

PLANT PHYSIOLOGY AND METABOLISM

UNIT-I

Water relation of plants: Unique physiochemical properties of water
Chemical potential, Water potential, Apparent free space, Bulk movement
of water. Soil plant atmosphere continuum (SPAC), transpiration and anti
transpiration, Stomatal regulation of transpiration.

Membrane transport: Passive non mediated transport. Nernst
equation. Passive mediated transport. ATP driven active transport.
Uniport, Symport, Antiport, Ion channels. Mineral nutrition,
Preliminary account of stress physiology.

UNIT-II

Photosynthesis: Photosynthetic pigments, absorption and transformation
of radiant energy, photo-oxidation, photosystem I & II, non cyclic and
cyclic transportation of electrons (photophosphorylation), Calvin cycle
and its control, Regulation of RUBP carboxylase activity. C₄ pathway,
CAM pathway. Differences between C₃ and C₄ plants. Glycolate pathway
and photorespiration, chlororespiration.

Respiration: Anaerobic and aerobic respiration. Amphibolic nature of
TCA cycle, Pentose phosphate pathway, Glyoxylate pathway, Oxidative
phosphorylation, Gluconeogenesis, High energy compounds: their
synthesis and utilization

UNIT-III

Enzymes kinetics: Discovery and nomenclature, characteristics of
enzymes, regulation of enzyme activity, mechanism of action, Michaelis-
Menten equation & enzyme inhibitors.

Primary and Secondary Metabolites : General structure, classification, distribution of Carbohydrates ,Proteins, Amino acids . Preliminary , account of Flavonoids , Alkaloids ,and Steroids .

Nitrogen metabolism: Symbiotic and a symbiotic nitrogen fixation, nodule formation ,sulfur and nitrogen assimilation .

Fat metabolism: Synthesis of long chain fatty acids, lipid biosynthesis, α - and β -oxidation.

Vitamins: Structure and function (Thiamine, Riboflavin, Ascorbic acid).

UNIT-IV

Plant growth regulators: Chemical nature, bioassay, physiological effects and mode of action of auxin, gibberellins, cytokinins, ethylene, Brassino steroids , Jasmonic acid and salicylic acid.

Photobiology: Photoreceptors, Phytochrome: History, discovery, physiological properties. Interaction between hormones and phytochrome, role of different phytochromes and cryptochromes in plant development and flowering.

Physiology of flowering: Photoperiodism and Vernalization. Circadian rhythms in plants.

Suggested laboratory exercises

1. Effects 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 of any enzyme and determination of its K_m 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.

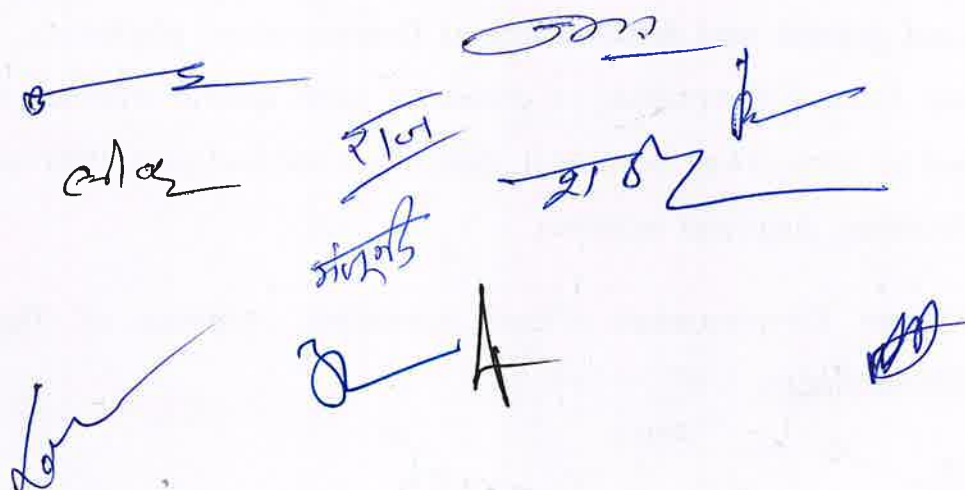
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6. Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.
7. To demonstrate photophosphorylation in intact chloroplast. Resolve the phosphoproteins by SDS-PAGE and perform autoradiography.
8. Extraction of seed proteins depending upon the solubility.
9. Determination of succinate dehydrogenase activity, its kinetics and sensitivity to inhibitors.
10. Desalting of proteins by gel filtration chromatography employing Sephadex G-25.
11. Preparation of the standard curve of proteins (BSA) and estimation of the protein content in extracts of plant material by Lowery's or Bradford. S method.
12. Fractionation of proteins using gel filtration chromatography by Sephadex G 100 or Sephadex G 200.
13. SDS-PAGE for soluble proteins extracted from the given plant materials and comparison of their profile by staining with Coomassie Brilliant Blue or silver nitrate.
14. Separation of isozyme of esterase's, peroxidase by native polyacrylamide gel electrophoresis.
15. Radioisotopes, methodology, autoradiography, instrumentation (GM account and scintillation counter) and principles involved.

Suggested readings

1. Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and molecular biology of plants. American society of plant physiologists, Maryland, USA.
2. Dennis, D.T. Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. (Eds) 1997. Plant metabolism (second edition). Longman Essex, England.
3. Galston, A.W. 1989. Life processes in plants. Scientific American library, springer-verlag, New York, USA.

4. Hooykas, P.J.J., Hall M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and molecular biology of plant hormones, Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to plant physiology, John Wiley & sons, Inc., New York, USA.
6. Lodish.H., Berk, A. Zipursky, S. L., Matsudaira P., Baltimore, D and Darnell, J. 2000. Molecular cell biology (Fourth edition). W.H. Freeman and company, New 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 (4th edition). Wadsworth publishing Co., California, USA.
10. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee. 1999. Concept of photobiology: photosynthesis and photomorphogenesis. Narosa publishing house, New Delhi.
11. Taiz, L. and Zeiger, E. 1998. Plant physiology. Sinauer Associates, Inc. Publishers, Massachusetts, USA.
12. Thomas, B. and Vince-Prue, D. 1997. Photoperiodism in plants. Academic Press, San Diego. USA.
13. Westhoff, P. 1998. Molecular plant development from gene to plant. Oxford University Press, Oxford, UK.



PLANT MORPHOLOGY & DEVELOPMENTAL ANATOMY

UNIT-I

Introduction: Basic concepts of plant development: Potency, commitment, specification, induction, competence, determination, Differentiation, morphogenetic gradient, cell fate and cell lineage.

Seed germination and seedling growth: Metabolism of nucleic acids, proteins and mobilization of food reserves, tropisms during seed germination and seedling growth, hormonal control of seedling growth, gene expression, use of mutants in understanding seedling development.

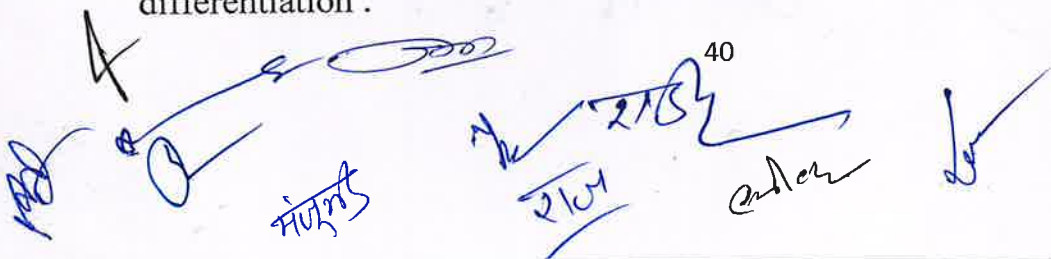
UNIT-II

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

UNIT-III

Leaf growth and differentiation: Determination, phyllotaxy, control of leaf form, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll, Leaf traces and leaf gaps, Petiolar anatomy. Secretory ducts and laticifers.

Flower Development: Floral meristems, genetics of floral organ differentiation.



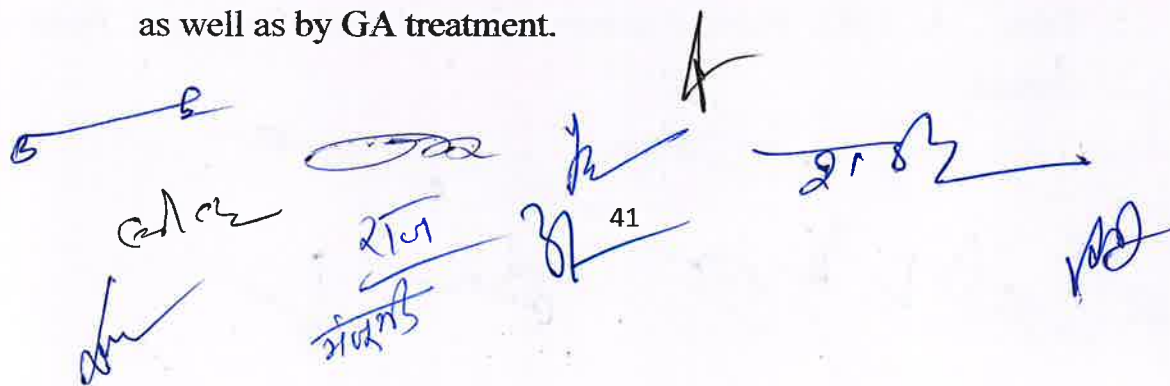
UNIT-IV

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

Seed coat development: External and internal morphology of seed and seed appendages. Ontogeny of seed coat, mature structure, Spermoderm pattern.

Suggested Laboratory exercises

1. Effect of gravity, unilateral light and plant growth regulators on the growth of young seedlings.
2. Role of dark and red light/far-red light on the expansion of cotyledons and epicotyl hook opening in pea.
3. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*.
4. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as *Coleus*, *Kalanchoe*, Tobacco.
5. Examination of shoot apices in a monocotyledon in both T.S, and L.S. to show the origin and arrangement of leaf primordia.
6. Study of alternate and distichous, alternate and superimposed, opposite and superimposed, opposite and decussate leaf arrangement.
7. Examination of rosette plants (*Launaea*, *Mollug*, *Raphanus*, *Hyoscyamus* etc.) and induction of bolting under natural conditions as well as by GA treatment.



8. 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.
9. Leaf anatomy of C_3 and C_4 plants.
10. Study of epidermal peels of leaves such as *Coccinia*, *Gaillardia*, *Tradescantia*. etc. to study the development and final structure of stomata and prepare stomatal index.
11. Demonstration of the effect of ABA on stomatal closure.
12. Study of whole roots in monocots and dicots.
13. 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.
14. Study of leguminous roots with different types of nodules.

Suggested Readings:

1. Atwell, B.J. Kriedermann, P.E. and Jumbull, C.G.N. (eds). 1999. Plants in Action : Adaption in
in Action : Adaption in
1. Nature Performance, in Cultivation, MacMillan Education. Sydney, Australia.
2. Bewley. J.D. and Black, M. 1994. Seeds: Physiology of Development and
and
3. Germination, Plenum Press. New York.
4. Burgess, I. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
5. Fahn , A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.

6. Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
7. Howell, S.H. 1998. Molecular Genetics of Plant Development. Cambridge University press, Cambridge.
8. Lyndon, .F. 1990. Plant Development. The Cellular Basis, Unmin Byman, London.
9. Murphy, T.M. and Thompson, W.E, 1988. Molecular Plant Development. Prentice Hall, New Jersey.
10. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
11. Raven, P.H., Evert, .F. and Eichhorn, S. 1992. Biology of Plants (5th edition). Worth, New York.
12. Salisbury, P.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing, Belmont, California.
13. Steves, T.A. and Sussex, I.M., 1989. Patterns in Plant Development (2nd edition). Cambridge University Press, Cambridge.
14. Waisel, Y., Eshel, A. and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.

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TAXONOMY OF ANGIOSPERMS

UNIT-I

Concept of the species (Taxonomic concept): Taxonomic hierarchy, species, genus, family and other categories, principles used in assessing relationship, delimitation of taxa and attribution of rank.

International code of botanical nomenclature: principles, rules and recommendations.

UNIT-II

Taxonomic tools: Herbarium, Flora, Monograph, Icons, Library Journals, and Botanical gardens.

Taxonomic Techniques: Histological, Cytological, Biochemical, Molecular and Serological, computer and GIS

Taxonomic evidences: Role of principles of various disciplines viz. Plant Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry and genome analysis and nucleic acid hybridization in plant taxonomy.

UNIT-III

System of classification: Phenetic versus phylogenetic systems- Benthum and Hooker, Engler and Prantel, Takhtajan, Cronquist's systems with merit and demerits, Primitive and Advanced characters.

Study of following families: Ranunculaceae, Caryophyllaceae, Leguminosae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae,

Asclepiadaceae , Apocyanaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae.

UNIT- IV

Study of Families of Monocots and Heterotrophic Nutrition:
Cyperaceae , Poaceae, Nepenthaceae, Orobanchaceae.

Phylogeny of Angiosperms: Ancestors of Angiosperms, time and place of origin of angiosperms, Habit of angiosperms, Primitive living angiosperms, Inter-relationship among the major group of angiosperms.

Suggested practical exercises:

1. Description of a specimen from representative, locally available families.
2. List of Locally Available Families.
3. Description of a species based on various specimens to study intraspecific variation: a collective exercise.
4. Study of dicot families: Ranunculaceae, Caparidaceae, Portulacaceae, Caryophyllaceae, Malvaceae, Tiliaceae, Sterculiaceae, Zygophyllaceae, Rhamnaceae, Sapindaceae, Leguminoceae, Combretaceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Primulaceae, Asclepiadaceae, Apocynaceae, Convolvulaceae, Solanaceae, Boraginaceae, Polemoniaceae, Acanthaceae, Pedialaceae, Lamiaceae, Polygonaceae, Marrtyniaceae, Bignoneaceae, Chenopodiaceae and Euphorbiaceae,
5. Monocot Families: Cyperaceae Poaceae and Liliaceae .
6. Families of Heterotrophic Nutrition: Nephanthaceae, Orchidaceae and Orobanchaceae
7. Description of various species of a genus, location of key characters and preparation of keys at generic level.
8. Location of key character and use of keys at family level.
9. Field trips within and around the campus, compilation of field notes .
10. Preparation of herbarium sheets of wild and cultivated plants, as are abundant.

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11. Training in using floras and herbaria for identification of specimens described in the clas
12. Comparison of different species of a genus and different genera of a family to calculate similarity coefficient and preparation of dendograms.

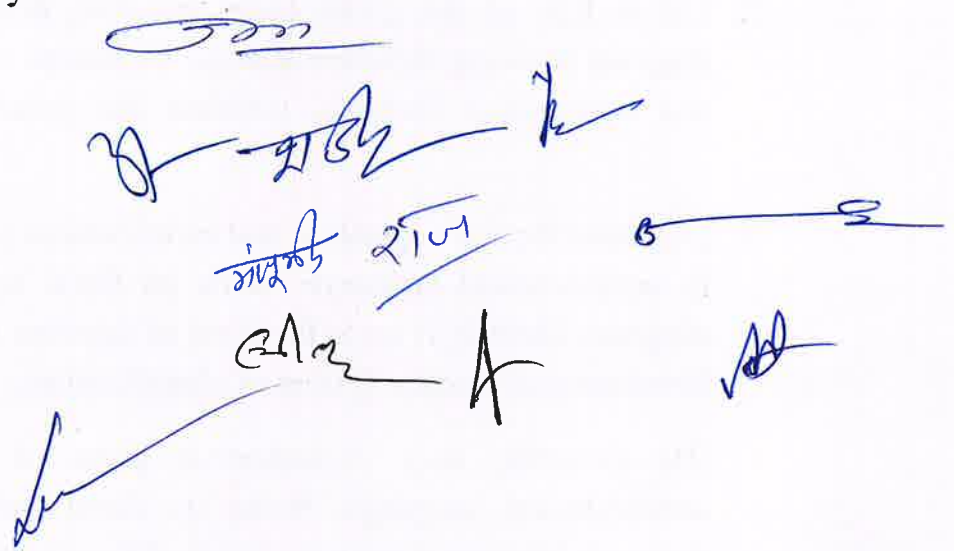
Suggested Readings:

1. Cole, A. J. 1969. Numerical Taxonomy. Academic Press, London.
2. Davis, P. H. and Heywood, V. H. 1973. Principles of Angiosperms Taxonomy, Robert E. Kreiger Pub. 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. Hesiop-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. Luchsinger, A. E. 1986. Plant Systematics (2nd Edition). Mcgraw-Hill Book Co., New York.
10. Nordenstam, B., El Gazaly, G. and Kassa, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.
11. Radford, A. E. 1986. Fundamentals of Plant Systematics. Harper & Row Publication, USA.
12. Singh, H. 1978. Embryology of Gymnosperms, Encyclopedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.

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- 13. Solbrig, O. T. 1970, Principles and Methods of Plant Biosystematics. The Macmillan Cocollier-Macmillan Ltd., London.
- 14. Solbrig, O. T. And Solbrig, D. J. 1979. Population Biology and Evolution. Addison-Wesley Publishing Co. Ind USA.
- 15. Stebbings, G L. 1974, Flowering Plant- Evolution Above Species Level. Edward Arnold Ltd. London.
- 16. Stace, C. A. 1989. Plant Taxonomy and Biosystematics (2nd Edition) Edward Arnold Ltd., London.
- 17. Takhtajan, A. L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
- 18. Woodland, D. W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.



PAPER CODE P-22-3037

PRACTICAL EXAM SKELETON PAPER

M.Sc. (Botany) Semester- III

Group-I General papers

Paper- IX--Plant physiology & metabolism,

Paper- X--Plant morphology & developmental anatomy

Paper- XI--Taxonomy of angiosperms

Time: 6 Hours

MM :150

1. Perform the given physiological exercise, write the method, principal and precautions. Draw suitable diagrams. 30
2. Cut a T.S. of the given plant material, draw its labelled cellular diagram showing different tissues. Comment upon the morphological and anatomical features, mention the points of special interest. 30
3. (A) Describe the vegetative and reproductive parts of given plant "A" in semitechnical language. Write its floral formula and draw floral diagram. Identify it up to the level of families following key based on Bentham and Hooker system of classification. 15
(B) Describe only reproductive parts of given plant "B" in semitechnical language. Write its floral formula and draw floral diagram. Identify it upto the level of families following key based on Bentham and Hooker system of classification. 10
(C) Herbarium 05
4. Identify and comment upon the spots(1-6) 6X5 30
5. Practical Record 15
6. Viva Voce 15

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ADVANCED PLANT PATHOLOGY-I

UNIT -I

Introduction: History and scope of plant pathology, objectives of plant pathology. biotic and abiotic pathogens. Nature, origin and evolution of parasitism.

Pathogen factors in disease development: Enzymes and Toxins. Penetration, infection and pathogenesis.

UNIT -II

Physiological specialization in phytopathogenic microbes.

Host factors in disease development, Inoculum Potential, Phenomena of resistance and susceptibility, Protective and defense mechanisms in plants, Phytoalexins. Breeding for disease resistance in plants.

UNIT - III

Environmental factors in disease development.: Epiphytotics, Epidemiology and plant disease forecasting.

Principles of plant protection, Physical, chemical and biological control of plant diseases, IPM, Application of biotechnology and information technology in pest management.

UNIT- IV

Molecular Plant Pathology : Molecular diagnosis, identification of genes and specific molecules in disease development, molecular manipulation of resistance.

Non-parasitic plant diseases: General account of nonparasitic diseases. General characteristics of some non-parasitic diseases and their control measures(Mango Tip necrosis, Khaira Disease of rice, citrus mottle leaf

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and Pansukh disease of rice).

Plant galls: Classification, anatomy, mechanism (host-parasite interactions) and physiology of insect induced plant galls. Some insect induced plant galls of Rajasthan (*Pongamia*, *Cordia*, *Ziziphus* and *Salvadora*).

Suggested practical exercises:

1. Camera Lucida drawing Technique.
2. Morphology and anatomy of some insect induced galls.
3. Sporometry (to measure spore size).
4. Contribution of eminent pathologists.
5. Field visits to show plant diseases.

Suggested readings :

1. Walker, J C. 1969 3rd Ed. Plant Pathology.
2. Mundkur, B B 1953 Fungi and plant diseases.
3. Tarr, S J J, 1972 The principles of plant pathology.
4. Sharma, P D, 2001, Plant Pathology.
5. Singh, R S, 1963, Plant Diseases. Oxford IBH Publ.
6. Singh, R S, 1963, Principles of Plant Diseases.
7. Clifton, A. 1958. Introduction to the Bacteria. McGraw Hill Book Co. New York.
8. Mandahar, C.L. 1978. Introduction to plant viruses. Chand & Co. Ltd., Delhi.
9. Trivedi, P.C. 1998. Nematode Diseases in Plants. CBS Publisher & Distributor, New Delhi

PAPER CODE P-22-3038

PRACTICAL EXAM SKELETON PAPER

M.Sc. (Botany) Semester III

PAPER: XII (A) Advanced plant pathology-I

Time: 3 Hours

MM. 50

1. Inoculate the given material under sterile conditions and write down precautions taken during the inoculation. 10
2. Write contribution of any two plant pathologist given below. 10
3. Prepare a double stained preparation of given material. Draw neat labelled diagram. Write down histopathological observations. 10
4. Identify and comment upon spots 1-5. 10
5. Practical Record 05
6. Viva voce 05

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ENVIRONMENTAL BIOLOGY & ARID ZONE ECOLOGY-I

UNIT-I

Ecosystem: Structure and ecological process in the Grassland (types of grassland-prairies and savannah, ICAR. Classification of Indian grasslands, significance of grasslands).

Forest: types- boreal, temperate and tropical forest, deforestation causes and effects.

Freshwater and Marine and Estuarine ecosystems (flora fauna, productivity, coral reef, mangrove). **Urban** (environmental and climatic conditions, physical complexes, flora and fauna).

Problems of urbanization: Air pollutants, drinking water supply, floods, waste disposal)

Rural ecosystems: Problems- discharge of chemical fertilizers, pesticides and drinking water.

UNIT-II

Pollution: Air pollution (primary and secondary pollutants), Water Pollution (eutrophication, oil, thermal, heavy metal pollution, treatment, disposal and recycling of wastewaters), soil and noise pollution: kinds, sources, quality parameters, effects on plants and ecosystems.

Remediation of soil, water (municipal) and air pollution, Green belt. Solid wastes and their management. 3Rs (Reduction, Recycle and Reuse) Principle, Social Forestry.

UNIT-III

Climate Issues: Greenhouse gases (CO_2 , CH_4 , N_2O , CFCs: sources, trends and role) and consequence of greenhouse effects (CO_2 fertilization, global

warming, sea level rise, Biodiversity erosion Ozone layer depletion and its consequence.

Applications of GIS and Remote Sensing Technology in environmental studies, the future of planet earth.

UNIT-IV

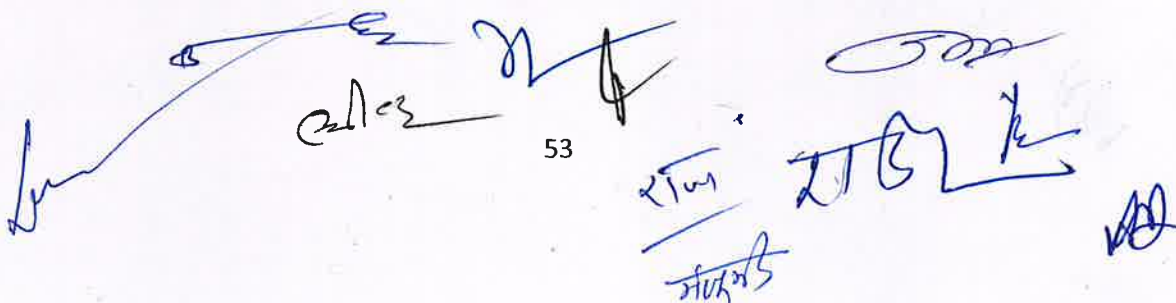
Environmental auditing, Environment Impact Assessment. Bio indicator and biomarkers of environmental health; Environment economics. Eco politics and green policies; Eco level.

Policies, Regulations, and related issues: water (Prevention and Control of Pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981: Environment (Protection) Act 1986, Wildlife protection) Act 1972: Forest (Conservation) Act 1980.

Suggested practical exercises:

1. To estimate PH, EC and Sacchi disc transparency for polluted and unpolluted water bodies.
2. To estimate chemical oxygen demand of polluted water sample.
3. To estimate biological oxygen demand of polluted water sample.
4. To estimate inorganic phosphorus content in water samples collected from polluted and unpolluted water bodies.
5. To estimate total hardness, calcium and magnesium content in water samples collected from polluted and unpolluted water bodies.
6. Find out the stomatal index of plant species growing in your locality.
7. Study of trichomes of selective plant species growing in your locality.
8. Study spread of root system of a perennial species in the soil.
9. Study ecological adaptations of halophytes in your nearby area.

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Suggested Readings:

1. Treshow, M. 1985. Air Pollution and Plant Life. Wiley Inter science.
2. Mason. C. F. 1991. Biology of Freshwater Pollution. Longman.
3. Hill, M. k. 1997. Understanding Environmental Pollution, Cambridge University Press.
4. Brij Gopal, P.S. Pathak and K.G. Saxena (Eds.). 1998. Ecology Today: An anthology of Contemporary Ecological Research. International Scientific Publications, New Delhi.
5. P. k. Goel, 1997. Water Pollution: Causes, Effect and control. New Age International Ltd., Publishers New Delhi.
6. P.L. Jaiswal, A. M. wadhvani and N. N. Chhabra (Eds.). 1983. Desertification and Its Control. ICAR, New Delhi.
7. R.K. Trivedy and P.K. Goel. 1998. An Introduction to Air Pollution. Technoscience Publications, Jaipur.
8. S.K. Maiti. 2004. Handbook of Methods in Environmental Studies Vol. 1&2. ABD Publisher, Jaipur.
9. I. P. Abrol and V. V. Dhruva Narayana (Editors) 1990. Technologies for Wasteland Development. ICAR, M.Sc. BOTANY SEM III

PRACTICAL EXAM SKELETON PAPER

M.Sc. (Botany) Semester III

PAPER: XII (B) Environmental biology & arid zone ecology-I

Time: 3 hours

Max Marks: 50

1. Find out the of given Polluted and unpolluted water samples.

OR

Find out the the selected water bodies with the help of sacchi disc.

- | | |
|--|----|
| | 05 |
| 2. Study the morphological & anatomical ecological adaptation of given plant. | 10 |
| 3. Conduct field test in the given soil sample (Any two) | 05 |
| 4. Study the density and frequency/abundance/dominance of plant species of college campus. | 10 |
| 5. Identify and comment upon spots 1-5. | 10 |
| 6. Practical Record. | 05 |
| 7. Viva Voce | 05 |

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PLANT BIOTECHNOLOGY & GENETIC ENGINEERING

UNIT-I

Plant Tissue culture: Principles, Concept, History, General methodology, culture media ingredients, preparation, methods of sterilization and disinfection, aseptic techniques and preparation of explants, histological and photographic techniques for plant tissue culture. Micropropagation in plants, Shoot morphogenesis and organogenesis, callus and suspension cultures, microspore culture and its importance.

Somatic embryogenesis: Principles, concepts and applications. **Protoplast technology:** Isolation methods, purification, viability tests, culture, plating efficiency, Somatic cell hybridization, selection of protoplast fusion hybrids, Cybrids and synthetic seeds, Applications of Soma clonal Variation.

UNIT-II

Plant tissue culture and Secondary metabolite production. Overview of Plant Tissue Culture Applications.

Recombinant DNA Technology: Tools and techniques, construction of genomic/cDNA libraries, electrophoresis and blotting techniques, nick translation, DNA microarrays and DNA footprinting, polymerase chain reaction and its types, DNA fingerprinting.

Vectors for plant transformation: Basic features of vectors (Promoters and terminators, selectable markers, reporter genes, origin of replication, Co-integrative and binary vectors), Optimization, clean gene technology.

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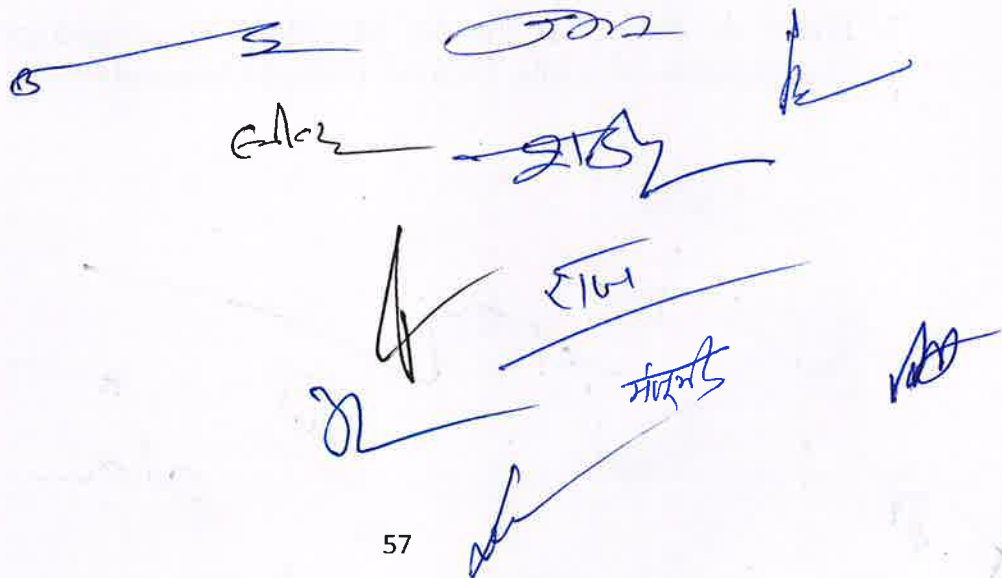
UNIT-III

Techniques for plant transformation: *Agrobacterium* mediated gene transfer, Direct gene transfer methods. The genetic manipulation of Herbicide tolerance, pest tolerance, plant disease resistance. Reducing the effects of viral disease, Strategies for engineering stress tolerance, Improvement of crop yield and quality, Molecular farming of carbohydrate & lipids (Starch, polyfructans, bioplastics), proteins (custom made antibodies, edible vaccines, oleosin system).

UNIT-IV

Metabolic Engineering and industrial Products: control mechanisms and manipulation of phenylpropanoid pathway, alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, Therapeutic proteins Antibiotics, ethanol, Polyketides, Vitamins, Biopolymers, Biological Pigments, Amino acids, solvents.

Science and society: Public acceptance of genetically modified crops (Public concerns, current status of transgenic crops, concerns about GM crops, regulation of GM crops and products), Introduction to Intellectual property, Biosafety guidelines, Environmental release of GMO's, Risk analysis).



Suggested practical exercises:

1. Preparation of media.
2. Surface sterilisation
3. Micro propagation technique
4. Organ culture.
5. Callus propagation. organogenesis, transfer of plants to soil.
6. Anther culture, production of Haploids.
7. Preparation of synthetic seeds
8. Cytological examination of regenerated plants.
9. Isolation of protoplasts from various plant tissues and testing their viability
10. Agrobacterium culture selection of transformants, reporter gene (GUS) assays.
11. Techniques: Biolistics. Membrane Filtration, Cell Counting

Suggested Readings:

1. J.Hammond.P. Mc.Gravey and V. Yusibov (Eds.): Plant Biotechnology. Springer Verlag. 2000.
2. T.J.Fu.G. Singh. and W.R. Curtis(Eds): Plant Cell and Tissue Culture for the Production of Food ingredients. Kluwer Academic/Plenum Press. 1999.
3. H:S. Chawla: Biotechnology in Crop improvement. International Book Distributing Company: |49X.
4. R.J.Henry: Practical Application of plant Molecular Biology. Chapman
5. P.K.Gupta: Plant Biotechnology Rastogi and Co. Meerut. 2010
6. Bhojwani. S.S. and Razdan, M.K. 1996. Plant Tissue Culture : Theory and Practice (a revised edition). Elsevier Science Publishers, New York. USA.
7. Slater A. Scott M, Fowler M: Plant biotechnology: the genetic manipulation of plants. Oxford: Oxford University Press. 2010

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PLANT REPRODUCTION BIOLOGY**UNIT-I**

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

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 allergy, pollen embryos.

UNIT-II

Female gametophyte: ovule-development, types of ovule megasporogenesis, organization of the embryo sac, structure of the embryo sac cells. Floral characteristics, pollination mechanisms and vectors, breeding systems, commercial considerations, structure of the pistil, pollen-stigma interactions, saprophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects), double fertilization, in vitro fertilization.

UNIT-III

Seed development and fruit growth : Endosperm development during early maturation and desiccation stages, embryogenesis, ultrastructure 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.

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UNIT-IV

Latent life (dormancy): Importance and types of dormancy, seed dormancy, overcoming seed dormancy, bud dormancy.

Senescence and programmed cell death (PCD): Basic concepts, types of cell death, PCD in the life cycle of plants. Metabolic changes associated with senescence and its regulation, influence of hormones and environmental factors on senescence.

Suggested practical exercises:

1. Study of microsporogenesis and gametogenesis in sections of anthers.
2. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa*, *Crotalaria* *Tradescantia*, *Brassica*, *Petunia*, *Solanum melongena*, etc.)
3. Tests for pollen viability using stains and in vitro germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
4. Estimating percentage and average pollen tube length in vitro.
5. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.
6. Pollen storage, pollen-pistil interaction, self-incompatibility, in vitro pollination.
7. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryo sac development thorough examination of permanent, stained serial sections.

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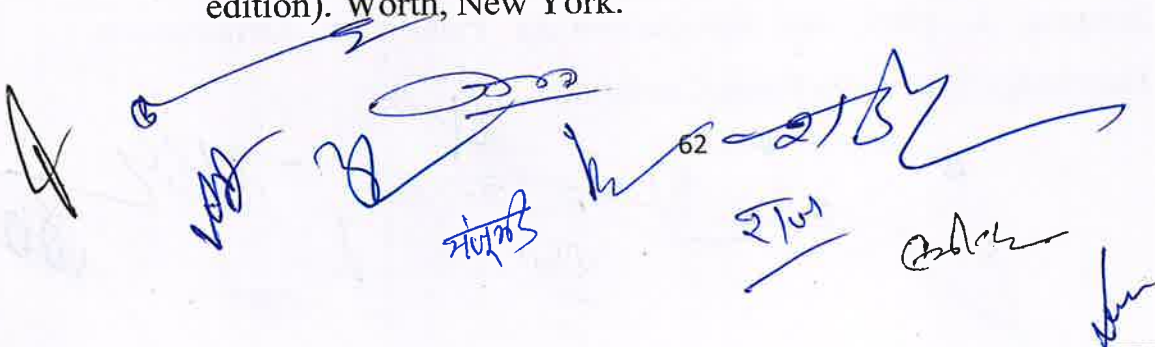
8. Field study of several types of flower with different pollination mechanisms (Wind pollination, thrips pollination, bee/butterfly pollination, bird pollination).
9. Emasculation, bagging and hand pollination to study pollen germination, seed set and fruit development using self compatible and obligate outcrossing systems. Study of cleistogamous flowers and their adaptations.
10. Study of nuclear and cellular endosperm through dissections and staining.
11. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds and polyembryony in citrus, jamun (*Syzygium cumini*) etc. by dissections.
12. Study of seed dormancy and methods to break dormancy.

Suggested Readings

1. Atwell, B.J. Grinderman, P.E. and Jambul, C.G.N. (eds). 1999. Plants in Action : Adaption in Nature Performance, in Cultivation, McMillan Education. Sydney, Australia.
2. Bewley. J.D. and Black, M. 1994. Seeds: Physiology of Development and Germination, Plenum Press. New York.
3. Bhojwani, S.S, and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
4. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.

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5. Fakery, K. and Van der Pihl, L. 1979. The Principle of Pollination Ecology. Pergamon Press, Oxford.
6. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.
7. Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
8. Howell, S.H. 1998. Molecular Genetics of Plant Development. Cambridge University press , Cambridge.
9. Leins, P., Tucker, S.C. and Endress, P.K. 1988. Aspects of Floral Development, J. Cramer, Germany.
10. Lyndon, .F. 1990. Plant Development. The Cellular Basis, Unwin Hyman, London.
11. Murphy, T.M. and Thompson, W.E, 1988. Molecular Plant Development. Prentice Hall, New Jersey.
12. Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
13. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
14. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
15. Raven, P.H., Evert, R.F. and Eichhorn, S. 1992. Biology of Plants (5th edition). Worth, New York.

A collection of handwritten signatures and scribbles in blue ink at the bottom of the page. The signatures are stylized and vary in length and complexity. Some appear to be initials or names, while others are more abstract scribbles. There is a small number '62' written near the center of the scribbles.

16. Salisbury, P.B. and Ross, C.W. 1992. Plant Physiology (4th edition).
Wadsworth Publishing, Belmont, California.
17. Steves, T.A. and Sussex, I.M., 1989. Patterns in Plant Development
(2nd edition). Cambridge University Press, Cambridge.
18. Sdgely, M. and Griffin, A.R. 1989. Sexual Reproduction to Tree
Crops. Academic Press, London.
19. Shivanna, K.. R. and Sawhney, VK. (eds.) 1997. Pollen
Biotechnology for Crop Production and Improvement. Cambridge
University Press, Cambridge.
20. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology : A
Laboratory Manual. Springer-Verlag. Berlin.
21. Shivanna, K.R. and Johri, B.M. 1985. The Angiosperm Pollen :
Structure and Function. Wiley Eastern Ltd.. New York.
22. The Plant Cell Special Issue on Reproductive Biology of Plants. Vol.
5(10) 1993. The American Society of Plant Physiologists, Rockville,
Maryland. USA.

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PLANT RESOURCE UTILIZATION & ETHNOBOTANY**UNIT-1.**

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

Origin of agriculture.

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

Plants used as avenue trees for shade, pollution control and aesthetics.

UNIT-2

Origin, evolution, botany, cultivation and uses of :

Cereal crops, Forage crops, Fodder crops , Fiber crops, and oil-yielding crops .Medicinal and Aromatic plants and Vegetable oil-yielding crops.

Important firewood and timber-yielding plants

Non-wood forest products (NWFPs) such as bamboos, rattans.

Raw materials for Paper making, Gums, Tannins, Dyes, Resins and Fruits.

UNIT-3

Principles of conservation ; extinctions; environmental status of plants based on International Union for Conservation of Nature. (IUCN).

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.

Ex situ conservation: Principles and practices, botanical gardens. Field gene banks, Seed banks, in vitro repositories, cryobanks.

General account of : Botanical Survey of India (BSI), National Bureau of plant Genetic Resources (NBPGR), Indian Council of Agricultural Research

(ICAR), Council of Scientific and Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

UNIT-4

Ethnobotany: History development and scope of Ethnobotanical study. interdisciplinary approaches, ethnic groups of India.

Applied Ethnobotany: role of Ethnobotany in National priorities, health care and development of cottage industries in India.

Suggested practical exercises:

1. Preparation of media.
2. Surface sterilization.
3. Micropropagation techniques.
4. Organ culture.
5. Callus propagation, organogenesis, transfer of plants to soil.
6. Anther culture, production of haploids.
7. Preparation of synthetic seeds.
8. Cytological examination of regenerated plants.
9. Isolation of protoplasts from various plant tissues and testing their viability.
10. Agrobacterium culture, selection of transformants, reporter gene (GUS) assays.
11. Polymerase chain reaction.
12. Techniques: Membrane Filtration, Cell Counting.

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Suggested readings:

1. Hammond, J. and McGarvey, P. and Yusupova, V. (Eds.) 2000: Plant Biotechnology, Springer Verlag.
2. Fu, T.J., Singh, G. and Curtis, W. R. (Eds.) 1999: plant cell and tissue culture for the production of food ingredients. Kluwer Academic/Plenum Press.
3. Chawla, H. S. 1998. Biotechnology in crop improvements. International book distributing company.
4. Henry, R. J. 1997. Practical application of plant molecular biology. Chapman and Hall.
5. Gupta, P. K. 2010. Plant biotechnology, Rastogi and Co. Meerut.
6. Bhojwani, S. S. and Razdan, M. K. 1996. Plant tissue culture: theory and practice (A revised edition). Elsevier Science Publishers, New York, USA.
7. Slater, A., Scott, N., Fowler, M. 2010. Plant biotechnology: the genetic manipulation of plants. Oxford, Oxford University Press.

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PAPER CODE P-22-4037

PRACTICAL EXAM SKELETON PAPER

M.Sc. (Botany) Semester- IV

Group-I General papers

Paper- XIII-- Plant biotechnology and genetic engineering

Paper- XIV-- Plant reproductive biology

Paper- XV-- Plant resource utilization and ethnobotany

Time: 6 Hours

M.M.:150

1. Perform the given Plant tissue culture and Genetic engineering exercise, Describe method, precautions taking during experiment. 30
2. Perform the given Plant Reproductive Biology exercise. "A" and "B" 15+15
3. Describe the various constituent found in given material. Write their botanical name, family, Plant part used & its economic importance. 30
4. Identify and comments upon the spots.1-6 30
5. Practical Record 15
6. Viva-Voce 15

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ADVANCED PLANT PATHOLOGY-II

UNIT I

Fungal diseases : Symptomatology, disease identification and control of Flag smut of wheat, Covered smut of barley, Blast of paddy, Smut of Jowar, Red rot of sugarcane, Flax rust and Early blight of potato.

UNIT II

Bacteria : Classification and nomenclature of bacterial plant pathogens. Methods of identification of bacterial pathogens (morphology, physiology, serology and pathogenicity) .

Bacterial diseases : Brown rot of potato, Blight of rice, Soft rot of vegetables ,Crown gall of stone fruits and Angular leaf spot of cotton.

UNIT III

Virus, viroid and phytoplasma diseases: Symptomatology and transmission of viral diseases; potato mosaics by Potato virus x and y ,Tomato mosaic , Bunchy top of banana . Viroids and important viroid diseases (Potato spindle tuber disease). Phytoplasma : General account and diseases; Sesamum Phyllody and Sandal spike.

UNIT IV

Nematology: General account of nematode diseases. Symptoms caused by nematodes. Methods used in Nematology. Control of plant parasitic nematodes. Interrelationship between nematode and other plant pathogens. Nematode Diseases: Root Knot disease of vegetables, Molya disease of wheat & barley, Ear- cockle of wheat and cyst of Soyabean .

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Suggested laboratory exercises:

1. Preparation of culture media.
2. Inoculation technique.
3. Fungal diseases.
4. Root knot diseases.
5. Gram staining.
6. Bacterial diseases
7. Viral diseases.
8. Mycoplasmal diseases.

Suggested readings:

1. Walker, J C. 1969 3rd Ed. Plant Pathology.
2. Mundkur, B. B. 1953 Fungi and plant diseases.
3. Tarr, S. J , 1972 The principles of plant pathology.
4. Sharma, P D, 2001, Plant Pathology.
5. Singh, R S, 1963, Plant Diseases. Oxford IBH Publ.
6. Singh, R S, 1963, Principles of Plant Diseases.
7. Clifton, A. 1958. Introduction to the Bacteria. McGraw Hill Book Co. New York.
8. Mandahar, C.L. 1978. Introduction to plant viruses. Chand & Co. Ltd., Delhi.
9. Trivedi, P.C. 1998. Nematode Diseases in Plants. CBS Publisher & Distributor, New Delhi.
10. Ray Choudhary S. P. and Nariani T R. Virus and Mycoplasma Disease of Plants in India.
11. Sasser, | N. & Jenkins W R. Nematology: Fundamentals and Recent Advances with emphasis on Plant Parasitic and Soil Forms.
12. Wallace, H R The Biology of Plant Parasitic Nematodes.
13. Bawden, F C. Plant Viruses and viral diseases.
14. Mehrotra, R S & Aggarwal, A 2003, Plant Pathology. TMH Publ.

69

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PAPER CODE P-22-4038

PRACTICAL EXAM SKELETON PAPER

M.Sc. (Botany) Semester IV

PAPER: XVI (A) Advanced plant pathology-II

Time: 3 Hours

MM. 50

1. Study the material 'A' carefully by preparing its suitable stained preparation & identify the causal organism associated with the disease giving reasons. 10
2. Bacteriological exercise. 05
3. Cut a section of the given material C & makes a suitable preparation so as to describe the morpho- histological abnormalities caused by the parasite in the host. 10
4. Identify and comments upon the spots.(1-5) 15
5. Practical Record 05
6. Viva-Voce 05

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ENVIRONMENTAL BIOLOGY & ARID ZONE ECOLOGY-II

UNIT-1

Desert: Definition, their formation, physiography, topography, distribution and characteristics of world desert, hot and cold deserts with special reference to India, consequence of desertification, combat desertification.

Desert as an ecosystem, biological production with particular reference to conservation of flora and fauna.

UNIT-II

Thar Desert: geomorphic evolution, characteristic of Thar Desert.

Sand dunes: classification, origin and morphology of sand dunes stabilization and management of sand dunes; wind breaks and shelter belt, afforestation, and desert control measures. Vegetation types and plant communities, wildlife, succession in vegetation of western Rajasthan and coastal sand dunes.

UNIT-III

Economic importance of desert plants: General economic plants, medicinal, famine food plants and crops.

Saline Arid Zones: The saline tracts and their vegetation (halophytes) with special reference, to Rajasthan; economic and social considerations in the management of salt affected soils. Afforestation in salt affected soils.

UNIT- IV

Water problem in Rajasthan particularly underground water resources and its change. Rain water harvesting. Dry land farming, arid lands and horticultural crops, Indira Gandhi Canal and its ecological implication. Waterlogging and salinity problems- The management alternatives.

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Suggested Laboratory Exercise:

1. Seed viability by T.T.C. method.
2. Dormancy (seed coat and temperature) in seeds.
3. Salinity of soil sample.
4. Relative humidity by air hygrometer.
5. Light intensity by lux meter.
6. Mark hot and cold desert on world map.

Suggested Readings:

1. P.L. Jaiswal, A.M. Wadhvani and N.N. Chhabra (Eds.).1983. Desertification and Its Control. ICAR, New Delhi.
2. Smith, R.L. 1996. Ecology and Field Biology, Harper Collins, New York.
3. W. P. Cunningham and M. A. Cunningham, 2003. Principles of Environmental Science: Inquiry and Applications. Tata Mcgraw-Hill



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PAPER CODE P-22-4039

PRACTICAL EXAM SKELETON PAPER

M.Sc. (Botany) Semester IV

PAPER: XVI (B) Environmental biology & arid zone ecology-II

Time: 3 hours

Max Marks: 50

1. Find out the TDS value of given samples with the help of digital T.D.S. method.

OR

Find out the primary productivity of the given plant species by leaf disc method. 10

2. Fill up the given map showing the distribution of desert regions in the world. Label the map properly. 10

3. Determine the light intensity in open, shade and laboratory condition by lux photometer. 10

4. Identify and comments upon the spots.(1-5) 10

5. Practical Record 05

6. Viva-Voce 05













