BOTANY 2018

Theory

Course	Nomenclature	Number of Papers	Number of Periods per week	Maximum marks	Minimum marks
Paper I	Algae, Lichens and Bryophytes	1	2	50	54
Paper II	Mycology, Microbiology and Phytopathology	1	2	50	
Paper III	Palaeobotany, Pteridophytes and Gymnosperms	1	2	50	
PRACTICAL COURSE			6	75	27

Duration of examination of each theory papers 3 hours
Duration of examination of practicals 5 hours

PAPER I: ALGAE, LICHENS AND BRYOPHYTES

Unit I: General characters, Classification and economic importance of Algae. Important features and life history of Chlorophyceace and Charophyceae. Structure and life cycle of *Volvox,Oedogonium*, *Coleochaete* and *Chara*.

Unit II: Important features and life history of Xanthophyceae and Phaeophyceae. Structure and life cycle of Vaucheria, Ectocarpus and Sargassum.

Unit III: Important Features and life history of Rhodophyceae. Structure and life cycle of Polysiphonia. Lichens: Morphology and structure of the two components; biological, ecological and economic importance.Vegetative multiplication methods with special reference to Parmelia and Usnea.

Unit IV: Bryophytes: General characters, alternation of generations and classification.Characters and Classification of Hepaticopsida. Morphology and life history of Riccia, Marchantia and Plagiochasma.

Unit V: Characters and classification of Anthocerotopsida and Bryopsida. Morphology and life history of Anthoceros and Sphagnum.

Suggested Laboratory Exercises

Algae: Microscopic preparation and study of following algal materials: *Volvox, Oedogonium, Coleochaete, Vaucheria, Chara, Ectocarpus, Sargassum* and *Polysiphonia*

Lichens: Study of Lichens

Bryophytes: Study of external morphology and microscopic preparations of following Bryophytes: *Riccia*, Marchantia, *Plagiochasma, Anthoceros* and *Sphagnum*

Suggested Readings

Bold, H.C., Alexopoulous, C.J. and Delevoryas, T. Morphology of Plant and Fungi (4th Ed.) Harper & Foul Co., New York, 1980.
Ghemawat, M.S., Kapoor, J.N. and Narayan, H.S. A text book of Algae, Ramesh Book Depot, Jaipur, 1976.
Gilbert, M.S. Cryptogamic Botany, Vol. I & II (2nd Ed.), Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 1985.
Kumar, H.D. Introductory Phycology, Affiliated East–West Press, Ltd., New York, 1988.
Pandey, S.N. and Trivedi, P.S.A Text Book of Botany 2000 Volume I, Vikas Pub. House Pvt. Ltd., New Delhi.
Puri, P.Bryophytes, Atmaram & Sons, Delhi, Lucknow, 1985.
Singh, V., Pande, P.C. and Jain, D.K.A Text Book of Botany, Rastogi & Co., Meerut, 2001.
Vashista, B.R. Botany for Degree Students (Algae, Fungi Bryophyta), S. Chand & Co. Ltd., New Delhi, 2002.

PAPER II: MYCOLOGY, MICROBIOLOGY AND PHYTOPATHOLOGY

Unit I: General characters, Classification and economic importance of fungi. Important features and life history of Mastigomycotina–*Pythium* and *Albugo*; *Zygomycotina–Rhizopus*; *Ascomycotina–Saccharomyces, Aspergillus* and *Penicillium*.

Unit II: Important features and life history of Basidiomycotina– *Puccinia, Agaricus* and wild Mushroom and *Ustilago*; Deuteromycotina–*Collectotrichum* and *Alternaria*.

Unit III: Viruses: Chemical and physical nature; Structure, multiplication and transmission of plant viruses. Tobacco mosaic virus and yellow vein mosaic virus disease. General account of Viroids, AIDS and Prions.

Unit IV: Bacteria–Structure, nutrition, cell division, reproduction and economic importance. Biofilms and Quorum sensing in microbes.Cyanobacteria–Life history of *Nostoc* and *Oscillatoria*; Nitrogen fixation – by BGA (Blue green algae).General account and biology of Mycoplasma and Phytoplasma.

Unit V: Causes and symptoms of plant diseases with special reference to green ear disease of Bajra, smut of wheat, citrus canker, little leaf of brinjal and root knot disease. A brief account of principles of plant protection.

Suggested Laboratory Exercises

Microscopic preparation and study of following fungal materials: *Albugo, Rhizopus, Saccharomyces, Aspergillus, Penicillium, Ustilago, Agaricus,* local Mushroom¸*Colletotrichum* and *Alternaria*. Viruses: Study of disease symptoms caused by Tobacco mosaic virus and yellow vein mosaic virus.

Bacteria: Gram staining of bacteria. *Nostoc, Oscillatoria* and study of bacteriological specimens. Study of symptoms of following diseases: (specimen or photographs)

Green ear disease of bajra
Smut of wheat
Citrus canker
Rust of wheat
Little leaf of bringal
Root knot nematode.

Suggested Readings

Alexopoulos, C.J. and Mims.Introductory Mycology, John Wiley and Sons, New York, 2000.

Bilgrami, K.S. and Dube, H.C. A Text Book of Modern Plant Pathology, Vikas Publ. House, New Delhi, 1976.

Biswas, S.B. and Biswas, A.An Introduction to Viruses, Vikas Publ. House, New Delhi, 2000.

Clifton, A.Introduction to Bacteria, McGraw Hill Co., New York, 1985.

Dube, H.C. Fungi, Rastogi Publication, Meerut, 1989.

Kaushik, P. Microbiology, Emkay Publication, 2001.

Madahar, C.L. Introduction to plant viruses, S. Chand & Co. Ltd., New Delhi, 1978.

Palezer, Chan and King. Microbiology, McGraw Hill Book Co., London, 1995.

Pathak, V.N. Fundamentals of Plant Pathology, Agro Botanica. 2000.

Purohit, S.S. Microbiology, Agro. Bot. Publication, Jodhpur, 2002.

Sharma, O.P. Fungi, Today and tomorrow Publication, 2000.

Sharma, P.D. Microbiology and Plant Pathology, Rastogi Publ. Meerut, 2003.

Singh, V. and Srivastava, V.Introduction to Bacteria, Vikas Publication, 1998.

Vashista, B.R. Botany for Degree student Fungi, S. Chand & Co., New Delhi, 2001.

PAPER III: PALAEOBOTANY, PTERIDOPHYTES AND GYMNOSPERMS

Unit I: Geological time scale, Fossilization. General characters and classification and Pteridophytes.Important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.Stelar systems in Pteridophyta.Structure and reproduction in *Rhynia*.

Unit II: Occurrence, Structure and life history of *Lycopodium, Selaginella* and *Equisetum*.

Unit III: Occurrence, structure and life history of *Adiantum, Marsilea* and *Azolla*. Heterospory in Pteridophyta.

Unit IV: Characteristics of seed plants, evolution of the seed habit. General features of gymnosperms and their classification; evolution, diversity and economic importance of Gymnosperms.*Cycas*:Morphology of vegetative and reproductive parts, anatomy of root, stem and leaf; Reproduction and life cycle.

Unit V: *Pinus* and *Ephedra*: Morphology of vegetative and reproductive parts, anatomy of root, stem and leaf, reproduction and life cycle.

Suggested Laboratory Exercises

Palaeobotany: Microscopic examination of slides of *Rhynia*.

Pteridophytes: Study of external morphology of *Lycopodium, Selaginella, Equisetm, Adiantum, Marsilea,* and *Azolla*. Microscopic study of temporary double stained preparations of stem/rhizome of *Lycopodium, Selaginella, Equisetum* and *Marsilea*.

Study of temporary single stained microscopic preparations of cone of *Selaginella* and T.S. of Sporophyll of *Adiantum* and sections of sporocarp of *Marsilea*.

Gymnosperms:Study of external morphology of plant parts of *Cycas*: young and old foliage leaf, scale leaf, bulbils, male cone, microsporophyll, megasporophyll and mature seed (if material is not available show photographs).

Microscopic temporary double stained preparations of rachis and leaflet of Cycas. Study of T.S. normal and Corolloid root by permanent slides.

Study of external morphology of plant parts of *Pinus* habit, long and dwarf shoot, male cone; female cone; winged seeds.

Microscopic temporary preparation of pollen grains (W.M.) of *Pinus.* Study through permanent slides T.S. stem: young and old; male/female cone of *Pinus.*

Study of habit and structure of whole male and female cone of *Ephedra*.

Microscopic preparation of male and female flowers of *Ephedra*.

Suggested Readings

Bold, H.C., Alexopolous, C.J. and Delevoryas, T. Morphology of plant and fungi (4th ed.), Harper and Foul, Co., New York, 1980.

Gifford, E.M. and Foster, A.S. Morphology and Evolution of Vascular Plants, W.H. Freeman and Company, New York, 1988.

Pandey, S.N., Mishra, S.P., Trivedi, P.S. A Text Book of Botany Vol. II, Vikas Pub.House Pvt. Ltd., New Delhi 2000.

Raven, P.H. Evert, R.F. and Eichhom, S.C. Biology of plants, (5th ed.), W.H. Reema and Co., Worth Publication, New York, U.S.A., 1999.

Sharma, O.P. Pteridophytes, Today and tomorrow Publication, 2000.

Sporne, K.R. The Morphology of Gymnosperms, B.I. Publ. Pvt., Bombay, Calcutta, Delhi, 1991.

Vashista, P.C. Gymnosperm, S. Chand & Co. Ltd., New Delhi, 2002.

Vashista, P.C. Pteridophyta, S. Chand & Co. Ltd., New Delhi, 2002.

Wilson, N.S. and Rothewall, G.W.Palaeobotany and evolution of Plants, (2nd ed.), Cambridge University Press, U.K., 1993.

BIOTECHNOLGOY 2018

PAPER I: BIOCHEMISTRY AND BIOSTATISTICS

Max Marks: 50

Unit 1: Introduction: General Composition of living matter-A Brief account and function of biomolecules.Bioenergetics: Principles of bioenergetics. Energy Rich compounds. Biological oxidation-reduction reactions.
Water: Properties of water molecule, Hydrophilic and hydrophobic groups in biological molecules.
Carbohydrates: Classification and general structure and properties of monosaccharides.
Lipids: Classification and general structure, properties of fats and Oils.

Unit II: Amino Acids: Classification, general structure and properties
Proteins: Classification three–dimensional structure (helicity, bending, pleats, salt-bridges etc) and the basis for intermolecular interactions in enzyme– substrate and antigen-antibody recognition.
Nucleotides: Composition, General structure and properties.
Nucleic Acids: Types and general structure, Non-canonical DNA Structures (Bent DNA, cruciform triple stranded, G quartet, slipped DNA)

Unit III: Enzymes: Classification, Nature specificity & mechanism of catalysis, kinetics, inhibition, allosteric control.
Enzyme Technology: Enzyme Production, various sources of enzymes, extraction, purification & packaging.
Enzyme Applications: Therapeutic, Manipulative, Industrial and Analytical (ELISA & Biosensors)

Unit IV: Collection, classification, Tabulation and diagrammatic and graphical representation of statistical data: Histogram, pie chart, bar diagram, frequency polygon. Measurement of central tendency: Mean, Median, Mode.

Unit V: Measurement of dispersion : Mean Deviation, Standard Deviation, Standard Error, Variance, Coefficient of correlation, test for significance : t-test, (Single sample Mean and Two sample Mean), Chi-Square Test and F-Test.

PAPER II:CELL BIOLOGY AND GENETICS

Max Marks: 50

Unit I: Cell as a basic unit of living systems: The cell theory.Prokaryotic and Eukaryotic Cell, Eukaryotic Cell – Shape Size, Volume, and Number.

Broad classification of cell types: PPLOs, Bacteria, Plant and Animal cells. A detail classification of cell types within an organism.Cell, tissue, organ and organisms as different levels of organization.

Unit II: Structure and functions of cell organelles; ultra structure of cell membranes, Cytosol, Golgibodies, Endoplasmic reticulum (rough and smooth), Ribosome, Cytoskeletal structure (actins, microtubule etc), Mitochondria, Chloroplasts, Lysosomes, Peroxisomes, and Nucleus (Nuclear membrane, nucleoplasm, nucleolus and chromatin).

Cell division, cell cycle and cell growth.

Unit III: Nature of genetic material, nucleic acids, DNA replication, Mendelian laws of inheritance, gene interaction.

Sex determination in plants and animals.Sex linkage, non-disjunction as a proof of chromosomal theory of inheritance.Linkage mapping of genes, interference, coincidence in Prokaryotes and Eukaryotes.

Unit IV: Chromosome: Chemical composition: Structural organization of chromatids, centromeres, chromatin, telomeres, nucleosomes, euchromatin and heterochromatin. Special types of chromosomes (e.g. polytene and lampbrush chromosomes); Mutations; spontaneous and induced; chemical and physical mutagens.

Unit V: Basic microbial genetics; conjugation, transduction and transformation.Isolation of auxotrophs, Replica plating techniques, analysis of mutations in biochemical pathways, one-gene-one-enzyme hypothesis. Extra chromosomal inheritance, genetic systems of mitochondria and chloroplast

PAPER III:MICROBIOLOGY AND COMPUTATIONAL BIOLOGY

Max Marks: 50

Unit I: Development of microscopy (Optical, TEM and SEM).The Concept of sterilization, Methods of sterilization (Dry heat, wet heat, radiation, chemicals and filtration etc.)

Unit II: Prokaryotic and eukaryotic microbial cells. The various forms of microorganisms-PPLO'S, Cocci,Bacilli and Spirilla. Nature of microbial cell surfaces,gram (+) ve and gram (-) ve bacteria, Types of bacteria on the basis of flagella. Flagellar types in Gram (+) ve and Gram (-) ve bacteria.

Unit III: Nutritional classification of microorganisms-symbiosis and antibiosis among microbial populations.Microorganisms in extreme environments.Pathogenicity among microorganisms. Defence mechanism against microorganisms and Serotypes.

Unit IV: Microbial metabolism: Spontaneous and induced variation arising in microbial population.Recombination events in bacteria. Nitrogen-fixing microbes in Agriculture.Products from microorganisms-fermentation products, and antibiotics.

Unit V: Computers: General introduction to Computers, organization of computers, digital and analog computers, computer algorithms.

Computer in online monitoring and automation.Application of computers in co-ordination of solute concentration, pH and temperature etc. of a fermenter in operation.

Introduction to Bioinformatics. Molecular databases, application of data associates tools e.g. BLAST, FASTA, Storage, Retrieval and analysis of sequences. Application of bioinformatics.

Practical

1. Quantitative estimation of the following in biological samples:
   a. Sugar in given solution
   b. Sugar in biological sample
   c. Extraction and separation of lipids
   d. Estimation of proteins
   e. Estimation of DNA/RNA
   f. Isolation and purification of proteins
   g. Assays for enzyme activity
   h. Kinetic activities on enzymes
   i. Chromatographic methods of separation of macromolecules

2. Demonstration of computers and application.
3. Aseptic techniques:
   a. Preparation of media, cotton plugging and sterilization
   b. Personal hygiene-microbes from hands, teeth and other body parts.
   c. Isolation of microorganism from air, water and soil sample. Dilution and pour plating, colony purification
   d. Enumeration of micro organism from: Total v/s viable counts.
   e. Identification of isolated bacteria. Gram staining, other staining methods, metabolic characteristic.
   f. Growth curve of microorganisms.
   g. Antibiotic sensitivity of microbes- use of antibiotic discs.

Suggested Readings

Cox, Nelson & Lehninger- Principles of Biochemistry, CBS Publishers & Distributors

L.Stryer- Biochemistry- W.H. Freeman & Co.
Geoffrey Zubay- Biochemistry- Mac-Millan Publishing Co.
J.L. Jain – Biochemistry – S. Chand & Co.
Conn, Stumpf & Blueumming- Outlines of Biochemistry- Wiley Eastern Ltd.
G.M. Malacinski & David Freifelder – Essentials of Molecular Biology- Jonnes &Barlet , Boston
Gardner, Simmons & Snustad- Principles of Genetics, John Wiley & Sons.
P.K. Gupta- a Text book of cell & molecular biology, Rastogi Publication Meerut.
Trevor Palmer- Enzymes- biochemistry, Biotechnology & Clinical Chemistry- Horwood Publishing House.
P D Sharma- Microbiology- Rastogi Publications
Pawar & Daginawala-General Microbiology Vol I & II – Himalaya Publishing House
A J Salle- Fundamental Principles of Bacteriology- Tata McGraw Hill
Pelczar, Chan & Kreib Microbiology – Tata McGraw Hill
Brock & Madigan- Biology of microganisms.Prentice Hall, Inc.
Higgins & Taylor – Bioinformatics, Oxford University Press.
Stephen P Hunt & Rick Liveey- Functional Genomics, Oxford University Press
Rashidi- Bioinformatics basic- Application to life Sciences & Medical Science ASM
B D Singh- Genetics, Kalyani Publishers

Practical

Time: 5.00 Hrs Max Mark: 75
Min Mark: 27

1.	Perform and explain the given biotechnology experiment. Show the result to the examiner	15
2.	Perform and explain the given microbiology experiment.	10
3.	Prepare a bacterial slide by Gram's staining method and report result	06
4.	Identify and comment upon the spots (1 to 6)	24
5.	Viva-Voce	10
6.	Practical Record	10

BOTANY 2018

Theory

Course	Nomenclature	Number of Papers	Number of Periods per week	Maximum marks	Minimum marks
Paper I	Taxonomy and Embryology of Angiosperms	1	2	50	54
Paper II	Anatomy of Angiosperms, Economic Botany and Ethnobotany	1	2	50	
Paper III	Cell Biology, Genetics, Plant Breeding and Evoloution	1	2	50	
PRACTICAL COURSE			6	75	27

Duration of examination of each theory papers 3 hours
Duration of examination of practicals 5 hours

PAPER I: TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS

Unit I: Diversity in plant form in annuals, biennials and perennials, Canopy architecture in angiosperms: tree-origin, development, arrangement and diversity in size and shape, Flower-modified shoot, structure and development of flower, Inflorescence-types of Inflorescence.

Unit II: Angiosperms: Origin and evolution. Some examples of primitive angiosperms. Angiosperm taxonomy; (Alpha-taxonomy, Omega-taxonomy, holotaxonomy) Taxonomic literature. Botanical nomenclature; principles and rules; taxonomic ranks, type concept, principle of priority. Classification of angiosperms; salient features of the systems proposed by Bentham and Hooker and Engler and Prantl.

Unit III: Major contributions of cytology and molecular biology, phytochemistry and taximetrics to taxonomy. Diversity of flowering plants as illustrated by members of the families Ranunculaceae, Papaveraceae, Caryophyllaceae, Capparidaceae, Cucurbitaceae, Rutaceae and Apiaceae.

Unit IV: Diversity of flowering plants as illustrated by members of the families Asteraceae, Acanthaceae, Apocynaceae, Asclepiadaceae, Scrophulariaceae, Lamiaceae, Euphorbiaceae, Musaceae and Poaceae.

Unit V: Embryology: Structure of anther and pistil. Development of the male and female gametophytes; pollen-pistil interactions, self incompatibility; Double fertilization; Development of endosperm and embryo; Brief account of experimental embryology. Basics of gene imprinting.

Suggested Laboratory Exercises

Field study of diversities found in leaf shapes, size, thickness and surface properties.

The following families are for detailed taxonomic studies:

1. Ranunculaceae: *Ranunculus, Delphinium*
2. Papareraceae: *Papaver, Argemone*
3. Caryophyllaceae: *Dianthus, Gypsophylla, Saponaria*
4. Capparidaceae: *Capparis, Cleome*
5. Rutaceae: *Murraya, Citrus*
6. Apiaceae: *Coriandrum, Foeniculum, Anethum*
7. Cucurbitaceae: *Luffa* or any Cucurbit
8. Asteraceae: *Helianthus, Calandula, Sonchus*
9. Acanthaceae: *Adhatoda, Barleria*
10. Apocynaceae: *Catharanthus, Thevetia, Nerium*
11. Asclepiadaceae: *Calotropis*
12. Scrophulariaceae: *Linaria, Antirrhinum*
13. Euphorbiaceae: *Euphorbia, Phyllanthus*
14. Lamiaceae: *Ocimum, Salvia*
15. Musaceae: *Musa*
16. Poaceae: *Avena, Triticum, Hordeum, Poa, Sorghum*

Suggested Readings

Bhandari, M.M. Flora of Indian Desert.

Bhojwani, S.S. and Bhatnagar, S.P. The Embryology of Angiosperms, 4th Revised and enlarged edition, Vikas Publ., New Delhi, 2002.

Davis, P.H. and Heywood, V.H. Principles of Angiosperm Taxonomy, Oliver and Boyd, London, 1963.

Fegerig K. and Vender Pifi The Principles of Pollination Ecology, Pergamon Press, 1979.

Gifford, E.M. and Foster, A.S. Morphology and Evolution of Vascular Plants, W.H. Freemad and Company, New York, 1979.

Heywood, V.H. and Moore, D.M. (eds.) Morphology and Evolution of Vascular Plants, W.H. Freeman and Company, New York, 1984.

Jeffrey, C. An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London, 1982.

Jones, S.D. Jr. and Suchsinger, A.E. Plant Systematic (2nd ed.) McGraw-Hill Book Co., New York, 1986.

Maheshwari, J.K. Flora of Delhi, CSIR, New Delhi, 1963.

Redford, A.E.: Fundamentals of Plant Systematics, Harper and Row, New York, 1986.

Sharma, O.P. Taxonomy: Tata McGraw Hill Pub. Company Ltd., New Delhi 2000.

Singh, G. Plant Systematics – Theory and Practices, Oxford and IBH Pvt. Ltd., New Delhi, 1999.

Singh, V., Pandey, P.C. and Jain, D.K. Angiosperms, 2005, Rastogi Pub., Meerut.

PAPER II: ANATOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND ETHNOBOTANY

Unit I: Anatomy of Angiosperms: Concept of stem cell in plants. Root system; Root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

Unit II: Shoot system: The shoot apical meristem and its histological organization; vascularization of primary shoot in monocotyledons and dicotyledons; cambium and its functions; formation of secondary xylem, a general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heart wood; secondary phloem-structure, function relationship; Periderm.

Unit III: Abnormal secondary growth and Leaf: Abnormal secondary growth in stems due to abnormal origin and activity of cambium. Leaf: Internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

Unit IV: Economic Botany, Food plants: Rice, wheat, maize, potato, sugarcane. Fibers: Cotton and Jute. Vegetable oils: Groundnut, mustard and coconut, General account of sources of firewood, timber and bamboos. Beverages: Tea and coffee; Rubber.

Unit V: Spices and Condiments: General account. Medicinal plants with special reference to Rajasthan: *Aloe, Asparagus, Commiphora, Boswellia, Pedalium, Zyziphus, Haloxylon, Tribulus, Vitex,* and *Withania*. Ethnobotany: Introduction, Methods of Ethnobotanical studies, knowledge of aboriginals in Rajasthan.

Suggested Laboratory Exercises

ANATOMY: L.S. of Shoot tip of study Cytohistological zonation and origin in leaf primordial. Anatomy of primary and secondary growths in monocots and dicots using hand sections (or prepared slides). Structure of secondary phloem and xylem. Growth rings in wood. Microscopic study of wood in T.S., T.L.S. and R.L.S. Internal structure of leaf. Structure and development of stomata (using epidermal peels of leaf). Anatomy of root, primary and secondary structures, Abnormal secondary growth in stem.

ECONOMIC BOTANY: Food plants: Study of morphology and structure. Simple microchemicals tests of the food storing tissues in rice, wheat, maize, potato and sugarcane. Microscopic examination of starch in these plants (except sugarcane)

Fibers: Study of cotton fiber, tests for cellulose. Vegetable oils: study of hand sections of Groundnut, Mustard and Coconut and staining of oils droplets by Sudan III and Sudan Black

Field visits: To study sources of firewood (10 plants), timber-yielding trees (10 trees) and bamboos. A list to be prepared mentioning special features

Medicinal Plants & Spices: Black pepper, cloves, cardamom describe them in briefly. Study of 10 medicinal plants. Write their botanical and common names, parts used and diseases/disorders for which they are prescribed.

Beverages & Rubber: Cofee, Tea & Rubber

ETHNOBOTANY: Ethobotanically important plants of Rajasthan (Abrus, Leptidenia and Calotropis)

Suggested Readings

Cutter, E.G. Plant Anatomy: Experiment and Interpretation, Part II. Organs, Edward Arnold, London, 1971.

Esau, K. Anatomy of Seed Plants, 2nd John Wiley & Sons, New York, 1977.

Fahn, A. Plant Anatomy. 2nd ed. Pergamon Press, Oxford, 1974.

Kocchar, S.L. Economic Botany in Tropics. 2nd ed. Mac-millan India Ltd., New Delhi, 1998.
Mauseth, J.D. Plant Anatomy, The Benjamin/Cummings Publ. Company Inc., Menloc Park, California, USA, 1988.
Sambamurthy, A.V.S.S. and Subramanyam, N.S. A Text book of Economic Botany, Wiley Eastern Ltd., New York, 1989.
Sharma, O.P. Hill's Economic Botany (Late Dr. A.F. Hill, Adapted by O.P. Sharma), Tata McGraw Hill Co., Ltd., New Delhi, 1996.
Simposon, B.B. and Conner-Ororzaly, M. Economic Botany Plants in Our World, McGraw Hill, New York, 1986.

PAPER III: CELL BIOLOGY, GENETICS, PLANT BREEDING AND EVOLUTION

Unit I: History of cell biology: Concept of cell and cell theory. Cell cycle and its regulation. Mitosis and meiosis. Structural and Molecular organization of cell. Structure and function of cell wall; plasmodesmata, plasma membrane; golgi complex, plastid, mitochondria, endoplasmic reticulum, peroxisomes, vacuoles and nucleus.

Unit II: Chromatin organization: Organization and structure of chromosomes. Concept of nucleosomes, chromatin remodeling. Types of chromosomes and determination of sex in plants. Chromosome alteration: Structural alteration; deletion, duplication, translocation, inversion; Numerical variation: aneuploidy and polyploidy. Molecular basis of mutation: Spontaneous and induced, brief account of DNA damage and repair. Introduction to epigenetics.

Unit III: Nature of inheritance; Laws of Mendelian inheritance and its exceptions. Crossing-over and linkage analysis. DNA the genetic material: Structure and replication, brief account of DNA- protein interaction. Definition of a gene-modern Concept of gene (Promoter, coding sequences, terminator). RNA polymerases and general transcription. Regulation of gene expression in prokaryotes and basics of gene regulation in eukaryotes.

Unit IV: Origin of Agriculture, Centers of origin of crop plants and centers of Diversity. Concepts of Centers and Non-center (Harlan Hypothesis) Principles of plant breeding-Domestication, Introduction, Selection, Clonal propagation, Hybridization, Mutation breeding; Breeding work done on wheat; Green revolution; Assessment and Consequences; Biodiversity and Conservation of germplasm.

Unit V: Theories of Evolution: Catastrophism, The Lamark's theory, Darwin's theory, Evidences of organic evolution, mechanism of evolution. Origin of basic biomolecules evolution of prokaryotic and eukaryotic cell. and Origin of species Population genetics: Allele and genotype frequency, Hardy- Weinberg principles.

Suggested Laboratory Exercises

CYTOLOGY

1. Study of cell structure from onion leaf peels
2. Comparative study of cell structure in onion cells and *Hydrilla*
3. Smear preparation of root tips for different stages in *Allium* root tip
4. Cytological examination special types of chromosomes (Slides)
5. Examination of electron micrographs of eukaryotic cells and cell organelles

GENETICS

1. Working out laws of inheritance using seed mixtures
2. Monohybrid, dihybrid and test crosses using seed samples

PLANT BREEDING

1. Demonstration of Emasculation techniques.

Practical Exam Scheme
B.Sc. Botany Part II

Q1. Describe a given flower in semi-technical language with flower diagram and formula mentioning special feature of identification. Cut a T.S. of anther/ovary/ovule of the same flower and describe from embryological point of view.

(10+4) (10+6)

Q2. Cut a T.S./V.S. of given stem/root/leaf and make a double stained preparation of the same. Draw a labeled diagram (outline and cellular), identify with special features.
(8+6) (9+7)

Q3. Prepare a smear of onion root tip, for observation of metaphase and anaphase stage of mitosis. Draw a labeled diagram of the same.

	(12+4)	(11+3)
Q4. Spots (1-9) three from each paper	(27)	(27)
Q5. Practical record	(6)	-
	75	75

Suggested Readings

Alberts, B., Bray, D ., Lewis, J., Raff, M., Roberts, K. and Watson, I.D. Molecular *Biology of cell*. Garland publishing Co., New York, USA

Chaudhary, H.K. Elementary principles of plant Breeding, Oxford & IBH Publishing New Delhi.

Gupta, P.K. A Textbook of cell and Molecular Biology, Rastogi Publications, Meerut,1999

Gupta, P.K. Cytology, Genetics, Evolution and plant Breeding, Rastogi, Publication, Meerut,2000.

Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. Molecular Cell Biology, W.H. Freeman & Co. New York, USA

Miglani, G.S. Advanced Genetics , Narosa publishing Co., Inc., USA

Russel, P.J. Genetics. The Benjamin/ Cummings Publishing Co., Inc., USA

Shukla, R.S. and Chandel, P.S. Cytogenetics, Evolution and Plant Breeding, S.Chand & Co.Ltd., New Delhi

Singh B.D. Textbook of plant Breeding. Kalyani publishers, Ludhiana,1999

Sinha, U. and Sinha, S. Cytogenetics, Plant Breeding and Evolution, Vikas Publishing House, New Delhi, 1997

Sunstand, D.P. and Simmons, M.J. Principles of Genetics, John Wiley & Sons Inc., USA 2000

BIOTECHNOLGOY 2018

PAPER I: MOLECULAR BIOLOGY

Max Marks: 50

Unit 1: Molecular basis of life, Structure of DNA, DNA replication in prokaryotes and eukaryotes. Concepts of genomics and proteomics.

Unit 2: DNA recombination-molecular mechanism in prokaryotes and eukaryotes. Insertion elements and transposons. Structure of prokaryotic genes.

Unit 3: Prokaryotic transcription, prokaryotic translation, prokaryotic gene expression (*lac*, his, *trp*, catabolic repression).

Unit 4: Structure of eukaryotic genes- transcription, eukaryotic translation, eukaryotic gene expression and transcription factors.

Unit 5: Gene expression in yeast, post translation regulation of gene expression. Developmental and environmental regulation of gene expression.

PAPER II: BIOPHYSICS

Max Marks: 50

Unit I: Law of thermodynamics, Enthalpy, Free Energy, Heat dissipation and heat conservation.Primary events in Photosynthesis.

Unit II: Strategies of light reception in microbes, plants and animals. Electrical properties of biological components.

Unit III: Generation and reception of sonic vibrations. Hearing aids, Intra and intermolecular interactions in biological system.

Unit IV: Physical methods applied to find out molecular structure: X-ray crystallography and NMR. General Spectroscopy, Lambert-Beer Law, Spectrophotometry & Colorimetery, UV-VIS, Fluorescence, AAS, IR, Raman Spectra

Unit V: Physical methods of imaging intact structure:
Ultra sound, Optical filters, X-ray, CAT scans, ECG, EEG, NMR imaging.

PAPER III: IMMUNOLOGY AND CELL CULTURE

Max. Marks: 50

Unit I: The immune system along with historical perspectives. Non-specific & specific immune mechanism, organs and cells of immunity and their function.Concept of Acquired and innate immunity and antigen.

Unit II: Structure and function of various classes of immuno-globulins
Humoral Immunity – Mechanism involved
Cell mediated immunity role of MHC, mechanism and cells involved.
Vaccines – Dead, live attenuated, recombinant, edible and chimeric vaccines.

Unit III: History of animal cell cultures. Biology of cultured Cells-the culture environment,Cell adhesion, Cell proliferation, energy metabolism.
Culture Vessels: The substrate, choice of culture vessels.
Laboratory requirements and sterilization techniques.
Simulating natural condition for growing animal cells- Importance of growth factor is serum.

Unit IV: Primary cultures: Isolation of tissue, primary explants cell line–
Nomenclature, Subculture & Propagation, finite and continuous cell lines.
Commonly used cell lines: their origin and characteristics, growth kinetic and cell lines.

Unit V: Application of animal cell culture
Cell Separation, characterization and differentiation
Transformation–Characteristics and applications
Transfection of animal cell & selectable markers.

Practical

1. Separation of molecules in cellular extract in aqueous buffer
(a) Gel Filtration
(b) Ion exchange chromatography
(c) TLC of extracted material
(d) Isolation of chromosomal and plasmid DNA from bacteria
(e) Restriction digestion of DNA and assigning restriction sites (demonstrations)
(f) Making competent cells of E-coli
(g) Transfection cells of plasmid DNA and selection for transformants.
2. Purification of antigens and antibodies
(a) Raising polyclonal antibodies
(b) Enzyme Linked Immunoassay
(c) Radio immunoassay
(d) Diagnosis of an infectious disease by an immunoassay

Book Recommended

Buchanan, Gruissem & Jones: Biochemistry and molecular biology of plants –American Society of Plant Physiologist, Maryland USA
Peter Paolella: Introduction to molecular biology. Tata McGraw Hill
Alberts, Bray, Lewis, Raff, Roberts & Watson: Molecular Biology of the cell. Garland Publishing Inc.
Darnell, Lodish & Baltimore: Molecular cell Biology –Scientific American Books
Roitt, Male & Brostoff: Immunology. Mobey, London
Roitt: Essential Immunology – Blackwell Scientific
Lewin: Gene VIII, Oxford University Press
Kuby J: Immunology –Understanding of immune system Wiley Liss NY

VolKenshtein: Biophysics, Russian Press
Deniel, M: Basic biophysics for biologists, Agrobios
Van HoIde: Principles of Physical biochemistry, Prentice Hall

Practical

Time: 5.00 Hr Max Mark: 75

		Min	Mark: 27
1.	Perform and explain the given Molecular Biology experiment. Show the result to the examiner	12	
2.	Perform and explain the given Biophysics experiment.	12	
3.	Perform and explain the given immunology and/or cell culture Experiment	12	
4.	Identify and Comment upon the spots (1 to 7)		21
5.	Viva-Voce	10	
6.	Practical Record		08

BOTANY 2018

Theory

Course	Nomenclature	Number of Papers	Number of Periods per week	Maximum marks	Minimum marks
Paper I	Ecology and Environmental Biology	1	2	50	54
Paper II	Plant Physiology and Biochemistry	1	2	50	
Paper III	Plant Biotechnology and Molecular Biology	1	2	50	
PRACTICAL COURSE			6	75	27

Duration of examination of each theory papers 3 hours
Duration of examination of practicals 5 hours

PAPER I: ECOLOGY AND ENVIRONMENTAL BIOLOGY

Unit I: Plants and Environment: Atmosphere (gaseous composition), water (properties of water cycle), light (global radiation, phytosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties) and biota.
Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes) temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity

Unit II: Population ecology: Concept and characters, growth curves, biotic potential, ecotypes and ecads. Seed: The significance, suspended animation; ecological adaptation and dispersal strategies

Community ecology and Succession: Community characteristics, frequency, density, cover, life forms and biological spectrum. Succession: concept, classification and examples (hydrosere & xerosere)

Unit III: Ecosystems and Productivity: Ecosystem — Structure, abiotic & biotic components, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles of carbon, nitrogen, phosphorus and Sulphur.
Productivity: Primary productivity, its measurements and factors affecting primary productivity

Unit IV: Environmental Biology of Indian Desert: Climate, vegetation types, adaptive strategies of desert plants. Desertification: meanings, causes, critical issues & driving forces. Agroforestry and its impact on desert agriculture. Desert biodiversity, Geomorphology, natural resources exploitation and their impact on desert environment

Unit V: Pollution Ecology: Definitions, classification, air, water and land pollution. Concepts of Industrial Ecology in pollution management. Global warming : Concepts and Current status. Phytogeography: Vegetation types of India — Forest and Grasslands. Biogeographical regions of India, Remote sensing: The basics and applications in ecological studies

Suggested Laboratory Exercises

1. To determine minimum number of quadrats required for reliable estimation of biomass in herbaceous vegetation
2. To study the frequency of herbaceous species and to compare the frequency distribution with Raunkaier's Standard frequency diagram
3. To estimate Importance Value Index for herbaceous vegetation on the basis of relative frequency, relative density and relative biomass in protected and Gochar land
4. To measure the vegetation cover of grassland through point frame
5. To measure the above ground plant biomass in a natural field
6. To determine diversity indices (richness Simpson, Shannon-Weaver) in natural fields
7. To estimate bulk density and porosity of soil samples
8. To determine moisture contents, water holding capacity and texture of soil samples
9. To estimate qualitatively nitrate, phosphate and potassium in soil samples
10. To study the vegetation structure through profile diagram
11. To estimate transparency and pH of different water bodies
12. To measure dissolved oxygen content in polluted and unpolluted water samples
13. To estimate salinity, hardness, carbonates and bicarbonate in different water samples
14. To determine the percent leaf area injury of different leaf samples collected around polluted site
15. To estimate dust holding capacity of the leaves of different plant species
16. Plant adaptive modifications: Specimens/Slides:
    - i) Succulents: *Opuntia, Euphorbia*
    - ii) Salt secretion: *Atriplex, Chloris*
    - iii) Salt accumulation: *Suaeda, Salsola, Zygophyllum*
    - iv) Xerophytes: *Calligonum, Capparis, Leptadenia, Parkinsonia*
    - v) Hydrophytes: *Eichhornia, Nymphaea, Hydrilla*

Suggested Readings

Dash, M.C. Fundamental of Ecology, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1996
Kormondy, E.J. Concepts of Ecology, Prentice – Hall of India Pvt., New Delhi, 1996
Kumar, H.D. General Ecology, Vikash Publishing House Pvt. New Delhi, 1995
Mukherjee, B. Environmental Biology, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1997
Odum, E.P. Basic Ecology, Sauders, Philadelphia, 1983
Sen, D.N. Environment and Plant Life in Indian Desert, Geobios International, Jodhpur, 1982
Sharma, P.D. Ecology and Environment, Rastogi Publications, Meerut 2002

PAPER – II
PLANT PHYSIOLOGY AND BIOCHEMISTRY

Unit 1: Plant-water relations: Importance of water to plant life; physical properties of water; diffusion and osmosis; absorption, transport of water and transpiration; physiology of stomata

Mineral nutrition: Essential macro- and micro-elements and their role, mineral uptake; deficiency and toxicity symptoms

Introduction to phloem transport; source-sink relationship; factors affecting translocation

Unit 2: Photosynthesis: Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration. Rubisco enzyme.

Unit 3: Respiration: Aerobic and anaerobic respiration; Kreb's cycle; electron transport mechanism (chemi – osmotic theory); redox potential; oxidative phosphorylation pentose phosphate pathway

Basics of enzymology: Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and cofactors; regulation of enzyme activity; mechanism of action, Protein structures

Unit 4: Nitrogen and lipid metabolism: Biological Nitrogen fixation. Importance of nitrate reductase and its regulation; ammonium assimilation. Structure and function of lipids; fatty acid biosynthesis; B-oxidation; storage and mobilization of fatty acids

Unit 5: Growth and development: Definitions; phases of growth and development. Brief account on seed dormancy, seed germination and senescence. Photoperiodism, physiology of flowering; florigen concept, biological clock, vernalization. Plant Hormones-auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, Physiological role and general mode of actions. Photomorphogenesis; Brief account on phytochromes and cryptochromes.

Suggested Laboratory Exercises

1. To study the permeability of plasma membrane using different concentrations of organic solvents
2. To study the effect of temperature on permeability of plasma membrane
3. To prepare the standard curve of protein and determine the protein content in unknown samples
4. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature
5. Comparison of the rate of respiration of various plant parts
6. Separation of chloroplast pigments by solvent method
7. Determining the osmotic potential of *vacuolar sap by* plasmolytic method
8. Determining the water potential of *any tuber*
9. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards

10. Bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant material
11. To study the regulation of stomatal movement using growth regulators, KCI and anti-transpirants

Suggested Readings

Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell (eds.). Plant Metabolism (2nd ed.), Longman, Essex, England, 1997

Galston, A.W. Life processes in Plants, Scientific American Library, Springer-Verlag, New York, USA, 1989

Hopkins, W.G. Introduction to plant physiology, John Wiley & Sons, Inc., New York, USA, 1995

Lea, P.J. and Leegood, R.C. Plant Biochemistry and Molecular Biology, John Wiley & Sons, Chichester, England, 1999

Mohr, H. and Schopfer, P. Plant Physiology, Springer-Verlag, Berlin, Germany, 1995

Salisbury, F.B. and Ross, C.W. Plant Physiology (4th ed.), Wadsworth Publishing Co., California, USA, 1992

Srivastava, H.S. Plant Physiology, Rastogi Publication, Meerut, 2001

Taiz, L. and Zeiger, E. Plant Physiology (2nd ed.), Sinauer Associats, Inc. Publishers, Massachusetts, USA, 1998

Suggested Readings

(for Laboratory Exercises)

Amar Singh. Practical Plant Physiology, Kalyani Publishers, New Delhi, 1977

Moore, T.C. Research Experiences in Plant Physiology: A Laboratory Manual, Springer-Verlag, Berlin, 1974

Nifa, A.J. and Ballou, D.P. Fundamental Laboratory Approaches for Biochemistry and Biotechnology, Fitzrierald Science Press, Inc., Maryland, USA, 1998

Robalts and Tucker, G.A. (Eds.) Plant Hormone Protocols, Humana Press, New Jersey¸ USA, 2000

Scot, R.P.W. Techniques and Practice of Chromatography Marcel Dekker, Inc., New York, 1995

Wilson, K. and Goulding, K.H. A Biologists Guide to principles and techniques of Practical Biochemistry, Ed-ward Arnold, London, 1986

PAPER-III
PLANT BIOTECHONOLOGY AND MOLECULAR BIOLOGY

Unit 1: Cell theory and concept of totipotency and pluripotency. History of plant tissue culture and biotechnology. Basic tools and techniques of Plant tissue culture and molecular biology: General introduction about applications of biotechnology, bioinformatics and NanoBiotechnology.

Unit 2: Introduction to Bacterial Genome organization Genetic recombination in bacteria. Introduction to vectors for gene cloning: p-BR322, Cosmids, Phagemids and BAC. c-DNA libraries. Detection and screening of recombinant DNA.

Unit 3: Concepts of organogenesis-somatic embryogenesis and androgenesis. Somaclonal variations and its applications. Protoplast isolation, fusion and somatic hybridization. Cryopreservation of germplasm. Introduction to bioreactors and production of secondary metabolites with special reference to alkaloids obtained from *Ephedra*, shikonin, diosgenin and Strategies used to optimize secondary metabolite production.

Unit-4: Genetic engineering of plants: *Agrobacterium* mediated gene transfer, t-DNA transfer mechanism integration and expression in plants. Direct method of gene transfer in plants: Chemical methods electroporation, particle gun delivery, lipofection, microinjection, macroinjection, pollen transformation, laser induced and silicon fiber mediated. Reporter (Lucifarase, GUS and GFP) and marker genes.

Unit-5: Biotechnology and society: Development of transgenic crop plants against biotic and abiotic stresses. Genetically modified crops: Golden rice, Bt cotton (as a model system). Intellectual Property Right (IPR) and Plant Breeder's Rights (PBR) in current regime of WTO. Impact of GM crops on society and environment.

SUGGESTED LABORATORY EXERCISES

1. Demonstration of the technique of micropropagation by using different explants, e.g. auxiliary buds, shoot meristems
2. Demonstration of the techniques of anther culture
3. Isolation of protoplasts from different tissues using commercially available enzymes
4. Demonstration of root and shoot formation from the apical and basal portions of stem segments in liquid medium containing different hormones
5. Demonstrations/poster on GM Crops and related issues

Suggested Readings

Bhojwani, S.S. Plant Tissue Culture: Application and Limitation, Elsevier Science Publishers, New York, USA, 1990

Old, R.W. and Primrose, S.B. Principles of Gene Manipulation, Black well Scientific Publications, Oxford, U.K., 1986

Raghavan, O. Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University, Press, New York, USA, 1986

Vasil, I.K. and Thorpe, T.A. Plant Cell and Tissue Culture, Kluwer Academic Publishers, The Netherlands, 1994

SUGGESTED READINGS

(for Laboratory Exercises)

Ball, R.D. (ed.) Plant Cell Culture Protocols, Humana Press, Inc. New Jersey, USA, 1999

Dixon, R.A. (ed.) Plant Cell culture: a Practical Approach, IRL, Press Oxford, 1987

Glick, B.R. and Thompson, J.E. Methods in Plant Molecular Biology and Biotechnology, CRC Press, Boxa Raton, Florida, 1993

Roberts, J. and Tucker, G.A. (eds.) Plant Hormone Protocols Humana Press, New Jersey, USA 2000.

BIOTECHNOLOGY 2018

Max Marks: 50

PAPER I: RECOMBIANT DNA TECHNOLOGY

Unit I: What is gene cloning and why do we need to clone gene? Tools and Techniques: Plasmid and other vehicle. Genomic-DNA, handling of DNA and RNA. Restriction enzymes and reagents. Laboratory techniques and other requirements.

Unit II: Safety measures and related regulations for recombinant DNA work, choice and selection of the tools and techniques. Vehicles: Plasmids and bacteriophages, available phagemids, cosmids and viruses.

Unit III: Purification of DNA from bacteria, plant and animal cells. Manipulation of purified DNA.Introduction of DNA into living cells. Cloning vectors for *E-coli*.

Unit IV: Cloning vectors for organism other than *E-coli*, yeast, fungi, plants- agro bacteria, plants viruses and animal viruses. Applications of cloning in gene analysis- how to obtain a clone of a specific gene, studying gene location and structure, studying gene expression.

Unit V: Gene cloning and expression of foreign genes in research and biotechnology. Production of protein from cloned genes. Gene cloning in medicine: Pharmaceutical compounds, artificial insulin gene, recombinant vaccine, and diagnostic reagents.

PAPER II: PLANT BIOTECHNOLOGY

Max Marks: 50

Unit I: Introduction to in–vitro methods. Terms and definitions. Use of growth regulators. Beginning of in-vitro cultures in India (Ovary and Ovule culture), in-vitro pollination and fertilization. Embryo culture, embryo rescue after wide hybridization and its application.

Unit II: Introduction to processes of embryogenesis and organogenesis and their practical applications. Clonal multiplication of elite species (micropropagation) through axillary bud, shoot tip and meristem culture Haploids and their applications. Somaclonal variation and their applications.

Unit III: Endosperm culture and production of triploids.

Single Cell suspension culture and their application in selection of variant mutants with or without mutagen treatment (of haploid cultures preferably).

Unit IV: Testing of viability of isolated protoplasts, various steps in the isolation and regeneration of protoplasts.

Somatic hybridization – Introduction, various methods of fusion of protoplasts (chemical and electrical), use of markers for selection of hybrid cells.

Unit V: Practical application of somatic hybridization (hybrids/cybrids). Use of plant cell, protoplasts and tissue culture for genetic manipulation of plants. Introduction to *Agrobacterium tumefaciens*: Tumour formation on plants using *A. tumefaciens* (monocots v/s dicots)

Hairy Root formation using using *Agrobacterium rhizogenes*

Practical applications of genetic transformation.

Plant genomics (e.g. Rice, Arabidopsis)

PAPER III: ENVIRONMENTAL AND ANIMAL BIOTECHNOLOGY

Max Marks: 50

Unit I: General metabolism of animal cells. Special secondary metabolites/products (Insulin, growth hormone, Interferon, t- plasminogen activator, and factor VIII) Expressing cloned proteins in animal's cells. Over production and processing of chosen protein: The need to express in animal cells.

Unit II: Production of vaccines in animal cells.Production of monoclonal antibodies. Growth factors promoting proliferation of animal cells (EGF, FGF, PGDF, IL-1, IL-2, NGF, and Erythropoietin). Bioreactors for large-scale culture of cells. Transplanting cultured cells.

Unit III: Renewable and Non–Renewable resources. What is Renewable should be Bio-assimable / Biodegradable. Major consumable items: Food, Fuel and Fibers. Conventional Fuels and their Environmental impacts: Fire wood, Plant and Wastes, coal, gas, animal oils. Modern fuel and their environmental impacts: Methanogenic bacteria and biogas, microbial hydrogen production, conversion of sugars to ethanol the gasohol experiment, Solar energy converters - hopes from the photosynthetic pigments, plant based petroleum industry, cellulose degradation for combustible fuel.

Unit IV: Biotechnological inputs in producing good quality and natural fibers- transgenic animals and transgenic plants. Microbial quality of food and water .Treatment of municipal waste and industrial effluents.

Degradation of Pesticides and other toxic chemicals by micro organisms. Thuringiensis toxin as a natural pesticide, Biological control of other insects swarming the agricultural fields. Enrichment of ores by microorganisms, Biofertilizers. Nitrogen fixing microorganisms enrich the soil with assimilable nitrogen.

Unit V: Biodiversity and its conservation: Alpha- and Beta-biodiversity, steps to preserve biodiversity, in-situ and ex-situ conservation.

Intellectual property, IPR, and plant genetic resources, TRIPS and GATT

Patenting: Patenting of genetic material, obligations and complications, current issues: Ethics, Environmental safety.Risk assessment of GEOs (Genetically Engineered Organisms), Plant Breeder's right and farmer's rights.

Practical

1. Initiating Plant tissue culture: differentiation of explants.
2. Growth of plant cells into undifferentiated mass
3. Large-scale cultivation of plant cells in suspension
4. Induction of differentiation by modulating the hormonal balance
5. Culture of lymphocytes from blood samples
6. Preparation of media, filler sterilization, monitoring microbial contamination (bacteria, fungi & mycoplasma)
7. Cloning of animal cells by cell and colony purification
8. Fusion of cultured cells with myeloma cells.

Books Recommended

Old & Primrose: Principles of gene manipulation, Blackwell Scientific Publications

Sambrose & Russell: Molecular cloning CSH Press

Ausber: Current protocols in molecular biology CSH Press

Michel: Introduction to environmental microbiology

B.D. Singh Plant Breeding: Kalyani Publisher

Alexander, M: Microbial Ecology, John Wiley & sons

EC Eldowney, Hardman & Waite: Pollution Ecology biotreatment- Longman Scientific Technical
Baker &Herson - Bioremediation –Tata McGraw Hill
P.C.Debergh & R.H. Zi mmerman: Micropropagation Technique & Applications. Kluwer Academic Publishers
K. Lindsey & M.G. K. Jones: Plant Biotechnology in Agriculture
R.A. Meyers: Molecules Biology & Biotechnology VCH Publishers N.Y.
B. D. Singh: Plant Biotechnology, Kalyani Publishers
Indra K Vasil & Trevar A Thorpe: Plant Cell & Tissue Culture, Kluwer Academic Publishers
S.S Bhojwani & M.K. Razdan: Plant Tissue Culture Theory & Practice, Elsevier

Practical

Time 5:00 hr
Max. Marks: 75
Min. Marks: 27

1.	Preparation of nutrient medium and its sterilization	13	
2.	Preparation of explant (pretreatment), sterilization and inoculation for the given tissue culture technique	08	
3.	Identification of microbial contamination in the given nutrient medium	07	
4.	Identify & comment upon the Spots (1to6)	27	
5.	Viva- Voce	10	
6.	Practical Record		10