Pub House, New Delhi.
12. Sharma P.D. 2000. Ecology and Environment, Rastogi Publications, Meerut.

Suggested Laboratory Exercises:

18. To determine minimum size and number of quadrat required for reliable estimate of biomass in grassland.
19. To compare protected and unprotected grassland stand using community coefficients (similarity indices).
20. To estimate IVI of the species in a grassland/woodland using quadrat method.
21. To determine gross and net phytoplankton productivity by light and dark bottle method.
22. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
23. To determine the Water holding capacity of soils collected from different locations.
24. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
25. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Wrinkler's method.
26. To estimate chlorophyll content in SO_2 fumigated and unfumigated plants leaves.
27. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
28. To study environmental impact of a given developmental activity using checklist as a EIA method.
29. To analyze plant community characters.
30. Soil/water test (different parameters).
31. Compare polluted and non-polluted plants (different parameters).
32. Study of morphological and anatomical adaptations of plants.

Paper XV: Practical
M.Sc. Botany Semester-III

Skeleton Paper

Duration: 6 hrs **Max. Marks: 100**

1. (a) Study the tracheary elements by maceration techniques. 10

or

Determine/study the phyllotaxy of selected plants (A).

or

L.S. of shoot tip to study the organization or meristem.

(b) With the help of suitable preparation, study the floral/epidermal/embryological ..... structure of the material (B) provided. Draw labeled diagram and comment upon its feature. 5

2. Perform the cytogenetical experiment/exercise, describe the methodology, record your observations and conclusion. 15
3. (a)Describe the given material(C) in semi-technical language, assign it to the relevant family with reasons, draw floral diagram. 10

   (b) Prepare an artificial key of given plant materials (D&E) or Prepare phenogram or dendogram in given exercise. 5
4. **Plant Pathology**--(a) Study the histopathology of the material(F). Make suitable preparation of the given material. Assign symptoms ,causal organism and identify the disease making pathological note of the given material. 10

   (b) Calibrate your microscope. Find out the average size of the fungal spore given to you.

   or

   Prepare suitable stained section of the given material (G). Draw labeled diagram, write symptoms and etiology of the disease. 5

   OR
4. **Plant Ecology--**(a) Determine organic matter content /conductivity/pH of the given soil sample.

   or

   Determine the dissolved O_2 in a given water body/total hardness of the given water sample. 10

   or

To determine minimum size of quadrat/density/frequency/ abundancy/IVI of herbaceous species of college campus.

(b) Prepare the glycerin mount of the given plant material (F) explaining their anatomical adaptations in relation to habitat.

or

Find out the leaf area index of polluted and non-polluted plants. 5

5. Spots (2x6) 12
6. Records 12
7. Sessional/Seminar/Project 8
8. Viva-Voce 8

M.Sc. Botany Syllabus

Semester-IV

Paper XVI . Biotechnology and Biometrics

XVII. Plant Morphology and Anatomy

XVIII. Seed Biology and Plant Breeding

XIX. Elective paper-(a) Adv. Plant Pathology-II (b) Adv. Plant Ecology-II (Arid Zone Ecology)

XX. Practical

Semester-IV

Paper XVI. Biotechnology and Biometrics

Maximum Marks : 100 Marks

Duration of Examination: 3 Hours

Semester Assessment : 70 Marks

Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

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- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Concepts and scope of plant biotechnology. Plant cell totipotency, Cellular differentiation.Plant tissue culture, Micropropagation-organogenesis, somatic embryogenesis, shoot bud differentiation and plantlet formation.

Protoplast isolation, purification, culture, regeneration and fusion. Somatichybrids and cybrids and their applications.

Germplasm conservation and cryopreservation.

Unit-II

Secondary Metabolites:Production of useful compounds through cell culture. Construction, operation and application of bioreactors.Production of bioactive compounds-alkaloids, antioxidants,flavanoids, terpenoids etc.

Biotransformation, hairy root culture, elicitation-chemical and biological elicitors.

Unit-III

Genetic Engineering of Plants:Aims and strategies for development of transgenics. Tools and techniques of recombinant DNA technology.Methods of gene transfer-Direct and indirect methods. *Agrobacterium*mediated gene transfer, biolistics, microinjection, electrofusion. *In Planta* transformation.

Gene cloning and vectors-plasmids, cosmids, Lambda phage, BAC, YAC.

Unit-IV

Genomic and cDNA library, genetic and physical mapping of genes, structural and functional genomics, molecular markers (RAPD, RFLP, AFLP). Transposon mediated gene tagging. High throughput sequencing, genome projects (wheat, Rice, Tomato), protein profiling and its significance. Chloroplasttransformation.

Intellectual property rights. Ecological risks and ethical concerns of GM crops. DNA and Protein microarray.

Unit-V

Biometry: Mean, median and mode, standard deviation and standard error, variance, coefficient of variance, probability distribution, chi-square test hypothesis, simple correlation.

Suggested Readings:

1. Bhojwani, S.S. and Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice (a revised edition), Elsevier Science Publishers, New York, USA.
2. Bhojwani, S.S. (1990). Plant Tissue Culture. Applications and Limitations. Elsevier Science Publishers, New York, USA.
3. Brown, T.A. (1999) Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
4. Callow, J.A., Ford-Lioyd, B.V. and Newbury, H.J. (1997) Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, Oxon, UK.
5. Chrispeels, M.J. and Sadava, D. (1994) Plants, Genes and Agriculture. Jones & Bartlett Publishers, Biston, USA.

6. Collins, H.A. and Edwards, S. (1998) Plant Cell Culture. Bios. Scientific Publishers, Oxford, UK.
7. Glazer, A.N. and Nikaido, H. (1995) Microbial Biotechnology. W.H. Freeman & Company, New York, USA.
8. Gustafson, J.P. (2000) Genomes. Kluwer Academic Plenum Publishers, New York, USA.
9. Henry, R.J. (1997) Practical Applications of Plant Molecular Biology. Chapman Hall, London, UK.
10. Jain, S.M., Sopory, S.K. and Veilleux, R.E. (1996) *In vitro* Haploid Production in Higher Plants,Vols. 1-5, Fundamental Aspects and Methods. Kluwer Academic Publishers, Dordrecht, The Netherlands.
11. Joles, O. and Jornvall, F. (Eds.) (2000) Proteomics Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
12. Kartha, K.K. (1985). Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.
13. Old, R.W. and Primrose, S.B. (1989) Principles of Gene Manipulation, Blackwell Scientific Publications, Oxford, UK.
14. Primrose, S.B. (1995) Principles of Genome Analysis. Blackwell Science Ltd., Oxford, UK.
15. Raghavan, V. (1986) Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York, USA.
16. Raghavan, V. (1997) Molecular Biology of Flowering Plants. Cambridge University Press, New York, USA.
17. Shantharam, S. and Montgomery, J.F. (1999) Biotechnology, Biosafety and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
18. Vasil, I.K. and Thorpe, T.A. (1994) Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.
19. Gupta, S.C. (2016) Fundamental of Statistics. Himalaya Publishing House, Mumbai.
20. Gupta, S.C. and Kapoor, V.K. (2000) Fundamentals of Mathematical Statistics (A Modern Approach).10th Edition, Sultan Chand & Sons,N. Delhi.
21. Rao, P.H. and Janardhan K. (2010) Fundamentals of Biostatistics. I.K.International Publishing House, New Delhi.

Suggested Laboratory Exercises:

1. Preparation of different explants and their surface sterilization.
2. Media preparation, sterilization and inoculation of explants.
3. Organogenesis and somatic embryogenesis and preparation of artificial seeds.
4. Demonstration of androgenesis in *Datura.*

5. Isolation of protoplasts from various plant tissues and testing their viability.
6. Effect of physical (e.g. temperature) and chemical (e.g.osmoticum) factors on protoplast yield.
7. Demonstration of protoplast fusion employing PEG.
8. Electroporation of protoplasts and checking of transient expression of the reporter gene.
9. Growth characteristics of *E. coli* using plating and turbidimetric methods.
10. Isolation of plasmids from *E. coli* by alkaline lysis method and its quantitation spectrophotometrically.
11. Restriction digestion of plasmid and estimation of the size of various DNA fragments.
12. Cloning of a DNA fragment in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
13. Demonstration of DNA sequencing by Sanger's di-deoxy method.
14. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.

Suggested Readings for Laboratory Exercises:

1. Butenko, R.G. (2000) Plant Cell Culture, University Press of Pacific.
2. Collin, H.A. and Edwards, S. (1998) Plant Cell Culture, Bios Scientific Publishers, Oxford, UK.
3. Dixon, R.A. (Ed.) (1987) Plant Cell Culture: Practical Approach. IRL Press, Oxford.
4. Gelvin, S.B. and Schilperoort, R.A. (Eds.) (1994) Plant Molecular Biology Manual. 2nd edition, Kluwer Academic Publishers, Dordrecht. The Netherlands.
5. George, E.F. (1993) Plant Propagation by Tissue Culture, Part I. The Technology, 2nd edition, Exegetics Ltd., Edington, UK.
6. George, E.F. (1993) Plant Propagation by Tissue Culture, Part 2, In Practice 2nd edition. Exegetics Ltd., Edington, UK.
7. Glick, B.R. and Thompson, J.E. (1993) Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
8. Glover, D.M. and Hames, B.D. (Eds.) (1995) DNA Cloning I: A Practical Approach, Core Techniques, 2nd edition. PAS. IRL Press at Oxford University Press, Oxford.
9. Hackett, P.B., Fuchs. J.A. and Meesing J.W. (1988) An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co., Inc. Menlo Park, California.

10. Hall, R.D. (Ed.) (1999) Plant Cell Culture Protocols. Humana Press, Inc., New Jersey, USA.
11. Shaw, C.H. (Ed.) (1988) Plant Molecular Biology: A Practical Approach, IRL Press, Oxford.
12. Smith, R.H. (2000) Plant Tissue Culture: Techniques and Experiments. Academic Press, New York.

Note: Excursions to visitthe various Agricultural Research Stations and other Institutes/University Departments of Plant Biotechnological Research in Rajasthan.

Paper XVII. Plant Morphology and Anatomy

Duration of Examination: 3 Hours

Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Modular type of growth. Diversity in plant forms in annuals, biennials and perennials. Convergence and evolution of tree habit in Gymnosperms and Angiosperms.

Unit-II

Morphology of roots: Structural modifications for food storage, respiration, reproduction and interaction with microbes.

Anatomical study of monocot and dicot roots.

Unit-III

Morphology of shoots: Branching patterns. Monopodial and sympodial growth. Canopy architecture. Modifications in stem and leaf.

Nodal anatomy: Leaf and branch traces and gaps.

Unit-IV

Anatomical study of monocot and dicot stems, Epidermal tissue system (stomata, trichomes, secretary glands). Secondary growth with special reference to anomalous structures in various stems.

Wood science: Types of woods, anatomy of wood of *Magnolia*, *Shorea*, and *Pinus*. Heart wood and sap wood.

Unit-V

Different types of leaves. Internal structure of various types of leaves in monocot and dicot plants.

Morphology of Flowers: A modified shoot, structure and development of flowers. Morphology of accessory parts of flowers. Pollens and Carpels morphology.

Suggested Readings:

1. Esau, K. (1966) Plant Anatomy. John Wiley & Sons, New York, USA.
2. Esau, K. (2006) Anatomy of Seed Plants. John Wiley & Sons, New York, USA.
3. Pandey, B.P. (2001) Plant Anatomy. S. Chand Publishing, New Delhi

4. Bhojwani, S.S. and Bhatnagar, S.P. (2000) The Embryology of Angiosperms. Vikas Publishing House, New Delhi.
5. Fahn, A. (1982) Plant Anatomy. Pergamon Press, Oxford.
6. Ganguly and Das. College Botany. Vol I and II, central Book Agency, Kolkata (India).
7. Leins, P., Tucker, S.C. and Endress, P.K. (1988) Aspects of Floral Development. J. Cramer, Germany.
8. Raghavan, V. (1999) Developmental Biology of Flowering Plants. Springer-Verlag, New York.
9. Raven, P.H., Evrt, R.F. and Eichhorn S. (1992) Biology of Plants. Worth, New York
10. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Develoments. Cambridge University Press, Cambridge.
11. Waisel, Y., Eshel, A. and Kafkaki, U. (Eds.) (1996) Plant Roots: The Hidden Hall. Marcel Dekker, New York.
12. Shivanna, K.R. and Rangaswamy, N.S. (1992). Pollen Biology: A Laboratory Mannual, Springer-Verlag, Berlin.
13. Koelling, C. (Ed.) (2016) Plant Anatomy, Morphology and Physiology. Syrawood Publishing House, New York, USA
14. Shibanna, K.R. and Johri B.M. (1995). The Angiosperm Pollen: Structure and Function. Wiley Eastern Limited, New York.
15. Eames, A.J. (1961) Morphology of the Angiosperms. McGraw-Hill Book Company, Inc., New York.
16. Eames, A.J. (1947) Introduction to Plant Anatomy, 2nd Edition. McGraw-Hill Book Company, Inc., New York.
17. Shivana, K.R. and Rangaswamy, N.S. (1992) Pollen Biology: A Laboratory Manual. Springer-Verlag, Berlin.

Suggested Laboratory Exercises:

1. Anatomical study of dicot and monocot stems with special reference to anomalous secondary growth.
2. Microscopic examination of vertical sections of leaves such as *Cannabis*, Tobacco, *Nerium*, maize and wheat to understand the internal structure of leaf tissue and trichomes glands etc.
3. Study of epidermal peels of leaves such as *Coccinia*, *Gaillardia*, *Tradescantia*etc. to study the development and structure of stomata and prepare stomatal index.
4. Study of whole roots in monocots and dicots.
5. Anatomical study of monocot and dicot roots.

6. Study of leguminous roots with different types of nodules.
7. Microscopic examination of anthers of *Datura*, *Tradescantia*, *Brassica*, maize etc. to study the pollen grains.
8. Tests for pollen viability and pollen germination.
9. Monopodial and sympodial types of branching in monocots and Dicots.
10. Study the morphology of root/shoot/floral parts of commonly occurring plants.

Note: Field survey/visit to study thedifferent types of flowering plants.

Paper XVIII. Seed Biology and Plant Breeding

Maximum Marks : 100 Marks

Duration of Examination: 3 Hours

Semester Assessment : 70 Marks

Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Significance of seed, suspended animation in seeds, seed dormancy, methods of breaking dormancy, types ofseeds, structure of seeds, transformation of seed parts, germination of seeds.

Unit-II

Ecological adaptations in seeds, storage of nutrients in seeds, material stored in seeds, mobilization of stored products during seed germination, seed dispersal mechanism.

Unit-III

Seed testing,seed separation and processing, germination test, viability, seedling evaluation.Structureof seeds of important crop plants with special reference to Rajasthan (wheat, pearl millet, mustard, gram, pea, spices).

Terminator seed technology, seed bank, seed certification. Legislation and seed law enforcement.

Unit-IV

Plant breeding: Aims and objectives, brief history, plant breeding work in India, crop varieties of important crops of India, research institutes related to plant breeding, plant introduction.

Unit-V

Plant selection methods (mass, pureline and clonal), hybridization, breeding methods in self& cross-pollinated and vegetatively propagated crops.

Heterosis and inbreeding depression and causes of hybrid vigour.

Suggested Readings:

1. Agarwal, RL (1980), Seed technology, oxford and IBH publishing co.pvt. Ltd. New Delhi.
2. Agrawal, G.K. and Rakwal, R. (Eds.) (2012)Seed Development: OMICS Technologies toward Improvement of Seed Quality and Crop Yield. Springer, Dordrecht.
3. Bewley, J D and Black, M (1994) Seeds: Psychology of Development and Germination. Plenum Press, New York.

4. Bewley J.D. and Black, M. (1982) Physiology and Biochemistry of Seeds in Relation to Germination. Springer-Verlag, Berlin.
5. Chopra, V.L. (2001) Plant Breeding: Theory and Practice. Oxford IBH Pvt. Ltd., New Delhi.
6. Khare, D and Bhale, MS (2014) seed technology scientific publishers, (India) Jodhpur, Revised 2nd Ed.
7. Kulkarni, G.N. (2002) Principles of seed teachnology, kalyani publishers, New Delhi.
8. Mohanan, K.V. (2010) Essentials of Plant Breeding. Prentice Hall of India Private Ltd.
9. Roberts, E.H. (2013) Seeds: Physiology of Development and Germination. Springer-Verlag New York.
10. Robert, R.W. (1999) Principles of Plant Breeding. John Wiley & Sons, New York, USA.
11. Singh Rajesh and Singh Rajeev (2018). Seed technology. Kalyani publishers, New Delhi.

Suggested Laboratory Exercises:

1. Seed structure of wheat, pearlmillet, mustard, gram, pea, etc.
2. Seed viability, Seed testing and Seed dormancy.
3. Seed storage content and seed germination.
4. Seed coat types of *Pisum*,*Cucurbita* and wheat.
5. Emasculation technique and Hybridization methods
6. Specimen study of modification of plants for vegetative propagation.
7. Specimen study of various seed dispersal mechanism (commonly occurring examples).

Note: Excursions to visit the CAZRI, NBPGR and other institutes in Rajasthan.

Paper XIX (a). Advanced Plant Pathology II

Duration of Examination: 3 Hours

Maximum Marks : 100 Marks
Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Concept of disease, animate and non-animate diseases.Classification of plant diseases. Major groups of plant pathogens and symptoms caused by them.

History of plant pathology and contribution of following scientists in the development of plant pathology: Dodge, Ganman, Butler, Walker, Stakeman, Horshfall, Diamond, T.S. Sadashivan, R.S. Singh, S.N. Dasgupta, S.P. Ray Chaudhary, G.Rangaswamy, N.Prasad, H.C. Arya andR.S. Mehrotra.

Disease pre-disposition factors and disease development, plant disease forecasting.Epiphytotics.

Unit-II

Bacterial diseases: Brown rot, Ring rot of potato, Fire blight of stone fruits, Tundu disease of wheat, Stalk rot of maize, Bacterial blight of rice, Soft rot of vegetables,Red strip of sugarcane, Crown gall disease, Angular leaf spot of cotton, Citrus canker.

Unit-III

Virology: Classification, morphology, physiology and nature of viruses. Symptomatology, isolation, purification and culturing of viruses. Viral infection, nutrition, synthesis and mutation.Transmission of viral diseases, acquired immunity, interference and synergism.General account of viroids.

Viral diseases: Potato virus X and Y, Potato yellow dwarf, Tomato mosaic and tomato ring mosaic, Tobacco necrosis, Cucumber mosaic, Bunchy top of banana, Bhindi yellow mosaic.

Unit-IV

Nematology: Classification and identification of plant pathogenic nematodes. Morphology and anatomy of nematodes.Methods used in nematology.

Nematode diseases: Ear cockle of wheat, Root knot of vegetables,Molya disease of wheat. Non-parasitic diseases: Diseases due to deficiency of Nitrogen, Zinc, Boron, Oxygen.

Preliminary studies on diseases due to excess of Ozone; PAN (Peroxyacyl nitrate), Sulphur dioxide, Sulphur and Hydrogen Fluoride in atmosphere, soil and water.

Unit-V

Cecidology: Classification and anatomy of galls. Some insect induced plant galls of Rajasthan(*Pongamia* leaf galls, *Cordia* leaf galls, *Zyziphus* stem galls, *Prosopis* stem galls). Mechanism and physiology of insect galls.

Plant pathogenic mollicutes (*Spiroplasma*, *Phytoplasma*), symptoms caused by them, their transmission and translocation in plants.

Important diseases caused by Mollicutes: Sesame phyllody, Grassy shoot of sugarcane, Sandal spike, Corn stunt, Citrus greening.

Suggested Readings:

1. Agrios, G.N. (1997) Plant Pathology. Academic Press, London.

2. Albajes, R., Cullino, M.L., Van Lenteren, J.C. and Elad, Y. (Eds.) (1999) Integrated Pest and Disease Management in Greenhouse Crops. Kiluwel Academic Publishers.
3. Clifton, A. (1958) Introduction to the Bacteria. McGraw Book Co., New York.
4. Khan, J.A. and Dijkstra, J.(2002) Plant Virus as Molecular Pathogens. The Haworth Press Inc., USA
5. Mandahar, C.I. (1978) Introduction to Plant Viruses. Chan Co. Ltd., Delhi.
6. Mehrotra, R.S. (1982) Plant Pathology. Tata McGraw Hill.
7. Mehrotra, R.S. and Agarwal, A.(2003) Plant Pathology. 2nd Edition TATA McGraw Hill. Pub.Company Ltd., New Delhi.
8. Singh, R.S. (1989) Plant Pathogens. The Prokaryotes.Oxford and IBH Publishing Company, New Delhi, India.
9. Purohit, S.S. (2002) Microbiology Fundamentals & Applications Agrobios (India) Pub., Jodhpur.
10. Rangaswamy, G. and Mahadevan, A. (1999) Diseases of Crop Plants in India (4th edition) Prentice Hall of India, Pvt. Ltd., New Delhi.
11. Horsfall, J.G. and Dimond, A.F. (1960) Plant Pathology vols. 1, 2 & 3. Academic Press, New York, USA.
12. Trivedi, P.C. (1998) Nematode Diseases in Plants, CBS Publisher and Distributor, New Dehli.
13. Trigiano, R.N., Windham, M.T. and Windham, A.S. (2008) Plant Pathology: Concepts and Laboratory Exercises. 2nd edition. CRC Press.

Suggested Laboratory Exercises:

1. Isolation of microorganisms, streaking on agar plates/pour plate method, isolation of clones and preservation.
2. Determination of growth of a microorganism (model organism: *Escherichiacoli*), effects of nutrients, e.g. glucose, fructose, sucrose.
3. Observations on bacterial and virus infected plants (symptoms).
4. Observations on important diseases caused by nematodes and mollicutes.
5. Observationsnon-parasitic diseases.

Note: Excursionsfor collection of diseased plant materialfrom different locations and to visit Agricultural Research Stations dealing pathological study in Rajasthan.

Paper XIX (b). Advanced Plant Ecology II-Arid Zone Ecology

Maximum Marks : 100 Marks

Duration of Examination: 3 Hours

Semester Assessment : 70 Marks

Continuous (Internal) Assessment : 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Deserts:Their formation, topography and distribution. Characteristics of deserts with special reference to water economy. The hot and cold deserts and other similar habitat. Arid regions of India with particular reference to Thar desert in Rajasthan.

Unit-II

Rajasthan:Geology, physiography, climate, vegetationand plant communities of deserts and soil. Saline tracts and their vegetation (Halophytes), Mangrove vegetation. Sand dunes-classification, stabilization and management.

Unit-III

Adaptation of plants and animals to arid conditions. Biotic factors including the role of man on the vegetation and fauna in arid zones. Types and distribution of wastelandsin India.

Unit-IV

Habit studies and phenology of desert plants through various seasons, root investigation, reproductive capacity, seed output, germination, dormancy, viability, and perennation.

Unit-V

Desert as an ecosystem, biological productivity, cycles and balances in the desert ecosystems, wind break and shelter belts. Indira Gandhi Canal and its ecological implications. Dry land farming. Underground water resources.

Suggested Readings:

1. Muller-Dombois, D. and Ellenberg, H., (1974) Aims and Methods of VegetationEcology. Wiley, New York.
2. Agarwal, S.K. (2011) Fundamentals of Ecology. APH Publishing Corp., New Delhi.
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. (2005) Fundamentals of Ecology. Saunders, Philadelphia.
6. Odum, E.P. (2005) Basic of 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.(996) Concepts of Ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
9. Chapman, J.L. and Reiss, M.J. (1988) Ecology, Principles and Applications, Cambridge University Press, Cambridge, U.K.
10. Sharma, P.D. (2000) Ecology and Environment, Rastogi Publications, Meerut.
11. Saxena, N.B. and Saxena, S. (2011) Arid Zone Ecology. Pragati Prakashan, Meerut.
12. Henderson-Sellers, A. and Pitman, A.J. (Eds.) (2012)Vegetation and Climate Interactions in Semi-arid Regions (Advances in Vegetation Science), Springer.

13. Thomas, D.S.G. (Ed.) (2011)Arid Zone Geomorphology: Process, Form and Change in Drylands 3rd Edition. Wiley-Blackwell.
14. Sen, D.N. (Ed.) (1990) Ecology and Vegetation of Indian Desert. Agro Botanical Publishers (India), Bikaner.

Suggested Laboratory Exercises:

1. To determine minimum size and number of quadrat required for reliable estimate of biomass in grassland/arid regions/saline tracts.
2. To compare protected and unprotected grassland stand using community coefficients (similarity indices).
3. To determine the Frequency/Density/Species cover in arid area using quadrat method.
4. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
5. To determine the water holding capacity of soils collected from different locations.
6. To determine percent organic carbon and organic matter contents in the soils of different habitat.
7. To estimate the dissolved O_2 in eutrophic and oligotrophic water samples by azide modification of Wrinkler's method.
8. To determine the total hardness of the given water samples.
9. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
10. Draw themap of arid and semi-arid regions of Rajasthan showing the major vegetation types.
11. Study the different plant communities of Rajasthan.
12. Seed germination and seed viability in the seeds of xeric environment.
13. Soil/water test (pH and Conductivity).
14. Study of morphological and anatomical adaptations of xerophytes and halophytic plants.

Note: Excursions to visit the CAZRI, AFRI and other Institute, and saline areas of Rajasthan.

M.Sc. Botany Semester-IV

Paper XX: Practical
Skeleton Paper

Duration: 6 hrs. **Max. Marks: 100**

1. **(a)**Perform the biotechnological exercise. **10**

   (b) Solve the biometric problem. **05**

2. **(a)** Make a suitable preparation of the given material**A**. Draw a labeled diagram and study the anomalous secondary growth. Discuss the pointsof special interest. **10**

   (b) Study the morphology/morphological adaptations of root/shoot/floral parts of the given material**B**, draw the labeled diagrams and comment upon its features. **05**

3. **(a)**Study the seed types/viability/testing/storage/germination of a given material **C**. **10**

   (b) Perform the emasculation technique/hybridization method. **05**

4. **Plant Pathology:**

   (a) Study the given material **D**,write symptoms and etiology of the disease. **07**

   (b) Bacterial preparation of the given material **E**, write and conclude about the results. **04**

   (c) Make a comparative phyto-pathological note on the materials**F**and **G**. **04**

OR

4. Plant Ecology:

   (a) Prepare a glycerin mount of the given plant material**D**, write anatomical adaptations. **07**

   (b) Draw the map of arid and semi-arid regions of Rajasthan showing the major vegetation types. **04**

   (c) Study the various types of trichomes and their rolling mechanism to withstand during drought of given plant material**E**. **04**

or

   Determine organic matter content/dissolved Oxygen/total hardnessin the given soil/water sample**E**.

5. Spots (2x6) **12**

6. Records **12**
7. Sessional assignments **08**
8. Viva-Voce **08**