

**JECRC UNIVERSITY
SCHOOL OF SCIENCES
SESSION 2014-15**

Details of various subjects and their credits with contact hours are given below:

Semester I

Sub. Code.	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1A Major	4	-	2	4	2	6
	Core 1B Major	4	-	2	4	2	6
BBO001A	Botany	4	-	2	4	2	6
	Core 3 Minor	4		2	4	2	6
BMC101A	General Studies	3	-	-	3		3
BMC 001A BMC 002A	Computer Applications	2	-	2	2	2	4
BMC051A	Environment Studies	3	-	-	3		3
							34

Semester II

Sub.Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1A Major	4	-	2	4	2	6
	Core 1A Major	4	-	2	4	2	6
BBO 003A	Botany	4	-	2	4	2	6
	Core 3 Minor	4		2	4	2	6
BMC 104A	General Studies	3	-	-	3		3
BMC003A BMC 004A	Computer Applications	2	-	1	2	1	3
BMC 102A	Communication Skills	3	-	-	3		3
							33

Semester III

Sub. Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1A Major	4	-	2	4	2	6
	Core 1A Major	4	-	2	4	2	6
BBO005A	Botany	4	-	2	4	2	6
	Core 3 Minor	4		2	4	2	6
BMC 107A	General Studies	3	-	-	3		3

BMC 005A	Computer Applications	2	-	1	2	1	3
BMC 006A							
BMC 105A	Communication Skills	3	-	-	3		3
							33

Semester IV

Sub. Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1A Major	4	-	2	4	2	6
	Core 1B Major	4	-	2	4	2	6
BBO007A	Botany	4	-	2	4	2	6
	Core 3 Minor	4		2	4	2	6
BMC108A	General Studies	3	-	-	3		3
BMC 007A BMC 008A	Computer Applications	2	-	2	2	2	4
BMC111A	Communication Skills	3	-	-	3		3
							34

Semester V

Sub. Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1 A Major	4	-	2	4	2	6
	Core 1 B Major	4	-	2	4	2	6
BBO009A	Botany	4	-	2	4	2	6
	Core 2Minor	4		2	4	2	6
BMC110A	General Studies	3	-	-	3		3
BMC113A	Communication Skills	3	-	-	3		3
BMC109A	Value Education	3	-	-	3		3
BBO011A	Seminar	2	-	-	2		2
							35

Semester VI

Sub. Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1A Major	4	-	2	4	2	6
	Core 1B Major	4	-	2	4	2	6
BBO012A	Botany	4		2		2	6
	Core 3 Minor	4	-	2	4	2	6
BMC113A	General Studies	3	-	-	3		3

BBO014A	Project	3	-	-	3	8
						35

BOTANY

SEMESTER –I		
Code	Title of Course	Credits
BBO001A	CELL BIOLOGY AND THALLOPHYTES	4
BBO002A	Practical Lab of Algae, Fungi and Basics of Cell Biology	2
	Total Credits	6
SEMESTER –II		
BBO 003A	BRYOPHYTA, PTERIDOPHYTA AND LICHENS	4
BBO004A	Practical Lab of Cryptogams and Lichens	2
	Total Credits	6
SEMESTER –III		
BBO005A	GENETICS AND PLANT BREEDING	4
BBO006A	Practical Lab on basics of Plant Breeding and Genetics	2
	Total Credits	6
SEMESTER –IV		
BBO007A	MORPHOLOGY, ANATOMY AND PLANT PHYSIOLOGY	4
BBO008A	Practical Lab on Fundamentals of Anatomy ,Morphology and Plant Physiology	2
	Total Credits	6
SEMESTER -V		
BBO009A	GYMNOSPERM, ANGIOSPERM AND PALEOBOTANY	4
BBO010A	Practical Lab on Spermatophytes and Pal eoBotany	2
BBO0110	Seminar(optional)	2
	Total Credits	6
SEMESTER -VI		
BBO012A	ENVIRONMENTAL MANAGEMENT AND ECONOMIC BOTANY	4
BBO013A	Practical Exercises based on Plant Ecology and Economic Botany	2
BBO014A	Project (optional)	8
	Total	6
	Total Credits	36

I Semester

L	T	P	C
4	-	2	6

BBO001A: Cell Biology and Thallophytes

Credit(s): 4

Unit-I

Evolutionary history of biological diversity: early earth and its origin of life. Major events in the history of life, phylogeny and the tree of life. General structure of Bacteria. Cell membrane and cell wall: the function of membrane, models of membrane structure, membrane protein and their function, carbohydrate in the membrane and cell wall.

Unit-II

Cell theory, cell size and shape, eukaryotic cell components. Nucleus- nuclear envelop, structure of nuclear pore complex, chromatin structure, DNA packaging in eukaryotes, euchromatin, heterochromatin, nucleolus and ribosome structure, mitosis, meiosis.

Unit-III

Cell organelles: Mitochondria structure, composition, semiautonomous nature, symbiont hypothesis mitochondrial nature.

Chloroplast- structure, composition, semiautonomous nature and chloroplast DNA. ER, Golgi body and lysosome structure and role. Peroxisome and glyoxisome: structure.

Unit -IV

Algae- General characteristics; Ecology and distribution, Range of thallus organization and reproduction; Basic criteria used in classification (Fritsch, and Smith)

Important classes in relation to applied Phycology listed below

Cyanophyceae- *Nostoc*

Chlorophyceae- *Volvox, Chara*

Xanthophyceae – *Vaucheria*

Phaeophyceae- *Ectocarpus*

Rhodophyceae – *Polysiphonia*

Unit -V

Fungi- General characteristics; Ecology and distribution; Range of thallus organization; Cell structure; Wall composition; Nutrition; Growth; Reproduction and spores; Heterokaryosis and parasexuality; Basic criteria used in classification.

Life cycle of *Sclerospora*, *Aspergillus Claviceps*, *Ustilago* and *Alternaria*.

BBO002A: Cell Biology and Thallophyta Practical Lab

Credit(s): 2

1. To identify the different morphological forms of bacteria viz. Cocci, Bacilli under the compound microscope.
2. To perform Gram staining of Bacteria.
3. To identify and comment upon the given specimen of Citrus Canker, Little Leaf of Brinjal, and Crown Gall.
4. To identify various parts of Dissecting and Compound microscope and to understand its functioning .
5. To prepare epidermal peel preparation of onion leaf and study internal structure of cell.

6. To draw electron microphotographs of eukaryotic cell with its various internal cell organelles.
7. To prepare and identify different stages of mitosis in root tips of onion.
8. To prepare and identify different stages of Meiosis in Onion flower bud .
9. To prepare and identify suitable temporary slides of the algal cyanobacteria and chlorophyceae viz. *Nostoc and Volvox*.
10. To prepare and identify suitable temporary slides of the algal member *Vaucheria, Ectocarpus and Polysiphonia*.
11. To prepare and identify suitable temporary slides of the fungal member *Sclerospora and Aspergillus*.
12. To prepare and identify suitable temporary slides of vegetative, asexual and sexual stages of *Ustilago and Alternaria*.

Suggested Books

1. Rastogi V.B. Organic Evolution. Rastogi Publication.
2. Clifton A., Introduction of Bacteria, McGrawHill Co. Ltd. New York 1985.
3. Kaushik P. Microbiology, Emkay Publication, 2001.
4. Pelczar, Chan and Krueger. Microbiology. McGraw Hill Co., London, 1995.
5. De Robertis & De Robertis Cell and Molecular Biology. Lippincott Williams and Wilkins.
6. P.K. Gupta, Cell and Molecular Biology. Rastogi Publication.
7. C.B. Powar – Cell Biology, Himalaya Publishing House.
8. V.B. Rastogi – Cell Biology. Rastogi Publications.
9. Gilbert, M. Smith Cryptogamic Botany Vol I and II, IInd Ed. Tata McGraw Hill Publishing Company Ltd. N.Delhi. 1985.
10. Ghemawat M.S., Kapoor, J.N. and Narayan H.S. : A text Book of Algae. Ramesh Book Depot. Jaipur 1976.
11. Kumar. H.D. Introductory Phycology. Affiliated East-West Press Ltd., Newyork 1988.
12. Singh V., Pande P.C. and Jain D.K. A Text BBook of Botany Rastogi and Co. Merrut, 2001.
13. Alexopolous, C.J. and Mims : Introductory Mycology, John Wiley and Sons, New York, 2000.
14. Dube, H.C. Fungi, Rastogi Publication, Merrut, 1989.
15. Sharma O.P. Fungi Today and Tomorrow Publication, 2000.

II Semester

L	T	P	C
4	-	2	6

BBO 003A: Bryophyta, Pteridophyta and Lichens

Credit(s): 4

Unit-I

Bryophyta: general characters, origin, affinities and classification. Marchantiales- Life cycle of *Riccia, Marchantia*. Jungermanniales- *Pellia*. Anthocerotopsida- *Anthoceros*, Bryopsida- *Sphagnum*

Unit-II

Evolution of sporophyte in bryophytes, Economic Importance of Bryophyta. General character of pteridophyta, classification by Smith and Sporne, Stellar system in pteridophyta, Alteration of generation.

Unit -III

Distribution, Structure and life history of *Rhynia* and *Psilotum*. Distribution, Structure and life history of *Lycopodium* , *Equisetum*

Unit-IV

Distribution, Structure and life history of *Selaginella*, *Adiantum* and *Marsilea*.

Unit-V

Lichens- distribution, nature of association of phycobiont and mycobiont, classification of lichens, structure and reproduction of lichens. Ecological Indicators of pollution and economic importance of lichens. Mycorrhiza – General account and its significance

BBO 004A: Bryophyta, Pteridophyta and Lichen Practical Lab

Credit(s): 2

1. To examine external morphology of vegetative and reproductive parts of *Riccia*, *Marchantia* and *Pellia*.
2. To prepare hand cut sections of vegetative and reproductive parts of *Riccia*, *Marchantia* and *Pellia*.
3. To observe external morphology under dissecting microscope of *Anthoceros* and *Sphagnum*.
4. To prepare hand cut sections of vegetative and reproductive parts of *Anthoceros* and *Sphagnum*.
5. To identify various morphological forms (Crustose, Foliose and Fruticose) of lichens and comment upon their economic importance to mankind.
6. To examine external morphology of vegetative and reproductive parts of *Rhynia* (Permanent mount preparation) and *Psilotum*.
7. To prepare hand cut and double stained sections of vegetative and reproductive parts of *Psilotum*.
8. To examine external morphology of vegetative and reproductive parts of *Lycopodium* and *Equisetum*.
9. To prepare hand cut and double stained sections of vegetative and reproductive parts of *Lycopodium* and *Equisetum*.
10. To examine external morphology of vegetative and reproductive parts of *Selaginella* and *Adiantum*.
11. To prepare hand cut and double stained sections of vegetative and reproductive parts of *Selaginella* and *Adiantum*.
12. To examine external morphology of vegetative and reproductive parts of *Marsilea*.
13. To prepare hand cut and double stained sections of vegetative and reproductive parts of *Marsilea*.

Suggested Books

1. Puri P. Bryophytes Atma Ram and Sons, Delhi, Lucknow 1985.
2. Sarabhai R.C. and Saxena R.C. Text Book of Botany Vol. I and II, Ratan Prakashan Mandir, Merrut, 1980.
3. Singh, Pandey and Jain. A text Book of Botany, Rastogi and Co. Merrut 2001.
4. Vashishta B.R. : Botany for degree students (Bryophyta.) S. Chand & Co. New Delhi 2002.
5. Sarabhai & Saxena, Text Book of Botany, Rastogi Publications. Merrut 1990.
6. Sporne, K.R. Morphology of Pteridophytes B.I. Publication Pvt. Mumbai (2002).
7. Vashishta P.C. Pteridophyta. S. Chand and Co. New Delhi

III Semester

L	T	P	C
4	-	2	6

BBO005A: Genetics and Plant Breeding**Credit(s): 4****Unit-I**

Mendel work, (Terminologies, Laws of inheritance, Modified Mendelian Ratios, Chi square, Pedigree analysis, Cytoplasmic Inheritance, Multiple allelism, Pleiotropism)

Unit-II

Sex determination in human, Drosophila and plants, Sex linked inheritance.

Linkage: concept & history, complete & incomplete linkage, Bridges experiment, Crossing over : concept and significance, cytological proof of crossing over.

Unit-III

Numerical chromosomal changes, euploidy, polyploidy and aneuploidy.

Unit-IV

Structural chromosomal changes : deletions, duplications, inversions and translocations.

Types of mutations, effects of physical and chemical mutagens.

Unit-V

Introduction and objectives of plant breeding, general methods of plant breeding, Conventional and non conventional methods of plant breeding, hybrid vigour, inbreeding depression, role of mutation and polyploidy in plant breeding. Introduction to the concept of Recombinant DNA Technology, Cloning vectors, Restriction and modifying enzymes, Transformation techniques (brief introduction).

Suggested Books

1. Rastogi V.B. Genetics. Rastogi Publications.
2. Gupta P.K. Classical to Modern Genetics. Rastogi Publications.
3. Sandu and Arora, Genetics.Himalaya Publishing House
4. Miglani G.S. Advanced Genetics, Narosa Publishing House, New Delhi (2000).
5. Gardner, Principles of Genetics. Wiley India
6. Choudhary H.K. Elementary Principles of Plant Breeding, Oxford and IBH Publishing Co. N.D. 1989.
7. Shukla R.S. and Chandel P.S. Cytogenetics, Evolution and Plant Breedings S Chand and Co. Ltd. New Delhi (2000).
8. Singh R.B. Text BBook of Plant Breeding Kalyani Publishers. Ludhiana.

BBO006A: Genetics and Plant Breeding Practical Lab**Credit(s): 2**

- 1.To prepare note and understand the terminologies proposed by Mendel.
2. To solve numerical problems based on Mendel's Law of Inheritance (Monohybrid and Dihybrid Crosses).
- 3.To analyse numerical problems based upon modified Mendelian Laws through Punnett square method.
- 4.To perform the numericals based on sex determination in Drosophila.
5. To perform the numericals based on sex determination in humans.
- 6.To comment upon the types of cloning vectors used in genetic engineering.
- 7.To comment upon the types of enzymes used in rDNA technology.
- 8.To prepare temporary slide and comment upon Bar Body .
- 9 .To perform emasculation of anther in a bisexual cross pollinated flower.
- 10.To prepare emasculation bag to avoid cross pollination in a bisexual flower.
11. To perform various methods of vegetative propagation found in plants.
12. To prepare transverse hand cut section and study the internal structure of anther.

IV Semester

L	T	P	C
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4	-	2	6
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BBO007A: Morphology, Anatomy and Plant Physiology

Credit(s): 4

Unit-I

Different types of tissues, their organization into root, stem and leaf (monocot & dicot), Concept of stele and its evolution, meristematic, simple and complex secretory tissue.

Basic Body plan of flowering plants, modular type of growth, diversity of plant forms: annual, biennials and perennials.

Unit-II

Shoot and root system: shoot and root apical meristem and its histological organization, vascularisation of primary shoot and root in monocot and dicots, monopodial and sympodial growth.

Morphology and anatomy of seed (monocot and dicot), significance of seed, seed dispersal, vegetative reproduction: vegetative propagation, grafting.

Unit-III

Plant water relationship: Significance of water, water potential, water absorption and transport, transpiration, mechanism of opening and closing to stomata.

Mineral Nutrition: Essential elements, micro and macro nutrients, soil factors affecting their availability, Physiological basis of deficiency, symptoms, ion uptake. Transport of inorganic and organic component, transport pathway Xylem and Phloem.

Unit-IV

Role of physical factors in growth of plants: Response to light, photomorphogenesis, Role of growth regulators: Auxin, Gibberelins, Cytokinins, ABA, Ethylene

Unit-V

Photosynthesis: Brief history, pigments, mechanism of light, absorption and energy transfer PSI and PSII e-transport, ATP synthesis C3, C4 and CAM photorespiration.

Suggested Books

1. Cutter E.G. 1969. Part I Cells and Tissues, Edward Arnold, London.
2. Cutter E.G. 1971. Plant Anatomy: Experiment and Interpretation Part-II, Organs, Educated Arnold. London.
3. Esau. K. 1977. Anatomy of seed Plants 2nd Eds. John Wiley & Sons, New York.
4. Fahn A. 1985. Plant Anatomy, Pergamon Press, Oxford.
5. Salisbury and Ross. Plant Physiology.
6. Teiz and Zeiger Plant Physiology.
7. V. Verma. Plant Physiology.

BBO008A: Morphology, Anatomy and Plant Physiology Practical Lab

Credit(s): 2

1. To use any commonly occurring dicotyledonous plant as a model to understand the basic body plan and modular type of growth.
2. To prepare hand cut section and stained preparation of L.S. of shoot tip.
3. To understand the difference between Monopodial and Sympodial types of branching.
4. To prepare transverse hand cut sections of monocot and dicot stem and root of sunflower, nerium, and maize for anatomical study.
5. To perform hand cut sections of monocot and dicot stem and roots having secondary growth in sunflower, nerium and maize.
6. To Examine structure of monocot and dicot seed.
7. Specimen study for modifications of plant parts for vegetative reproduction.
8. To study the permeability of plasma membrane using different concentration of solvent.
9. To separate chlorophyll pigment by solvent method.
10. To study the apical growth of plant by Arc Auxanometer.

11. To study photosynthesis by inverted funnel method and Moll's half leaf method.
12. To study the demonstration of stomatal transpiration by four leaf method.
13. To demonstrate the phenomenon of osmosis by potato osmometer.

V Semester

L	T	P	C
4	-	2	6

BBO009A: Gymnosperm, Angiosperm and Paleobotany

Credit(s): 4

Unit-I

Classification and characteristic features of different groups of Gymnosperm. Distribution, morphology, vegetative and reproductive parts, anatomy and life cycle of *Cycas*.

Unit-II

Distribution, Morphology of vegetative and reproductive parts, anatomy, reproduction and life cycle of *Pinus* and *Ephedra*, Economic Importance of Gymnosperm.

Unit-III

Angiosperm – origin and evolution. Some examples of primitive angiosperm.

Introduction, Principles of taxonomy, units of classification, Concept of Genus and species, Binomial nomenclature, ICBN, Botanical gardens and Herbaria.

Unit-IV

Classification of angiosperm Linnaeus, Bentham and Hooker's system, Engler and Prantle system of classification.

Diversity of flowering plants as illustrated by members of the families, Brassicaceae, Malvaceae, Fabaceae, Solanaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Liliaceae and Poaceae, Asteraceae.

Unit-V

Fossilization, types of fossils, technique to study fossils, geological time scale, Applied aspect of PaleoBotany (use in coal and petroleum exploration).

Fossil Pteridophyta – *Lepidodendron*, *Calamites*

Fossil Gymnosperms – *Williamsonia*

BBO010A: Gymnosperm, Angiosperm and PaleoBotany Practical Lab

Credit(s): 2

1. To understand terminology used for the plant description and their identification.

2. To study Key for the identification of angiospermic plant families.

3. To perform description of some important angiospermic plant families:

Brassicaceae – *Brassica campestris*

Malvaceae – *Hibiscus rosasinensis*, *Abutilon*

Fabaceae – *Pisum sativum*, *Cassia*, *Acacia*

Solanaceae – *Datura*, *Withania*

Apocynaceae – *Vinca rosea*, *Thevetia*

Asclepeideaceae – *Calotropis*

Euphorbiaceae – *Euphorbia*, *Ricinus*

Liliaceae – *Onion*, *Asphodelus*

Poaceae – *Triticum*

Esteraceae – *Helianthus*, *Tridax*

4. To study the external morphology of vegetative and reproductive parts of *Cycas*.

5. To prepare suitable double stained preparation of T.S of root, stem, rachis, leaflet and microsporophyll of *Cycas* and assign them to their respective systematic position.

6. To study the external morphology of vegetative and reproductive parts of *Pinus*.
7. To prepare suitable double stained preparation of T.S of root, stem and foliage leaf of *Pinus*.
8. To study reproductive structure (Male cone and Female cone) of *Pinus* and identify and assign them to their respective systematic position.
9. To study the external morphology of vegetative and reproductive parts of *Ephedra*.
10. To prepare suitable double stained preparation of T.S of stem (node and internode) of *Ephedra*.
11. To study reproductive structure (Male Strobilus and Female strobilus) of *Ephedra* and identify and assign them to their respective systematic position.
12. To Study types of fossils. Fossil Pteridophyta – *Lepidodendron*, *Calamites*, Fossil Gymnosperms – *Williamsonia*.
13. To understand the techniques used for fossil study.

Suggested Books

1. Vashishtha P.C. Gymnosperm, S. Chand Company.
2. Singh Pandey Jain, A text Book of Botany, Rastogi Publication.
3. Biswas C and Johari B M .The Gymnosperm.Narosa Publishing house.
4. Wilson N.S., Rothwell G.W. PaleoBotany and Evolution of Plants. IInd Ed. Cambridge. Univ. Press, U.K. (1990).
5. Willis K.J and McElwain J.C. The Evolution of Land Plants.Oxford University Press.
6. V.V. Shivrajan, Introduction to Principles to the Plant Taxonomy, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Angiosperm Taxonomy, Singh, Pandey, Jain Rastogi Publishers, Meerut.
8. Gurucharan Singh, Plant Systematics (2001). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

VI Semester

L	T	P	C
4	-	2	6

BBO012A: Environmental Management and Economic Botany

Credit(s): 4

Unit-I

Introduction to Ecology, Community and Ecosystem Inter-relationships between living world and environment, Biosphere, biomes, ecosystem and its components (abiotic and biotic) Bioenergetics.

Unit-II

Biogeochemical cycles, Hydrologic cycle. Concept of habitat and niche.

Population and Community Ecology (Part Population attributes, density, natality, mortality, age ratio, sex ratio, dispersal and dispersion of population, exponential and logistic growth, life history strategies, population interactions).

Unit-III

Biodiversity and regional conservation strategies success stories with reference to India and sustainable utilization. Principles of wildlife management, wildlife sanctuaries, parks and biosphere reserves in India, endangered and threatened species of plants and animals in India, germplasm banks.

Unit-IV

Basic concept of center of origin of cultivated plants . Food plants – rice, wheat , maize , potato and sugarcane . Vegetable oils: coconut , groundnut and mustard . Spices: General account with an emphasize on those plants cultivated in Rajasthan (cumin, capsicum, coriander) Beverages: tea and coffee. Fibers: cotton and jute.

Unit-V

Medicinal plants: General account with an emphasize on those cultivated in Rajasthan (senna, isabgol, safed musli). Wood: General account of sources of firewood, timber and bamboos; Rubber. Legumes or pulses, starch or sugar yielding plants. EthnoBotany: a general account.

BBO 013A: Environment Management and Economic Botany Practical Lab Credit(s): 2

1. To study plant communities by quadrat methods so as to determine percentage frequency and density of plant species.
2. To estimate bulk density of grassland soil.
3. To find out the porosity of grassland and wood land soil sample.
4. To determine the moisture content of grassland soil.
5. To measure dissolved oxygen (D.O.) in given polluted and unpolluted water sample.
6. To measure water holding capacity of soil.
7. To study the basic concept of center of origin of cultivated plants proposed by Vavilov.
8. To study the common name, botanical name, family, part used and economic importance of plants used as cereals (rice, wheat, maize).
9. To study the common name, botanical name, family, part used and economic importance of sugar yielding plants (potato and sugarcane).
10. To study the common name, botanical name, family, part used and economic importance of Vegetable oils yielding plants (coconut, groundnut and mustard).
11. To study the common name, botanical name, family, part used and economic importance of fiber yielding plants (cotton and jute) and types of wood.
12. To study the common name, botanical name, family, part used and economic importance of plants used as spices and beverages (tea and coffee).
13. To study general account with an emphasize on medicinal plants cultivated in Rajasthan (senna, isabgol, safed musli).
14. Visit to any national park or sanctuary.

Suggested Books:

1. P.D. Sharma, Ecology and utilization of plants. Rastogi publication.
2. Odum E P., and Barrett G.W., Fundamentals of Ecology. Thomson Asia Pvt. Ltd.
3. Rajagopalan R, Environmental Studies Oxford University Press.
4. P.D. Sharma. Ecology and utilization of plants. Rastogi Publication.
5. S.L. Kochar., Economic Botany in Tropics. McMillan Publishing House.
6. B.P. Pandey Economic Botany in Tropics.
7. Sambhamurthy. Economy Botany.

M. Sc. BOTANY

Objectives of the course

The Curriculum for Post-graduate Programme of Botany envisages specialized education, simultaneously introducing the concepts of breadth and depth learning. With this in mind, we aim to provide a firm foundation in every aspect of Botany and to explain a broad spectrum of modern trends in Botany and to develop experimental, observational, computational skills also which lead him/her as an ambassador of sustainable development of our country.

It is imperative to know the importance and scope of the discipline, to inculcate interest in and love of nature with its myriad living forms, to impart knowledge of science as the basic objective of Education, to develop a scientific attitude to make students open minded, to develop an ability to work on their own and to make them fit for the society, to expose themselves to the diversity amongst life forms, to develop skill in practical work, experiments, equipments and laboratory along with collection and interpretation of biological materials and data, to make students aware of natural resources and environment and the importance of conserving it, to develop an ability for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient and to make them able to appreciate and apply ethical principles to biological science research and studies.

M.Sc BOTANY
SEMESTER – I

Code	Title of Course	Credits
MBO001A	CELL BIOLOGY	4
MBO002A	MOLECULAR BIOLOGY	4
MBO003A	CYTOGENETICS AND PLANT BREEDING	4
MBO004A	ALGAE, FUNGI AND BRYOPHYTA	4
MBO005A	Thallophyta, Cell and Molecular Biology Practical Lab	12
	Total	28
	Credits	
SEMESTER – II		
MBO 006A	PTERIDOPHYTES, GYMNOSPERMS & PALEOBOTANY	4
MBO 007A	TAXONOMY OF ANGIOSPERMS	4
MBO008A	MICROBIOLOGY	4
MBO009A	PLANT ECOLOGY	4
MBO010A	Pteridophytes, Spermatophytes, Microbiology and Plant Ecology Practical Lab	12
	Total	28
	Credits	
SEMESTER – III		
MBO011A	PLANT PHYSIOLOGY & METABOLISM	4
MBO12A	PLANT MORPHOLOGY & DEVELOPMENTAL ANATOMY	4
MBO13A	PRINCIPLES OF PLANT PATHOLOGY-I	4
MBO14A	PLANT BIOTECHNOLOGY-I	4
MBO15A	Morphology, Anatomy, Physiology, Pathology and Biotechnology of Plants Practical Lab	12
	Total	28
	Credits	
SEMESTER – IV		
MBO016A	PLANT REPRODUCTIVE BIOLOGY	4
MBO017A	PLANT RESOURCE UTILIZATION & ETHANOBOTANY	4
MBO018A	ADVANCE PLANT PATHOLOGY-II	4
MBO019A	PLANT BIOTECHNOLOGY- II	4
MBO020A	Reproduction, Economic Botany, Biotechnology and Pathology of Plants Practical Lab	10
MBO0210	Seminar	2
	Total	28
	Credits	
Total Credits of All Four Semesters		112

Botany

I Semester

MBO001A: CELL BIOLOGY

Credit(s): 4

Unit-I

Introduction to modern tools and techniques of cell biology: advances in light and electron microscopy, techniques supplementing microscopy (cytochemistry, microprobe analysis, x-ray diffraction, etc.), Cell fractionation and visualization/characterization of various cell fractions.

Unit-II

Fundamentals of Cell: Structural organization of cell, difference between plant and animal cell; prokaryotic and eukaryotic cell, specialized plant cell types.

Cell wall, plasma membrane and plasmodesmata: Structure and functions, biogenesis, growth models and functions, sites for ATPases, ion carriers, channels and pumps, receptors. Role in movement of molecules and macromolecules, comparison with gap junctions.

Unit-III

Chloroplast and mitochondria: Structure, organization and function of mitochondrial and chloroplast genomes, diversity and evolution of organelle genomes, chloroplast protein targeting to different compartments, mitochondrial DNA and male sterility, transfer of genes between nucleus and organelles

Unit-IV

Plant vacuole: Structure and function.

Other Cellular organelles: Structure and functions of micro-Bodies, Golgi apparatus, ribosomes, lysosomes, endoplasmic reticulum, cytoskeleton.

Nucleus: Structure, nuclear pores, nucleosome organization, nucleolus, Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, karyotype analysis, banding patterns, karyotype evolution.

Unit-V

Specialized types of chromosomes: polytene, lampbrush, B-chromosomes and sex chromosomes, molecular basis of chromosome pairing. Cell cycle and apoptosis: Control mechanisms, role of cyclins and cyclin-dependent kinases, and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.

Suggested Readings

1. Krishnamurthy, K.V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
2. De, D.N: 2000. Plant Cell Vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.
3. Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA.
4. Hall, J.L. and Moore, A.L. 1983. Isolation of Membranes and Organelles from Plant Cells. Academic Press, London, UK.
5. Harris, N. and Oparka, K.J. 1994. Plant Cell Biology: A Practical Approach. IRL Press, at Oxford University Press, Oxford, U.K.

6. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology: Structure and Function. Jones and Bartlett Publishers. Boston, Massachusetts.
7. Karp, G. 1999. Cells and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc., U.S.A.
8. Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.

MBO002A: MOLECULAR BIOLOGY

Credit(s): 4

Unit-I

DNA: Structure, types (A, B and Z forms), replication, damage and repair mechanisms. DNA Replication: Prokaryotic and eukaryotic DNA replication- Unit of replicon, enzymes involved, mechanism of DNA replication origin and replication fork.

Structure and function of different types of RNAs- mRNA, t-RNA, r-RNA, snRNA, small nuclear proteins, ribosomes- subunits and its molecular structure and functions.

Unit-II

Transcription: Prokaryotic and eukaryotic transcription: Transcriptional factors and machinery, RNA polymerases, regulatory elements and mechanism of transcription regulation- formation of initiation complex, transcription activators and repressors, capping, elongation, and termination, RNA processing, RNA editing, splicing, polyadenylation, RNA transport- nuclear transport of mRNA, mRNA stability.

Unit-III

Translation: Prokaryotic and eukaryotic translation- translational machinery, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, aminoacylation of tRNA, aminoacyl tRNA synthetase, termination of translation, regulation of translation- translational proof-reading, translational inhibitors, co and post-translational modifications of proteins.

Unit-IV

Control of gene expression at transcription and translational level: Regulation of prokaryotes and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

Cell signaling: Hormones and their receptors, Cell surface receptors, signaling through G protein coupled receptors, signal transduction pathways, mechanism and cellular response to environmental signaling.

Unit-V

Cellular communication: Regulation of hematopoiesis, General principles of cell communication, Cell adhesion and role of different adhesion molecules, Gap junctions, Extracellular matrix integrins, Neurotransmission and its regulation.

Suggested Readings

1. Lewis, B. 2000. Genes VII. Oxford University Press, New York.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.
3. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.
4. Rost, T. et al. 1998. Plant Biology. Wadsworth publishing Co., California, USA.
5. Buchanan, B.B., Gruissem, W., and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.

6. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. *Molecular Cell Biology* (4th Edition). W.H. Freeman and Co., New York, USA.
7. Glick, B.R. and Thompson, J.E. 1993. *Methods in Plant Molecular, Biology and Biotechnology*. CRC Press, Boca Raton, Florida.
8. Glover, D.M. and Hames, B.D. (Eds.), 1995. *DNA Cloning 1: A Practical Approach, Core Techniques*. 2nd edition. PAS, IRL Press at Oxford University Press Oxford.
9. Hackett, P.B., Fuchs, J.A. and Messing, J.W. 1988. *An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation*. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California.
10. Shaw, C.H. (Ed.), 1988. *Plant Molecular Biology: A Practical Approach*. IRL Press Oxford.
11. Albert B. Bray, D., Lewis, J., Raff, M., Robert, K. and Watson, J.D. 1989. *Molecular Biology of the Cell* (2nd editions), Garland Publishing Inc., New York.
12. Malacinski, G.M. and Freifelder, D. 1998 : *Essentials of molecular Biology* (3rd edition). Jones and B Artlet Publishers, Inc., London.

MBO 003A: CYTOGENETICS AND PLANT BREEDING

Credit(s): 4

Unit-I

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

Unit-II

Genetic recombination and genetic mapping: Recombination, independent assortment and crossing over, molecular mechanism of recombination, role of RecA and RecBCD enzymes, site-specific recombination, chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps.

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

Unit-III

Mutations : Spontaneous and induced mutations, physical and chemical mutagens, molecular basis of gene mutation, transposable elements in prokaryotes and eukaryotes, mutation induced by transposons, site-directed mutagenesis, DNA damage and repair mechanisms, inherited diseases and defects in DNA repair, initiation of cancer at cellular level.

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

Unit-IV

Origin, occurrence, production and meiosis of haploids, aneuploids and euploids, origin and production, of autopolyploids, chromosome and chromatid segregation, allopolyploids, types, genome constitution and analysis, evolution of major crop plants, induction and characterization of trisomics and monosomics.

Molecular cytogenetics: Nuclear DNA content, C-value paradox, cot curve and its significance, restriction mapping - concept and techniques, in situ hybridization - concept and techniques, physical mapping of genes of chromosomes, flow cytometry and confocal microscopy in karyotype analysis.

Unit-V

Genetic system and breeding methods: Reproduction and breeding systems in plants. Recombination, genetic control and manipulation of breeding systems including male sterility and apomixis. Selection and breeding strategies for self-pollinated, cross-pollinated and clonally propagated crop plants, breeding for crop quality, biotic and abiotic stresses.

Suggested Readings

1. Atherly, A.G., Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
2. Burnham, C.R. 1962. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
3. Busch, H. and Rothblum, L. 1982. Volume X. The Cell Nucleus rDNA Part A. Academic Press.
4. Hartl, D.L. and Jones, E.W. 1998. Genetics : Principles and Analysis (4th edition). Jones & Bartlett Publishers, Massachusetts, USA.
5. Khush, G.S. 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Lewis, R. 1997. Human Genetics : Concepts and Applications (2nd editions). WCB McGraw Hill, USA.
7. Russel, P.J. 1998. Genetics (5th edition). The Benjamin/Cummings Publishing Company INd., USA.
8. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics (2nd edition). John Wiley & Sons Inc., USA.
9. Fukui, K. and Nakayama, S. 1996. Plant Chromosomes: laboratory Methods. CRC Press, Boca Ratan, Florida.
10. Sharma, A.K. and Sharma, A. 1999. Plant Chromosome Analysis, Manipulation and Engineering. Hoarwood Academic Publisher, Australia.
11. Acquaah G (2007). Principles of Plant Genetics and Breeding, Blackwell Publishing Ltd.USA.
12. Allard RW (1999). Principles of Plant Breeding (2nd Edition), John Wiley and Sons,

MBO004A: ALGAE, FUNGI AND BRYOPHYTA

Credit(s): 4

Unit-I

Algae in diversified habitats (terrestrial, fresh water and marine), thallus organization; cell ultra structure; reproduction (Vegetative, asexual and sexual); classifications of algae based on pigments, cell wall composition, reserved food material and flagellation; salient features of cyanophyta, chlorophyta, bacillariophyta, xanthophyta ,pyrrhophyta ,phaeophyta and rhodophyta with special reference to *Spirullina*, *Nitella* ,*Pinnularia*, *Gonyaulax*, *Laminaria*, *Gelidium* and *Batrachospermum*.

Unit-II

General characters; cell ultra structure ;thallus organization; cell wall composition ; nutrition reproduction, heterothallism; heterokaryosis; parasexuality; sex hormones and recent trends in classification of fungi; Phylogeny of fungi;

Unit-III

general account of mastigomycotina, zygomycotina, ascomycotina, basidiomycotina and deuteromycotina with special reference to *Physarum*, *Perenospora*, *Neurospora*, *Polyporus* , *Drechslera* and *Colletotrichum*.

Fungi in industries, medicines and as food. Fungal diseases in plants and animals including humans; Mychorrhizae; fungi as biocontrol agents.

Unit-IV

Morphology, structure, distribution, reproduction and classification of bryophytes; General account of marchantiales, jungermaniales, anthocerotales, sphagnales, funariales and polytrichales with special reference to *Plasiochasma*, *Notothylus* and *Polytrichum*. Economic and ecological importance of bryophytes.

Unit-V

Recent trends in Phycology and Bryology:- Algae as a rich source of protein (SCP), algae in space, algae as biofertilizers, algal blooms, algae in food and industry, algae in pharmaceuticals and parasitic algae. Benthic macroalgae and factors affecting their environment Economic Importance of Bryophytes with special reference to Ecology, as pollution indicators and in monitoring pollution, anti microbial properties of bryophytes, geobotanical prospects.

Suggested Readings

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology, John Wiley & Sons Ind.
2. Anderson RA (2005) Algal Culturing Techniques. Physiological Society of America. Elsevier Academic Press, USA.
3. Cole KM and Sheath RG (1990). Biology of the Red Algae. Cambridge Univ. Press, Cambridge.
4. Fritsch FE (1935, 1945). The Structure and Reproduction of Algae Vols. I and II. Cambridge University Press, Cambridge, UK.
5. Geissler and Greene SW (1982) Bryophyte Taxonomy, methods, practices and floristic exploration. J Cramer, Germany.
6. Kumar, H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
- 7.. Lee RE (1989). Phycology. Vol. II. Cambridge Univ. Press. Cambridge, USA.
8. Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology, New Age Intermediate Press.
9. Puri, P. 1980. Bryophytes. Atma Ram & Sons, Delhi.
10. Round, F.E. 1986. The Biology of Algae. Cambridge University Press, Cambridge.
11. Shaw AJ and B Goffinet (2000) Bryophyte Biology. Cambridge University Press, Cambridge

MBO005A: Cell Biology, Mol.Biology and Thallophyta Practical Lab Credit(s): 6

1. Fluorescence staining with FDA for cell viability and cell wall staining with calcofluor.
2. Demonstration of SEM and TEM.
3. Isolation of plant DNA and its quantitation by a spectrophotometric method.
3. Isolation of DNA, and preparation of 'cot' curve.
4. Isolation of RNA and quantitation by a spectrophotometric method.
- 5.Orcein and Feulgen staining of the salivary gland chromosomes of Chironomas and Drosophila
- 6.Morphological study of any representative members of algae, fungi and bryophytes present in your locality in their natural habitat as mentioned in the syllabus.

7. Isolation and culture of algae.
8. Symptomology of some diseased specimens: White rust , downy mildew, powdery mildew , rusts , smuts , ergot , groundnut leaf spot , red rot of sugarcane, wilts and paddy blast.
9. Study of Morphological and Reproductive part of s : *Plasiochasma* , *Pellia* , *Notothyllus*, *Andreaea* and *Polytrichum* .

II SEMESTER

MBO006A: PTERIDOPHYTES, GYMNOSPERMS & PALEOBOTANY Credit(s): 4

Unit-I

Pteridophytes; Morphology, anatomy, reproduction; classification, distribution life history and general account of fossil pteridophyte, psilopsida, lycopsida, sphenopsida and pteropsida classes.

Unit-II

Morphology, anatomy, reproduction; classification, distribution life history of: *Lycopodium* , *Gleichenia*, *Dryopteris*, *Isoetes* and *Ophioglossum*. Origin and evolution of stele, heterospory and seed habit. Economic importance of pteridophytes

Unit-III

Gymnosperms; Morphology, anatomy, reproduction; classification, distribution, life history and evolution. Brief account of families of pteridospermales (Lygenopteridaceae, Medullosaceae, Caytoniaceae ,Glossopteridaceae;)

Unit-IV

Cycadeoidales , Cordaitales and living gymnosperms (families of Cycadales,, Ginkgoales,, Coniferales .

Unit-V

Brief account of families: Ephedrales, Welwitschiales and Gnetales
Formation and types of fossils, techniques of study of fossils, geological time scale, Applied aspects of paleobotany.

Suggested Readings

1. Parihar, N.S. 1996. Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.
2. Sporne, K.K. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd., Bombay.
3. Stewart, W.N. and Rathwell, G.W. 1993. PaleoBotany and the Evolution of Plants. Cambridge University Press.
4. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms. New Age International Pvt. Ltd., New Delhi.
5. Singh, H. 1978, Embryology of Gymnosperms, Encyclopaedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.
6. Willis, K. J. and McElwain, J. C 2002, The Evolution of Plants ,Oxford University Press Inc. New York.

MBO007A: TAXONOMY OF ANGIOSPERMS

Credit(s): 4

Unit-I

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

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

Unit-II

Taxonomic evidence: Morphology, anatomy, palynology, embryology, cytology, phytochemistry, genome analysis and nucleic acid hybridization. Taxonomic tools: Herbarium, floras, histological, cytological, phytochemical, serological, biochemical and molecular techniques, computers and GIS.

Unit-III

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

Unit-IV

Sustainable utilization of bio-resources and ecosystem research. Concepts of phytogeography: Endemism, hotspots and hottest hotspots, plant explorations, invasions and introductions, local plant diversity and its socio-economic importance.

Unit-V

Diagnostic features, systematics, phylogeny and economic importance of Ranunculaceae, Magnoliaceae, Fabaceae (Papilionaceae, Mimosaceae, Caesalpiniaceae), Rosaceae, Cucurbitaceae, Apiaceae, Apocyanaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Euphorbiaceae, Orchidiaceae, Liliaceae, Araceae and Poaceae.

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. Heslop-Harrison, J. 1967. Plant Taxonomy -English Language Book Soc. & Edward Arnold Pub. Ltd. U.K.
5. Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
6. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
7. Nordenstam, B., El Gazaly, G. and Kassas, M. 2000 Plant Systematics for 21st Century. Portlant Press Ltd., London.
8. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper & Row Publications, USA.
9. Singh, H. 1978, Embryology of Gymnosperms, Encyclopaedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.
10. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Cocollier- MacMillan Ltd., London.
11. Solbrig, O.T. and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Wesley Publishing Co. Ind USA.
12. Stebbings, G.L. 1974. Flowering Plant - Evolution Above Species Level. Edward Arnold Ltd. London.
13. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition) Edward Arnold Ltd., London.
14. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.

Unit-I

Scope, history and development of microbiology, contribution of Van Leeuwenhoek- Joseph Lister, Pasteur, Koch, Jenner.

Classification of microorganisms; Hackel's three kingdom concept, Whittaker's five kingdom concept. Modern trends in classification (ribotyping, nucleic acid hybridization, RNA fingerprinting, molecular chronometer)

Unit-II

Occurrence, salient features and designation of following:

Gram Negative bacteria: Spirochaetes, Aerobic or microaerophilic, Anaerobic bacteria Rickettsias and Anoxygenic phototrophs, Oxygenic phototrophs, Mycobacteria, Actinomycetes. Archaeobacteria: Methanotrophs, Halophiles, and Sulfur dependent archaeobacteria. Pathogenic types of toxins (exotoxin, endotoxin and enterotoxin).

Unit-III

Morphology & Ultra structure of Bacteria. Cultivation of Bacteria; anaerobic, aerobic culture media, growth curve, growth kinetics, batch, continuous culture, growth measurements. Pure culture techniques, preservation methods.

General account of Mycoplasma- Characteristics, cell morphology, diseases caused in plants by mycoplasma.

Unit-IV

Viruses- Nomenclature, classification, properties and structure of viruses Life cycle and pathogenesis of following RNA virus- Picorna, ortho, Rabdo, Hepatitis and HIV Vaccinations.

Immunology: General account of immunity, allergy, properties of antigens and antibodies. Antibody structure and function, affinity and antibody specificity, Monoclonal antibodies and their uses, antibody engineering, serology.

Unit-V

Application of Microbiology: application of microbiology in industrial, agriculture and waste management: symbiotic nitrogen fixation, Mycorrhiza and VAM fungi. Food Microbiology: Contamination and spoilage of food products, Food preservation methods. Application of microbial enzymes in food industry, Microbiology of fermented milk products.

Suggested Readings

1. Frazier WC and Westhoff Dc (1998). Food Microbiology. Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Industrial Microbiology, G. Reed (editor), CBS Publishers (AVI Publishing Company)
3. Genetics and biotechnology of industrial microorganisms, C.L. Hershnergev, S.W. Queener and Q. Hegeman. Publisher: American Society of Microbiology. Ewesis. et.al. 1998. Bioremediation principles. McGraw Hill.
4. General Microbiology by R.Y. Stanier, John L. Ingraham and Mark L. Wheelis pagex, Mc Millian Press.
5. Principles of Microbiology by Ronald M. Atlas, Mc Graw Hill.
6. Microbiology by Michael J. Pcleczar, Chan and Krieg, Mac Graw Hill.
7. Fundamentals of Microbiology by Edward Alcamo, Jones and Bariett Publishers.

8. Brock- Biology of Microorganisms by Madigan, Martina and Parker, Prentice Hall.
9. Microbiology principles & Applications - J.J. Black, John Wiley, Prentice Hall
10. Products & Properties of Algae by Zizac Adams M.R. and Moss M.O. (1995) Food Microbiology. Royal Society of Chemistry Publication, Cambridge.
11. Michel. R. Introduction of Environmental Microbiology. 1999. ASM Book

MBO009A: PLANT ECOLOGY

Credit(s): 4

Unit-I

Introduction to ecology, evolutionary ecology, ecological models; Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure, population growth. Competition and coexistence, intra-specific interactions, interspecific interactions, mutualism and commensalism, prey-predator interactions.

Unit-II

Vegetation organization: Concepts of community and community coefficients, Species Diversity and Pattern Diversity in Community, Concept of Habitat and Ecological Niche.

Vegetation development: Temporal changes (cyclic and non-cyclic), mechanism of ecological succession. Changes in Ecosystem Properties during Succession, Concept of Climax. The biosphere, biomes and impact of climate on biomes.

Unit-IV

Nature of ecosystem, production, food webs, energy flow through ecosystem, Biogeochemical Cycles (global) of C, N, P and S, resilience of ecosystem, ecosystem management.

Unit-V

Biodiversity– assessment, conservation and management, biodiversity act of India and related international conventions. Sustainable development, natural resource management in changing environment. Molecular ecology, genetic analysis of single and multiple population, molecular approach to behavioural ecology, conservation genetics.

Suggested Readings

1. Smith, R.L. 1996. Ecology and Field Biology, Harper Collins, New York.
2. Muller-DoMbois, D. and Ellenberg, H., 1974. Aims and Methods of Vegetation Ecology, Wiley, New York.
3. Begon, M. Harper, J.L. and Townsend, C.R. 1996. Ecology, Blackwell Science, Cambridge, U.S.A.
4. Ludwig, J. and Reynolds, J.F. 1988. Statistical Ecology. John Wiley & Sons.
5. Odum, E.P. 1983. Basic Ecology, Saunders, Philadelphia.
6. Barbour, M.G., Burk, J.H. and Pitts, W.D. 1987. Terrestrial Plant Ecology, Benjamin/Cummings Publication Company, California.
7. Kormondy, E.J., 1996. Concepts of ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
8. Chapman, J.L. and Reiss, M.J. 1988. Ecology, Principles and Applications. Cambridge University Press, Cambridge, U.K.
9. Molan, B. and Billharz, S. 1997. Sustainability Indicators, John Wily Sons, New York.
10. Heywood, V.H. and Watson, R.T. 1985. Global Biodiversity Assessment. Cambridge University Press.

11. N.S. Subrahmanyam and A.V. S.S. Sambamurty. 2000. Ecology. Narosa Publishing House, Delhi
12. S.K. Maiti. 2004. Handbook of Methods in Environmental Studies Vol. 1 &2. ABD Publisher, Jaipur.
13. J. L. Chapman and M. J. Reiss. 1995. Ecology principles and applications. Cambridge University Press.
14. C. Faurie, C. Ferra, P. Medori and J. Devaux. 2001. Ecology Science & Practice, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
15. G.T. Miller Jr. 2005. Essentials of Ecology. III Edition, Thomson, Brooks/Cole

MBO 010A: Pteridophytes, Spermatophytes, Microbiology and Plant Pathology

Practical Lab

Credit(s): 6

1. Morphological and anatomical study of representative members of pteridophytes (Psilotum, Lycopodium, Selaginella, Isoetes, Equisetum, Gleichenia, Pteris, Dryopteris, Adiantum, Ophioglossum and Marsilea)
2. Morphological and anatomical study of representative members of gymnosperms in their natural habitat found. (Zamia, Aurocaria, Taxus, Thuja and Ephedra).
3. Study of fossils in their natural form.
4. Description of a specimen from representative, locally available families.
Ranunculaceae, Leguminosae Cucurbitaceae, Umbelliferae- Apiaceae, Asteraceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Bignoniaceae, Chenopodiaceae, Euphorbiaceae, Poaceae and Liliaceae.
5. Location of key characters and use of keys at family level.
6. Field trips within and around the campus, compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant.
7. Preparation of culture media -Liquid & Solid media, Enrichment, Selective & Differential mediums. Preparation of slant, deep tube and plate culture.
8. Isolation of pure culture by Pour plate, Serial dilution and Streak plate method.
9. Fermentative production of ethyl alcohol by Yeast.
10. Isolation of antibiotic resistant mutants by antibiotic disc method.
11. To determine minimum size and number of quadrat required for reliable estimate of biomass in grasslands.
12. To determine gross and net phytoplankton productivity by light and dark bottle method.
13. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
14. To determine the Water holding capacity of soils collected from different locations.
15. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.

III SEMESTER

Unit-I

Water relation of plants: Unique physiochemical properties of water, Chemical potential, Water potential, Soil plant atmosphere continuum (SPAC), Stomatal regulation of transpiration.

Membrane transport: Passive non mediated transport. Nernst equation. Passive mediated transport. ATP driven active transport, Uniport, Symport, Antiport, Ion Channels.

Unit-II

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

Unit-III

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. C₃ and C₄ plants. Glycolate pathway and photorespiration.

Unit-IV

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

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

Unit-V

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

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

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

Abscisic acid - chemical nature, bioassay, physiological effects and mode of action.

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

Physiology of flowering: Photoperiodism and Vernalization.

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. Hooykaas, P.J.J., Hall M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands.
4. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
5. 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.
6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA.
7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.

8. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee 1999., Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
10. Taiz, L. and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
11. Thomas, B. and Vince-Prue, D. (1997) Photoperiodism in Plants (second edition), Academic Press, San Diego. USA.

MBO012A: PLANT MORPHOLOGY & DEVELOPMENTAL ANATOMY

Credit(s): 4

Unit-I

Introduction: An overview of plant development.

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, secretory ducts and laticifers, 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.

Unit-IV

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

Unit-V

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

Suggested Readings

1. Atwell, B.J. Kriedermann, P.E. and Jumbull, C.G.N. (eds). 1999. Plants in Action: Adaption in Nature Performance, in Cultivation, MacMillan Education. Sydney, Australia.
2. Bewley. J.D. and Black, M. 1994. Seeds: Physiology of Development and Germination, Plenum Press. New York.
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.
5. Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
6. Howell, S.H. 1998. Molecular Genetics of Plant Development. Cambridge University press, Cambridge.

7. Lyndon, R.F. 1990. Plant Development. The Cellular Basis, Unwin Hyman, London.
8. Murphy, T.M. and Thompson, W.E, 1988. Molecular Plant Development. Prentice Hall, New Jersey.
9. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
10. Raven, P.H., Evert, R.F. and Eichhorn, S. 1992. Biology of Plants (5th edition). Worth, New York.
11. Steeves, T.A. and Sussex, I.M., 1989. Patterns in Plant Development (2nd edition), Cambridge University Press, Cambridge.
12. Waisel, Y., Eshel, A. and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.

MBO013A: PRINCIPLES OF PLANT PATHOLOGY-I

Credit(s): 4

Unit-I

History and scope of plant pathology: Beginnings of modern plant pathology, conformation of Provost's work Anton De Bary, Khun period, plant pathology in 20th century. Contribution of Woronin, S. D. Garrett, J. C. Horsefall, K.C. Mehta, S. T. Sadavasivan, M. J. Trimulachari.

General account of diseases caused by plant pathogens. Symptomology and Epidemiology : Disease identification based on symptoms, (external and internal,) epidemiology (Slow and rapid,) epiphytotics, disease forecasting.

Unit-II

Methods of Studying plant diseases and their diagnosis : Field observation, collection of samples, laboratory studies, culturing of pathogenic organisms (fungi, bacteria, mycoplasma etc) , Koch's postulates.

Pathogen attack and defense mechanisms: Physical, physiological, biochemical and molecular aspects.

Unit-III

Plant disease management: Chemical, biological, IPM systems, development of transgenics, biopesticides, plant disease clinics. Information technology in plant pathology: Preliminary account of application of information technology in plant pathology.

Unit-IV

Stages of disease development : Pre penetration, Penetration, post penetration and colonization. Defense mechanism in host : Structural, physiological, genetical and chemical. Role of environmental factors in disease development.

Unit-V

Introductory Virology : Nomenclature and classification of plant viruses, ultrastructure of TMV, TYMV, and Bacteriophage. Chemistry of plant viruses, isolation and purification of plant viruses. Economic importance of viruses.

MLO : Classification, morphology and characteristics of MLO's Identification techniques of MLO's

Suggested Readings

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. John Wiley & Sons Inc.
2. Agrios, G.N. 1997. Plant Pathology. Academic Press, London.
3. Albajes, R., Gullino, M.L., Van Lenteren, J.C. and Elad, Y. 2000. Integrated Pest and

- Disease management in Greenhouse Crops. Kluwer Academic Publishers.
4. Bridge, P., Moore, D.R. & Scott, P.R. 1998. Information Technology Plant Pathology and Biodiversity. CAB International, U.K.
 5. Clifton, A. 1958. Introduction to the Bacteria. McGraw Hill Book Co. New York.
 6. Mandahar, C.L. 1978. Introduction to plant viruses. Chand & Co. Ltd., Delhi.
 7. Mehrotra, R.S. Plant Pathology, Tata McGraw Hill.
 8. Rangaswamy, G. & Mahadevan, A. 1999. Diseases of crop plants in India (4th edition) Prentice Hall of India, Pvt. New Delhi.
 9. Horsfall, J.G. & A.E. Dimond. Plant Pathology Vol. 1,2 & 3. Academic Press, New York, London.
 10. Trivedi, P.C. 1998. Nematode Diseases in Plants. CBS Publisher & Distributor, New Delhi.

MBO014A: Plant Biotechnology-I

Credit(s): 4

Unit-I

Basic concepts, principles and scope of Biotechnology Plant tissue culture: General introduction, history and scope of plant tissue culture, comparison of different plant tissue culture media, concept of totipotency, organogenesis, somatic embryogenesis (direct & indirect), callus culture and suspension culture, somaclonal variation, hardening and acclimatization of plants.

Unit-II

Protoplast culture: Isolation and culture of protoplast, somatic hybridization, hybrid selection and regeneration, concept of hybrid and cybrid, achievements and limitations of protoplast culture.

Unit-III

Transgenic plants: Concept and history of transgenesis in plants, principles and techniques of gene cloning: direct DNA transfer to plant cells, *Agrobacterium* mediated transformation: Ti plasmid, process of T- DNA transfer and integration.

Unit-IV

Genetic engineering: Molecular tools and their applications: Restriction enzymes, c DNA and genomic library, DNA sequencing, polymerase chain reaction, DNA fingerprinting, genetic markers-RFLP analysis, isolation and purification of DNA.

Vectors, promoter, terminator, marker and reporter genes, ethical and ecological issues of transgenesis, terminator technology (GURT)

Unit-V

Intellectual Property Rights: History and evolution of IPR, forms of IPR: patent, design and copyright, distinction among various forms of IPR, rights/ protection, infringement or violation remedies against infringement (civil and criminal), Indian Patent Act 1970.

Suggested Readings

1. Bhojwani, SS. 1990. Plant Tissue Culture: Applications and Limitations.
2. Bhojwani, SS and Razdan, MK. 1996. Plant Tissue Culture: Theory and Practice (a revised edition). Elsevier Science Publishers. New York, USA.
3. Brown, TA. 1999. Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
4. Callow, JA; Ford-Lloyd, BV and Newbury, HJ. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, Oxon, UK.

5. Chawla, HS. 2002. Introduction to Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd.
6. Chrispeels, MJ and Sadava, DE. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers. Boston, USA.
7. Collins, HA and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers. Oxford, UK.
8. Gustafson, JP. 2000. Genomes. Kluwer Academic Plenum Publishers. New York.
9. Jolles, O and Jomvall, H.(eds.) .2000. Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
10. Primrose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd, Oxford, UK.
11. Edwards and Sue. 1998. Plant Cell Culture. Bio Scientific Publishers, London.
12. Kumar, U. 2001. Methods in Plant Tissue Culture. Agrobios, Jodhpur.
13. Ignacimuthu, S. 2001. Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd. California.
14. Shantharam, S and Montgomery, JF. 1999. Biotechnology, Biosafety and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
15. Singh and Rita. 2004. Plant Biotechnology. Global Vision Publishing House.
16. Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall, London
17. Philips, GC. 1995. Plant Cell, Tissue and Organ Culture: Fundamental Methods, Narosa Publishing House.

**MBO0150: Morphology, Anatomy, Physiology, Ecology and Plant Biotechnology
Practical Lab**

Credit(s): 6

1. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids.
2. To determine the chlorophyll a/ chlorophyll b ratio in C₃ and C₄ plants.
3. Extraction of seed proteins depending upon the solubility.
4. Preparation of the standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by Lowry's or Bradford's method.
5. Radioisotope methodology, autoradiography, instrumentation (GM count and Scintillation counter) and principles involved.
6. Effect of gravity, unilateral light and plant growth regulators on the growth of young seedlings.
7. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as *Coleus*, *Kalanchoe*, *tobacco*. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
8. Study of alternate and distichous, alternate and superposed, opposite and superposed, opposite and decussate leaf arrangement.
9. Microscopic examination of vertical sections of leaves such as *Cannabis*, tobacco, *Nerium*, maize and wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the C₃ and C₄ leaf anatomy of plants.
10. Study of whole roots in monocots and dicots. Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives. (use maize, aerial roots of banyan, *Pistia*, *Jussiaea* etc.) Origin of lateral roots. Study of leguminous roots with different types of nodules.
11. Isolation and identification of pathogens
12. Exercises and Plant diseases as per theory syllabus.

SEMESTER-IV

MBO016A: PLANT REPRODUCTIVE BIOLOGY

Credit(s): 4

Unit-I

Reproduction: Vegetative options and sexual reproduction, flower development, genetics of floral organ differentiation.

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, megasporogenesis, organization of the embryo sac, structure of the embryo sac.

Pollination, pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms and vectors, breeding systems, structure of the pistil, pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, bio'chemical 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.

Unit-IV

Polyembryony, apomixis, embryo culture, dynamics of fruit growth, biochemistry and molecular biology of fruit maturation.

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

Unit-V

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 Readings

1. Bewley. J.D. and Black, M. 1994. Seeds: Physiology of Development and Germination, Plenum Press. New York.
2. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Deihi.
3. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.
4. Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
5. Howell, S.H. 1998. Molecular Genetics of Plant Development. Cambridge University press, Cambridge.
6. Leins, P., TucKer, S.C. and Endress, P.K. 1988. Aspects of Floral Development, J. Cramer, Germany
7. Lyndon, R.F. 1990. Plant Development. The Cellular Basis, Unnin Byman, London.

8. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
9. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
10. Steeves, T.A. and Sussex, I.M., 1989. Patterns in Plant Development (2nd edition), Cambridge University Press, Cambridge.
11. Shivanna, K.R. and Sawhney, VK. (eds.) 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
12. Shivanna, K.R. and Johri, B.M. 1995. The Angiosperm Pollen : Structure and Function. Wiley Eastern Ltd.. New York.

MBO017A : PLANT RESOURCE UTILIZATION & ETHANOBOTANY Credit(s): 4

Unit-I

Plant Biodiversity: Concept, status in India, utilization and concerns Sustainable development: Basic Concepts. Origins of agriculture.

World centres of primary diversity of domesticated plants : plant introductions and secondary centres.

Unit-II

Origin, evolution, Botany, cultivation and uses of (i) Food, forage and fodder crops, (ii) fibre crops, (iii) medicinal and aromatic plants and (iv) vegetable oil-yielding crops.

Unit-III

Important fire-wood and timber-yielding plants and non-wood forest products(NWFPS) such as bamboos, rattans. raw materials for paper making, gums, tannins, dyes resins and fruits.

Unit-IV

Green revolution : Benefits and adverse consequences. Innovations for meeting world food demands. Plants used as avenue trees for shade, pollution control and aesthetics.

Principles of conservation, extinctions, environmental status of plants based on International Union for Conservation of Nature.

Unit-V

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.

Strategies for conservation - *ex situ* conservation : Principles and practices, Botanical gardens. field gene banks, Seed banks, *in vitro* repositories, cryobanks, general account of the activities of Botanical Survey of India (BSI), National Bureau of plant Genetic Resources(NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation ,non formal conservation efforts.

Suggested Readings

1. Anonymous 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (BBOoklet). National Bureau of Plant Genetic Resources, New Delhi.
2. Arora, R.K. and Nayar, E.R. 1984. Wild Relatives of Crop Plants in India. NBPGR Science Monograph No.-7.
3. Baker, H.G. 1978. Plants and Civilization (3rd edn.) C.A. Wadsworth, Belmont.
4. Bole, P.V. and Vaghani, Y. 1986. Field Guide to Common Indian Trees. Oxford University Press, Mumbai.

5. Chandel, K.P.S., Shukla, G. and Sharma, N. 1996. Biodiversity in Medicinal and Aromatic Plants in India : Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.
6. Cristi, B.R. (ed.) 1999. CRC HandBook of Plant Sciences and Agriculture. Vol. I. In situ conservation. CRC Press, Boca Raton, Florida, USA.
7. Conway, G. 1999. The Doubly Green Revolution : Food for All in the 21st Century, Penguin BBOoks.
8. Conway, G. and Barbier, E. 1990. After the Green Revolution. Earthscan Press, London.
9. Council of Scientific and Industrial Research 1986. The Useful Plants of India, Publications and Information Directorate, CSIR, New Delhi.
10. Council of Scientific and Industrial Research (1948 - 1976). The Wealth of India. A Dictionary of Indian Raw Materials and Industrial Products. New Delhi. Raw Materials I-XII, Revised Vol. I-III (1985-1992) Supplement (200).
11. Directory of Indian Wetlands, 1993. WWF INDIA, New Delhi and AWB, Kuala Lumpur.
12. Falk, D.A., Olwel, M. and Millan C. 1996. Restoring Diversity, Island Press, Columbia, USA.
13. FAO/IBPGR 1989. Technical Guidelines for the Safe Movement of Germplasm, FAO/IBPGR, Rome.
14. Gadgil, M. and Guha, R. 1996. Ecology and Equity : Use and Abuse of Nature in Contemporary India. Penguin, New Delhi.
15. Heywood, V. (Ed). 1995 Global Biodiversity Assessment. United Nations Environment Programme. Cambridge University Press, Cambridge, U.K.
- 16.. Heywood, V.H, and Wyse lackn, P.S. (Eds) 1991. Tropical Botanical Gardens. Their Role in Conservation and Development. Academic Press, San Diego.
17. Kocchar, S.L. 1998. Economic Botany of the Tropics, 2nd edition. Macmillian India Ltd., Delhi.
18. Kothari, A. 1997. Understanding Biodiversity: Life Sustainability and Equity. Orient Longman.
19. Nair, M.N.B. et. al. (Eds.) 1988. Sustainable Management of Nonwood Forest Products. Faculty of Forestry, University Putra Malaysia. 43004 PM Serdang, Selangor, Malaysia.
20. Paroda, R.S. and Arora, R.K. 1991. Plant Genetic Resources Conservation and Management. IPGRI (Publication) South Asia Office, C/o NBPGR. Pusa Campus, New Delhi.
21. Pinstrup-Anderson, P. et. al. 1999. World Food Prospects :Critical Issues for the Early 21st Century. International Food Policy Research Institute. Washington, D.C., USA.
22. Plant Wealth of India 1997. Special Issue of Proceedings Indian National Science Academy B-63.
23. Plucknett, D.L., Smith, N.J.H., William, J.T. and Murti Annishetty, N. 1987. Gene Banks and Worlds Food. Princeton Univrersity Press, Princeton, New Jersey, USA.
24. Rodgers, N.A. and Panwar, H.S. 1988. Planning a Wildlife Protected Area Network in India. Vol. I. The Report. Wildlife Institute of India, Dehradun.
25. Sahni, K.C. 2000. The Book of Indian Trees. 2nd edition. Oxford University Press, Mumbai.
26. Sharma, O.P. 1996. Hill's Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharma). Tata McGraw Hill Co. Ltd., New Delhi.
27. Swaminathan, M.S. and Kocchar, S.L. (Eds.) 1989. Plants and Society. Macmillan Publication Ltd., London.
28. Thakur, R.S., Puri, H.S. and Husain, A. 1989. Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants, CSIR, Lucknow.
29. Walter, K.S. and Gillett, H.J. 1998. 1997 IUCN Red List of Threatened Plants. IUCN,

the World Conservation Union. IUCN, Gland, Switzerland and Cambridge, U.K.

MBO018A: ADVANCED PLANT PATHOLOGY-II

Unit-I

Plant Pathology : 1. Principles of Plant Pathology: History, Classification of crop diseases: Viral, Bacterial, Fungal and Nematode. Deficiency of micronutrients.

Seed Pathology : Methods of detection of internal and external seed borne Fungi, Bacteria and Viruses, biodeterioration and mycotoxins.

Role of enzymes and toxins in disease development. Cell wall degrading enzymes ; Cellulolytic , Pectolytic, Proteolytic and Lipolytic. Toxins lycopersamine, alternic Acid, Fusaric acids, Piricularin, Victorin, aflatoxins.

Unit-II

Symptomology, causal organism, etiology and management of diseases of :

Fungal diseases: Wheat - Rust, Smut, Bunt

Pearl millet - Green ear, ergot and smut

Crucifers – rust

Paddy- Paddy blast

Cotton - Wilt

Grapes -Downy mildew and powdery mildew

Unit-III

Bacteria: Classification and nomenclature of bacterial plant pathogens. Symptomology, causal organism, etiology and management of Bacterial diseases: Brown rot of potato, blight of rice, soft rot of vegetables, Crown gall disease.

Non-parasitic diseases and control measures.

Unit-IV

Nematology: Brief history, classification and identification of plant pathogenic nematodes. Symptomology, causal organism, etiology and management of nematode disease: Molya disease of wheat & barley/ear cockle of wheat, root-knot diseases.

Unit-V

Status of fungi, bacteria and virus research in Plant Pathology in India: An overview

Antibiotics of fungal origin and their production.

Production of Ergot alkaloids.

Suggested Readings:

1. Agrios, G. N. 1978 : Plant Pathology

2. Aneja, K. R. 1993. : Experiments in Microbiology, plant pathology and Tissue culture

3. Gangopadhyay , S. 2004: Clinical Plant Pathology

4. Mahadevan, A. and R. Shridhar, 1982. Methods in physiological plant pathology

5. Nyvall, R. F. 1979 : Field Crop Diseases Handbook

6. Paul Khurama, S. M. 1998: Pathological Problems of Economic crop plants and their management .

7. Planke, J. E. Ander, 1968 : Disease Resistance in plants.

8. Rangaswami, G. 1979 : Diseases of crop plants in India

9. Singh, R. S. 1998 : Plant Diseases

10. Rangaswamy G. (1975): Diseases of crop plants in India.

11. Raychudhary , S.R.et al.(1975): Advances in Mycology and Plant Pathology.

12. Sharma,O.P.(1989): Text Book of Fungi.

13. Barger, G. (1931): Ergot and Ergotism.

14. Whipps, J.M. and R.D.Lumsden (1989): Biotechnology of fungi for improving plant growth.

MBO019A: PLANT BIOTECHNOLOGY -II

Credit(s):4

Unit-I

Plant Tissue culture: Concept, History. General methodology, culture media ingredients, preparation, methods of sterilization and disinfestations, 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.

Unit-II

Protoplast technology: Isolation methods, purification, viability tests, culture, plating efficiency, Somatic cell hybridization, selection of protoplast fusion hybrids.

Protoplast technology applications. Somaclonal variation. Plant tissue culture and Secondary metabolite production.

Unit-III

Recombinant DNA Technology: tools and techniques, construction of genomic/cDNA libraries, polymerase chain reaction, 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.

Techniques for plant transformation: *Agrobacterium* mediated gene transfer, process of T-DNA transfer and integration, practical applications of *Agrobacterium*-mediated gene transfer, Direct gene transfer methods.

Unit-IV

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-V

Metabolic Engineering and industrial Products: control mechanisms and manipulation of phenylpropanoid pathway, alkaloids, industrial enzymes, polyhydroxybutyrate, therapeutic proteins, Antibiotics, ethanol, Vitamins, Biopolymers.

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, Assessment and management.

Suggested Readings

1. J.Hammond,P. McGarvey and V. YusiBBOv (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,1998.
4. R.J.Henry: Practical Application of plant Molecular Biology.Chapman and hall.1997.

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 N, Fowler M: Plant biotechnology: the genetic manipulation of plants. Oxford: Oxford University Press.2010

MBO019A- Seminar

Credit(s): 2

A student has to select , prepare hard copy and present a seminar on the topic selected from the syllabus.

MBO021A: Plant Reproduction, Economic Botany, Biotechnology and Pathology Lab Exercises

Credit(s): 6

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, *Brassica*, *Petunia*, *Solanum melongena*, etc.)
3. Tests for pollen viability using stains and in vitro germination. Pollen germination using hanging drop.
4. Estimating percentage and average pollen tube length in vitro.
5. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryo sac development thorough examination of permanent, stained serial sections.
6. Field study of several types of flower with different pollination mechanisms (Wind pollination, thrips pollination, bee/butterfly pollination, bird pollination).
7. Emasculation, bagging and hand pollination to study pollen germination.
8. Food crops: Wheat, rice, maize, chickpea (Bengal gram), potato, tapioca, sweet potato, sugarcane. Morphology, anatomy, microchemical tests for stored food materials.
9. Forage/fodder crops: Study of any five important crops of the locality (for example fodder Sorghum, bajra, berseem, clove, guar bean, gram, *Ficus* sp.)
10. Plant fibers: (a) Textile fibres : cotton, jute, linen, sun hemp, *Cannabis*.
(b) Cordage fibres: coir (c) Fibres for stuffing: silk cotton or kapok
11. Medicinal and aromatic plants: Depending on the geographical location college/university select five medicinal and aromatic plants each from a garden crop field (or from the wild only if they are abundantly available).
12. Vegetable oils : Mustard, groundnut, soybean, coconut, sunflower, castor, Morphology, microscopic structure of the oil-yielding tissues, tests for oil and iodine number.
13. Gums, resins, tannins, dyes : Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins (*Acacia*, *Terminalia*, mangroves, tea, *Cassia spp.*, *myrobalans*) and dyes (turmeric, *Bixa orellana*, indigo, *Butea monosperma*, *Lawsonia inermis*) and perform tests to understand their chemical nature.
14. A recognized Botanical garden or a museum (such as those at the Forest Research Institute, dehradun.
15. Preparation of synthetic seeds.

SEMESTER-I

S1022: Animal Diversity (Non Chordates) CREDIT(S)-4

Animal Diversity (Non chordates)

Taxonomy and classification: General principles of taxonomy - Binomial nomenclature, - Trinomial nomenclature, Rules of nomenclature, Concept of Five kingdom, concept of protozoa, metazoan and levels of organization. Basis of Classification: symmetry, coelom, segmentation and embryology.

Protozoa: General characters and Outline Classification upto class, Locomotion, Economic importance.

Porifera: General characters and Outline Classification upto class, Economic importance, canal system of sponges.

Coelenterata: General characters and Outline Classification upto class, Coral and coral reefs.

Ctenophora: General characters and Outline Classification upto class.

Platyhelminthes: General characters and Outline Classification upto class, parasitic adaptations

Aschelminthes: General characters and Outline Classification upto class.

Annelida: General characters and Outline Classification upto class, vermiculture (outline).

Onychophora- Peripatus (salient features) and as connecting link.

Arthropoda: General characters and Outline Classification upto class, Metamorphosis in insects, General introduction aBBOut Apiculture, Sericulture.

Mollusca: General characters and Outline Classification upto class, General introduction aBBOut Pearl culture.

Echinodermata: General characters and Outline Classification upto class, Water vascular system of star fish.

Hemichordata: Classification (upto class) and Habit, habitat, distribution and General characters.

Suggested BBOoks

- R.L.Kotpal :Modern text BBOok of biology – Invertebrate –(Rastogi Publication, Meerut).
- Jordan, E. L. : Invertebrate Zoology (S. Chand Co. New Delhi.).
- Dhami and Dhami : Invertebrate Zoology (S. Chand & Co. New Delhi).
- Shrivastava, : Economic Zoology. (Commercial Pub.brue,N.Delhi).
- Vishwapremi K.K., : Economic Zoology (Akashdeep Pub.House,New Delhi).
- V.P.Agrawal and L. D.Chaturvedi: A text BBOok of Invertebrate Zoology –(Jagmander BBOok Agency, New Delhi).

S1023: LaBBOratory Exercises Credit(s)-2

Organization and working of optical microscope, compound and dissecting,

1. Method of preparation of permanent slides.

2. Study of museum specimens and Permanent Slides:

- Protozoa:** *W.M. of Amoeba, Euglena, Balantidium, Elphidium, Opalina, Nyctotherus, Vorticella; Paramecium: binary fission, conjugation*
- Porifera:** *Leucosolenia, Euplectella.*
- Coelentrata:** *Hydra w.m., Obelia colony, Obelia Medusa, Vellela, Alcyonium, Metridium, Gorgonia, Physalia, Penatulla, Aureli.*
- Platyhelminthes:** *Taenia, Scolex of Taenia, Planaria w.m.*
- Aschelhelminthes :** *Ascaris, Dracunculus.*
- Annelida:** *Neanthes, Heteronereis, Aphrodite, Arenicola, Pontobdella,*
- Arthropoda:** *Limulus, Spider, Scorpion, Centipede, Millipede, Lepas, Balanus, Squilla, Eupagurus, Crab, Mantis, Locust, moth, Beetle, Pediculus w.m., Bedbug w.m., Termite w.m., Cyclops w.m.*
 - **Onychophora :** *Peripatus.*
 - **Mollusca:** *Chiton, Aplysia, Cypraea, Mytilus, Pearl oyster, Dentalium, Loligo, Nautilus.*

- Echinodermata:** *Pentaceros, Echinus, Ophiothrix, Antedon.*
- Hemichordata :** *Balanoglossus*
- 3. Larval forms of invertebrates-Taenia (cysticerus), Fasciola (miracidium, radia, cercaria, sporocyst). Crustacean larva (megalopa larva, nauplius larva, zoea larva), Unio (glochidium larva).
- 4. Life cycles of selected invertebrates- Honeybee, silk worm.
- 5. Permanent preparation of study materials- Hydra, Obelia colony, sponge-fibre, spicules, gemmules, Nereis parapodia.
- 6. Study of parasitic (ectoparasites and endoparasites) invertebrates.
- 7. Preparation of culture of Paramecium/ TriBBOlium.

SEMESTER II

S2022: Molecular Biology and Genetics Credit(s)-4

Genetic Material: Nucleic acids- Identification of genetic material, Evidences that DNA is the genetic material, Evidences that RNA is the genetic material, DNA: structure, polymorphism.

DNA Replication (Prokaryotes and Eukaryotes): Experiments of Messelson and Stahl; Mechanism of replication, Enzymology of DNA replication (Enzymes and Proteins associated with DNA replication), Elementary idea aBBOut DNA repairs.

RNA– Central Dogma, Types of RNA (mRNA, rRNA, tRNA), Synthesis of RNA (Transcription in Prokaryote and Eukaryotes), RNA processing, RNA splicing.

Genetic Code – Essential features, Wobble hypothesis.

Protein synthesis –Translation in Prokaryotes and Eukaryotes.

Heredity: Mendel and his work, Laws of Inheritance, Gene interaction (Intragenic and Intergenic interaction)

Multiple allelism

Sex- linked Inheritance

Gene– Concept, types and functions of gene.

Regulation of gene expression: Inducible system; Lac operon, Repressible system; Tryptophan. Cytoplasmic inheritance in animals

Mutations, Eugenics, Genetic counseling, Euthenics, Euphenics

Suggested BBOoks

- De Roberties, E.D.P.and De Roberties, E.M.F.: Cell and Molecular Biology, B.I. Publications Pvt. Ltd. Lippincott Williams and Wilkins.
- Karp, G.: Cell and Molecular Biology Concepts and Experiments, John Wiley and Sons.
- Lodish, H, Matsudaira, P. and Darnell, J. Molecular cell biology, W.H. Freeman and company.
- Gardner : genetics
- Rastogi V.B.: Genetics
- Freifelder, D. Essential of Molecular biology, Narosa Publishing House.
- Rajan, S.S. Introduction of molecular biology, Anmol Publications Pvt. New Delhi.
- Rastogi, S.C. Cell biology, New age international (P) Ltd, Publishers.

S2023: LaBBOratory Exercises Credit(s): 2

1. Study of mitotic cell division.

2. Study of meiotic cell division.
3. Cytological preparation of mitotic stages from onion root tip.
4. Cytological preparation of meiotic stages from grasshopper testes.
5. Study of giant chromosomes in salivary glands of Chironomous larva of *Drosophila*.
6. Study of Barr Body for identification of Gender in Human.
7. Identification of male and female drosophila.
8. Study of life-cycle of drosophila.
9. Identification of wild and mutants (yellow Body, ebony, vestigial wings, and white eye)
10. Study of permanent prepared slides: Sex comb, Salivary gland chromosomes.
11. Human pedigree analysis (theoretical fundamental and exercises).

SEMESTER-III

S3022: Biology of Chordates CREDIT(S): 4

Protochordata: Classification upto order, General characters,

Ascidia: retrogressive metamorphosis, salient features of Amphioxus.

Agnatha: Classification upto order, General characters,

Salient features: Petromyzon, Ammocoet larva.

Gnathostomata: Classification upto order, General characters, Salient features of Ostracoderm.

Pisces: Migration in fishes, Adaptive radiation in fishes, Pisciculture, Parental care

Salient features: Dipnoi (Lung fishes), Scoliodon.

Amphibia: Classification upto order, General characters, Adaptive radiation in Amphibian,

Neoteny, Parental care.

Reptilia: Classification upto order, General characters, Poisonous and non-poisonous snakes, poison apparatus.

Aves: Classification upto order, General characters, Flight adaptation and Migration in birds, Perching mechanism; feather and its development.

Mammals: Classification upto order, General characters, Dentition, hair and its development.

Suggested BBOoks

- R.L.Kotpal :Modern text BBOok of biology –Vertebrate –(Rastogi Publication, Meerut).
- Young, J.Z. : Life of Vertebrate.(E L B S) 1983.Oxford.
- Dalela, R.C. : A text BBOok of Chordate Zoology, (Jai Prakash Nath publications, Meerut.).
- Newman, H.H. : The phylum Chordate, (Satish BBOok Enterprise, Agra).
- Jordon, E.L. : Vertebrate Zoology, (S.Chand and Co., New Delhi.).
- B.B. Waykar, A.Y. Mahajan, B.C.: More Animal Diversity. (Prashant Publication Jalgaon)
- G.P. Vani, P. M. Vyawahare.: Animal Diversity. (Prashant Publication Jalgaon)
- Gilbert : Development biology

S3023: LaBBOratory Exercises Credit(s): 2

Study of museum specimens and Permanent Slides: **Protochordates** - Amphioxus, *Amphioxus*: VLS Anterior region, T S passing through Oral Hood, TS passing through pharynx and gonads, through caudal region.

Agnatha – Petromyzon.

Pisces - Hippocampus, Rhacophorus, Zygaena, Torpedo, Chimaera, Acipenser. Amia, Clarias, Agnaila, Exocoetus, Echeuis, Protopterus

Amphibians - Ichthyophis, Proteus, Ambystoma; Axolotal, Alytes; Hyla, Frog: VS of skin.

Reptiles - Testudo; Chelone; and fresh water Tortoise; Sphenodon; Hemidactylus. Phrynosoma; Draco; Chameleon; Hydrophis; Viper; Crocodilus.

Aves – Archaeopteryx, V.S. skin of bird.

Mammals -Ornithorhynchus, Tachyglossus, Macropus, Bat, Loris; Manis. V.S. skin of mammal, T.S. of mammalian liver, Duodenum, pancreas, stomach, intestine, testes, ovary, kidney, spinal cord.

1. **Study of scales in fishes** : cycloid scales, ctenoid scales, Placoid scales.

2. **Anatomy** : General viscera, afferent and efferent branchial blood vessels, cranial nerves of Scoliodon

3. **Permanent preparations of the following**: Placoid scales; Herdmania spicules, Striped muscle fibers and blood film of any vertebrate.

Note:- Study of live animals should be done without paining them prefer studies of species which are easy to culture. Digital media can be used to study various characters of animal species. Use of animals for dissection is subject to the conditions that these are not banned under the Wild life (Protection) Act

SEMESTER-IV

S4022: Developmental Biology, Immunology and Evolution CREDIT(S): 4

Animal development: Gametogenesis (Spermatogenesis and oogenesis - vitellogenesis), fertilization, cleavage and morulation, blastulation, gastrulation, fate map, morphogenetic movement, Significance of cleavage and gastrulation.

Parthenogenesis

Elementary idea aBBOut embryonic induction: primary organizer and competence.

Developmental stages of chick (upto 96 hours).

Elementary idea of stem cells, teratology, ageing, cloning, transgenic animals.

Immunology -Overview of immune system; types of immunity

Mechanism of humoral immunity, Immunity regulating cells : Macrophages, lymphocytes (B & T types), Plasma cells and memory cells.

Antigens: Properties of antigens, Haptens

AntiBBODies: Basic structure, classes and function,

Antigen-AntiBBODY interaction: precipitation reaction, agglutination reaction, neutralization reaction, complement and lytic reaction and phagocytosis.

Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism or mutation theory.

Natural Selection, Genetic basis of evolution : Speciation, Isolation, Variation, Adaptations, Convergence and Divergence Adaptation. Mimicry.

Palaentology- fossils; geological division of earth crust; imperfection of the geological record, Continental drift.

Suggested BBooks

1. Gilbert, S.F. (2006) 8th edn. Developmental Biology, Sinauer Associates, Inc.

□ Kindt, T. J., Goldsby, R. A., OsBBOrne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.

- Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI edition. Roitt's Essential Immunology, Blackwell Publishing
- Ridley, M. : Evolution, Oxford University Press.
- Arora, M.P., Kanta, C. : Organic Evolution, Himalayan Publishing House.
- Rastogi, V.B.: Organic Evolution, Rastogi Publications, Meerut.
- Rastogi, V.B.: Development Biology

S4023: LaBBOratory Exercises Credit(s): 2

1. Study of development stages of frog: - egg, cleavage, blastula, gastrula, neurula (neural plate, neural fold, neural tube), tadpole larva, metamorphic stages of tadpole.
2. Study of development stages of chick - 18h, 24h, 33h, 48h, 72h , 96h of incubation.
3. Window making in shell of egg to study chick embryo.
4. Identification of blood groups in humans.
5. Determination of Rh factor in humans.
6. Study of cell permeability in mammalian RBC.
7. Study of evolution of Horse through various models.
8. Adaptive modification of feet/claws in birds.

SEMESTER-V

S5022: Ecology, Ethology and Biostatistics CREDIT(S): 4

Ecology, Ethology and Biostatistics

Basic concepts of ecology.

Biogeochemical cycles- O₂, CO₂, N, P, H₂O cycle and role of microbes.

Population Ecology: Density and methods of its measurement, natality, mortality, age and ratio distribution, biotic potential, dispersal and dispersion of population, population interactions and propagation, brief idea of demography.

Community Ecology: Characteristics of natural communities structure, composition, stratification, host-parasite interactions.

Ecological Succession: Types and patterns of succession, concept of climax (mono-, di-, polyclimax), ecotone and edge effect, niche.

Major biomes of the world. Ecological indicators.

Concepts of Ethology- Motivation, Fixed Action Patterns (FAP), Sign Stimulus; Innate Releasing Mechanism (IRM); Action Specific Energy (ASE); Learning; Imprinting.

Methods of Studying Behaviour : Studies in LaBBOratory- Neuroanatomical, Neurophysiological and Neurochemical techniques.

Brief account on Pheromones, Biological Clocks, Orientation.

Introduction: Definition, Functions, scope and application of biostatistics.

Frequency distribution: Collection and tabulation of data, Graphical presentation of frequency distribution- Bar diagram, Histogram, Frequency Polygon, smooth frequency curve, ogives, Pie charts.

Measures of Central Value: Average; Mean, Mode, Median. Mean and Standard Deviation.

Statistical Inference: test of significance of mean; Standard error of mean and standard deviation; student's 't' test , chi-square test.

Suggested BBooks

- Odum, E.P.: Fundamental of Ecology, W.B. Saunders, New Delhi.
- Odum, E.P.: Fundamental of Ecology, W.B. Saunders, New Delhi.
- Verma, P.S. and Agarwal, U.K.: Environmental Biology, S. Chand and co., New Delhi.
- Gupta, P.K.: Environmental Biology, Rastogi Publication, Meerut.
- Manning, A.: An introduction to Behaviour, Edward Arnold, London.
- Mathur, R.: Animal Behaviour, Rastogi Publications, Meerut.
- Wallace, R.A.: Animal Behaviour, Goodyear Publishing Co., 18, Grazimek Encyclopedia of Ethology.
- Bailey: Biostatistics
- Goon, A.K.M and Gupta, B.D.: Fundamental of Statistics.
- Gupta, S.P.: Biostatistics.

S5023: LaBBOratory Exercises Credit(s): 2

Water analysis: alkalinity, acidity, dissolved oxygen, B.O.D. (Biological oxygen demand), free carbon dioxide,

1. **Soil analysis :** moisture content, water holding capacity, carbonate and bicarbonate
2. Behavior of Paramecium/ Zoo-planktons (Thigmotrophism, thermotrophism, chemotrophism).
3. Study of any stored insect pest / Food preference in Tribolium.
4. Antennal grooming in Cockroach / Phototactic response in Earthworm or grain or pulse pests.
5. Listing of all animals found in and around your locality or A visit to a zoo/ national park / wildlife sanctuary.
6. Construction of Frequency table, Histogram, Polygon, Pie-chart.
7. Exercise on Mean (Arithmetic, Geometric, Harmonic), Mode & Median.

SEMESTER-VI

S6022: Animal Physiology and Biochemistry CREDIT(S): 4

Physiology of Digestion: Nature of food stuff, various types of digestive enzymes and their action in alimentary canal, hormonal control.

Physiology of Respiration: Mechanism of breathing: exchange of gases, transport of oxygen & carbon dioxide in blood, regulation of respiration.

Physiology of Circulation: Composition and function of blood, mechanism of blood clotting, heart beat, cardiac cycle, blood pressure, body temperature regulation and homeostasis.

Physiology of nerve impulse and Reflex Action: Functional architecture of a neuron, origin and propagation of nerve impulse, synaptic transmission, reflex action and its control.

Physiology of muscle contraction: Functional architecture of skeletal muscles, chemical and biophysical events during contraction and relaxation of muscle fibre.

Physiology of Excretion : Nitrogenous excretory products, role of liver in formation of these end products, Functional architecture of a nephron, mechanism and regulation of urine formation.

Physiology of endocrine glands: Types of Endocrine glands, their secretion, functions and mechanism of action, disorders related to hypo and hyper secretion – pituitary, adrenal, thyroid, islet of langerhan's, gonads (testes & Ovary).

Preliminary idea of Neurosecretion, Hypothalamic control of Pituitary function, Neuroendocrine and endocrine mechanism of insects.

Structure, function and significance of CarBBOhydrates, Proteins and Lipid.

CarBBOhydrate MetaBBOLism: Glycolysis, Citric acid cycle, Pentose phosphate pathway,

Oxidative Phosphorylation, electron transport chain, Regulation of metaBBOLism

Protein MetaBBOLism : Transamination, Deamination, DecaBBOxylation, fate of ammonia (Ornithine cycle).

Lipid MetaBBOLism: β -oxidation of fatty acids.

Suggested BBOoks

- A TextBBOok of Animal Physiology; Berry, A.K.; Emkay Publisher, Delhi
- Text BBOok of Medical Physiology; Chatterjee, M.N and Shinde, R.; Jaypee brothers.
- Animal Physiology: adaptation and Environment, Schiemdt Neilsen. Cambridge
- Animal physiology and biochemistry, Dr. K.V. Sastry; rastogi publications, Meerut, India.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IVEdition. W.H Freeman and Co.
- Biochemistry. XXVIII Edition. Lange Medical BBOoks/McGraw-Hill.
- Biochemistry, Berry, A.K. Emkey Pub. New Delhi.
- H.S. Srivastava, Element of Biochemistry, Rastogi Publications Meerut.
- Leninger, A.D. Principles of Biochemistry, CBS Publishers and Distributors, Shahdra, Delhi.
- Jain, J.L. Fundamentals of Biochemistry, S.Chand publishers New Delhi.
- Murray, R.K., Harper's Biochemistry; Appleton and Lange, Norwalk, Connecticut

S6023: LaBBOratory Exercises Credit(s): 2

Study of blood count (theoretical fundamental).

1. Counting of red blood cells in given blood sample
2. Counting of white blood cells in given blood sample.
3. Differential count of W. B. Cs.
4. Estimation of haemoglobin content in given blood sample.
5. Estimation of haematocrit values in given blood sample.
6. Demonstration of enzyme activity (catalases) in microorganisms.
7. Study of salivary digestion.
8. Study of histological structure of major endocrine glands of mammals.
9. Qualitative estimation of carBBOhydrates in given samples.
10. Qualitative estimation of proteins in given samples.
11. Qualitative estimation of lipids in given samples.
12. Identification of different kinds of mono-, di- and polysaccharides in the given samples.
13. Paper chromatography.