THIRUVALLUVAR UNIVERSITY
MASTER OF SCIENCE
M.Sc. Botany
(With effect from 2020– 2021)

The Course of Study and the Scheme of Examination

Sl. No.	*Study Components*		*ins. hrs / week*	*Credit*	*Title of the Paper*	*Maximum Marks*		
	Course Title					*CIA*	*Uni. Exam*	*Total*
SEMESTER I								
1	Core	Paper 1	5	4	Phycology and Bryology	25	75	100
2	Core	Paper 2	5	4	Mycology, Lichenology Bacteriology, Virology and Plant Pathology	25	75	100
3	Core	Paper 3	5	4	Pteridophytes, Gymnosperms and Paleo-Botany	25	75	100
	Practical	Practical	5	3	Practical-I, covering Papers I, II & III	0	0	0
Internal Elective for same major students (Choose any one)								
4	**Core Elective**	**Paper-1**	5	3	A. Microbiology B. Pharmacognosy	25	75	100
External Elective for other major students (Inter/multidisciplinary papers)								
5	**Open Elective**	**Paper-1**	5	3	A. Mushroom Cultivation B. Horticulture and Landscaping	25	75	100
			30	**21**		**125**	**375**	**500**
SEMESTER II						*CIA*	*Uni. Exam*	*Total*
6	Core Practical	Paper 4	5	4	Anatomy and Embryology of Angiosperms	25	75	100
7		Paper 5	5	4	Cell and Molecular Biology	25	75	100
8		Paper 6	5	4	Genetics,Plant Breeding and Evolution	25	75	100
9		Practical 1	0	0	Practical-I, covering Theory Papers I, II & III	25	75	100
10		Practical 2	5	3	Practical-II, covering Theory Papers IV, V & VI	25	75	100
Internal Elective for same major students (Choose any one)								
11	**Core Elective**	**Paper-2**	5	3	A.Techniques in Botany B. Industrial Microbiology	25	75	100
External Elective for other major students (Inter/multidisciplinary papers)								
12	**Open Elective**	**Paper-2**	5	3	A. Organic farming B. Herbal Sciences	25	75	100
13	***Field Study**		-	2		100	-	100
14	**Compulsory Paper**		2	2	**Human Rights**	25	75	100
			32	**25**		**300**	**600**	**900**

*** Field Study**

There will be field study which is compulsory in the first semester of all PG courses with 2 credits. This field study should be related to the subject concerned with social impact. Field and Topic should be registered by the students in the first semester of their study along with the name of a mentor before the end of the month of August. The report with problem identification and proposed solution should be written in not less than 25 pages in a standard format and it should be submitted at the end of second semester. The period for undergoing the field study is 30 hours beyond the instructional hours of the respective programme. Students shall consult their mentors within campus and experts outside the campus for selecting the field and topic of the field study. The following members may be nominated for confirming the topic and evaluating the field study report.

(i). Head of the respective department
(ii). Mentor
(iii). One faculty from other department

THIRUVALLUVAR UNIVERSITY
MASTER OF SCIENCE - M.Sc. BOTANY

(With effect from the Academic year 2020-2021)

SEMESTER-I
PAPER – 1

CORE PAPER: PHOCOLOGY AND BRYOLOGY

No. of teaching hours: 5
Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To understand the salient features and economic importance of algal diversity
- To study the structure and reproduction of various genera mentioned in the field of lower plants.
- To familiarize the salient features and economic importance of Bryophytes

Unit – I Classification and general characters of Algae

General account of phycology, Contributions of Indian Phycologist, Criteria for algal classification, F.E. Fritch classification of algae, Range of thallus organization, Algae of diverse habitats, Algal pigments and its significance in classification, ultra-structure of flagella, eyespot and pyrenoids, Algal reproduction- (vegetative, asexual and sexual), life cycles and molecular phylogeny of algae, fossil algae.

Unit – II Diversity of Algae

General features, range of vegetative structure, reproduction, life cycle and phylogeny, brief knowledge of the following genera

Chlorophyta : *Chlamydomonas*, *Hydrodictyon, Ulva, Cladophora, Pithophora, Chara*and*Nitella.*
Xanthophyta **:***Botrydium*and*Vaucheria*

Bacillariophyta : *Nitzhia* and *Cyclotella*
Phaeophyta :*Ectocarpus,Dictyota, Padina* and*Sargassum*
Rhodophyta : *Polysiphonia, Ceramium,Gelidium and Gracilaria*
Cyanophyta : *Anabaena, Spirulina. Oscillatoria* and*Lyngbya*

General characteristic of the following divisions Cryptophyceae, Dinophyceae, Euglenophyceae and Chrysophyceae,

Unit – III Useful and harmful aspects of Algae

Algae as source of food for human, animal feed, Nutraceuticals; Pharmaceuticals, biofuel, bio-ethanol, biofertilizers, industrial applications of algae. Role of algae in CO_2 sequestration, pollution indicator, bioremediation and soil fertility. Mass cultivation of algae- seaweed cultivation methods - Rope cultivation, net cultivation and raft cultivation. microalgae Culturing techniques and photo bioreactor-based production; Downstream processing. heterotrophic production. **Algal Bloom** - Bioluminescence, Bloom formation and Eutrophication; Harmful algal blooms and toxin production; Bloom control measures and algal toxins.

BRYOLOGY

Unit IV General Overview on Bryophytes

Bryophytes as Amphibians of the kingdom Plantae, Different theories, Origin and evolution of bryophytes. General characters, habit, habitat, distribution, biogeography, growth forms, life forms colonization, Life cycle, Gametophyte, reproduction, sporophyte, alteration of generations, resemblances and differences of bryophytes with algae and pteridophytes. Watson Classification. Evolution and Ecological significance and distribution of bryophytes. Fossil forms of bryophytes. Economic importance of bryophytes.

Unit V Diversity of Bryophytes

General account of Sphaerocarpales, Marchantiales, Jungermanniales, Calobryales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Range of variation in structure and evolution of gametophytes, sex organs, sexual and vegetative reproductions and sporophytes in Bryophytes mentioned below: *Riccia*, *Targionia, Reboulia, Pellia, Porella, Anthoceros, Sphagnum* and *Funaria.*

Outcome of the course

Students will understand the morphology and organization of the thallus and their role in medicine, industrial and food. Students will understand the interrelationship of algae, bryophytes.

Text Books

1. Fritsch, F.E. 1979. The structure and Reproduction of Algae Vol. I & II. Bishan Singh, Mahendra Pal Singh, Dehradun.
   Delhi.651 pp.1999.

2. O.P. Sharma. 2011, Algae, TATA McGraw-Hill, India.
3. R. N. Chopra. 2005.Biology of Bryophytes. New Age International (P) Ltd. New Delhi.
4. P.R. Yadav, 2015. Text Book of Bryology. Discovery Publishing House Pvt. Ltd.

Reference Books

1. Prescott, G.W. 1984. Algae: A review, Bishan Singh, Mahendra Pal Singh. Dehradun.
2. Kumar, H.D. Introductory Phycology. 2nd Ed. Affiliated East-West Press, New
3. Morris, I. 1986. An introduction of Algae. Cambridge University Press U.K.
4. R. E. Lee. 2008.Phycology, 4th Ed. Cambridge University Press
5. V.J. Chapman. 2015. The algae, Springer
6. Watson, 1975. Bryophytes. Hutchinson Library, Series, London.
7. Pandey, S.N., S.P.Misra and P.S. Trivedi. 2002. A Textbook of Botany Volume II. Vikas Publishing House Pvt Ltd, New Delhi.
8. Rashid, A. An Introduction to Bryophyta. Ist Ed. Vikas Publishing House Pvt. Ltd., New Delhi. 298 pp. 1998.
9. Vashishta. B.R., Sinha, A.K. and Adarsh Kumar, 2005. Botany for Degree students- Bryophyta. S. Chand and Company Ltd., New Delhi.
10. AfrozAlam. 2015. Text Book of Bryology. I K International Publishing House Pvt. Ltd.
11. Alain Vanderpoorten, 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.

Semester I
CORE PAPER 2

CORE PAPER:MYCOLOGY, LICHENOLOGY, BACTERIOLOGY, VIROLOGY AND PLANT PATHOLOGY

No. of teaching hours: 5

Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To understand and realize the classification, structure, reproduction and economic importance of Mycology and Lichenology, Bacteriology and Virology.
- To acquire knowledge on pathogen causing diseases in plants and mode of action and its control measures.

UNIT I Mycology

Classification of fungi proposed by Alexopoulous and Mims(1979). Occurrence and Distribution – mycelial structure and its modification – Chemistry of fungal cell – growth – nutrition – structure – reproduction – life cycle of fungi. Contributions of Indian Mycologists.Phylogeny and Interrelationship of major groups of fungi. Myxomycotina :*Physarum, Stemonites*

Chytrioliomycotina: *Allomyces, Blastocladia, Synchitrium*
Zygomycotina: *Mucor, Rhizopus, Pilobolus*
Ascomycotina: *Aspergillus, Xylaria, Morchella, Taphrina*
Oomycotina: *Cystopus, Phytophthora, Pythium*
Basidiomycotina: *Lycoperdon, Auricularia, Polyporus, Pleurotus*
Deuteromycotina: *Atternaria, Colletotrichum, Fusarium*

UNIT IILichenology

General account of Lichens – classification by Miller (1984), Habit and Habitat – Morphology – structure of lichens. Vegetative and Asexual reproduction by fragmentation – Soredia – Isidia and Sporulation. Sexual reproduction by Spermogonium and Carpogorium, Post plasmogamy changes – Apothecia structure of lichen apothecium. Ecological significance and Economic importance of Lichens – Lichens as pollution indicators. Phycobionts and Mycobionts. Structure associated with the lichen thallus, Nutrition.

UNIT IIIBacteriology

General characteristics – Classification by Bergey's (1994) – Ultrastructure of bacterial cell – gram positive and gram negative – Staining Methods – Reproduction – fission – budding and endospore. Isolation and cultivation of bacteria – Nutritional types. Bacterial growth curve – phase of growth – verities of growth – Measuring bacterial growth – Spectrophotometric method – Microscopic counting – serial dilution and viable plate count. Effect of physical and chemical factors on growth - P^H, temperature, media components and radiation. Bacterial cultural techniques and Economics importance of bacteria.

UNIT IVVirology

Viruses – General features of virus, Classification and Nomenclature – Morphology and Structure of virus – Properties of viruses – Detection of viruses – Biological activity of viruses. Physical, chemical and structural components of viruses. Transmission of viruses, Multiplication of viruses – Isolation and purification of viruses. Epidemiology of virus infection, Evolutionary importance of viruses. Bacteriophages – Classification – Lytic and lysogenic cycle. Viroid and Prions.

UNIT V Plant Pathology

Concept ofplant diseases – Causes of plant diseases. Types and Symptoms Identification of plant diseases. Host parasite interrelationship and Interactions. Disease control methods – cultural, physical, chemical and biological methods. Legislation and Quarantine measure – eradication – burning – removal of alternate host. Koch's postulate – Environment and Nutrition in disease – development – defense mechanism – Principles of plant disease. Common Plant Diseases: Disease caused by Fungi (Blast of Paddy, White rust of Mustard and Rust of Wheat), Bacteria (Blight of Paddy, Black arm of Cotton and Ring rot of Potato), Virus (Bunchy top of Banana, Yellow – vein mosaic disease and Cucumber mosaic). Mycoplasma (Grassy shoot disease of Sugarcane and Little leaf disease).

Outcome of the course

Students will understand the morphology and organization of the thallus and their role in industrial, medicine and food. Students will understand the interrelationship of amycology, lichenology, bacteriology, virology and plant pathology.

Text Books

1. Gnanamanickam, S.S., 2002. Biological Control of Crop Diseases, CRC. Press. Florida
2. Dube, H.C 2013. An Introduction of Fungi. 4th Edition Scientific Publisher, India.
3. Alexopoulous. C.J. Mims C.H and Black well, M., 2007. Introductory Microbiology. 4th edition John Wiley and Sons, New York.

Reference Books

1. Vashishta, B.R and sinha,A.K., 2011. Fungi. IstEdition. Published by S. Chand and Company Ltd. New Delhi.
2. Hale, M.E (1983), Biology of Lichens. Clasendon Edward Arnold, Maryland.
3. Salle, A.J., 1997. Fundamental Principles of Bacteriology. 7th Edition. Tata Mc Graw Hill publishing company Ltd, New Delhi.
4. Bates,J.W. and A.M. Farmer, 1992. Bryophtes and Lichens in a changing Environment, 1st Edition, Oxford, Clarendon.
5. Agrios G.N. 2005. Plant Pathology.5th Edition, Elsevier Amsterdam.
6. George, N. Agrios, 2005, Plant Pathology. 5th Edition. Academic Press.
7. Schumann, G.L., 2006. Essential Plant Pathology. APS Press.
8. Pelezar,J.M., chan E.C.S and Kreig, R.N. 2008. Microbiology. 13th Tata Mc. Graw Hill Publishing Company Ltd, New Delhi.

SEMESTER I
CORE PAPER - 3

Core Paper: PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY

No. of teaching hours: 5

Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To understand the enormous, range of diversity and range of diversification of all species in the world.
- To realize the fundamental values of diversity and their importance of human welfare.
- To define and characterize diversity of lower vascular plants to understand the dynamics of diversity to realize the significance of diversity and its fossil forms.

PERIDOPHYTES
Unit I General Topics

General characters - Sporne's classification of Pteridophytes. Range of structure, reproduction and evolution of the gametophytes, Gametophyte types – sex organs. Apogamy and Apospory. Life cycles. Stelar evolution- Protostele – types, Siphonostele, Solenostele and Dictyostele.Detailed account of Soral evolution – soral types, soral characters and phylogeny of ferns.Teleome concepts. Heterospory and seed habit. Economic importance of Pteridophytes.

Unit II Diversity in Pteridophytes

Range of structure, evolution of sporophytes in Pteridophytes of the forms - *Psilotum, Isoetes, Ophioglossum, Angiopteris, Osmunda, Dichranopteris, Alsophila* and *Salvinia.*

General characteristics and life cycle patterns in Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

GYMNOSPERMS
Unit III Diversity in Gymnosperms

Classification of Gymnosperms (Sporne,1967). Economic importance of Gymnosperms.A general account of distribution of gymnosperms. Morphology, anatomy, reproduction, phylogeny and relationship of the following orders with special reference to the genera mentioned against each order.

Cycadopsida :*Cycas,Zamia*
Coniferopsida: *Cupressus ;Podocarpus ; Araucaria*
Gnetopsida :*Gnetum ; Ephedra*

General characteristics of Cycadales, Ginkgoales, Coniferales and Gnetales (Comparative study only).

PALAEOBOTANY

UNIT IV General topics

Geological Scale; Radiocarbon dating; Gondwana flora of India. Contribution of Birbal Sahni to Paleaobotany. Study of fossils in understanding evolution. Fossilization and fossil types. Economic importance of fossils – fossil fuels and industrial raw materials and uses.

UNIT V Fossil forms

Detailed study of the following fossil forms –Fossil Pteridohytes :*Rhynia, Lepidodendron, Lepidocarpon, Sphenophyllum*and *Calamites*.FossileGymnosperms :*Lyginopteris, Heterangium, Laginostoma, Cordaites*and*Welweltschia.*

Outcome of the course

After successfully completing this course, the student will be able to recognize morphological, anatomical and reproductive characteristics of extinct and extant Pteridophytes, Gymnosperms and Paleo-Botany. The student will understand the evolutionary history of plant kingdom.

Text Books

1. Vashishta. P.C., A.K. Sinha and Adarsh Kumar. 2008. Botany for Degree students - Pteritophyta. S. Chand and Company Ltd., New Delhi.
2. Shripad, N.A. 1998. Paleobotany, Oxford and IBH Publishing Co. Pvt Ltd., New Delhi.
3. Vashishta, P.C. 1991. Gymnosperms. S. Chand & Company Ltd., Ram Nagar, New Delhi.
4. Gifford, E.M and Foster, E.S., 1984. Morphology and evolution of vascular plants. 3rd edition, W.E. Freeman and Co, New York.
5. Sporne, K.R. 1962. The morphology of Pteridophytes. Hutchinson Univ. Library, London.
6. Sporne, K.R. 1965. The morphology of Gymnosperms. Hutchinson Univ. Library, London.

Refence Books

7. Banks, H.P,1970. Evolution and Plants of the past. Wadsworth publishing Co, Belmont.
8. Beck,C.B, 1988. Origin and evolution of Gymnosperms. Columbia University press, New Delhi.
9. Bhatnagar, S.P. and Alok Moitre,2003. Gymnosperms, New Age International, New Delhi.
10. Bierhorst, D.W, 1971. Morphology of vascular Plants. Macmillan publishing Co, New York.
11. Biswas,c., B.M.Johri, 1999. The Gymnosperms, Narosa Publishing House, Chennai.
12. Delevoryas, T., 1962. Morphology and evolution of fossil plants. Holt Rinehart and Winston, New York.
13. Gensel, P.G and Andrews, H.N., 1984. Plant life in the Devonian. Preger publications, New York.
14. Graham, L.E., 1993. Origin of land plants. John Wiley & Sons, New York.
15. Mukta Bhargava, 2003. The latest portfolio of theory and practice of Gymnosperms. Dominant Publishers and Distributors, New Delhi.
16. Parihar, N.S., 2005. An introduction to Embryophyta– Pteridophytes – Central Book Depot, Allahabad.
17. Pandey, S.N., S.P.Misra and P.S. Trivedi. 2002. A Textbook of Botany Volume II. Vikas Publishing House Pvt Ltd, New Delhi.
18. Rashid.A. 2007. An Introduction to Pteridophyta – Vikas publications, New Delhi.

Semester I
Core Elective
Paper 1
(Choose either A or B)
A. MICROBIOLOGY

Core Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To provide advanced knowledge, understanding, and critical judgment appropriate for the application of microbiology.
- To explain the processes of reproduction, adaptation, survival, and interaction of microorganisms with their associated hosts and environment.
- To explain the theoretical basis of the tools, technologies and methods commonly used in microbiology.
- To develop practical skills in the use microbiological methodologies,tools, techniques and highlight the role microorganisms in the human welfare.

Unit I Microbial Taxonomy

Brief outline of microbial diversity-Microbial taxonomy, Microbial flora of soil. General feature and classification ofmicroorganism like Rickettsia', Mycoplasma, Archaebacteria – Actinomycetes – Protozoa. Brief outline of methods in microbiology for isolation and culture of microorganisms from environment and infected plants, Culture media characterization and preparation – staining of microbes. Estimation of microorganisms in soil, water and air.

Unit II Bacterial Structure

Nutrition and growth curve of Bacteria – measurement of growth. Methods of culturing bacteria - sterilization- kinds of media and preparation techniques- - pure culture-maintenance and preservation. Bacterial staining methods: simple staining, Gram's staining, acid fast staining, staining of flagella and other types of staining.

Unit III Viruses

Morphology of Viruses- Classification of Viruses – transmission of viruses- Virus-Vector relationships- replication of Virus. General account on Mycoplasma and Spiro plasma-

Satellite virus. Bacteriophages- Viroid's and Prions- Isolation and purification of viruses. Uses of virus in Biotechnology.

Unit IV Environmental microbiology

Microbial flora of soil – influence of environmental factors like pH, light, organic matter, moisture and temperature. Role of microbes in cycling of nitrogen, carbon and phosphorus. Microbial control—methods of physical control (heat, cold, desiccation, radiation and sound waves). Microbial leaching of minerals. Sterilization by filtration, chemical agents—disinfectants, antiseptics and antibiotics.

Unit V Industrial microbiology

Role of microbes in waste water treatment, General design and application of biofermentor. Microbes in food spoilage and food poisoning. Food preservation – Microorganisms as food—Probiotics. Genetically modified food. Industrial products of microorganisms. Microbes used as biofertilizers -*Rhizobium, Azospirillum, Acetobacter, Azolla*and blue-green algae. Application of fungal enzymes in different industries—immobilization of enzymes – biofuel, ethanol, biogas and biodiesel production.

Outcome of the Course

Student Learning Outcomes. Upon graduation, Microbiology majors should have a thorough knowledge and understanding of the core concepts in the discipline of Microbiology. Microbiology students will be able to: Describe how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology .

Text Books

1. Dubey, R. C. and D. K. Maheswari. 2012. A text of Microbiology (Revised edition). S. Chand and Company Ltd., New Delhi.
2. Ananthanarayanan, R. and CKJ. Paniker, 2004.Textbook of Microbiology. Orient Longman Pvt. Ltd.,
3. Prescott, L. M., J. P. Harley and D. A. Klein. 2005. Microbiology. Sixth edition, International edition, Mc Graw Hill.

4. Pelczar, T. R. and M. J. Chan and N. R. Kreig. 2006. Microbiology. Fifth edition, Tata Mc Graw-Hill INC. New York.

Reference Books

5. Dubey, R.C. and D.K. Maheswari, 2007. A Textbook of Microbiology, S. Chand & Company, New Delhi
6. Powar, C. B and Daginawala 1991.General Microbiology Vol-I and Vol-II Himalaya publishing house, Bombay.
7. Sullia, S.B and S. Shantharam, 2005. General Microbiology, Oxford & IBH
8. Vasanthkumari.R.2007. A Textbook of Microbiology. BI Publications Pvt. Ltd.

Core Elective
Semester I
(Choose either A or B)
B. PHARMACOGNOSY

Core Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To understand and involves the fundamentals of Pharmacognosy like scope, classification of crudedrugs, their identification and evaluation,
- To find out the phytochemicals in the modern extraction techniques. Characterization and identification of the herbal drugs and their applications.
- To reveal the range of herbal products and their novel usage in human life

UNIT1Introduction

Definition. History and scope of Pharmacognosy. Indigenous system of medicine: Ayurveda, Homeopathy, Unani, traditional Chinese Medicine, Naturopathy, Yoga and Siddha. Classification of drug of natural origin. Adulteration/Substitution and drug evaluation. Significance of Pharmacopeial standards.

UNIT 2 Plant constituents

Occurrence, distribution, classification, isolation, identification test and pharmaceutical applications: plant metabolites, carbohydrate lipids, protein and amino acids, nucleic acids, glycosides, terpenoids, volatile oil / essential oil / resin and tannins.

UNIT 3 Therapeutic Uses of Plants and Drugs

Occurrence, distribution, organoleptic evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs. (a) Laxatives: Aloes. Rhuburb. Castor Oil. Ispaghula. (b)Cardiotonic- Digitalis Arjuna. (c) Carminatives and G.I. regulators. Umbelliferous fruits, Coriander, Cardamom, Ginger, Black pepper, Asafoetida, Nutmeg and Clove. (d) Astringents: Catechu (e) Drugs acting on nervous systems - Belladonna, Aconite, *Withaniasomnifera*, Ephedra and Opium.(f) Anti diabetics- Pterocarpus, *Gymnemasylvestre*.

UNIT 4 Industrial uses of Medicinal Plants

Perfumes and flavorings agents- peppermint oil, Lemon oil, Orange oil, Lemon grass oil and Sandal wood. Pharmaceutical aids- honey. Arachis oil, Starch, Kaolin, Pectin, Olive oil, Lanolin, Bees wax, Acacia,Sodium alginate, Agar, Guargum and Gelatin.Miscellaneous- liquorice, Garlic, Picrorhiza, Dioscorea, Linseed, Shatavari, Shankhapushpi, Pyrethrum and Tobacco.

UNIT 5 Crude Plant Drugs

Collection and preparation of crude drug for the market as exemplified by ergot, Opium, Rauwolfia, Digitalis and senna.Gross anatomical studies of Senna, Datura, Cinnamon, Cinchona, Fennel, Clove, Ginger, Nuxvomica and Ipecacuanha.

Outcome of the Course

The students are able to identify drug from natural origin and their supply, cultivation,collection, storage along with their special conditions and also define drugs from natural origin.identify the cultivation and collection conditions.identify the storage of drugs.Recall the knowledge about modern concept and scope of Pharmacognosy. To learn the fundamental principles on cultivation, collection processing and evaluation of medicinal plants. Discuss the phyto-chemical screening techniques and able to identify the Phyto-constitutes of plants.

Text Books

1. Trease. G.E. and Evanes W.C. 2009. Pharmacognosy. 16th Edn. Elsevier
2. Wallis T. E. 2005. Textbook of Pharmacognosy, 5th Edn. CBS publishers.
3. S. B. Gokhale. 2008. Pharmacognosy, Pragati Books Pvt. Ltd.
4. C. K. Kokate 2008. Pharmacognosy 53rd Edn. Nirali publisher.
5. Mohammed Ali. 2019. Textbook of Pharmacognosy 2Edn. CBS Publisher.

Reference Books

6. Horborne. J.B. 1983. Phyto chemical methods. Chapman and Hall. London.
7. Biren Shah and A.k. Seth 2010. Textbook of pharamcognosy and Phytochemistry. 8th Edn. Reed Elsevier India Pvt. Ltd.
8. Pharmacopoeia of India. Govt. of India. Ministry of health 1955 and 1966.

Semester I
Open Elective
PAPER – 1
(Choose either A or B)
A. MUSHROOM CULTIVATION

OpenElective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To create awareness about the Mushroom among the people.
- To strengthen the promotion of mushroom cultivation by establishing a well-equipped laboratory and offices.
- To know and explore the cultivation in Tamil Nadu
- To understand and provide the Unit with appropriately trained personnel for the promotion of mushroom production in the country.
- To increase the production and consumption of mushrooms.
- To develop new products for food, and assist in managing biological resources
- To make our economy strongly by exporting Mushroom product

UNITI Introduction

Mushroom – introduction, Life cycle of Mushrooms. Types and identification - edible and poisonous Mushrooms - external factors for growth. Economic importance of Mushrooms as food.

UNIT-II Mushroom Cultivation Methods

History and scope of mushroom cultivation-early cultivation- domesticated mushrooms today- other domesticated fungi. - selection - 'starter' - preparation of spawn - preparation of Compost (outdoor and indoor beds) - incubation - Harvesting and marketing

UNIT-III Spawn preparation

Spawn production - grain, powder and granular spawn - mother spawn - planting spawn - spawn preparation-spawning techniques-environmental conditions for spawn run-preparation of culture (Tissue culture and spore culture), preservation and storage of culture - various media (PDA, malt extract, Wheat extract, compost extract)

UNIT-IV Different types of Mushrooms

Cultivation of white Button Mushrooms (*Agaricusbisporus*) and Oyster Mushrooms (*Pleurotus*spp) – materials – sterilization – spawning and fruiting – house design for *Pleurotus* – preservation, canning drying, Cultivation of paddy straw Mushrooms – Preparation, Spawn making – Methods of Cultivation.Mushrooms are different types in Tamil Nadu: a) Button Mushroom b) Oyster Mushroom c) Milky Mushroom about 70% of its population living in the rural areas and their main income source is agriculture. Primary data was collected through questionnaires and secondary data from online.

UNIT-V Mushroom harvesting technology

Mushroom technology – nutritive value of edible MushroomsProtein, carbohydrate, fat, mineral, and vitamin - Medicinal value of Mushrooms, Advantages of Mushrooms Cultivation – Harvesting & Marketing (Local, National and International level).

Outcome of the Course

The students are able to specify in the Marketing aspects-make profit with consumer satisfaction, financial aspects-arrange the financial support, and Socio-economic aspects-make people aware about good or bad products with reasonable price.

Text Books

1. Shubhrata R.Mishra,2014. Techniques of Mushroom Cultivation. Discovery Publuishing House Pvt. Ltd.New Delhi.
2. Kannaiyan.S and Ramasamy, K, 1980. A Handbook of Edible Mushroom. Today andTomorrows. Printers and Publishers, New Delhi, 104 p.
3. Tewari,S.C.and Pankaj Kapoor,2018, Mushroom Cultivation Mittal Publication New Delhi.

Refences Book

1. Pathak V.N, Nagendra Yadav and Maneesha Gaur. 1998.
2. Mushroom Production and Processing Technology. Agrobios (India) Jodhpur, 179 p.
3. Suman, B.C. and Sharma, V.P.2007, Mushroom cultivation in India. Daya Publishing House New Delhi.
4. Chauhan,M., Gajre.K. and Prajapati.P.2013, Scientific Cultivation of Mushroom. Biotech Books New Delhi

Semester I
OPEN ELECTIVE
PAPER – 1
(Choose either A or B)
B. **HORTICULTURE AND LAND SCAPING**

OpenElective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To understand horticulturists, apply their knowledge, and technologies used to grow intensively produced plants for human food and non-food uses and for personal or social needs.
- To real their work involves plant propagation and cultivation with the aim of improving yields, diseases, plant growth, nutritional value, quality, and resistance to insects, and environmental stresses.
- To the students also work as gardeners, therapists, designers, growers, and technical advisors in the food and non-food sectors of horticulture.

Unit I Introductions

Garden Design and Landscaping Garden and Garden design. Knowledge of plants – Soils- Irrigation – Transplanting Potting- Soil less culture. Lawn – Rock garden – Rosary – water garden – terrace garden – Kitchen garden –Landscaping Fences for utility and beauty – Archers and pergolas – Green house and glasshouse – summer house.

Unit II Propagation Methods

Propagation techniques – Vegetative Propagation, Sexual propagation – Seed Germination techniques– Seed dormancy – Seedling raisings – Vegetative cuttings – Layering – grafting – Budding – Stocks – Scion relationships – micro propagation.

Unit III Nutrition and Diseases Management

Nutrition and Diseases Manures and Manuring – Training and pruning – Irrigation techniques. Classification of Irrigation, Methods of Irrigation. Applications and use of plant growth regulators in horticulture – Some important diseases of Horticultural plants and its plant protection.

Unit IV Floriculture and Pomology

Floriculture and Pomology Culture of Economically important flowers: Jasmine – Rose – Cut flowers. Fruit culture: Mango – Guava – Banana - Papaya.

UnitV Post-Harvest Techniques

Post-harvest technology Flower arrangements and decorations- harvesting – Marketing - post harvest Storage of fruits and vegetables – Preservation of fruits and vegetables.

Outcome of the Course

The students will be able to recognize the major areas of Horticulture and Landscape horticulture includes the production, marketing and maintenance of landscape plants. Olericulture includes the production and marketing of vegetables. Pomology includes the production and marketing of fruits. The career in the field of horticulture is the best career choice for students. Horticultural crops i.e. fruit and vegetable acquire a place of important as protective food. They provide much needed health supporting vitamins, minerals. Besides, their value in human consumption, horticultural crops play an important role in commerce, particularly in export trade and processing industry.

Text Books

1. Bose T.K. 1990. Fruits of India. Tropical and subtropical, Naya Prakash, Calcutta.
2. A.K. Tiwari., 2012. Fundamentals of Ornamentals Horticulture and Landscape Gardening. Publisher: Nipa (2012) ISBN-10: 9381450072; ISBN-13: 978-9381450079.
3. Bose .T.K. Som. M.G. and Katrir. J. 1993. Vegetable Crops, Naya Prakash, Calcutta.
4. Bose .T.K. and D.Mukherjee. 1987. Gardening in India, Naya Prakash, Calcutta.
5. Bose .T.K.. and C.P. Yadav. 1989. Commercial flowers, Naya Prakash, Calcutta.

Reference Books

6. Edman, J.B. T.L. Senn, F.S. Andrews and R.G. Halfacre, 1988. Fundamentals of Horticulture, Tata MacGraw Hill Publishing house company, New Delhi.

7. Hartman. H.T. and Kester D.E . 1986. Plant propagation principles and practices Prentices Hall of India Ltd., New Delhi.
8. Janick. J.W.H. 1988. Horticulture Science. Freeman and Co., Sanfrancisco.
9. Nambisan .K.M.P. 1992. Design Elements of Landscape Gardening- Oxford and IBH Publications.
10. Prasad,S and U.Kumar, 1999. Principles of Horticulture. Agrobotanica, bikaner
11. Shanmugavelu K.G. 1989. Production Technology of vegetable Crops. Oxford India. Publication, New Delhi.

SEMESTER II
CORE PAPER 4

Core Paper: ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

No. of teaching hours: 5

Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To understand and provide an insight into the internal structure and reproduction of the most evolved group of plants, the Angiosperms.
- To understand the origin, structure, growth, development and reproduction of angiosperms through anatomy and embryology.
- To get an insight in to the histochemistry with special reference to various stains and staining procedures

ANATOMY OF ANGIOSPERMS

Unit – I Tissue system

Xylem and Phloem and their elementsPrimary and Secondary structures, differentiationpatterns of secondary wallsstructural variation and characteristics of phloem componentphylogenetic trends and specialization of xylem and phloem. Periderm - Structure anddevelopmentprotective tissue in monocots. Wound healing and grafting, tyloses and lenticels. Growth ringsheart and sap wood, porous and non-porous wood.

Unit II Meristems

Meristem and Differentiation - Classification of Meristems - Growth Patterns – ApicalMeristem- Theories of Apical Meristem - organization – Pro-meristem shoot apex and rootapex. Vascular Cambium - Origin, Structure, and types. Cambial activity Normal and anomalous -- (Anomalous secondary thickening in dicots and monocots).

Unit III Nodal and Leaf anatomy

Nodal anatomy – uni, tri and multi-lacunar nodes and their phylogenetic relationshipsSecretory structures – external and internal. Leaf anatomy:Types of stomata,Ontogeny and histogenesis of bifacial and unifacial leaf-kranz anatomy. Wood anatomy: Physical, Chemical and Mechanical properties of wood.

EMBRYOLOGY

Unit IV Sporogenesis and Fertilization

Microsporogenesis: Morphology, cytology, development and formation of microspores and male gametes – role of tapetum male gametophytes development pollen structure.

Pollen sterility and fertility and role of palynology.Megasporogenesis: Types and structure of ovules. Megasporogenesis – Special structures of ovules. Organization of the embryo sac, types of embryo sac, role of synergids and Antipodal haustoria, nutrition of embryo sac.

Unit V Endosperm and Embryo Development

Pollen – pistil interactions and fertilization: barriers of fertilization, control of fertilization and current concept of fertilization heterospermy, polyspermy and heterofertilization. Endosperm: classification and endosperm types, Endosperm haustoria – Embryogenylaws of embryogeny - development of dicot and monocot embryo –nutrition of embryo.Polyembryony: classification and types. Apomixis: Parthenogenesis and Parthenocarpy.

Outcome of the Course

The students will be able to recognize the anatomical differences between monocotyledons and dicotyledons of roots, stems, leaves, bark and wood. In addition, they will clearly understand the seed-to-seed developmental aspects of angiosperms.

Text Books

1. Bhojwani, S.S. and Bhatnagar, S.P. 1981. Embryology of angiosperms. Vikas PublicationPvt.Ltd. New Delhi.
2. Eames, A.J and Mac Daniel, 1975. An introduction to Plant Anatomy. TMH edition, TataMacGraw Hill, New Delhi.
3. Pandey.S.N. and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishinf House Pvt.Ltd , New Delhi.
4. Esau, K. 1989. Anatomy of seed plants. John Wiely& Sons, Newyork
5. Maheshwari, P. 1963. An Introduction to embryology of Angiosperms. Tata Mc GrowHill. Newyork.

Reference Books

6. Pandey, P.B. 2000. Plant Anatomy. S.Chand& Co.,
7. Esau, K. 1972. Plant anatomy. John Wiely& Sons, Newyork.
8. Shivanna.K.R. 2003. Pollen biology and biotechnology. Oxford IBH, New Delhi
9. Singh.V., P.C. Pandey and D.K.Jain. 2003. Embryology of Angiosperms. Rastogi

Publications. Meerut.

SEMESTER II
CORE PAPER –5

Core Paper: CELL AND MOLECULAR BIOLOGY

Core Paper **No. of teaching hours: 5**
Credits: 4 **Marks (Ex.75+In.25=100)**

Objective

- To understand the structure and function of basic components of prokaryotic and eukaryotic cells, especially its membrane organization and organelles.
- To introduce to rapid contemporary changes witnessed in plant molecular biology.
- To analysis the basic organization of genetic material and the realms of events associated with replication and gene expression will be examined.
- To understand the molecular mechanism of gene regulation and gene expression.

UNIT I Cell and Cell organelles

General account of Prokaryotic and Eukaryotic Cell, Cell wall, plasma membrane. Ultrastructure, Chemistry and Functions of mitochondria, Dictyosomes, lysosomes, endoplasmic reticulum, ribosomes, peroxisomes, Glyoxysomes, vacuoles, chloroplast, mitochondria, Nucleus – history, Ultrastructure, chemistry and functions of cytoskeleton andits role in motility. Structure and functions of Nucleolus—importance of nucleolus in cell division.

UNIT II Chromosomes and Cell Cycle

Chromosomes: Types, Fine structure of eukaryotic chromosome, chemistry – Kinetochore, chromomeres, satellite chromosome, Euchromatin and Heterochromatin-special types of chromosomes – lamp brush chromosome, polytene chromosome. Architectural changes of chromosomes: detailed study of chromosomal deficiency, duplication, inversion and translocation and their role in evolution. Karyotype analysis – Importance of Cytotaxonomy. Cell reproduction, events of the eukaryotic cell cycle, variations in cell-cycle organization, cell cycle control system. Model organisms in cell-cycle analysis.Mitosis, cytokinesis and Meiosis. Mitotic inducers and inhibitors, variations in mitosis and meiosis.

UNIT III Cell Signaling

Hormones and their receptors, Cell surface receptors, signalingthrough G – Protein, coupled receptors, signal transduction pathways, secondmessengers, regulation of

signaling pathways, Light signaling in plants. Ion Channel –Leaked receptors, Enzyme linked receptors, Cytoplasmic and Nuclear receptors.

UNIT IV DNA Replication

DNA Replication: Methods of replication, various enzymes involved, Replication origin andreplication fork, Fidelity of replication, extra-chromosomal replicons. Repair andRecombination: DNA damage and repair mechanisms.RNA synthesis and processing – Transcription mechanism - Factors - Formation ofinitiation complex, Transcription activator and repressor, RNA polymerases, Capping,Elongation.RNA processing - RNA editing, Splicing and polyadenylation, structure and functionof different types of RNA, RNA transport, Transcription inhibitors, Post-transcriptional modification of gene.

UNIT V Transcription and Gene Regulation

Protein synthesis and processing – Genetic code, Ribosome, Formation of initiationcomplex, Initiation factors and their regulation complex, Elongation and elongationfactors, Termination, Amino acylation of tRNA, tRNA idendity, tRNA synthetase,Proof reading, Translational inhibitors, Post-translational modification of proteins.Gene Regulation – Operon concept: TrpOperon and Ara Operon.

Outcome of the course

Students will gain knowledge about the basic and fundamental organization of life and genetic material and their applications in molecular aspects.

Text Books

1. David R Hyde. 2010. Genetics and Molecular biology. Special Indian edition, Tata Mc Graw Hill P.Ltd., New Delhi.
2. Gerald Karp. 2010. Cell and Molecular Biology (6thedn). John Wiley and Sons Inc. ISBN – 13 978-0-470-48337-4.
3. Klein Smith, L. J. and V. M. Kish. 1995. Principles of Cell and Molecular Biology (2nd edition). Harper Collins College Publishers, New York, USA.
4. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition).

References Books

1. Alberts, B. and D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson. 1999. Molecular Biology of Cell. Garland Publishing, Inc., New York.
2. David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi.
3. Krishnamurthy, K. V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
4. Lewin, B. 2000. Genes VII. Oxford University Press, New York.

5. Lodish, H. and A. Berk, S. L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell. 2000. Molecular Cell Biology. 4th Edition. WH Freeman and Co., New York.
6. Wolfe. S. L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.
7. Wayne M Becker, Lewis J Kleinsmith, Jeff Hardin (2007). *The world of the cell* (VI Edn). Pearson.
8. Geoffrey M Cooper, Robert E Hausman (2009). *The Cell: A molecular approach* (V Edn). Sinaeur.
9. Gerald Karp (2008). *Cell and Molecular biology: Concepts and experiments* (V Edn). John Wiley &Sons.
10. Allison.A. 2007. Fundamental Molecular Biology. Blackwell Publishing, UK.
11. H. Lodish et al. 2012. Molecular Cell Biology, 7th Ed. W.H Freeman and Company,
12. De Robertis& De Robertis, 2004. Cell and Molecular Biology. Williams and Wilkins. USA.
13. Freifelder, 1990. Molecular Biology, Narosa Publishing House, New Delhi.
14. Mary A. Schuler Raymond and E.Zrelinski, 2005. Methods in Plant Molecular Biology, Academic Press an imprint of Elsevier.
15. Peter Porella, 1998. Introduction to Molecular Biology, Mc Graw – Hill, New York.
16. Rastogi, S.C. 2010. Cell Biology. New age International Pub. New Delhi.
17. Watson Baker Bell, Gana Levine Losick, 2004. Molecular Biology of the gene, Pearson Education.
18. William D. Stansfield. Jaine S. Colone Raul J. Chand, 2004. Molecular and Cell Biology, Tata Mc Graw-Hill Publishing company, New Delhi.
19. Daniel L Hartl, Elizabeth W Jones (2012). *Genetics: Analysis of genes and genomes* (VII Edn). Jones and Bartlett publishers.
20. Geoffrey M. CooperandRobert E. Hausman2015. The Cell: A Molecular Approach. 7thedn. Sinauer Associates is an imprint of Oxford University Press.

SEMESTER II
CORE PAPER 6

Core Paper: GENETICS, PLANT BREEDING AND EVOLUTION

Core Paper **No. of teaching hours: 5**
Credits: 4 **Marks (Ex.75+In.25=100)**

Objective

- To acquire a knowledge on features of sexual reproduction and understand the basic principles of genetics applied to plant breeding procedures.
- To provide students advanced knowledge on microbial and plant genetics and its applications.
- To familiarize students on the various types of genetical techniques and procedures.
- Understanding of how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc
- To highlight the breeding developing upon production breeding, quality breeding, adaptive breeding and protection breeding regardless of breeding system.
- Evolutionary biology is to teach past history & origin of living organisms.

UNIT1 Principle of Genetics

Laws of inheritance, modified Mendelian – mono-hybrid; dihybrid- test cross, back cross- alleles epitasis- nitration of genes-complementary genes - dominance - segregation independent assortment-gene mapping methods. linkage maps-sex determination. Extrachromosomal inheritance– inheritance of mitochondrial and chloroplast genes; maternal inheritance, polygenic inheritance,

UNIT2 Molecular Genetics

Non-Mendelian Inheritance - cytoplasmic inheritance – chloroplast – Mitochondrial genome in higher plants. Microbial genetics: Algal, Fungal, bacterial and viral genetics. Molecular genetics: Nucleic acids as genetic material – types of nucleic acids – replication of DNA – methods and models in DNA repair mechanism – enzymes – split genes – jumping and mobile genes (Transposable) – concepts of gene – cistron – muton-recon.Mutation– types, causes and detection, mutant types – lethal, conditional,

biochemical loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. – physical and chemical mutagens, molecular basis of gene mutation, point and frame shift and suppressor mutation. Gene regulatory mechanisms – Genetic disorders in human.

UNIT 3 Plant Breeding Methods

History and objectives of plant breeding; centers of origin, plant introduction – history, agencies, procedure, germplasm collection, merits and demerits.Modes of reproduction; Control of pollination – self incompatibility, male sterility.Selection – mass selection, pureline selection, clonal selection with reference to methodology, merits and demerits, their application.Heterosis and Inbreeding depression – effects of inbreeding, genetic basis of heterosis – theories explaining heterosis and inbreeding depression.

UNIT4 Plant Breeding Techniques

Selection in segregating populations – Pedigree method, bulk method and back cross method. Hybridization: Inter and Intra-varietal, inter and intra-specific and inter and tra-generic hybridization –Hybrid vigour. Numerical changes of chromosomes – haploids, aneuploids, secondary polyploids, euploids – auto and allopolyploids, role of polyploids and Mutation in plant breeding. Molecular mechanism of crossing over gene conversion, ordered and unordered tetrad analysis somatic cell hybridization-mutation. Special breeding techniques- Mutation breeding; Breeding for abiotic and biotic stresses. Cultivar development- testing, release and notification, maintenance breeding,Participatory Plant Breeding, Plant breeders‟ rights and regulations for plant varietyprotection and farmers rights.

UNIT5 Evolution

The modern evolutionary theory in relation to the origins and dynamics of genetic diversity in time and space, reproductive isolation and evolutionary relationships among organismal groups. Natural selection; levels of selection. Darwin and the theory of evolution, quantitative traits. Types of selection; sexual selection; genetic drift; gene flow; adaptation; convergence; species concepts;life history strategies; adaptive radiation; biogeography. Origin of genetic variation; polygenetic traits, linkage and recombination; epistasis, gene-environment interaction; heritability; population genetics; molecular

evolution - cladistics.phylogenetic analysis and comparative methods; Speciation; extinction and biodiversity.

Outcome of course

Students will know the principle of genetics value and the importance on improving the molecular genetics. On the successful completion of the course, the student will be able to: Comprehensive, detailed understanding of the basis of heredity. Understanding the role of genetic mechanisms in evolution. The ability to evaluate conclusions that are based on genetic data. Understanding the role of genetic technologies in industries related to biotechnology, pharmaceuticals, energy, and other fields.

Text Books

1. Gardner EJ &Snustad DP. 1991. Principles of Genetics. John Wiley & Sons.
2. Klug WS & Cummings MR. 2003. Concepts of Genetics. Peterson Edu.
3. Lewin's Genes XII Hardcover-2 March 2017. J. E. Krebs et al.,
4. Russell PJ. 1998. Genetics. The Benzamin/Cummings Publ. Co.
5. Snustad DP & Simmons MJ. 2006. Genetics. 4th Ed. John Wiley & Sons.
6. Strickberger MW. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India
7. Tamarin RH. 1999. Principles of Genetics. Wm. C. Brown Publs.
8. Uppal S, Yadav R, Subhadra& Saharan RP. 2005. Practical Manual on Basic and Applied Genetics.Dept. of Genetics, CCS HAU Hisar.

Reference books

1. Plant breeding with farmers requires testing the assumptions of conventional plant breeding: Lessons from the ICARDA barley program. p. 297-332.
2. David A. Cleveland, and Daniela Soleri (ed.). Farmers, scientists and plant breeding: integrating knowledge and practice. CABI Publishing International, Wallingford, Oxon, UK.Ceccarelli S., Grando S., 2007. D
3. Denis, J.C. and Adams, M.W. (1978). A factor analysis of plant variables related to yield in dry beans. I. Morphological traits. Crops Science, 18:74–7

4. L. Skot AFRCIGER, Plant Breeding Station PlasGogerddan, Near Aberystwyth SY23 3EB Dyfed, UK

5. A.P.M. den Nijs, Centre for Plant Breeding and Reproduction Research (CPRO-DLO) Droevendaalsesteeg 1 PO Box 16 6700 AA Wageningen THE NETHERLANDS

6. Sinha V and Sinha S: 1998 Cytogenetics plant Breeding and Evolution, Vikas Publishing house Pvt ltd , Newdelhi

7. Swaminathan ,M.S.Gupta , P.K and Singa U-1974 Cytogenetic to crop plants , Macmillan Ltd Newdelhi

E-Materials

GENETICS &PLANT BREEDING

List of Journals

- Australian Journal of Biological Sciences, Australia
- Australian Journal of Agricultural Research, Australia
- Biometrics, UK
- Bio-Techniques
- Cereal Research Communication, Hungary
- Crop Improvement, Ludhiana, India
- Crop Science, USA
- Czech Journal of Plant Breeding Genetics, Prague,
- Plant Breeding, Germany •Plant Molecular Biology, The Netherlands •
- Sorghum and Millet Newsletter, ICRISAT
- Theoretical and Applied Genetics, Germany
- Wheat Research, Japan

Semester II
Core Elective
PAPER – 2
(Choose either A or B)
A. TECHNIQUES IN BOTANY

Core Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To understand and familiar with modern instruments used in plant science field.
- To Understand Principle, working, ray diagram and application of advance microscopes
- The students are able to stain the bacteria with differential staining techniques.
- To understand bio-analytical methods used in various molecular biology.

UNIT I Microscopy

Structure, working principle and applications of Light, Dark field, Bright Field, Phase Contrast, Confocal, Fluorescence, Scanning and Transmission Electron microscopy, Material preparation for Electron microscopy. Microscopic measurements: Micrometers – Ocular and Stage; Haemo-cytometer and Camera Lucida.

UNIT II Micro-techniques and Culture Techniques

Sectioning of Biological specimens - Free hand, staining of the sections, Mounting and mountants, Fixing coverslips and ringing. Collection and Preservation of plant material. Cryopreservation.Culture Technique: Principles, types (Bacteria, Fungi, Algae, Plant) media preparation, sterilization, inoculation, Equipment – Laminar air flow, thermobath, shaker, stirrer, hot airOven.

UNIT III Histochemical and Spectroscopic techniques

Introduction to Histochemical techniques – staining of Proteins, Carbohydrates, and Lipids. Microslide preparation—Whole mounts, Smears and Squashes. Maceration technique.Colorimetry, UV-Visible and Atomic Absorption Spectrophotometry, IR,

NMR and Mass Spectrophotometry and X-Ray Diffraction analysis. Flow Cytometry, Autoradiography: Isotopes used in Biology

UNIT IV Molecular and separation Techniques

Blotting techniques- Southern, Northern and Western; ELISA; RIA and PCR (Thermocycler and Real Time PCR). DNA finger printing; RFLP; RAPD, MALDI and FISH techniques. Electrophoresis – General principles – Electrophoresis- Agarose gel; SDS –PAGE. Chromatography – Principles and applications of Paper, Thin layer, Column, Ion exchange, affinity, Gel permeation, Adsorption and Partition chromatography. HPLC and FPLC. HPTLC and GC. Centrifugation: Basic principles of Sedimentation; Preparative Ultracentrifugation.

UNIT V Tissue culture techniques

Introduction - tissue culture techniques - laboratory organization – preparation of nutrient media. Methods of sterilization – Chemical and Physical methods. Preparation of explants – callus initiation, subculture and hardening. Concepts of totipotency and redifferentiation. Cell suspension culture – callus culture, Anther and pollen culture – haploids and their significances. Embryo culture - Meristem culture for virus-free clones.

Text Books

1. Ananta Swargiary. 2017. Biological tools and Techniques. Kalyani Publishers, New Delhi.
2. Prasad and Prasad, 2000. Outlines of Micro technique. Emkaypubl, New Delhi.
3. Practical Biochemistry: Principles and Techniques. Ed. E. Wilson and J. Walker (2000) Cambridge Publ.
4. Chawla, H.S. 2000. Introduction to biotechnology. Oxford and IBH publishing Co.,
   New Delhi.
5. Johannson DA. 1975. Plant Microtechnique. McGraw Hill.

Reference Books

6. Nagarajan, P. and Senthilkumar, N. 2001. Molecular biology principles and methods a practical approach, SreeNarmatha Printers,Coimbatore.

7. Sharma, R.K. and S.P.S. Sangha. 2009. Basic Techniques in Biochemistry and Molecular Biology. I.K. International Pvt. Ltd, New Delhi.
8. Keith Wilson and John Walker.2010. Principles and Techniques of Biochemistry and Molecular biology. Cambridge University Press, New York.
9. Palanichamy, S. and M. Shunmugavelu. 1997. Research methods in Biological Sciences. Palani Paramount Publications, Palani.
10. P.R. Yadav and Rajiv tyagi, 2006. Biological Techniques, Discovery Publishing House, New Delhi.
11. Susan carson, Heather B. Miller and D. Scott, 2012. Molecular biology techniques, Elesiver.
12. Bajpai P.K. 2006. Biological instrumentation and Methodology. S Chand Publishers, New Delhi.
13. Sabari Ghosal and Srivastava A. K. 2009. Fundamentals of Biological Techniques and Instrumentation. PHI Learning Private Ltd. New Delhi.

Semester II
Core Elective
PAPER – 2
(Choose either A or B)
A. INDUSTRIAL MICROBIOLOGY

Core Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To understand the importance of microbes, basics of a sterilization, fermenter design and types.
- To study the avenues of exploiting microbes in bioconversion technology.
- To study the industrial production, product recovery and commercial application in fermentation.

UNIT – I Industrial Biotechnology

Introduction - Historical account – development – scope of industrial microbiology, source and characters of industrially important microbes – Microorganisms in industry – Sterilization – preparation of media – isolation methods for microorganisms – culture and preservation and stability. Principles of storage of microbes at low temperature in liquid nitrogen, Preparation of inoceleem – Screening methods and methods for strain improvement.

UNIT – II Industrial Fermentations Techniques

Types of fermentation – components of fermentation process – factors involved in fermenter design, differences between biochemical and chemical processes; biochemical reactions, operational consideration. Fermenter configuration and different types of fermentors; Principle of operation characteristics of fermentors, Methods used for down – stream processing and product recovery – filtration, centrifugation, cell disruption, extraction, dialysis, purification, drying, packing and labeling, Manufacturing practices and Fermentation economics.

UNIT – III Methylotrophs

Methanogens and methylotrophs, Mechanism of methane production – Economic importance of methylotrophs. Hydrogen fuel, Microbial leaching. Sulphur utilizing, sulphate reduction pathway – use of nucleotides as nitrogen source for growth of certain microorganisms (pathway of nucleic acid breakdown). Immobilization of microbial cells and enzymes methods and applications – Biofuel, ethanol, biogas, biodiesel and hydrogen production, Microbial polyesters, biosurfactants and recombinant products.

UNIT – IV Microbial production of food

Microbes in food production and food poisoning, microbial single cell protein (SCP). Fermented dairy products, fermented meats, leavening of breads, microbiology and production of ethanol and alcoholic beverages – beer, manufacturing and production of distilled beverages, wines, vinegar, Baker's yeast production – food and fodder yeast production, fermented vegetables, pickles, olives, soy source, mushroom, algae and cheese.

UNIT – V Microbial production of Metabolites

Microbial production of primary and secondary metabolite, commercial production of antibiotics with special reference in penicillin, streptomycin and their derivatives. Vitamins and growth stimulants – Vitamin A, Vitamin B12; Organic acids – citric acid, fumaric acid, Bacterial gluconic acid and ∝ - Ketoglutaric acid. Amino acid – L – glutamic acid, Lysine. Enzymes – Amylase and proteases. Microbial transformation of steroids and alkaloids production. Large scale production of recombinant molecules interferon, human protein, insulin, somatostation, vaccines and anticancer agents.

Outcome of the Course

The students are able to clarify scope of Industrial and Pharmaceutical Microbiology. Industrial microbiology may be defined as the study of the large-scale and profit motivated production of microorganisms or their products for direct use, or as inputs in the manufacture of other goods.Know various Culture media and their applications and also understand various physical andchemical means of sterilization. Know General bacteriology and microbial techniques for isolation of pure cultures of

bacteria, fungiand algae. Master aseptic techniques and be able to perform routine culture handling tasks safely andeffectively

Text Books

1. Nduka okafor, 2007. Modern Industrial Microbiology and Biotechnology. Ist Editions. Science Publishers.
2. Waiter, M.J., organ, N.I., Rockey., I.S and Higton, G., 2002. Industrial Microbiology – An Introduction, Black well science Publisher.

Reference Books

1. Patel, A.H., 2010. Industrial Microbiology 4th edition. Macmillan Publisher, India.
2. Casida, JR L.E., 2009. Industrial Microbiology. New Age International (P) Ltd., Publishers, New Delhi.
3. Okafor, 2007. Modern industrial microbiology and Biotechnology. Scientific publisher. Enfield, USA.
4. Demain, A.I, 2001. Industrial Microbiology and Biotechnology. 2nd Edition, ASSI Press, Washington.
5. Danial Forciniti. 2008. Industrial Bioseparations – principles and practice, Wiley – Black well.
6. Richard, H., Batlz, Julian, E., Davis and Arnold, I. Demain., 2010. Manual of Industrial Microbiology and Biotechnology, 3rd edition, ASM Press.
7. Stanbury, P., F., Whitekar, A and Hall. 2000. Principles of fermentation technology. Butterworth, Heinemann.

Semester II
Open Elective
PAPER – 2
(Choose either A or B)
A. ORGANIC FORMING

Open Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objective

- The Students are able to identify and conserving environment and natural resources, re-establishing ecological balance, encouraging sustainable agriculture, improving soil fertility, conserving flora and fauna.
- To increase genetic diversity and promote more usage of natural pesticides.Control pests, diseases and weeds
- To encourage production and use of organic and biological sources of nutrients like biofertilizers, organic manure, compost for sustained soil health and fertility and improving soil organic carbon and to promote production and use of biopesticides, bio-control agents etc as alternative inputs in organic farming.
- To facilitate, encourage and promote development of organic agriculture in the country

UNIT I Importance of organic farming

Introduction: Farming, organic farming, concept and development of organic farming. Historical development of Organic Agriculture in India, Present status of Organic Agriculture. Types of organic farming, Benefits of organic farming. Conventional farming v/s organic farming, Scope and Present state of organic farming, national and international status.

Unit II Organic manure

Organic Manure, advantages of organic manure, Farm Yard Manure /Rural compost, City compost, Oil cakes, Animal wastes, etc. Green Manure – Green Manure with Leguminous crops in crop rotation. In-situ incorporation of crop residues –Benefits.

Preparation of Compost- Different Methods, Enrichment of compost and Nutrient composition. Preparation of vermin compost.

Unit III Bio-fertilizer

Fertilizer, chemical fertilizer, Bio-fertilizers, types of Bio-fertilizer, advantages and disadvantages. Study of growth characteristics of various microbes used in biofertilizers production. Storage, shelf life, quality control and marketing. Types of biofertilizer – Bacteria (*Azospirillum*), Cyanobacteria (*Nostoc*), Fungi (*Glomus*) Nitrogenous Biofertilizers (*Rhizobium*) phosphate and Seaweed Liquid Fertilizer.

Unit IV Bio-pesticides

Biological control, History and concept of biopesticides. Importance, scope and potential of biopesticide. classification of biopesticides, botanical pesticides and biorationales. Mass production technology of bio-pesticides. Major classes-Properties and uses of Fungicides, Bacteriocide and Herbicides. Importance of Neem in organic Agriculture.

Unit V Standards for organic products

Organic crop management, quality of organic foods and Human Health, Organic Standard, Organic Certification Process, Operational Structure of Organic Certification, Farm inspection and certification, Marketing of Organic Products. Conversion to organic farming, Process, Income generation activities: Apiculture, Mushroom production, Terrace farming. Organic Farming and national Economy Socio Economic impacts.

Outcome of the Course

The Students are able to appreciating in Organic farming is a farming method that involves growing and nurturing crops without the use of synthetic based fertilizers and pesticides.Organic farming uses method like green manure and composting which replaces nutrients taken from the soil from the previous crops, organic farming relies on natural breakdown of organic matter and hence allows the production of nutrients in the soil. It improves soil fertility and feeds nutrients to the soil to feed the plant. Organic farming is one of the effective methods for soil management.Organic Farming also controls other organisms with the help of methods such as biological pest control and Integrated Pest Management.

Text Books

1. Joshi, M., Setty, T.K.P. and Prabhakarasetty 2006. Sustainability through Organic farming.1st Edition.Kalyani Publishers, Ludhiana, India.
2. Bavec, F. and Bavec, M. 2007. Organic Production and Use of AlternativeCrops. CRC Press, Boca Raton, FL.
3. Sarath Chandran Unni M.R Sabu Thomas, 2019. Organic Farming, 1st Edn. Global Perspectives and Methods, Elsevier.
4. Niir Board 2004. The Complete Technology Book On Bio-Fertilizer And Organic Farming, National Institute Of Industrial Re.

References Books

5. A C Gaur, 2011Handbook of Organic Farming and Biofertilizers
6. Shalini Suri. 2011. Biofertilizers and Biopesticides, Aph Publishing Corporation
7. H.C. Lakshman and A. Channabasava 2o14 Vedams eBooks (P) Ltd (New Delhi, India)
8. NPCS Board of Consultants & Engineers2008, the Complete Book on Organic Farming and Production of Organic Compost, Asia Pacific Business Press Inc.
9. Ahmad Mehraban. 2013. The Basis of Organic Fertilizers, LAP LAMBERT Academic Publishing.
10. S M Singh, 2018. Organic Manure: Sources Preparation and Usage in Farming Lands,Siya Publishing House

Semester II
Open Elective
PAPER – 2
(Choose either A or B)
B. HERBAL SCIENCE

Open Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives:

- To study the importance of herbal medicine in India
- To identify the herbal medicine uses plant
- To cultivation medicinal plants
- To understand the morphological characters of medicinal plants

UNIT I Introduction of Herbal Sciences

Role of plants in naturopathy- A historical perspective of medicinal plants in India.Importance and relevance of medicinal drugs in India. Indian system of medicineviz, Siddha, Ayurveda,Allopathy, Unani and Homeopathy. Study of Phytochemicals—reserve materials, secretory materials and excretory materials.Indian Systems of Medicine (Ayurveda, Siddha, Unani, Tibetan, Yoga and Naturopathy) Ayurveda: Historical perspective, Swasthavritta (measures to be adopted for maintaining the health of healthy person in a positive way through prevention, promotion and correction).

UNIT II Medicinal Plants Therapeutic Compounds

Chemical constituents. Therapeutic and other Pharmaceutical uses of Root - *Withanaisomnifera, Hemidesmus indicus*. Stem –*Tinsoporacordifolia,Ephedra gerardiana*. Underground stem – Zingeberofficinale, Curcuma longa, Wood -*Santalum album*, Bark - *Saracaasoca, Terminalia arjuna.* Leaves- *Ocimumsantum,*

Adathodavasica. Flower- *Syzyginumaromaticum, Crocus sativus*. Fruit- *Termianliabellirica, Emblica officinalis*. Seeds- *Strychnosnuxvomica*. Whole plants- *Phyllanthus amarus*.

UNIT III Gardening Medicinal Plants

Medicinal gardening – garden in the hills and plains, house gardens, important plants for gardening. Poisonous plants of India—Types of Plant poison- active plant poison- treatment for plant poisons, Some important poisonous plants, their toxicity and action. Adulteration of crude drugs and its detection—methods of adulteration, types of adulteration. Medicinal plants of export values. Rejuvenating herbs—role of non flowering plants in the field of medicine.

UNITIV Cultivation of Medicinal Plants

Cultivation of medicinal plants in India. Breeding methods applied to medicinal plants. Herbal medicine preparation: Decoction, infusion, syrup, tincture and poultice. Food: herbal salad, chutney, soup and Tea. Exports values of medicinal plants- Bark - Cinchona, Leaves – Adathoda and Eucalyptus, Flower - Clove. Fruits and seed - Wood apple, Gooseberry and Poppy seed, Underground stem - Ginger, Unorganized drugs. Gum - Acacia, Resin - Turpentine, Fixed oil - Castor oil

UNITV Conservation of Medicinal Plants

Study of some common plants of medicinal value Binomial, common name, part of uses, active principles and medicinal uses. *Azadirachtaindica*, *Acalyphaindica, Achyranthes aspera, Aloe vera, Alternanthera sesselis, Cinnamomumzeylanicum,Centellaasiatica, Digitalis purpurea,Emblica officinalis, Ocimum sanctum, Phylanthusamarus, Solanum trilobatum, Syzygiumcumini*. The endemic medicinal plants of India. Conservation of existing and endangered medicinal plants.

Outcomes of the Course

The students are able to learnt the major use of herbal medicines is for health promotion and therapy for chronic, as opposed to life-threatening, conditions. However, usage of

traditional remedies increases when conventional medicine is ineffective in the treatment of disease, such as in advanced cancer and in the face of new infectious diseases.

Text Books

1. Agarwal, O.P,1985.Vol-II. Chemistry of of organic – natural products.
2. Chopra,R.N., Chopra,I.C ., Handa, K.L.,and Kapur,L.D.1994.Indigenous drugs of India.
3. Tilgner, SharolMarie . 2018. Herbal ABC's: The Foundation of Herbal Medicine.
4. Bhagwan Das—Fundamentals of Ayurveda.
5. Kandasamy Pillai,1972. History of Siddha medicine. Govt. of Tamilnadu.

Reference Books

6. Krup,P.V. Handbook of medicinal plants Vol I &II, CCRIMH, NewDelhi.
7. Nadkarni,K.M.,1976.Indian Materia Medica Vol I &II, Popular Prakashan Pvt. Ltd.
8. Wallis,T.E.,1967. Text book of Pharmacognosy, J.A. Churchill Ltd.
9. C.K. Kokale, C.K. Kokate& Purohit – Pharmacognosy, NiraliPrakasan, New Delhi.
10. E.Edwin Jerald &Sheeja Edwin Jerald – Text Book of Pharmacognosy and Phytochemistry, CBS Publishers & Dist., NewDelhi.

SEMESTER III
Core PAPER – 7

Core Paper: MORPHOLOGY AND TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Core Paper **No. of teaching hours: 5**
Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To familiarize with technical terms related to angiosperms, as to cope up in tune with recent advances of biomes being viewed from plant functional traits.
- To develop skill in species recognition, identify them using pertinent floras, familiarize with diagnostic features of families included in syllabus and
- To acquire knowledge on cultivation and utilization of plant resources as food crops, commercial crops and drug yielding plants.

Unit I Morphology

Stem: Forms, buds, modification of stem, bark texture and sap color with examples. Leaf: Type- simple and compound, phyllotaxy, terms related to shape apex, base and margin, texture and surface, venation and stipules.Inflorescence types – racemose, cymose and special.Flower: Sexuality, symmetry, brackets, calyx, corolla, androecium, gynoecium, placentation.Fruits: Types and classification.Seeds: Parts, types and classification.

Unit II Nomenclature and Classification of Angiosperms

Classification of Linnaeus, Bentham and Hooker, Engler and Prantl,Takhtajan and Arthrur Cronquist. Detailed account of APG3 classification. Biosystematics and Molecular Taxonomy, DNA barcode, Chemotaxonomy and Numerical taxonomy.Principles of ICBN-Typification, Principles of priority and their limitations Citation, key for identification of plants, General indexes, Monographs, Periodicals, Floras and Manuals, Data banks, use of molecular tools in taxonomy, Use of Cladistics methodology in Taxonomy.Floras and their usage: Emphasis on Asian Floras.Plant preservation techniques; Herbaria, digital herbaria; world and regional herbaria; Botanic gardens – role in *ex situ* conservation of plants, details on Botanic Garden Conservation International, and Botanical Survey of India.

Unit III Families of Angiosperms

Study of the following plant families, with details on (i) distribution (ii) diagnostic features (iii) description and their interrelationship and phylogeny (iv) economic importance of at least six species in each family.

Nymphaeaceae, Menispermaceae, Sterculiaceae, MeliaceaeCelastraceae, Rhamnaceae, Sapindaceae, Myrtaceae, PortulacaceaeSapotaceae Combretaceae, Lythraceae, Passifloraceae, Apiaceae.

Unit IV Families of Angiosperms

Boraginaceae, Bignoniaceae, Lamiaceae, Acanthaceae, Lauraceae, Araceae, Commelinaceae Typhaceae. Casuarinaceae Cyperaceae Arecaceae

Levels and types of Biodiversity, Status and values of the Biodiversity, hot spots, Endemism, IUCN, Red-list categories, National Biodiversity Act.

Unit V Plants in Human Welfare

Cultivation and utilization of food crop, Cereals (Paddy and Ragi), pulses (Black gram and green gram). Spices – Pepper and cardomum; Edible oils – Sesame and Groundnut Aromatic oils, Eucalyptus and Citronella oil. Commercial crops—Sugarcane, Rubber, Tea, Fibers- Cotton, Jute; Timbers- Teak and Dalbergia. Drug yielding plants – *Phyllanthus amarus* and *Solanum trilobatum*; Adulteration in drugs.

Outcome of the Course

Upon completion of this course students are expected to be familiar with technical terms of angiosperm plants, acquire ability to identify species using floras utilizing the knowledge gained on diagnostic features of plant families and knowledge on economically important various plant resources.

Text Books

1. Mabberley, D. J., 2014. Mabberley's Plant Book. Cambridge University Press.
2. Pandey B. P., 2009. Taxonomy of Angiosperms. S. Chand & Co. Ltd. New Delhi.
3. Kochhar, S. L., 2012. Economic Botany in the Tropics. Laxmi Publications; Fourth edition.

Reference books

1. Dutta, S. C., 2003 Systematic Botany, New Age International (P) Ltd, Publication, New Delhi.
2. Naik, V. N., 2002. Taxonomy of Angiosperms, Tata McGraw-Hill, New York.
3. Subramanyam, N. S., 1995. Modern Plant Taxonomy. Vikas publishing House, New Delhi.
4. Lawrence, G. H. M., 1964, Taxonomy of Vascular plants, Oxford & IBH Publishing company (P) Ltd, New Delhi.
5. Sivarajan, V. V., 1999. Principles of plant taxonomy, Oxford and IBH.

SEMESTER III
CORE PAPER – 8

Core Paper: BIOTECHNOLOGY AND GENETIC ENGINEERING

No. of teaching hours: 5
Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To better understanding of all aspects of the plant transgenic/genetic engineering process, for enhancing efficiency, precision, and proper expression of the added genes or nucleic acid molecules.
- To learn and familiarizes Genetic engineering, also called genetic modification, to direct manipulation of an organism's genome using biotechnology.
- To train the students in the aspects of innovative applications and techniques in tissue culture to conserve endemic, endangered plants and improve the quality of the economically important plants/crops.
- To learn the recent advances in genetic engineering and production of transgenic plants

UNIT I General Biotechnology

Introduction and history of Biotechnology, Scope, Potentialities and constraints of biotechnology. Fermentation Process –traditional and modern biotechnology; General

requirements of fermentation processes.: Various types of fermentor and design of fermentors. Algal biotechnology. Fungal biotechnology.Recent trends in genomics and Genetics of Arabidopsis thaliana, Biofertilizers – cultivation and applications of biofertilizers (Nitrogeous and phosphatic biofertilizers).

UNIT II Industrial Biotechnology

Production of industrial enzymes - amylases, lipases, cellulases and protease. Methods of enzyme immobilization and applications. Production of biogas, and alcohol. Production of Single cell protein, biopesticides and biofertilizers. Production of biopolymers. Pants as bioreactors: Edible vaccines - Production of antibiotics, viral antigens and peptide hormones in plants, biodegradable plastics in plants. Applications of secondary metabolites: Isolation and characterization – drug development, Biopesticides, growth regulators, Biofertilizers. Value addition via bio transformation. Biocatalyst, Bio remediation, Bio fuels.

UNIT III Application of Plant Biotechnology

Transgenic plants: Resistance to biotic stress – insect and pest resistance: resistance from microorganisms. Resistance to abiotic stress: herbicide, glyphosate, phosphinothricin, sulfonylureas and imidazolinones. Transgenic plants as bioreactor- molecular pharming, therapeutic products. Biotechnology of nitrogen fixation: Nitrogenase - Nif genes and their organization - Genetic engineering of nif genes in yeast cells.Conventional methods of crop improvement, selection, mutation, polyploidy and clonal selection.

UNIT – IV Gene Cloning

Basic principles: Restriction endonucleases - Cloning vectors–plasmids, phages and cosmids, Transposans, primary vectors and plasmidsexpression vectors. Methods of gene transfer – transformation, conjugation, electroporation, liposome mediated gene transfer, transduction, direct transfer of DNA, viral vectors, particle gun method and microinjection; Intergenomic interaction, Agrobacterium and crown gall tumors:Tiand Ri plasmid mediated transfer –*Agrobacterium tumifaciens*. Gene cloning strategies.Mechanism of T-DNA transfer to plants, Agro infection. Plant viral vectors. Direct transformation of plants by physical methods. Genetic engineering in plants:Selectable markers, Reporter genes and Promoters used in plant vectors. Genetic engineering of plants for bacteria, fungi, virus, pest and herbicide resistance.

UNIT – V Genomics, IPR and Bioethics

Genomics: Definition--Preparation of genetic maps: Molecular genetic maps – cereals, legumes, and forest trees - Genomics for evolutionary studies. Gene cloning: Genomic and c-DNA libraries - Choice of host organisms for cloning- bacteria, plants and yeast. Gene addition and deletion approach in genetic engineering. Human genome project. Gene theraphy. IPR – patents, Trade secrets, Copy rights and Trademarks, Geographical indications, ethical issues of patenting.rDNA Technology, chromosome walking, screening expression libraries – immunological, Southern, Western and Northern blotting, Dot blots, in-situ hybridization.

Outcome of the course

Students are expected to be educated from the systematic training given in the different branches of applied biotechnology will enhance the confidence in students to take up entrepreneurial ventures in developing bio tagged products, and provide services in national and multinational industries dealing with bio utility and bio resource management.

Text Books

1. Dubey, R.C., 2008. A Text Book of Biotechnology, S.chand and Co. Ltd., New Delhi.
2. Smith, R.H., 2000.Plant tissue culture – techniques and Experiments., Acagemic press, New York.
3. Huang, P.C., 2012. Genetic Engineering Techniques: Recent Developments., Elsevier.
4. Suresh kumarGahlawat, Raj kumarsalar, Priyanka Siwach, Joginder singhDuhan, Suresh kumar, Pawan kaur., 2017. Plant Biotechnology: Recent Advancements and developments., S pringer.
5. Slata, A., N.W. Scott and M.R. Flower, 2010. Plant Biotechnology: The genetic manipulation of plants, 2nd Edition, Oxford University press.
6. Plant Biotechnology: An Introduction to Genetic Engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University Press, 2008.

Reference Books

1. Satyanarayana, U., 2008. Biotechnology, Books and Allied (p) Ltd., Kolkata.
2. Smith, J.E., 2009. Biotechnology, 5th Edition, Cambridge University Press India Pvt. Ltd., New Delhi.
3. Primrose, S.R., Twynman and old,P., 2005.Principles of gene manipulation, Black well science Ltd., New Delhi.
4. Isil AksanKurnarz, 2015. Techniques in Genetic Engineering, CRC Press.
5. Arie Altman and Paulmichaelhasegaua, 2012. Plant Biotechnology and Agriculture prospects for the 21st century, Academic Press.
6. C. Neal Stewart, Jr., 2016. Plant Biotechnology and Genetics, Principles, Techniques and Applications. John Wiley and Sons.
7. C.M. Govil, Ashok Aggarwal and Jitender Sharma, 2017. Plant Biotechnology and Genetic Engineering, PHI, Learing Pvt. Ltd.

SEMESTER III
CORE PAPER 9

Core Paper: ECOLOGY AND CONSERVATION BIOLOGY

No. of teaching hours: 5

Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To acquire knowledge on the biotic and abiotic components of the environment, biodiversity, structure of global terrestrial and aquatic biomes, natural resources, environmental protection and conservation aspects.

Unit I Ecosystem and energy cycle

The Environment: Biotic and abiotic components. Ecosystem: Concept, structure and function, producer, consumers, decomposers, Energy flow – ecological succession. Food chain, food web and ecological pyramids. Biogeochemical cycling – basic types: the water, Carbon, Phosphorous and Nitrogen cycles.Introduction, types characteristics features, structure and functions of the following Ecosystem: Tundras, temperate coniferous and deciduous forest, temperate grassland, tropical rain forest, tropical moist and dry deciduous forest, tropical savannas, desert and aquatic (ponds, lakes, rivers, estuaries, oceans).

Unit II Study of Vegetation and phytogeography

Autecology and Synecology. Ecological life cycle – species interaction – types – Population Ecology and its characteristics – density, Mortality, Natality. Survival and r and k selection. Ecological Niche – ecotone and edge effect Methods of studying vegetation – Qualitative and Quantitative characters – Quadrat studies. Density, Abundance, frequency and IVI, Polygraph charting – Raunkiaer's Life forms. Principles of plant phytogeography, floristic regions of the world, phytogeographical zones of India, endemism – endemic plants.

Unit III Evolution of Ecosystem

Development and evolution of ecosystems – Ecological succession-causes – migration – ecesis – aggregation- colonization and stabilization of plant communities—Climax and sub climax—concepts of climax and stability of ecosystem. Succession in pond, rocks bogs and sand dunes, mechanism, changes involved in succession and theories of succession. Plant indicators.

Unit IV Environmental pollution and abatement

Types of pollution; causes of pollution, major pollution- air pollution – sources, oxides of Carbon, Sulphur, Nitrogen—PAN, hydrocarbons; water pollution, soil, noise, thermal, nuclear pollution - effects and control measures of all the above pollution types; liquid and solid waste and E-wastes management.Photochemical smog, Greenhouse effect, Ozone layer depletion and Acid rain; Bioaccumulation, Bioabsorption, Biotranslocation, Eutrophication — algal bloom. Phytoremediation.

UnitV Conservation Biology

Biodiversity hotspots; Principles of Conservation: Natural resources—types--Conservation of Natural Resources - alternative resources. Global Environmental changes: Deforestation its role in Global warming and Climate change. El Nino—its role in climate change. Public Awareness - Environmental Protection Act and Environment movements.

Outcome of the Course

Students are expected to be familiar with components of the environment, major species composition, structure and functional ecology of terrestrial and aquatic ecosystems and conservation aspects

Text Books

1. Singh, J.S., Singh, S.P & Gupta, S.R. 2017. Ecology, Environmental Science and Conservation. S. Chand (G/L) & Company Ltd.
2. Dash, M.C, 2004. Fundamentals of Ecology, Tata McGraw, Hill, New Delhi.
3. Shukla, R.S and P.S. Chandel, 2007. A text book of Plant Ecology. S. Chand & Co, New Delhi

Reference books

1. Odum, E.P. Gary W. Barrelt, 2004. Fundamentals of Ecology – 15th edition, Thomson Asia Pvt., Ltd.,
2. Russell K. Monson, 2014. Ecology and the Environment. Springer Dordrecht, Heidelberg, New York.
3. Archibold, O.W. 1995. Ecology of World Vegetation. Chapman & Hall, London
4. Richards, P.W. 1996. Tropical rain forests. Cambridge University Press, Cambridge.

Semester III
Core Elective
PAPER – 3
(Choose either A or B)

A. PLANT TISSUE CULTURE

Core Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To understand and the production of exact copies of plants that produce particularly good flowers, fruits, or have other desirable traits.
- To quickly produce mature millions of plants.
- To acquire knowledge on the production of multiples of plants in the absence of seeds or necessary pollinators to produce seeds.
- Toimprove the state of health of the planted material and to increase the number of desirable germplasms available to the plant breeder.

UnitI Basics of Tissue culture

Concepts of Totipotency – Conditions of aseptic culture – Laboratory equipment – Culture vessels and different types of culture - Sterilization methods: Physical and chemical – Sterilization of Tools, Water, Vessels, Nutrient Media, Working Area, Methods of the surface disinfections - Inoculation and initiation of tissue culture – Acclimatization

UnitIIMethods and media Preparations

Explant preparation, callus initiation, growth and maintenance, Multiplication and Organogenesis – Media preparation: MS and Root media - Embryogenesis, Somaclonal variation, Germiclonal variation establishment, growth and maintenance of cell suspension culture, Methods of sub culturing and transfer of regenerated plants to the field.

UnitIII Micro Propagation

Tissue and organ culture; Cellular differentiation and regulation of morphogenesis - Somatic embryogenesis - Control of organogenesis and embryogenesis - Single cell

culture - Establishment of suspension cultures - Meristem and Nodal culture – Synthetic seed technology.

UnitIV Haploids and variation in Tissue culture

Haploid production – Androgenesis: Anther and microspore culture - Gynogenesis: Embryo culture - Protoplast isolation: Culture – regeneration - Somatic hybrid-cybrids – *In vitro* selection of mutants – mutants for salts, disease, cold, drought, herbicide and other stress conditions - Meristem culture and virus elimination - Shoot tip culture.

UnitVApplication of Tissue culture

Industrial application: Secondary metabolite production and single cell proteins by cell culture – Bioreactors – Genetic transformation using Ti plasmid Manipulation of gene expression in plants – Tissue culture as a tool for Biotechnology: Production of marker free transgenic plants - Developing insect-resistance, disease-resistance, herbicide resistance; stress and senescence tolerance in plants – Rapid propagation of Banana, Rose and orchids

Outcome of the Course

The students are educatedto plant tissue culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. It is widely used to produce clones of a plant in a method known as micropropagation.These techniques have certain advantages over traditional methods of propagation. They produce exact copies of plants required that have desirable traits. They produce mature plants quickly. Multiple plants are produced in the absence of seeds,

Text Books

1. Bhojwani, SS. and MK Razdan. 1996. Plant tissue Culture: Theory and Practice (a revised edition). Elsevier science publishers, New York.
2. U Satyanarayana, 2008. Biotechnology, Books & Allied Ltd.
3. Razdan M K 2019 Introduction to Plant Tissue Culture 3rdEdn. Oxford & IBH Publishing
4. Roberta Smith. 2012. Plant Tissue Culture - Techniques and Experiments, Elsevier, 3rd Edn.
5. Timir Baran Jha and Biswajit Ghost. 2005. Plant tissue culture (Basic and Applied). University Press, Hyderabad.

6. Thorpe, T.A. 1981. Plant tissue culture methods and application in agriculture, Elsevier.

Reference Books

7. Reinert.J and Yeoman, M.M. 1983. Plant cell and Tissue culture - Laboratory manual, Narosa publishing house, New Delhi.
8. Razdan.M.K. 2003. Introduction to Plant Tissue Culture. Oxford & IBH Publishing C.Pvt.Ltd, New Delhi.
9. Kalyan Kumar D.E.1992. Plant tissue culture, Agrobios, New Delhi.
10. T. Pullaiah, 2009. Plant Tissue Culture: Theory and Practicals, Scientific Publishers Journals Dept.
11. Timir Baran Jha and Biswajit Ghosh, 2016. Plant Tissue Culture : Basic and Applied, Platinum Publishers; 2nd Edn.
12. **Anis** Mohammad and **Ahmad** Naseem. 2016. Plant Tissue Culture: Propagation, Conservation and Crop Improvement, Springer.

Semester III
Core Elective
PAPER – 3
(Choose either A or B)
B. NANOBIOTECHNOLOGY

Core Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To the student's activities will markedly speed the development of nanotechnology-based products for cancer patients, reduce the risk of doing and encourage private-sector investment in this promising area of technology development.
- To developing new tools, such as peptides nanosheets, for medical and biological purposes is another primary objective in nanotechnology
- To advance research in the cutting-edge areas of Nano biotechnology, foster innovations and promote translational

UNIT I Introduction, History & Applications

1) Various definitions and Concept of Nano-biotechnology & Historical background. 2) Fundamental sciences and broad areas of Nanobiotechnology. 3) Various applications of Nano-biotechnology 4) Cell – Nanostructure interactions

Unit II Protein-based Nanostructures, Nanobio- machines &Signaling

1) Overview, chemistry and structure, Genetics & Secondary cell-wall polymers 2) Self-assembly in suspension, Re-crystallization at solid supports, Formation of regularly arranged Nano-particles 3) Cell as Nanobio-machine, link between the signaling pathways & molecular movements as well as neuron function 4) Concepts in nanobio-machines for information processing and communications

UNIT III Microbial Nanoparticle Production

1) Overview and concept of microbial nano-particle production 2) Methods of microbial nano-particle production 3) Applications of microbial nano-particles 4) Bacteriorhodopsin and its potential in technical applications – overview, structure, photoelectric applications, photochromic applications and applications in energy 10 20.83% conversion

Unit IV DNA-Protein Nanostructures

1) Overview and introduction 2) Oligonucleotide-Enzyme conjugates 3) DNA conjugates of binding proteins 4) Non-covalent DNA-Streptavidin conjugates 5) DNA-Protein conjugates in microarray technology

Unit V Biomaterials & Bio-electronics

1) Biomaterials- types, properties and applications 2) Biomaterial nano-particle systems for bio-electronic & biosensing applications 3) Biomaterial-based Nano-circuitry 4) Protein-based Nano-circuitry 5) DNA as functional template for Nano-circuitry

Course Outcome

After learning the course, the students should be able to: Develop a fundamental understanding of basic concepts of nano-biotechnology and its uses in the field of life sciences. ¬ Evaluate applications of various concepts & techniques of nano-biotechnology to facilitate biotechnological advancement and innovations.

Text Books

1. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley Publishers, April 2004.
2. Nanobiotechnology in Neurodegenerative Diseases. Mahendra Rai, Alka Yadav. 2019.
3. Nanobiotechnology for Sustainable Bioenergy and Biofuel Production 1st Editionby Madan L. Verma (Editor) 2020. ISBN-13: 978-0367085872; ISBN-10: 0367085879

Reference Books

5. Nanotechnology: A Gentle Introduction to Next Big Idea, Mark Ratner and Daniel Ratner, Low Price edition, Third Impression, Pearson Education. 2006.
6. Nanotechnology, William Illsey Atkinson, JAICO Publishing House, Second Impression-2008. 4) Bio molecular computation for Bio nanotechnology, Liu and Shimohara, Artech House-London, 2007.

Semester III
Open Elective
PAPER – 3
(Choose either A or B)
A. ETHNOBOTANY

Open Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To conserve the indigenous knowledge of the region and create awareness in the young generation.
- To develop new products for food, herbal, and pharmaceutical companies and assist in managing biological resources

UNIT I Introduction

Ethnobotany: Introduction, concept, scope and objectives. its significance within the limits of the state, the nation and the conservation of rare heritage from global point of view. The loss of mankind, if the heritage is not preserved and reached by present generation. Landmarks in history of ethnobiology- relation between geology, phyto geography and ethnobotany.

UNIT II Methodology of Ethnobotany

Methodology of Ethno botanical studies. a) Field work b) Herbarium c) Ancient Literature d) Temples and sacred places. Plants used by the tribal: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. Indigenous societies and interactions with plants- a global view. Relationship between man and plants- for benefit of both and developmental strategies of both. Relationship between man and plants-mutually destructive approaches.

UNIT III Ethnobotany Practices

Linkage of ethnobotany with other sciences and disciplines in biology- food and nutrition, medicine, sociological and cultural practices, religions and social costumes and economic relations, archaeology, history and politics. Plants and Tribal medicine: Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiracthaindica* b) *Ocimum sanctum c) Vitex negundo. d)*

Gloriosa superba e) Tribulus terrestris f) Pongamiapinnata g) Cassia auriculata h) Indigoferatinctoria.

UNIT IV Ethnobotany in Modern Medicine

Role of ethnobotany in modern medicine with special example Rauvolfiasepentina., Trichopuszeylanicus. Major tribes of south India and their ethnobotanical and ethno-biological heritage- Paayar, Kurichiar, Paniyar, Mulla, Karuman, Naikas, Shola Naikas, Thodas, Kothas, Kurumbas, Irulas, Mayalali, KattuNaikas

UNIT V Applications and Conservation of Ethnobotany

Ethnobotany and conservation of plants with special reference to India- Mythology and conservation of ecosystems, conservation of selected medicinal plant species: scared groves, forestry and unique ecosystems, and their ethnobiological values, plants and animals in art, tradition and ethnography: methodologies in ethno-botanical research. Ethnobotany as a source of drug.

Outcome of the course

At the end of the course students should have increased: Your capacity to think critically; your ability to design and execute an experiment; your confidence and ability in communicating ideas. This will serve as a lasting and practical basis for a career, for example, in research - whether industry or academia - as well as teaching, media, law, commerce, government or management.

Text Books

1. Das, A.P. and Pandey, A.K. (2007). Advances in Ethnobotany. Bishen Singh and Mahendra Pal Singh, Dehradun.
2. Sahu, T.R. (2007). Indigenous Knowledge: An application. Scientific Publishers. Jodhpur.
3. Gary J Martin, 2008. Ethnobotany A Methods manual, Earth scan, London.

Reference Books

1. Jain, S.K. (1995). Manual of Ethnobotany, Scientific Publishers, Jodhpur.
2. Jain, S.K. (ed.) (1981). Glimpses of Indian. *Ethnobotny*, Oxford and I B H, New Delhi
3. Journal of Ethnobotany. Deep Publishers, Lucknow

4. Jain, S.K. (ed.) (1989). Methods and Approaches in Ethnobotany. Society of Ethnobotanists, Lucknow, India.
5. Jain, S.K. (1990). Contributions of Indian Ethnobotany. Scientific publishers, Jodhpur.
6. Jain and Mudgal. Dictionary of Ethnobotany. Deep Publication, Delhi.
7. Cotton, C.M. (1997). Ethnobotany – Principles and Applications. John Wiley and Sons – Chichester.
8. Journal of Ethnopharmacology. International Society of Ethnopharmacology.
9. S. K. Jain. (1996). Ethnobotany in Human Welfare.Deep Publications. Lucknow.
10. Schultes and Reiss von (1995). Ethnobotany: Evolution of a Discipline. Chapman & Hall.

Semester III
Open Elective
PAPER – 3
(Choose either A or B)
B. FORESTRY AND CARBON MANAGEMENT

Open Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- The objective of this study is to bring the concept of normal forest into forest carbon management in India.
- To understand the maintaining or enhancing ecosystem carbon storage is increasingly becoming an important goal for forest management.
- To considering carbon in the context of land management activities, it is necessary to consider the overall management

UNIT I Introduction to Forests

Importance of forest, major forest types of India. Forest influences and protection, conservation strategies of forest, Exoties and its significance. Factors influencing resource availability. Locality factors of forest-climate, physiography, geology and soil condition, biotic factors, influence of plant completion, parasites, epiphytes, climber, weeds on forests. Forest resources and utilization – forest products, forest laws and policies, People and forest, social and community forestry, forest industries. Genetic Engineering and its application in forest, Remote sensing and GIS in forestry.

UNIT II Forestry Management

Forest resource inventory, tending operation in forestry – Weeding, cleaning, thinning, improvement felling, pruning and climber cutting. Forest regeneration – natural and artificial, their significance. Forest management system – Silviculture and Silvicultural system – clear felling system, shelter wood system, selection system, coppice system. Production forestry – concept of forest growth, growing stock – increment, rate of growth, rotation and yield and its regulation. Concept of forest working plan its purpose and salient features and micro plan.

UNIT III Approaches and Planning Forestry Management

Afforestation and reforestation, Plantation in various types of ecosystems. Sustainable Forest Management (SFNT), Criteria and indicators of forest management. Ecological, social and economic dimension of forest resource management. Approaches to forest conservation. Forestry organization – role and functions of various forestry wings. Participatory forestry – Joint forest management – approaches, methods and present status.

UNIT IV Energy issues and climate change

Climate change, global warming and greenhouse effect, green-house gases (GHGS) and their sources, quantifying Co_2 and methane emissions, global warming potential (GWP), the radiative balance, earth's carbon reservoirs and carbon cycle.Controlling Carbon dioxide: Efforts to restrict carbon dioxide levels – Kyoto Protocol, methods to increase carbon dioxide absorption in power and agricultural production, forestry and industry, Copenhagen summit and its implications. Carbon trading – concept of carbon credits, standard and branded credits (European, Indian), global and Indian Scenarios.

UNIT V Carbon Sequestration

Carbon management through abiotic sequestration, geologic injection, conventional and non-conventional techniques, carbon sequestration in vegetation, deep saline aquifers deposit, ocean carbon absorption, alternatives and risks, carbon farming and carbon trading, carbon auditing methane source and sinks, methane emissions from rice (paddy) and wetlands.Strategic management of carbon emissions – best management Practices, types of certification, studies related to global warming and its control in different ecosystem, REDD and REDD+ mechanism.

Outcome of the Course

The students are able to forests sequester (or absorb) and store carbon dioxide from the atmosphere, helping reduce greenhouse gas emissions.Carbon sequestration is the process by which atmospheric carbon dioxide is taken up by trees, grasses, and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage, and roots) and soils.

Text Books

1. De Vere Burton L. 2000. Introduction to Forestry Science, Delmar Publications, New York.
2. Montagnini, Florencia, Jordan, Carl F, 2007. Tropical Forest Ecology: The Basis for conservation and Management. Springer Publication.
3. Brohe, Arnaud, Nick Eyre, and Nicholas Howarth, 2009. Carbo Markets: An International Business Guide (Environmental Insights), Routledge.

Reference Books

1. West, P.W. 2004. Trees and Forest Management. Springer Publication.
2. James P. Kimmins, 2006. Forest Ecology, Pearson Publication.
3. A.P. Mitra et.al. 2004. Climate change and India: Uncertainly Reduction in Greenhouse Gas Inventory Estimates, Universities Press (India) Pvt. Ltd.
4. Labatt, Sonia and Robert, R. White, 2007. Carbon Finance: The Financial Implications of climate change (Wiley Finance). Wiley Finance.
5. Egbert Boeker and Rienk Van Grondella. 2013. Environmental science – Physical Principles and Applications.
6. Adrian Newton, 2007. Forest Ecology and conservation: A hand book techniques. Oxford University Press.
7. Lal, J.B. 2007. Forest Ecology. NatarajPublication.
8. Bhattacharya, P., Kandya, A.K, and Krishna Kumar, 2008. Joint Forest Management in India, Aavishkar Publisher, Jaipur. Vol I and II.

SEMESTER IV
CORE PAPER 10

Core Paper: PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

No. of teaching hours: 5

Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To understand water and nutrient translocation in plant
- To study the process and mechanism involved in photosynthesis and respiration
- To understand the stress and growth development
- To understand the mechanism and application on biochemistry and plant functions

Unit I Water relations

Physical and chemical properties of water- water in soil -water absorption by roots - water transport system- Transpiration types , factors affecting and significance – stomata structure and function– opening and closing of stomata mechanism – mineral nutrition – essential nutrients -macro and micro nutrients mineral nutrition – essential nutrients – macro and micro nutrients –diffusion- absorption of solutes translocation of solutes

Unit II Photosynthesis, Respiration and Nitrogen metabolism

Photosynthesis Chloroplast - ultra structure, photosynthetic pigments – structure and function, Emerson enhancement effect- mechanism of electron transport – photophosphorylation (PS-I & PS-II) – proton transport –Z- scheme –electron flow and ATP synthesis. C_3, C_4 and CAM pathways and features photorespiration and its significance, RuBISCO. Respiration –types, Glycolysis – TCA cycle – electron transport and ATP synthesis– respiration and its significance. Secondary metabolism in plants. Nitrogen Metabolism, Amino acid biosynthesis.

Unit III Plant growth development and Stress Physiology

Plant growth- definition – growth factors –growth dynamics and growth analysis – Growth regulators (auxin, gibberellins, cytokinins, abscisic acid, ethylene), photoperiodism – classification of plants and mechanism of flowering in photoperiodic sensitive plants – phytochrome – vernalization mechanism and application –photo-trophism – geo-trophism. Stress **-** Biotic stresses and mechanism of resistance. Water stress – water deficits and plant growth - physiology and biochemical functions affected by water stress. salt stress injury – mechanism of salt tolerance in halophytes. Seed dormancy.

Unit IV Plant Biochemistry

Atomic structure—Nature and different types of chemical bonds are important in plant physiology, Vander Waals interactions. Hydrogen concentration, Buffers—Biological buffer systems, Carbohydrates classification—properties of mono, oligo and polysaccharides. Amino acids structure and functions- proteins classification - primary, secondary, tertiary and quaternary structure of protein. Ramachandran plot - denaturation of proteins, pH, Biomolecules—Lipids metabolisms-structure—phospholipids, glycolipids, steroids. Nucleic acids—Chemistry of nucleic acids – denaturation and renaturation.

Unit V Thermodynamics and Enzymology

Bio-energetics—Laws of thermodynamics—entropy, enthalpy and free energy. Exergonic and endergonic reactions, Redox potential, Structure and hydrolysis of ATP, high energy compounds. Enzymes—Nomenclature, Classification and properties; Factors affecting enzyme activity—Activation energy—enzyme kinetics—enzyme inhibition—enzyme regulation. General principles of extraction and purification of enzymes. Enzyme immobilization. Michaelis-Menten equation. Application of enzymes in industry and medicine.

Outcome of Course

Students will understand the (i) phenomena of carbohydrate synthesis in plants and use of the carbon to generate energy to maintain plant functions; and (ii) control of plant

functions through growth regulators. (iii) phenomena of protein synthesis in plants and use of the nitrogen to generate energy to maintain plant function.

Text Books

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

2. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California. Taiz, L., Zeiger, E., 2010. Plant Physiology, Fifth edition, Sinauer Associates, Massachusetts, USA.

3. Lincoln Taiz, Eduardo Zeiger, Ian Max Møller, Angus Murphy. 2018. Fundamental of Plant Physiology, Oxford University Press, 2018; ISBN: 1605357901, 9781605357904.

4. Jain, V.K. 2017 (19th Edition) Fundamentals of Plant Physiology. S. Chant&co, New Delhi.

Reference Books

1. Nelson DL and Cox MM. (2004) Leininger Principles of Biochemistry, 4th Edition, W.H. Freeman and Company, New York, USA.
2. Davies P J. (2004) Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
3. Dennis,D.T., Turpin,D.H., Lefebver,D.D. and Layzell,D.B. 1997.Plant metabolism. Longman Essex, England.
4. S.K.2006 A text book of Plant Physiology S. Chant&co, New Delhi.
5. Panda, S.K, 2005. Advances in Stress Physiology of plants, Scientific publishers India, Jodhpur.
6. Devlin, R.M. and Baker, N.R. 1973. Photosynthesis, Reinhold Affiliated EastWest Press Pvt. Ltd, New Delhi.
7. Hewitt, E.J. and Cutting, C.V. 1979. Nitrogen metabolism of plants, Academic Press, London.
8. Roberts, E.A. 1987. Plant growth regulators. Kluwer Academic publishers, London.

SEMESTER IV
CORE PAPER 11

Core Paper: RESEARCH METHODOLOGY

No. of teaching hours: 5

Credits: 4 **Marks (Ex.75+In.25=100)**

Objectives

- To understand the importance research writing
- To study the importance of instrumentation in Plant Science field
- To understand the basic biostatistics and research tools
- To understand the computer application in plant biology

UNIT I Research Methodology

Meaning and scope of research; Research design—Choice of the problem—Scientific writing – Characteristics, Logical format for writing thesis and papers. Abstracts preparation. Introduction – components. Review of literature – Primary and secondary references. Materials and methods –collection, selection and preparation. Result-Tables and graphs model, Discussions-Summary-Reference-types of styles –proof correction. Reporting the results in conference by oral and poster presentation—reports writing.

UNIT II Instruments

Principles and application of Clinical centrifuge, High speed centrifuge, Radioactive Isotopes and half-life of Isotopes uses —Autoradiography, Scintillation counter, GM counter. Chromatography – types and uses. Electrophoresis techniques; Principle and

applications of Colorimeter, Principle and applications of spectrophotometer, UV- visible spectrophotometer and Atomic absorption spectrophotometer.

UNIT III Basic Biostatistics

Biostatistics- aims and scope, Data- collection of data, classification and tabulation of data—primary and secondary data. Frequency distribution-types, Graphical or diagrammatic representation of data- types and uses. Measures of central tendency — characters, merits and demerits - mean, median mode, harmonic mean and geometric mean. Measures of dispersion- range, quartile deviation, mean deviation, standard deviation, coefficient of variations, Standard error.

UNIT IV Research tools of Statistics

Probability – types, rules of probability, normal and binomial distribution. Test of significance, level of significance. 't' – test, 'F' test, Z-test, Chi-square test, ANOVA-one way and two way. simple and multiple correlation- types. Simple regression-types-. Sampling and experimental designs of research—Randomized block design and Split plot design.

Unit V Computer Application

Computer in biological science, scope and prospects– Classification-Input and output devices. Operation system- function and components. MS windows – MS-Word-folders, files, MS Excel – Data storage – Data analysis – MS Power point – creating slides – templates – animation and transitions. Online publications: Electronic journals – Email, e-access. Biostatistics packages, Data base preparation, Graphic applications in biology.

Outcome of course

Students will understand the basics of bioanalytical instruments, analysis of bioactive ingredients using conventional and advanced instruments, and analyze the data statistically and the ethical guidelines to be followed during experimental and research work.

Text Books

1. Kothari, C.R and Gaurav Garg, 2019 (4th Edition). Research Methodology—Methods and Techniques. New Age International Publisher, New Delhi. ISBN 10: 9386649225 ISBN 13: 9789386649225.
2. Keith Wilson and John Walker, 2010 (7th Edition). Principles and Techniques of Biochemistry and Molecular Biology 7th Edition. Publisher: Cambridge University Press. ISBN-10: 9780521516358.

Refence Books

1. Balagurusamy, E. 1985. Programming in Basic. Tata Mac Graw Hill. Pub, Co, U.K.
2. Connor and Peter Woodford, 1979. Writing Scientific paper in English. Pitman Publ. Co, U.K.
3. Deenadayalu, R. 987. Computer Science Vol I. Tata MacGraw Hill. Pub, Co, U.K.
4. Prasa, SW. 2007. Elements of Biostatistics. Rastogi publications, Meerut.
5. Rangasamy, R.A, 1995. A text book of Agricultural Statistics. New Age International publications, Chennai,
6. Scholkopf, Isuda and Vent Kernel, 2005. Methods in Computational Biology. Ane Books, New Delhi.
7. SreeRamalu, V.S, 1988. Thesis writing. Oxford & IBH publ, New Delhi.
8. Singh, R. 2006. Research Methodology in plant science. M.J.P. Publications, New Delhi.
9. Pranab Kumar Banerjee. 2015. Introduction to Biostatistics (A text book of biometry). S. CHANT & CO. New Delhi.

SEMESTER IV
Core Elective
Paper – 4
(Choose either A or B)

A. BIOINFORMATICS AND IPR PATENTING

Core Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To provide the knowledge on bioinformatics and its applications.
- To familiarize the students on protein and nucleic acid data bases and genomics and proteomics. The basic objective introduces the newly emerging and rapidly evolving field that integrates biological data and computer calculations.
- To get the skill in phylogenetic tree construction.
- To impart information of computer aided drug designing and practice of molecular docking using suitable online tools and software.

UNIT I Basic Principles of Computing in Bioinformatics

Introduction of Bioinformatics - Definition and History of Bioinformatics - Scope of Bioinformatics - Need and Potential of Bioinformatics. Computational Biology and Bioinformatics, Sequence of Software in Bioinformatics, Bioinformatics and the Internet - World Wide Web - Internet Protocols - Internet Browser - Search Engines – e- books, e

– journals and e – mail. Applications of Internet. Human Genomic Project and relevant genes. Pharmacoinformatics.

UNIT II Biological Databases

Types of Data and Databases, Nucleotide Sequence Databases – GenBank, EMBL and DDBJ, Protein Sequence Databases – SWISSPROT and TrEMBL, Secondary Databases – PROSITE, PRINTS and BLOCKS, Protein Structure Databases – PDB, CATH and CSD, Literature Databases – PubMed and Scopus, Databases and Analysis tools – BLAST and FASTA. Information retrieval from databases – Search Concepts, Tools for Searching, Homology Searching, Finding Domain and Functional site homologies.

UNIT III Structural Bioinformatics

Molecular structure viewing tool – Rasmol, Protein structure. Prediction – Secondary structure prediction (Chou Fasman Method and other bioinformatics tools for seconfary structure prediction) and Tertiary structure prediction (Comparative Modelling, Abinitio Prediction, Homology Modeling). Genomics – Types (Structural and Functional), Single Nucleotide Polymorphism, Gen – SNIP. Proteomics – Protein Expression Analysis, Mass Spectrometry in Protein Identification, Protein sorting, Metabolomics, KEGG.

UNIT IV Techniques in Bioinformatics

An introduction Sequence Analysis, Global and Local Alignment, Pair wise analysis, Scoring Matrices. Multiple Sequence Alignment Methods and Significance – Molecular Visualization – JS Mol / RasMol. Prediction of activity spectra – PASS. Molecular Phylogeny – Gene and species, trees. Molecular Evolution and Kimuras Theory. Phylogenetic tree – Cladogram and Phylogram. Significance of Molecular Phylogeny, Computer aided. Drug design and Molecular docking. Brief study about docking tools.

UNIT V IPR and Patenting

Intellectual Property (IP) – Definition – Intellectual Property Rights (IPR). Intellectual Property Protection (IPP), Choice of Intellectual Property Protection. Plant Genetic Resources – Patent Systems – Sources of Patent Information – Patenting Methods – Patenting of higher plants. Patenting of transgenic organisms and isolated genes,

Patenting of genes and DNA sequences – Plant Breeders Rights and Farmers Rights. Patenting of Life forms, Ethical issues of patenting, International Conventions and Corporations with Patwnt Applications, A brief account on Geographical Indication (GI).

Outcome of the Course

After completion of this course students can explore the information on biological data collection, comparison and analyses to find the interrelation between them for solving structural, functional and evolutionary problems using computational tools, various software's, databases and technologies.

Text Books

1. Teresa, K., Attwood and David J. Parry – Smith, SamironPhukan, 2011.Introduction of Bioinformatics, Dorling Kindersley Pvt. Ltd., India.
2. Ignacimuthu, S. 2012. Basic Bioinformatics, Narosa Publishing House., New Delhi.
3. Xiong, J., 2006. Essential Bioinformatics, Cambridge University Press.

References

1. Rocha, M. and Fereisa, P.G., 2018. Bioinformatics Algorithms, Ist Edition, Academic Press.
2. Momand, J. and Mc Curdy, M., 2017. Concepts in Bioinformatics and Genomics. Oxford University Press.
3. Jereny, R., 2015. Bioinformatics: An Introduction, Springer Publishing Co.
4. Hyde William Cornish., 2011. Intellectual Property Rights, Global Vision Publishing House., New Delhi.
5. Primrose, S. R., Twynman and P. Old., 2005. Principles of gene manipulation, Black Well Science Ltd., New Delhi.
6. Narayanan, P., 2006. Patent Law, Eastern Law House., New Delhi.
7. Bryan Bergeron, 2006. Bioinformatics Computing, Prantice Hall of India., New Delhi.
8. Westhead, D.R., Parish, J.H. and Twyman, R. M., 2008. Bioinformatics, Ist Edition, Bios Scientific Publisher Ltd., Oxford, UK.

9. Mount, D. W., 2001. Bioinformatics – Sequences and Genome Analysis, Ist Edition, Cold Springer, Harbor Laboratory Press., New York.

SEMESTER IV
Core Elective
Paper – 4
(Choose either A or B)

B. WOOD SCIENCE and TECHNOLOGY

Core Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- This course equips students with the knowledge of the macro and micro-structure of softwoods and hardwoods and their relation with properties of wood. The course exposes students to wood identification skills and practices.
- To explain the effect of silvicultural practices on wood quality, anatomical aspects of plantation timber and application of ultra-structure of wood.

UNIT IWOOD CHEMISTRY

Chemical constituents of wood and bark, Cellulose: structure, chemical properties, effect of acids and bases. Hemi-cellulose: structure, chemical properties, effect of acids and bases. Lignin: structure and chemical properties. Extractives in some prominent timber

species and their importance. Resins, oleo resins, gum oleo resins in some characteristic woods.

UNIT IIPHYSICAL PROPERTIES OF WOOD

Density and specific gravity. Variation in density of early sap wood and late wood constituents.Effect of growth rings on density. Physical properties of wood asinfluenced by moisture content and maximum moisture content of wood. Specificgravity of wood substance. Anisotropy in Wood.

UNITIIITHERMAL PROPERTIES OF WOOD

Dimensional changes on heating green wood. Effect of dry and wet heat and heatingin presence or absence of air on strength and dimensional stability**.** Thermal expansion, specific heat, thermal conductivity and diffusivity. Change oftemperature in wood under heating. Effect of moisture on thermal properties. Thermal properties of wood.

UNITIVECONOMICS OF SAWN MATERIAL

Economic conversion of logs, various interacting parameters and decision making. Timber scale. Comparison of sawing for logs of forest and plantation origin. Various associated systems relating to sawn material including scriber deck and auto stacking.

UNITVWOOD DURABILTY

Natural durability, durability of heartwood and sapwood. Causes for naturaldurability. Classification of timbers on the basis of natural durability. Nature andconditions Estimate of losses of wood by bio-degradation in storage, processing and service. Importance of wood preservation.

Outcome of the Course

The students are able to gain comprehensive knowledge in Wood Science and Technology. Wood technology in broad sense combines the disciplines of wood anatomy, biology, chemistry, physics and mechanical technology.possess right professionalism, value, attitudes and ethics. It possesses social accountability. They have skills as manager and entrepreneur

Text Books

1. Bodig, J. and Jayne, B.A. (1982). Mechanics of Wood and Wood Composites. Van Nostrand Reinhold Company, New York, London, Melbourne
2. Desch, H.E. and Dinwoodie , J.M. (1996) Timber - Structure, Properties, Conversion and Use. 7th edn, Macmillan, Basingstoke, England.
3. Dinwoodie, J.M. (2000) . Timber: Its nature and behavior. 2th edn, E & FN Spon, London

4. Fengel, D. and Wegener, G. (1984). Wood: Chemistry, Ultrastructure, Reactions. Walter de Gruyter, Berlin
5. Haygreen, J.G. and Bowyer, J.L. (1989). Forest Products and Wood Science. Iowa State Univ. Press
6. Kollmann , F.F.P. and Côté, W.A. Jr. (1968) Principles of Wood Science and Technology. Springer-Verlag, Berlin Heidelberg New York

Reference books

7. Panshin, A.J. and de Zeeuw, C. (1980) Textbook of Wood Technology, 4th ed. , McGraw-Hill, New York.
8. Timell, T.E. Springer Series in Wood Science. Books on Wood Anatomy, Transport Processes, Growth Stresses, Wood-Water Relations, Biomass, Natural Products, Fibers a.o.
9. Tsoumis, G. (1991). Science and Technology of Wood: Structure, Properties, Utilization. Van Nostrand Reinhold, New York.
10. Walker, J.C.F. et al (1993). Primary Wood Processing: Principles and Practice. Chapman & Hall, London.
11. Zobel, B.J. and van Buijtenen, J.P. (1989). Wood Variation. Springer-Verlag Berlin Heidelberg New York.

Wood Chemistry

12. Fengel, D. and Wegener, G (1984). Wood: Chemistry, Ultrastructure, Reactions. Walter de Gruyter, Berlin.
13. Lin, S.Y. and Dence, W.(Eds) (1992) .Methods in Lignin Chemistry Springer-Verlag Berlin Heidelberg New York.
14. Rowell, R. (1984). The Chemistry of Solid Wood. American Chemical Society,Washington, D.C.

SEMESTER IV
Open Elective
Paper – 4
(Choose either A or B)

A. BIODIVERSITY AND CONSERVATION

Open Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To understand the level of biodiversity from biomes species to genetic levels, values of biodiversity, biodiversity hotspots, threats to biodiversity and modes of biodiversity conservation.

UNITI Introduction about Biodiversity

Biodiversity – ecosystem, species and genetic diversity, magnitude and global, national and local levels of accumulation of species diversity in plants and animals;Levels of biodiversity study: alpha, beta and gamma biodiversity;Ecosystems diversity: brief account of Earth's major terrestrial and aquatic ecosystems and their characteristic features – forests, grasslands, deserts, pons, lakes, estuaries and oceans.

UNITII Values of Biodiversity

Values of biodiversity – consumptive and productive uses – as sources of food, fodder, timber, medicinal and ornamental plants, social, ethical, aesthetic and option values. Biodiversity hot spots – the presently recognized 36 global hotspots, eight hottest hot spots, mega diversity countries, centers of plant diversity and endemism.

UNITIII Agro-Biodiversity

Agro-biodiversity and wild relatives of cultivated plants, transgenic organisms and environmental issues – importance of agro-biodiversity, global food security; plant quarantine wing – need and importance of it in protecting regional biodiversity.

UNITIV Ecosystem and Convention Biodiversity

Biodiversity and various ecosystem services; Biodiversity prospecting and indigenousknowledge systems, community biodiversity registers. Regulation of biodiversity: Convention onBiological Diversity, National Biodiversity Authority, CITES. Problems in biodiversity regulation

UNITV

Threats to and loss of biodiversity, deforestation – causes and consequences.IUCN categories endangered, threatened, vulnerable, Red Data Books.Endangered plants of India – *In situ* and *ex situ* modes of conservation of biodiversity, Biodiversity Act of India, IPR and farmers' rights, Patenting system in India.

Outcome

Students are expected to gain knowledge on the extend of biodiversity at various levels,ecosystem services of biodiversity and modes of biodiversity conservation.

Text books

1. Krishnamurthy KV (2003) An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
2. Singh, J.S., Singh, S.P & Gupta, S.R. 2017. Ecology, Environmental Science and Conservation. S. Chand (G/L) & Company Ltd.
3. Dadhich LK and Sharma AP (2002) Biodiversity –Strategies for Conservation, APH Publishing Corporation, New Delhi.

Reference books

1. Berlatsky (2013) Biodiversity – Global Viewpoints. Gale Cengage Publishers. ISBN: 9780737769050.
2. Gillespie A (2012) Conservation, Biodiversity and International Law. Edward Elgar Publishing ISBN: 9780857935151.
3. Levin, S., 2013. Encyclopedia of Biodiversity. 2nd Edition.
4. Michael P. Marchetti, Peter B. Moyle 2010. Protecting Life on Earth: An Introduction to the Science of Conservation. University of California Press.
5. Groombridge, B. (Editor). 1992. Global Biodiversity Status of the Earth's Living Resources. Springer.

SEMESTER IV
Open Elective
Paper – 4
(Choose either A or B)

B. BIOLOGICAL INVASIONS

Open Elective Paper **No. of teaching hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Objectives

- To understand the nature and ability of invasive plant species, their impact on native biodiversity, case studies on terrestrial and aquatic invasive plants and control measures of biological invasions.

UnitI Biological Invasions

Biological invasions: Introduction- attributes of invasive plant species, Reproductive capacity allelopathy effects – Phenotypic plasticity- plant fitness to the new environment. Hypotheses related to invasive species – natural enemy and empty niche hypotheses. World's worst 100 invasive species- Databases for biological invasions.

UnitII Terrestrial Ecosystem

Plant invasion in terrestrial ecosystem – Examples and case studies of invasive plant species – biology, ecology of the following species and impact of invasion on native biodiversity – *Lantana camara*, *Parthenium hysterophorus, Chromolaenaodorata*and *Mikania micrantha.*

UnitIII Freshwater Environment

Freshwater environment water hyacinth invasion – biology and ecology of *Echhorniacrassipes* its invasiveness and impact on freshwater biodiversity and problems on environment and wiser management. Marine bio invasions: Introduction- Natural and climate change mediatedinvasions-vectors of marine invasions- Biofouling- Ballest water management – establishment of marine invasive species examples and case study of the sea weed *Kappaphycusalvarezii*in coastal marine ecosystem.

UnitIV Management of Invasion

Management of Invasions: Impacts of exotics on plant productivity;Biological control of invasive plant species- Mechanical, chemical and biological control measures- Positive resource use - Quarantine and EIA assessments.

UnitV Global Climate Changes and Bioinvasions

Global climate change and bio-invasions – Economic loss caused by invasive species;Case study of one terrestrial and aquatic invasive plant species from the local environment and preparation of report for submission with a review of literature on these two selected species.

Outcome of Course

Students will acquire knowledge on plant invasiveness, attributes and impact of invasive species on biodiversity and productivity of native ecosystem and control measures of plant invasions.

Text books

1. Singh, J.S., Singh, S.P & Gupta, S.R. 2017. Ecology, Environmental Science and Conservation. S. Chand (G/L) & Company Ltd.
2. Kohli, R. K., Batish, D. R., Singh, J. S., Singh, H. P., Bhatt, J. R. 2012. Invasive alien plants: an ecological appraisal for the Indian subcontinent. CAB International.

Reference books

1. GISP – Global Invasive Species Programmehttps://www.gisp.org/
2. E., Russel, L., Zern, J., Aquino, T. and Tsomondo, T. 2001. Economic and environmental threats of alien plants, animal, and microbe invasions. Agriculture, Ecosystems and Environment, 84: 1-20.
3. Rilov, G. and Crooks. (2009). Biological invasions in marine ecosystems-ecological, Managemant and Geographic Perspectives. Springer-Verlag, Berlin Heideberg.
4. Singh, S.P., Biological Suppression of Weeds. Biological Control Centre, Bangalore, 1989.
5. Williamson, M. 1996. Biological Invasion, Chapman & Hall, London.

SEMESTER - I
Core Practical – I

Phycology, Bryology, Mycology, Lichenology,Bacteriology, Virology, Plant Pathology,Pteridophytes,Gymnosperms and Palaeo-botany

Core Practical **No. of Practical hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Core Paper-1: Phycology, Bryology

Field trips to be conducted for students to get familiarized with the local flora of algae and bryophytes. External morphology and internal structure of vegetative and reproductive parts of the following Genera:

Algae:*Chlamydomonas*, *Hydrodictyon, Ulva, Cladophora, Pithophora,Chara*and*Nitella.Botrydium*and*Vaucheria; Nitzhia* and *Cyclotella; Ectocarpus,Dictyota, Padina* and*Sargassum; Polysiphonia, Ceramium,Gelidium and Gracilaria; Anabaena, Spirulina. Oscillatoria* and*Lyngbya.*

Bryophytes:*Riccia*, *Targionia, Reboulia, Pellia, Porella, Anthoceros, Sphagnum* and *Funaria.*

Core Paper-2: Mycology, Lichenology, Bacteriology, Virology, Plant Pathology

Mycology: Structure, reproduction and diagnostic features of *Stemonites, Synchytrium, Peronospora,Pilobolus, Aspergillus, Erysiphe, Claviceps.Puccinia, Polyporus, Alternaria, Fusarium,Colletotrichum Parmelia, Usnea* and*Cladonia*.

Bacteriology and Plant Pathology: Identification of Bacterial, fungal and Viral plant diseases included in theory syllabus. Gramstaining techniques of Bacteria.

Core Paper-3: Pteridophytes, Gymnosperms and Paleobotany

Field trips to be conducted for students to get familiarized with the local flora of pteridophytes, gymnosperms and fossil forms.External morphology and internal structure of vegetative and reproductive parts of thefollowing Genera:

Peridophytes:*Psilotum, Isoetes, Ophioglossum, Angiopteris, Osmunda, Dichranopteris, Alsophila* and *Salvinia*.

Fossil forms:*Rhynia, Lepidodendron, Lepidocarpon, Sphenophyllum*and *Calamites.*

Gymnosperms:*Cycas, Zamia, Cupressus, Podocarpus, Araucaria* and *Ephedra*.

Fossil forms:*Lyginopteris, Heterangium, Lagenostoma, Cordaites*and*Welweltschia.*

SEMESTER - II
Core Practical – II

Anatomy, Embryology, Cell & Molecular Biology, Genetics, Plant Breeding, and Evolution

Core Practical **No. of Practical hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Angiosperm Anatomy

1. Examination of Root and Shoot apices.
2. Maceration, clearing and peeling techniques.
3. Cambial variant in *Bougainvillaea, Boerhaavia, Nyctanthes, Bignonia, Aristolochia, Strychnosss*and *Dracaena*.
4. Nodal Anatomy – Different types of nodes.
5. Different types of stomata.
6. Calculation of stomatal index and frequency.

Embryology

1. Slides showing stages of anther, embryo sac, endosperm and embryo development.

2. Types of ovules.

3. Pollen germination and viability test.

4. Dissection of embryo – *Tridax, Crotalaria* and *Cleome*.

5. Endosperm and endosperm haustoria – Cucurbitaceae members.

Cell Biology

1. Study of cell division – Mitosis (*Allium cepa, Rhoeo, Urgenia, Scilla*).

2. Study of cell division - Meiosis (*Allium cepa, Helianthus, Tredescantia* flower buds).

3. Study of chromosomal aberrations and polyploidy.

4. Karyotype analysis – preparation of ideogram.

5. Study of special types of chromosomes.

6. Isolation of mitochondria and chloroplast (Demonstration).

Molecular Biology

1. Preparing Buffer solutions and pH determinations; Centrifugation techniques

2. DNA extraction from plant material.

3. Isolation of plasmid DNA from microbes.

4. Separation of plant genomic DNA by electrophoresis

4. Separation of plant proteins by vertical electrophoresis.

5. Southern blotting (Demonstration)

6. Western blot detection of proteins (Demonstration)

Genetics

1. Genetics problem in Mendelian inheritance, gene interaction, quantitative inheritance.

2. Construction of chromosome map by three point crossing over.

3. Survey of genetic inheritance in a population.

Plant breeding

1. Technique of emasculation in monocot and dicot plants and bagging.

2. Techniques in selfing and hybridization.

3. Induction of polyploidy condition in plants by colchicines.

4. Methods of vegetative propagation – Layering, Budding and Grafting.

5. Effect of hormones on shoot and root induction on stem cuttings. (Demonstration)

SEMESTER III
Core Practical– III

Morphology and Taxonomy of Angiosperm, Economic Botany, Plant Biotechnology and Genetic Engineering, Ecology and Conservation Biology

Core Practical **No. of Practical hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Morphology and Taxonomy of Angiosperm

1. Detailed study of the families mentioned in the theory with two representative species from the local area.
2. Familiarity of the binomial nomenclature of the available species from the local flora using Gamble's flora with volume and page numbers.
3. Herbarium preparation.

Economic Botany

1. Identification of family, genus, species and morphology of the useful different organs of plants mentioned in the theory paper.

Plant Biotechnology and Genetic Engineering

1. Isolation of single cell protein (*Spirulina*).
2. Demonstration of Immobilization of yeast cells.
3. Preparation of plasmid DNA.
4. Demonstration of PCR technique with known primers.
5. Bio control of plant insects using *Bacillus thuringianensis*.

Ecology: Methods of studying vegetation

1. Quadrat method: List quadrat, count-quadrat and minimum size of quadrat for given vegetation.
2. Find the density, abundance and frequency of given vegetation by meter quadrat method.
3. Transect method: Line transect, belt transect and bisect method.
4. Find the Relative frequency, relative density and relative dominance for given vegetation. Important value index and polygraph charting.
5. Phenology study: Each student has to select a plant and prepare a report on the phenology.
6. Ecological adaptation of plants.
7. Ecological instruments.

Conservation Biology

1. Estimation of the dust pollution on plants and environment.
2. Ex-situ conservation and In-situ conservation methods
3. Estimation of pH, BOD and COD of organisms in the Environmental condition.

SEMESTER IV

Core Practical – IV

Plant Physiology, Biochemistry and Research Methodology

Core Practical **No. of Practical hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Plant Physiology

1. Determination of osmotic potential by plasmolytic method.
2. Determination of water potential using gravimetric method.
3. Determination of water potential using dye method.
4. Effect of monochromatic light on apparent photosynthesis
5. Effect of CO_2 concentration on apparent photosynthesis
6. Effect of temperature on photosynthetic membrane
7. Estimation of chlorophyll content by Arnon's methods.

Plant Biochemistry

1. Test for Starch, Amino acids and Proteins in Plants
2. Estimation of Carbohydrates by anthrone reagent method.
3. Estimation of starch by Lugol's iodine method
4. Estimation of proteins by Lowry's or Bradford's method.
5. Estimation of amino acids by ninhydrin method

Research Methodology

1. Demonstration of Microtomy techniques.
2. Demonstration of Column and Thin Layer Chromatography techniques.
3. Demonstration of pHmeter/paper, Colorimeter, UV-Visible Spectrophotometer, Ultra and Micro Centrifuge and Horizontal and Vertical Gel Electrophoresis techniques.
4. Tabulation, calculation and Graphical representation of Statistical data in Plant Science field.
5. Application of Computer in the field of Plant Biology

Core Practical - I

Phycology, Bryology, Mycology, Lichenology,Bacteriology, Virology, Plant Pathology,Pteridophytes,Gymnosperms and Palaeo-botany

Time; 4 Hours
Max. Marks: 100
External Practical: 65
Record: 10
Internal: 25

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1. Cut the transverse/ longitudinal sections of the given material **A** and **B.** Identify by giving reasons. Draw labeled sketches. Submit the slide for valuation. (2x6= 12)

2. Take transverse/ longitudinal sections of the given materials **C, D** and **E** stain it and mount in glycerin. Submit the slides for valuation. Identify by giving reasons. Draw labeled sketches. (3x6= 18)

3. Identify the fossil slides **F** and **G**. Give reasons. Draw labeled diagrams. (2x5= 10)

4. Identify the given pathological specimen **H.** Write the causal organism, Symptoms and controlmeasures. Draw labeled diagrams. (7)

5. Write critical notes about the given spotters **I, J, K, L, M** and **N**. Identify and Draw label sketches. (6x3 = 18)

Core Practical – I
Phycology, Bryology, Mycology, Bacteriology, Lichenology, Plant Pathology,Pteridophytes,Gymnosperms and Palaeo-botany
Key

Q. NO	Material	Identification	Reason	Diagram	Slide	Total
1.	A Algae	1	2	½+½= 1	2	6
	B Fungi	1	2	½+½= 1	2	6
2.	C Bryophytes	1	2	½+½= 1	2	6
	D Pteridophytes	1	2	½+½= 1	2	6
	E Gymnosperms	1	2	½+½= 1	2	6
3.	**Fossil slides**	**Identification**	**Era**	**Reason**	**Diagram**	**Total**
	F Pteridophytes	1	1	2	½+½= 1	5
	G Gymnosperms	1	1	2	½+½= 1	5
4.	**Pathological specimen**	**Name of the Disease**	**Causal organism**	**Symptoms**	**Control measures**	**Total**
	H	1	1	3	2	7
5.	**Spotters**	**Identification**	**Reason**	**Diagram**		
	I Algae/Fungi	1	1	**½+½= 1**	-	3
	J Bryophytes	1	1	**½+½= 1**	-	3
	K Pteridophytes	1	1	**½+½= 1**	-	3
	L Gymnosperms	1	1	**½+½= 1**	-	3
	M Lichens	1	1	**½+½= 1**	-	3
	N Bacteria	1	1	**½+½= 1**	-	3
	Total Marks					65
	Record Note Book					10
	External Total Marks					**75**

Core Practical - II

Anatomy, Embryology, Cell & Molecular Biology, Genetics, Plant Breeding and Evolution

Time: 4 Hours
Max. Marks: 100
External Practical: 65
Record: 10
Internal: 25

1. Cut the transverse/ longitudinal section of the given material **A.** Identify by giving reasons. Draw labeled sketches. Submit the slide for valuation. (6)

2. Take the transverse section of the given material **B.** Stain it and mount in glycerin. Submit the slides for valuation. Identify by giving reasons. Draw labeled sketches of ground plan and a sector enlarged. (8)

3. Dissect and display any one developmental stage of **C.** Leave the slide for valuation. Draw labeled sketches. (6)

4. Make a suitable Squash preparation of **D.** Show any two phase of the mitosis. Draw labeled diagrams and leave the slide for valuation. (8)

5. Write the Protocol for **E** and describe the procedure. (10)

6. Find out the solution for the Genetics problem **F.** Find out the ratio. (5)

7. Work out the Genetic problem **G.** Find out the order of genes and the distance between them. Construct a chromosome map. (10)

8. Write critical notes about the given spotters **H, I, J** and **K.** Identify and Draw labeled sketches. (4x3=12)

Core Practical – II

Anatomy, Embryology, Cell & Molecular Biology, Genetics, Evolution and Plant Breeding

Key

Q. NO	Material	Identification	Reason	Diagram	Slide	Total
1.	A Anatomy	1	2	1	2	6
2.	B Anatomy (Anamolous)	1	2	2	3	8
3.	C Embryology	-	-	2	4	6
4.	D Cell Biology	2	2	2	2	8
		Aim	**Requirements**	**Procedure**	**Result**	
5.	E Molecular Biology	1	2	5	2	10
6.	**F Genetics**					5
7.	**G Genetics**					10
8.	**Spotters**	**Identification**	**Reason**	**Diagram**		
	H Anatomy	1	1	1	-	3
	I Embryology	1	1	1	-	3
	J Cell Biology	1	1	1	-	3
	K Plant breeding	1	1	1	-	3
	Total Marks Record Note Book					65 10
	External Total Marks					**75**

Core Practical - III

Morphology and Taxonomy of Angiosperm, Economic Botany, Plant Biotechnology, Genetic Engineering, Ecology and Conservation Biology

Time: 4 Hours
Max.Marks:100
External Practical: 60
Herbarium: 05
Record:10
Internal: 25

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1. Find the Binomial of **A** and **B** using Gamble's Flora. (2x2=4)

2. Refer **C** and **D** to their respective families based on their characters and indicate their taxonomical hierarchy. (2x5=10)

3. Prepare an artificial key (Intended key) based on the vegetative and reproductive characters of specimens given in **E, F, G, H** and **I.** (5x1=5)

4. Spot at the site **J** and **K**. Write the Family, Genus and species name and the useful part of the given spotters. (2 x4= 8)

5. Write the protocol for **L**. (1x7= 7)

6 Calculate the given parameters based on the given Quadrate **M**. (1x10=10)

7. Take the transverse section of **N**. Identify, draw diagrams and write notes. Submit the slide for valuation. (1 x7=7)

8. Identify and write critical notes of **O**, **P** and **Q**. (3x3= 9)

Core Practical- III
Morphology and Taxonomy of Angiosperm, Economic Botany, Plant Biotechnology, Genetic Engineering, Ecology and Conservation Biology
Key

Q. No.	Material	Genus & Species		Volume/Page No.		Total
1	**A Binomial**	**½+½= 1**		**½+½= 1**		2
	B Binomial	**½+½= 1**		**½+½= 1**		2
2	**Taxonomy description & Hierarchy**	**Characters**	**Diagram**	**Hierarchy**		
	C	**2**	**2**	**1**		5
	D	**2**	**2**	**1**		5
3	**Taxonomic key**	**Intended**				
	E	1				1
	F	1				1
	G	1				1
	H	1				1
	I	1				1
4	**Economic Botany**	**Genus**	**Species**	**Family**	**Useful part**	
	J	1	1	1	1	4
	K	1	1	1	1	4
5	**Biotechnology**	**Aim**	**Requirements**	**Procedure**	**Result**	
	L	**1**	**2**	**3**	**1**	7
6	**Ecology Quadrat**	**Aim & Procedure**	**Tabulation & Calculation**	**Result & Graph**		
	M	1+3 = 4	4	2		10
7	Ecology	Identification	Reason	Diagram	Slide	
	N	1	2	2	2	7
8	**Spotters**	**Identification**	**Reason**		**-**	
	O Biotechnology	1	2		-	3
	P Ecology	1	2		-	3
	Q Conservation Biodiversity	1	2		-	3
	Total Marks with Herbarium					**65**

	Record	**10**
	External Total Marks	**75**

Core Practical - IV

Plant Physiology, Biochemistry and Research Methodology

Time: 4 Hours
Max. Marks: 100
External Practical: 65
Record: 10
Internal: 25

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1. Set up the experiment **A** assigned to you. Record your observations and interpret your results. (15)

2. Analyses the given biochemical content of the plant material **B**. Record your observations and interpret your results. (10)

3. Comment on the experimental set up **C**. (6)

4. Analyses the given problem **D.** Tabulate, calculate and find out the result. Draw a graph based on the results. (10)

5. Identify the given spotters **E, F, G, H, I** and **J**. Draw diagrams and explain its mode of operation. (6x 4 =24)

Core Practical - IV
Plant Physiology, Biochemistry and Research Methodology

KEY

Q. No.	Material	Experimental Set up	Materials & Methods & Procedure	Tabulation & Calculations	Result	Graph	Total
1	A Physiology	**2**	**5**	**4**	**2**	**2**	**15**
2	B Biochemistry	**2**	**3**	**2**	**1**	**2**	**10**
3			Procedure	Diagram	Result		
	C Physiology/ Biochemistry		**2**	**2**	**2**		**6**
4		Formula	Tabulation	Calculations	Result	Graph	
	D Biostatistics	**1**	**1**	**3**	**2**	**3**	**10**
5	**SPOTTRES**	Identification	Diagram	Notes			
	E, F, G, H, I & JPhysiology/ Biochemistry/ Research Methodology	**1**	**1**	**2**			**6x4 = 24**
	Total **Record**						**65** **10**
	External Total Marks						**75**