

M.Sc. BOTANY

2023-2024

(Syllabus from the Academic Year 2023- 2024)



THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

Re –Accredited with ‘A’ Grade by NAAC (Affiliated to Bharathidasan University)

Tiruchirappalli -620 023

THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-23.

GENERAL COURSE PATTERN FOR PG - BOTANY - 2023-2024 ONWARDS

S.NO.	PART	COURSE	Sub-Code	COURSE TITLE	Hrs.	Credits	CIA	Sem. Exam	Total
I SEMESTER									
1		Core - I		Plant Diversity – I: Algae, Fungi, Lichen and Bryophytes	6	5	25	75	100
2		Core - II		Plant Diversity – II: Pteridophytes, Gymnosperms and Paleobotany	6	5	25	75	100
3		Core - III		Horticulture and Plant Breeding	5	4	25	75	100
4		Core - IV		Microbiology and Plant Pathology	5	4	25	75	100
5		Core -V-P		Practical – I	6	4	40	60	100
6		SEC- I		Skill Enhancement Course – I: Nursery and Gardening	2	2	25	75	100
TOTAL					30	24	165	435	600
II SEMESTER									
7		Core - VI		Cell and Molecular Biology	5	5	25	75	100
8		Core - VII		Anatomy and Embryology of Angiosperms	5	5	25	75	100
9		Core - VIII		Ecology, Phytogeography and Conservation Biology	5	4	25	75	100
10		Core – IX -P		Practical – II	5	4	40	60	100
11		CBE- I		Discipline Specific Elective – I: Biotechnology & IPR	5	3	25	75	100
12		NME - I		Non-Major Elective - I :	3	2	25	75	100
13		SEC- II		Skill Enhancement Course – II Bioinformatics	2	2	25	75	100
TOTAL					30	25	190	510	700
III SEMESTER									
14		Core- X		Taxonomy of Angiosperms and Economic Botany	6	5	25	75	100
15		Core- XI		Genetics and Evolution	5	4	25	75	100
16		Core - XII-P		Practical – III	5	4	40	60	100
17		CBE - II		Discipline Specific Elective – II: Herbal Technology	4	3	25	75	100
18		CBE - III		Discipline Specific Elective – III: Forestry and Wood Technology	5	3	25	75	100
19		NME - II		Non-Major Elective - II :	3	2	25	75	100
20		SEC- III		Skill Enhancement Course – III: Biostatistics	2	2	25	75	100
TOTAL					30	23	190	510	700
IV SEMESTER									
21		Core -XIII		Plant Physiology and Biochemistry	6	4	25	75	100
22		Core - XIV-P		Practical IV	5	4	40	60	100
23		CBE - IV		Discipline Specific Elective – IV: Research Methodology and Biological Techniques	5	3	25	75	100
24		SEC -IV		Skill Enhancement Course – IV: Plant Tissue Culture	2	2	25	75	100
25		EA		Extension Activity	-	1	25	75	100
26		Project			12	4	25	75	100
	TOTAL	30	18	165	435	600			
GRAND TOTAL					120	90	710	1890	2600

Non –Major Elective Courses for P.G.

Receiving from other P.G. Departments

S.No.	Course	Title	Offering Department
1.	NME - I	Immunology	Zoology
2.	NME - II	Human Physiology	Zoology

Offering to other P.G. Departments

S.No.	Course	Title	Receiving Department
1.	NME - I	Applied Plant Biotechnology	Zoology
2.	NME - II	Plant Physiology	Zoology

SEMESTER – I
CORE PAPER - I

Hours : 6 Credits : 5 Code :

PLANT DIVERSITY – I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES

Learning Objectives	Course Outcome
To learn about the classification and reproductive cycle of algae, fungi, lichens, and bryophytes.	Relate to the structural organizations of algae, fungi, lichens and Bryophytes.
To gain knowledge about the ecological and economic importance of algae, fungi, lichens and bryophytes.	Demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance
To spark interest in the evolutionary roots of plant development.	Explain life cycle patterns in algae, fungi, lichens and Bryophytes
To study the biodiversity and reproductive processes of algae, fungi and bryophytes	Compare and contrast the mode of reproduction in diverse groups of basic plant forms.
To expose the beneficial and harmful view point.	Discuss and develop skills for effective conservation and utilization of lower plant forms.

Unit I

ALGAE: Classification of algae by F. E. Fritsch (1935-45). Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range of thallus organization, algae of diverse habitats, reproduction (vegetative, asexual and sexual) and life cycles. Phylogeny and inter-relationships of algae, origin and evolution of sex in algae.

Structure and life cycle of the following genera: *Scytonema*, *Ulva*, *Codium*, *Diatoms*, *Dictyota* and *Gelidium*.

Unit II

FUNGI: General Characteristics, occurrence and distribution. Mode of nutrition in fungi. Classification of Fungi by Alexopoulos and Mims (1979) - Phylogeny and inter-relationships of major groups of fungi. Heterothallism in fungi, sexuality in fungi, Para sexuality, sex hormones in fungi General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.

Structure and life cycle of the following genera: *Plasmodiophora*, *Phytophthora*, *Rhizopus*, *Taphrina*, *Polyporus* and *Colletotrichum*.

Unit III

LICHENS : Introduction and Classification (Hale, 1969). General characters, Occurrence and inter-relationship of phycobionts and mycobionts. Structure and reproduction in *Usnea* and *Parmelia*.

Unit IV

BRYOPHYTES: General characters and Classification of Bryophytes by Watson (1971). Distribution, Structural variations and evolution of gametophytes and sporophytes in Bryopsida, Anthocerosida and Mosses. General characters of major groups - Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Reproduction - Vegetative and sexual, spore dispersal mechanisms in bryophytes, spore germination patterns in bryophytes. Structure and life cycle of the following genera: *Lunularia*, *Porella* and *Polytrichum*.

Unit V

ECONOMIC IMPORTANCE: Algae - Economic importance in Food and feed - Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine, biofertilizers, Vitamins and biofuel), Medicinal value and Diatomaceous earth. Fungi – Economic importance in food, industries and medicine. Culturing and cultivation of mushrooms *Pleurotus*. Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.

Recommended Texts:

1. Kumar, H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Barsanti, L. and Guadtieri, P. 2014. Algae: Anatomy, Biochemistry and Biotechnology, 2ndEdition, CRC Press, ISBN: 1439867321.
3. Sharma, O.P. 2011. Fungi and Allied Microorganisms, McGraw Hill, ISBN:9780070700383, 0070700389
4. Kevin K. 2018. Fungi biology and Application, 3rd Edition, Wiley Blackwell.
5. Pandey, P.B. 2014. College Botany-1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
6. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
7. Sharma, O.P. 2014. Bryophyta, Mcgraw Hill, ISBN: 9781259062872, 1259062872 Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London
8. Sharma,O.P.2017. Bryophyta, MacMillanIndiaLtd.Delhi.

Reference Books :

1. Sundaralingam, V. 1991. Marine algae. Bishen Singh and Mahendra Pal Singh Publishers, Dehradun.
2. Edwardlee,R. 2018. Phycology, 5thEd., Cambridge UniversityPress, London.
3. Nash, T.H. 2008. Lichen Biology, Cambridge University press.
4. Johri, R.M., Lata, S. and Tyagi, K. 2012. A Textbook of Bryophyta. Dominant Publishers & Distributors Pvt., Ltd., New Delhi. ISBN: 9789384207335.
5. Alexopoulos, C.J. and Mims, M. 2007. Introductory Mycology. 4th Edition, Wiley Publishers, ISBN: 9780471522294

Web Resources :

1. <https://www.britannica.com/science/algae>
2. <https://en.wikipedia.org/wiki/Bryophyte>
3. <https://www.britannica.com/plant/bryophyte/Ecology-and-habits>
4. <https://www.livescience.com/53618-fungus.html>.
5. http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf
6. <https://www.youtube.com/watch?v=vcYPI6y-Udo>
7. https://www.youtube.com/watch?v=XQ_ZY57MY64
8. <http://www.plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf>

SEMESTER – I
CORE PAPER - II

Hours : 6 Credits : 5 Code :

PLANT DIVERSITY – II : PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

Learning Objectives	Course Outcome
To investigate the classification, and life history of the various classes and major types of Pteridophytes and Gymnosperms.	Recall on classification, recent trends in phylogenetic relationship ,general characters of Pteridophytes and Gymnosperms.
To characterize diversity of lower vascular plants in order to comprehend the dynamics of diversity to realize the importance of diversity	Learn the morphological / anatomical organization, life history of major types of Pteridophytes and Gymnosperms.
To research the economic importance of Pteridophytes and Gymnosperms.	Comprehend the economic importance of Pteridophytes, Gymnosperms, and fossils.
To study and understand the phylogeny and Paleontology of Pteridophytes and Gymnosperms.	Understanding the evolutionary relationship of Pteridophytes and Gymnosperms.
To learn about the concept of fossils and process of fossilization; distinctive characteristics of fossil records of Pteridophytes and Gymnosperms.	Awareness on fossil types, fossilization and fossil records of Pteridophyte and Gymnosperms.

Unit I

PTERIDOPHYTES: General characteristics and classification (Reimer, 1954). Range of structure, reproduction and evolution of the gametophytes, Gametophyte types – sex organs. Apogamy and Apospory. Life cycles. Stellar evolution. Heterospory and seed habit, Telome theory and Economic importance of Pteridophytes.

Unit II

PTERIDOPHYTES: Structure, anatomy, reproduction and life history of the following genera: *Isoetes*, *Selaginella*, *Angiopteris*, *Osmunda*, *Pteris* and *Azolla*.

Unit III

GYMNOSPERMS: General characters - A general account of distribution of Gymnosperms. Morphology, anatomy, reproduction, phylogeny and classification (K.R. Sporne, 1965). Economic importance of Gymnosperms.

Unit IV

GYMNOSPERMS: Morphology, anatomy, reproduction and life history of the following genera: *Cupressus*, *Araucaria*, *Podocarpus*, *Ginkgo* and *Ephedra*.

Unit V

PALEOBOTANY: Geological Time Scale: Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany. Gondwana flora of India. Fossilization and fossil types. Evolutionary significance of fossils – fossil fuels and industrial raw materials and uses. Study of fossils : *Rhynia*, *Lepidodendron*, *Cordaites*, *Lyginopteris* and *Williamsonia*.

Recommended Texts:

1. Vashishta, P.C. Sinha, A.K and Anil Kumar. 2016. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi.
2. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
3. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
4. Sharma, O.P. 2017. Pteridophyta, McGraw Hill Education, New York.
5. Vashishta, P.C., A.K. Sinha and Anil Kumar. 2018. Botany for Degree students - Gymnosperms. S. Chand and Company Ltd., New Delhi.
6. Johri, R.M., Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominant and Distributed, New Delhi.

Reference Books :

1. Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.
2. Pandey, S.N and Trivedi, P.S. 2015. A Text Book of Botany Vol. II- 12th edition (Paper back), Vikas Publishing.
3. Rashid, A. 2013. An introduction to Pteridophyta – Diversity, Development and differentiation (2nd edition), Vikas Publications.
4. Arnold, A.C. 2005. An Introduction to Paleobotany. Agrobios (India). Jodhpur
5. Sporne, K.R. 2017. The morphology of Pteridophytes (The structure of Ferns and Allied Plants) (Paper back), Andesite Press.
6. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson & Co., London.
7. Taylor, E, Taylor, T, Krings, M. 2008. Paleobotany: The Biology and Evolution of Fossil Plants, 2nd Edition, Academic Press.

Web Resources :

1. <https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/>
2. http://www.bsienvi.nic.in/Database/Pteridophytes-in-India_23432.aspx
3. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y
4. <https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC>
5. <https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf>
6. <https://www.palaeontologyonline.com/>
7. <https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ>
8. <https://trove.nla.gov.au/work/11471742?q&versionId=46695996>

SEMESTER – I**CORE PAPER - III****HORTICULTURE AND PLANT BREEDING**

Hours :5 Credits : 4 Code :
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Learning Objectives	Course Outcome
Know about the brief history, divisions, classification and structure of horticultural plants.	Identify the various horticultural plants and the conditions that affect their growth and productivity
Acquire knowledge on plant growth processes and stages of plant growth	Demonstrate the propagation, growth, and maintenance of plants in horticulture systems.
Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.	Understand the objectives and the methods of crop improvement through plant breeding.
Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures	Compare and contrast the genetic basis of breeding self and cross – pollinated crops
Compare and contrast the genetic basis of breeding self and cross pollinated crops.	Apply horticultural skills and knowledge to explore career opportunities in horticulture industry

Unit I

HORTICULTURE : Introduction, Scope and Importance of Horticulture. Divisions of Horticulture, Classification of horticultural plants – Fruits and Vegetables. Important Horticultural Research Centres in India. Garden Implements. Types (Formal, Informal and Kitchen) and Components of Garden.

Unit II

Indoor and outdoor plants - Flower arrangements – Fruits and Vegetable carving – Establishment and maintenance of Topiary, Bonsai, Rockery, Orchard and Lawn - Training and Pruning Techniques. Role of Plant Growth Regulators in Horticulture.

Unit III

Plant propagation methods by Seeds – Propagation through specialized underground structures – Corm, Tuber, Sucker, Bulb, Bulbil and Rhizome; Vegetative Propagation – Cutting, Layering, Grafting and Budding.

Unit IV

PLANT BREEDING Plant breeding–Objectives. Methods of breeding – Selection methods - Pureline, Mass and Clonal - Hybridization techniques - types and steps involved. Heterosis and Hybrid vigour.

Unit V

Breeding for disease resistance –. Mutation – Polyploid and its application in Plant Breeding – Breeding for Crop Quality– Rice, cotton and Tomato, Breeding for nutritional quality. Sources for quality traits.

Recommended Texts:

1. Acquaah, G. 2011. Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK.
2. Janik, J. 1972. Horticultural Science. W.H. Freeman & Company, San Francisco.
3. Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India.
4. Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi.
5. Schilleter, J. C. and Richey, H. W. 2005. Text Book of general Horticulture. 2nd ed. Biotech Books, Delhi.
6. Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.
7. Subba Rao, N.S. 1997. Biofertilizers in Agriculture and Forestry. India Book House Limited, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
8. Chaudhari, H.K. 1984. Elementary Principles of Plant Breeding. Oxford & IBH Publishing Company.
9. Brown, T.A. 1992. Genetics a Molecular Approach, 2nd Ed. Chapman and Hall.
10. Chahal, G.S and Gosal, S.S. 2018. Principles and Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi.
11. Singh, B.D. 2013. Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi
12. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers.
13. Chaudhary, R.C. 2017. Introductory principles of plant breeding, Oxford IBH Publishers, New Delhi.

Reference Books :

1. Acquaah, G. 2002. Horticulture Principles and Practices. 2nd ed. Pearson Education (Singapore) Pvt. Ltd.
2. Ashman, M.A. and Puri, G. 2002. Essential soil science-A clear and concise introduction to soil science. Blackwell scientific publishers, London.
3. Denisen, E.L. 1979. Principles of Horticulture. MacMillan Publishing co, Inc. New York.
4. Dirr, M. and Heuser, C.W. 2009. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Timber Press, Oregon, USA.
5. Thomson, L.M. and Troen, F.R. 1975. Soils and soil fertility Tata, McGraw Hill Publication Co. Ltd. New Delhi.
6. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. CBS Publication, Delhi, India.
7. Allard, R.W. 2010. Principles of Plant Breeding. 2 nd ed. John Wiley and Sons, Inc. New Jersey, US.

Web Resources :

1. <https://www.kobo.com/in/en/ebooks/horticulture>
2. <https://www.gale.com/gardening-and-horticulture>
3. <https://www.iaritoppers.com/p/horticulture-icar-ecourse-pdf-books.html>
4. <https://www.amazon.in/Introduction-Horticulture-N-Kumar-ebook/dp/B08M4289M6>
5. https://www.researchgate.net/publication/316438576_Polyembryony_in_Horticulture_and_its_significance

SEMESTER – I
CORE PAPER - IV

Hours :5
Credits `: 4
Code :

MICROBIOLOGY AND PLANT PATHOLOGY

Learning Objectives	Course Outcome
To provide students with basic understanding of microbiology and plant pathology.	Recognize the general characteristics of microbes and plant defense mechanism
To provide comprehensive knowledge about microbes and its effect on man and environment.	Explain about the stages in disease development and various defense mechanisms in plants
To provide comparative analysis of major groups of microbes.	Elucidate concepts of microbial interactions with plants
To provide the basic knowledge about the applications of microbes in various fields.	Analyze the importance of harmful and beneficial microbes
To elucidate the role of pathogens in crops and improving the disease resistance.	Determine and interpret the detection of pathogens and appreciate their adaptive strategies.

Unit I

BACTERIA: Types of microorganisms. General characteristics of bacteria. Morphology and Fine structure – Outline classification of Bergey’s manual of 9th edition. Bacterial photosynthesis, Respiration. Bacterial growth – batch culture and continuous culture. Growth Curve. Factors affecting bacterial growth. Nutritional types of bacteria. Genetic recombination- Transformation, Transduction and Conjugation. Isolation techniques -serial dilution technique, Pure culture techniques (Pour plate, Streak plate and Spread plate methods). Maintenance of bacterial culture. Gram Staining.

Unit II

VIRUSES: General characters, Classification, Structure, Multiplication (transduction, transfection, lytic and lysogenic cycles). Overview of Phycoviruses and Mycoviruses. Viruses of Eukaryotes – Animal & Plant viruses. General account of Mycoplasma and Bacteriophages. Brief account on Viroids, Virusoids and Prions

Unit III

Food Microbiology: Beneficial role of microbes – yoghurt, Cheese, Bread, Wine, Tempeh, Miso. Spoilage of fruits, vegetables, meats, poultry, eggs, bakery products, dairy products and canned foods. **Microbial toxins** - Exotoxin, Endotoxin & Mycotoxin.

Soil Microbiology: Microbial flora of soil and its importance, factors affecting the microbial community in soil. Interaction among soil microbes (positive and negative interactions) & with higher plants (rhizosphere&phyllosphere).

Environmental Microbiology: Water borne diseases - Cholera. Air borne diseases - Swine flu. Microbial degradation of chemical pesticides and hydrocarbon.

Unit IV

PLANT PATHOLOGY: Classification of plant diseases, Symptomology (important symptoms of plant pathogens). Principles of plant infection – Inoculum, inoculum potential, Pathogenicity. Disease triangle. Host parasite interrelationship and interaction. Causal agents of plant diseases - biotic causes (Fungi, Bacteria Virus, Mycoplasma, Nematodes) - Abiotic causes (Physiological, deficiency of nutrients & minerals and pollution). Mechanism of penetration- Disease development of

pathogen (colonization) and dissemination of pathogens. Role of enzymes and toxins in disease development.

Unit V

Defence mechanism of host – structural and biochemical defences. Important diseases of crop plants in India - Sheath blight of rice, Late blight of potato, Little leaf of Brinjal and Red rust of tea. Principles of disease management – Cultural practices, physical, chemical and biological methods, disease controlled by immunization. Biocontrol - merits and demerits: Plant quarantine and legislation. Integrated Pest Management system. Diagnostic technique to detect pest/pathogen infection– Immuno fluorescence (IF).

Recommended Texts:

1. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition.
2. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi
3. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher.
4. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383.

Reference Books :

1. Agrios, A.G. 2007. Plant Pathology, Elsevier. ISBN: 9780120445653.
2. Jeffery, C., Pommerville. 2014. Alcamos Fundamentals of Microbiology. 10th Edition. Johnsand Bartlett Learning.
3. Pelczar, M. J. 2007. Microbiology. 35th Edition, Tata-McGraw Hill Publications, New York,ISBN: 0074623260.
4. Ravi Chandra, N.G. 2013. Fundamentals of Plant Pathology, Phi Learning, ISBN:812034703X.
5. Willie, J. and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594
6. Chaube, H.S. and Singh, R. 2015. Introductory Plant Pathology CBS Publishers, ISBN: 978-8123926704.
7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata McGraw Hill New Delhi.

Web Resources :

1. <https://www.britannica.com/science/plant-disease>.
2. <https://www.planetatural.com/pest-problem-solver/plant-disease/>
3. <https://www.elsevier.com/books/plant-pathology/agrios/978-0-08-047378-9>
4. <https://www.elsevier.com/life-sciences/immunology-and-microbiology/books>

SEMESTER – I
CORE PAPER - V
CORE PRACTICAL PAPER – I

Hours : 6 Credits : 4 Code :

Practical Covering

Core Paper I

- Algae
- Fungi
- Lichen
- Bryophytes

Core Paper II

- Pteridophytes
- Gymnosperms
- Paleobotany

Core paper III

- Horticulture
- Plant Breeding

Core Paper - IV

- Microbiology
- Plant Pathology

SEMESTER – I
SKILL ENHANCEMENT COURSE– I

Hours : 2 Credits : 2 Code :

NURSERY AND GARDENING

Learning Objectives	Course Outcome
To recognize the importance of nursery and gardening	Recognize the basic process required for growing and maintaining plants in nurseries.
To gain an understanding of nursery management.	Explain the different methods of plant propagation and various gardening styles.
To develop skills necessary to manage a wholesale nursery	Apply techniques for effective hardening of plants and computer applications for creative gardening
To acquire knowledge regarding theory and practice of rising plants.	Compare and contrast cultivation of different vegetables and growth of plants in nursery and gardening
To develop an interest to become an entrepreneur	Develop new strategies to enhance growth and quality of nursery plants

Unit I

NURSERY: Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

Unit II

Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed testing and certification.

Unit III

Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - Green house - Mist chamber, Shade house and Glass house.

Unit IV

GARDENING: Definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design.

Unit V

GARDENING OPERATIONS: Soil laying, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings: Transplanting of seedlings - Cultivation of Brinjal, Jasmine and Banana - Storage.

Recommended Texts:

1. Bose T.K and Mukherjee, D. 1972. Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K. 1989. Plant Propagation, Wile Eastern Ltd., Bengaluru.
3. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser and Andres. 1957. Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.

Reference Books :

1. N.L. Patel, S.L. Chawla, T.R. Ahlawat: Commercial Horticulture, 2016, ASPEE College of Horticulture, Navsari Agricultural University, Navsari 396 450, Gujarat,
2. Prasad S & Kumar U. 2005. Greenhouse Management for Horticultural Crops. 2nd Ed. Agrobios.
3. George Acquaaah, 2002, Horticulture-principles and practices. Prentice-Hall of India pvt. Ltd., New Delhi.
4. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden, Trivandrum.

Web Resources :

1. <https://www.kopykitab.com/Nursery-And-Gardening-SEC-by-Prof-C-D-Patil-Dr-G-M-Rane-Dr-S-A-Patil>
2. <https://www.wonderslate.com/nursery-and-gardening-management/ebook-details?siteName=books&bookId=38078&preview=true>
3. https://books.google.co.in/books/about/Nursery_Hindi_Book_Bonsai_Plants_Nursery.html?id=-nfDDwAAQBAJ&redir_esc=y
4. <https://www.amazon.in/Gardening-Books/b?ie=UTF8&node=1318122031>
5. <https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648>

SEMESTER – II
CORE PAPER - VI

Hours :5 Credits `: 5 Code :

CELL AND MOLECULAR BIOLOGY

Learning Objectives	Course Outcome
Enable to learn various cell structures and functions of prokaryotes and eukaryotes and cellular organelles.	Recall a plant cell structure and explain its function.
To understand the cell division and its molecular mechanism so as to appreciate and manipulate normal and abnormal cell and tissue growth.	Illustrate and explain the structure of various cell organelles.
To enlighten people of past molecular biology developments.	Explain the structure and functional significance of nucleic acid.
To comprehend the molecular processes.	Compare and contrast the DNA replication (prokaryotes and eukaryotes), enzymes involved in replication, DNA repair
A thorough examination of DNA structure, replication process, transcription process and translation processes	Discuss the concept of gene expression and its regulation

Unit I

Cells - Concept of prokaryote and Eukaryote. Structural organization of plant cell, specialized plant cell types. Cell cycle and Apoptosis; Control mechanisms, role of cyclin dependent kinases. Retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.

Unit II

Chloroplast-structure and function, genome organization, gene expression, RNA editing, Mitochondria; structure, genome organization, biogenesis. Cytoskeleton: Microtubules, and Actin Filaments

Unit III

Nucleus: Structure and function, nuclear pore, Nucleosome organization, euchromatin and heterochromatin. RNA and DNA Structure. A, B and Z Forms. DNA damage and repair (Thymine dimer, photoreactivation, excision repair).

Unit IV

Replication of DNA. Eukaryotic replication; Enzymes – Primase, DNA polymerases, replication fork. Leading and lagging strands. Prokaryotic - Rolling circle replication. Replicon, regulation of replication.

Unit V

Transcription: Prokaryotes - RNA polymerase, initiation - promoter sequences. Processing of tRNA and rRNA. Initiation in eukaryotes, elongation and termination; splicing of mRNA, Ribozymes. Differential splicing. Protein Synthesis: In prokaryotes - Initiation, elongation and termination. Eukaryotic translation. Post translational modifications. Targeting and Secretion of proteins. Regulation of gene expression in Eukaryotes – gene amplification, rearrangement

Recommended Texts:

1. Roy, S.C and Kumar, K.D.C. 1977. Cell Biology, New Central Book Agency, Calcutta.
2. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments.6th edition. John Wiley & Sons.
3. Aminul, I. 2011. Text Book of Cell Biology. Books and Allied (P) Ltd, Kolkata, India.
4. Geoffrey M.Cooper.2019.TheCell:AMolecularApproach, OxfordUniversityPress.
5. Turner, P.C., Mclennan, A.G., Bates, A.D. and White, M.R.H. 2001. Instant notes on molecular biology.
6. Watson, J.D, Baker T.A., Bell S.P., Gann A., Levine M., Losick R. 2014. Molecular Biology of the Gene (7th edition), Pearson Press.
7. Snustad Peter, D. Michael J. Simmons. 2015. Principles of Genetics, John Wiley Sons.
8. Clark, D. 2010. Molecular Biology. Academic Press Publication.
9. David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi.
10. Geoffrey M. Cooper and Robert E. Hausman. 2015. The Cell: A Molecular Approach. 7 thedn. Sinauer Associates is an imprint of Oxford University Press.

Reference Books :

1. Alberts B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York.
2. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
3. Lodish S, Baltimore B , Berk, C and Lawrence K, 1995 , Molecular Cell Biology , 3rd edn, Scientific American Books, N.Y
4. De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8th edn, Info-Med, Hongkong.
5. Lewin, B. 2000. GENE VII. Oxford University Press, New York, USA 7. Cooper G M and Hausman R E,2007 , The Cell: Molecular Approach 4th Edn, SinauerAssociates,USA.
6. Genes X– Benjamin Lewin, Jones and Bartlett, 2011 4. Molecular Biology of the Cell – Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD, Garland Publishers, 1999 5. Principles of Biochemistry – Lehninger, W.H. Freeman and Company, 200

Web Resources :

1. <https://www.pdfdrive.com/cell-biology-books.html>
2. <http://www.bio-nica.info/Biblioteca/Bolsover2004CellBiology.pdf>
3. <https://www.e-booksdirectory.com/listing.php?category=549>
4. <https://www.elsevier.com/books/molecular-biology/clark/978-0-12-813288>
5. <https://www.kobo.com/in/en/ebooks/molecular-biology>

SEMESTER – II
CORE PAPER - VII

Hours : 5
Credits : 5
Code :

ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Learning Objectives	Course Outcome
Learn the importance of plant anatomy in plant production systems.	Learn the structure, functions and role of apical vs lateral meristems in monocot and dicot plant growth.
Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.	Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.
Understand the mechanism underlying the shift from vegetative to reproductive phase	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development
Trace the development of male and female gametophyte	Understand the various concepts of plant development and reproduction
Understand the recent advances in palynology	Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset

Unit I

Cell wall: Morphological and physico-chemical changes; Plasmodesmata- types of pits – growth of cell wall – formation of intercellular spaces; Meristems: Classifications: Theories of shoot and root apices. Vascular Cambium: Composition and organization – multiplicative and additive divisions. Xylem: Primary and secondary xylem – tracheary elements and vessels – vessel less dicots – xylem rays and axial parenchyma ; Phloem: Ultra structure and ontogeny of sieve tube elements and companion cell. Evolution of tracheary elements.

Unit II

Periderm: Structure, organization and activity of phellogen. Phelloderm and Rhytiderm, Normal secondary thickening in Dicots; Anomalous secondary growth in Dicots (*Amaranthus*, *Aristolochia*, *Bignonia*, *Nyctanthus*) and arborescent Monocots (*Draeceana*). Structure and types of Stomata; Leaf abscission, wound healing, Major nodal types.

Unit III

MICROSPORANGIUM AND MALE GAMETOPHYTE: Structure and development of Anther: Male gametophyte; Palynology: Morphology and ultrastructure of pollen wall, pollen kits substances, pollen analysis, pollen storage, pollen sterility and pollen physiology.

Unit IV

MEGASPORANGIUM AND FEMALE GAMETOPHYTE: Structure and development of Megasporangium; Types of ovules, Endothelium, obturator and nucellus. Megasporogenesis: Female gametophyte: Structure, types, haustorial behavior and Nutrition of embryo sacs. Fertilization: Double fertilization and triple fusion; Sexual incompatibility. Endosperm: Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminant endosperm. Embryogeny: Development of monocot (*Luzula*) and dicot (*Capsella*) embryos.

Unit V

POLYEMBRYONY: Causes of Polyembryony, classification, induction and practical application. Apomixis and its significance. Seed and Fruit development and role of growth substances. Parthenocarpy and its importance.

Recommended Texts:

1. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
4. Pandey.S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. VikasPublishinf House Pvt. Ltd, New Delhi.
5. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.

Reference Books :

1. Swamy, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill publishing Co Ltd, New Delhi.
2. Pullaiah, T., Lakshiminarayana, K and Hanumantha Rao, B. 2006. Text book of Embryology of Angiosperms. Regency Publications, New Delhi.
3. Bierhorst, D.W. 1971. Morphology of Vascular Plants. Macmillan publishers, New York.
4. Crang, R., Lyons-Sobaski, S and Wise, R. 2018. Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing.
5. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
6. Eames, A.J and Mac Daniels, L.H. 2013. Introduction to Plant Anatomy, 3rd Edition. McGraw-Hill Inc., US.

Web Resources :

1. <https://www.ipni.org/>
2. <http://www.theplantlist.org/>
3. https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm
4. http://aryacollegeludhiana.in/E_BOOK/Botany/plant_anatomy.pdf
5. <https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf>
6. http://greenlab.cirad.fr/GLUVED/html/P1_Prelim/Bota/Bota_typo_014.html.

SEMESTER – II
CORE PAPER - VIII

Hours : 5 Credits : 4 Code :

ECOLOGY, PHYTOGEOGRAPHY AND CONSERVATION BIOLOGY

Learning Objectives	Course Outcome
To analyze and comprehend the fundamental ideas of plant ecology as a scientific study of environment.	Understand the scope and importance of population ecology, plant communities and ecosystem ecology.
To study the plant communities and plant succession stages	Understand the applied aspect of environmental botany.
To be aware of the causes, impacts and control measures of pollution.	Students will spot the sources and pollution and seek remedies to mitigate and rectify them
To study biodiversity management and conservation	Identify different plant communities, identify threatened, endangered plant species and create awareness program in protection of biodiversity.
To enhance the knowledge of the students and equip them in evaluate and protecting invaluable components of nature and interactions with the environment	Analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions.

Unit I

ECOLOGICAL PRINCIPLES: Introduction – History, scope, concepts, Synecology, autecology; Raunkier’s life forms. Climatic, edaphic and biotic factors; Adaptations of Hydrophytes, Xerophytes and Halophytes. Community dynamics–trends of succession (Hydrosere and Xerosere).

Unit II

Ecosystem – Components, types and functional aspects: Food chain and food web, energy flow, Laws of thermodynamics. Productivity– primary and secondary productivity – GPP & BPP. Energy resources; renewable and non-renewable.

Soil- Formation, types and profile. Bio Geo Chemical Cycles of Nitrogen, Phosphorus and Sulphur

Unit III

Pollution: Sources, nature and impact of different types of pollution –Air, Water, Soil, Thermal, Radioactive and Noise. Pollution Indicators. Climate change – Greenhouse effect and global warming, ozone depletion and acid rain. Waste management-Solid and e-waste, recycling of wastes. Eco-restoration / remediation, ecological foot prints - carbon foot print – eco-labeling - environmental auditing.

Unit IV

PHYTOGEOGRAPHY: Phytogeographical Zones - Vegetation types of India and Tamil Nadu .Distribution-Continuous, Discontinuous and Endemism. Theories of discontinuous distribution- Continental drift, Age and area hypothesis. Geographical Information System (GIS) Principles of remote sensing and its applications.

Unit V

Definition, types of biodiversity – values of biodiversity – Hot spots – Threats to biodiversity: habitat loss. Poaching of wild life – Invasion of exotic species, man and wild life conflicts – endangered and endemic plant species of India, Red list categories of IUCN, Conservation of Biodiversity –*in situ* and *ex situ* methods.

Recommended Texts:

1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
2. PushpaDahiya and ManishaAhlawat. 2013. Environmental Science- A New Approach, Narosa Pub. House, New Delhi.pp.2.1-2.60.
3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.
4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.
5. NeerajNachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.

Reference Books :

1. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
2. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
3. Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
4. Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
5. Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.
6. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
7. Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

Web Resources :

1. <https://www.intechopen.com/chapters/56171>
2. <https://plato.stanford.edu/entries/biodiversity/>
3. <https://sciencing.com/four-types-biodiversity-8714.html>.
4. <https://www.iaea.org/topics/plant-biodiversity-and-genetic-resources>
5. http://www.bsienvnis.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx
6. <https://www.youtube.com/watch?v=qtTLiQoYTyQ>
7. <https://www.youtube.com/watch?v=208B6BtX0Ps>

8. <https://www.youtube.com/watch?v=6p1TpVJYTds>

Hours :5
Credits `: 3
Code :

SEMESTER – II

DISCIPLINE SPECIFIC ELECTIVE - I

BIOTECHNOLOGY & INTELLECTUAL PROPERTY RIGHTS

Learning Objectives	Course Outcome
To understand the gene structure, vectors and basic techniques of genetic engineering	Knowledge on the fundamentals and significance of rDNA technology
To learn the cloning strategies, cDNA library construction and screening	Understand the methodology of construction of cDNA library and their screening
To learn the fundamental and applications of direct and indirect gene transfer methods	Explain the role of different gene transfer methods their merits and demerits
To study the production of transgenic plants and their applications	Compare and contrast the transgenic plants and natural plants.
To expose the students to the basic concepts IPR	Discuss on the importance of IPR and its advantages

Unit I

Gene structure. Basic techniques and tools of genetic manipulation: Cutting and joining of DNA molecules Enzymes involved in genetic engineering. Adaptors, linkers and homopolymer tailing. Plasmids and phage vectors: pBR322, pUC, Bacteriophage, single stranded DNA vectors, filamentous phage vectors, cosmids, BAC, YAC, expression vectors and shuttle vectors.

Unit II

Cloning strategies: Cloning genomic DNA – PCR as an alternative to genomic cloning. DNA libraries - genomic DNA libraries, properties of cDNA libraries, preparation of cDNA, full-length cDNA cloning. Screening Strategies: Sequence - dependent screening, screening by hybridization, probe designing, screening expression libraries – Immunological, Southern, Northern and Western blotting.

Unit III

Gene transfer : Direct DNA transfer methods– protoplast transformation, particle bombardment, electroporation and microinjection. Indirect DNA transfer – *Agrobacterium*, Crown gall, *Ti* plasmid, *Agrobacterium* mediated transformation, Mechanism of T- DNA transfer .

Unit IV

Management of transgenics: Transgene stability and genome silencing- Escape and loss of transgene, Marker free plants. Transgenic plants: Insect resistant plants, Herbicide resistant plants, Salt tolerance. Heterologous expression in plants: Edible vaccines, Golden rice.

Unit V

Intellectual property rights: IPR -Definition, Theories on concept of property: Tangible vs Intangible. Kinds of Intellectual Property Rights- Patents, Trademarks, Copyrights, Trade Secrets. International Regime Relating to IPR –TRIPS, WIPO, WTO, GATT & PCT. Geographical Indication . India's Patent office, Patent Act 1970, Patent filing procedure for ordinary application. International Patent classification system. Infringement, Biopiracy.

Recommended Texts:

1. R.C. Dubey. 2015. A text book of Biotechnology, S.Chand& Co., New Delhi
2. P. Parihar. 2015. A text book of Biotechnology, Argobios Publications, Jodhpur
3. S. Ignacimuthu: Plant Biotechnology, Oxford & IBM Publishing Co., New Delhi
4. Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
5. Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
6. Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.
7. Kalyan, C.K. 2010. Indian Patent Law and Practice, India, Oxford University Press

Reference Books :

1. Trevan, Boffey, Goulding&Stanbury: Biotechnology – The Biological Principles, Tata
2. McGraw Hill Publishing Co., New Delhi.
3. P.K. Gupta: Elements of Biotechnology, Rastogi Publications, Meerut.
4. M.D. Kumar: A text book on Biotechnology, East west press, New Delhi.
5. S.S. Purohit: Agricultural Biotechnology, Agrobios Publications, Joshpur T.A. Brown Gene cloning.
6. A.K Chatterji: Introduction to Environmental Biotechnology, Prentice Hall India Pvt., Ltd., New Delhi.
7. Damodar Reddy, S.V. 2019. Intellectual Property Rights -- Law and Practice, Asia Law House, Hyderabad.
8. World Intellectual Property Organization. 2004. WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf Journal of Intellectual Property Rights (JIPR): NISCAIR.
9. Intellectual Property Law in the Asia Pacific Region. 2009. Kluwer Max Planck Series.
10. Ramakrishna B and Anil Kumar, H.S. 2017. Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Notion Press, Chennai.

Web Resources :

1. <http://cipam.gov.in/>
2. <https://www.wipo.int/about-ip/en/>
3. <http://www.ipindia.nic.in/>
4. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
5. https://swayam.gov.in/nd2_cec20_ge04/preview

SEMESTER – II
CORE PAPER - IX
CORE PRACTICAL PAPER – II

Hours : 5 Credits : 4 Code :

Practical Covering

Core Paper VI

- Cell Biology
- Molecular Biology

Core Paper VII

- Anatomy
- Embryology

Core paper VIII

- Ecology
- Phytogeography
- Conservation Biology

Discipline Specific Elective I

- Biotechnology
- IPR

SEMESTER – II
SKILL ENHANCEMENT COURSE - II
BIOINFORMATICS

Hours : 2 Credits : 2 Code :

Learning Objectives	Course Outcome
Study about Bioinformatics and its role in Biology and sequences used in Bioinformatics.	Know about basics of Bioinformatics and Information technology and their relationship with biology.
Impart knowledge on Biological Database and its types.	Understand the usage of various biological Databases.
Learn about various Database of Bioinformatics	Gain knowledge about nucleotide sequence database.
Know about Proteomics and Genomics.	Understand about Protein sequence database.
Understand gene finding, protein prediction, phylogenetic analysis and drug designing.	Correlate the gene prediction, Biomolecular visualization, phylogenetic analysis and drug designing in future studies

Unit I

INTRODUCTION TO BIOINFORMATICS

Information Technology in Biology, Types of Sequences used in Bioinformatics - DNA Sequences, RNA Sequences, Protein Sequences, application of Bioinformatics, fields related to Bioinformatics

Unit II

BIOLOGICAL DATABASES

Biological databases and its significance - objectives, properties and classification of Biological databases, Symbols used in databases, Sequence alignment – local and Global.

Unit III

GENOMICS

Nucleotide Sequence Databases, Nomenclature of DNA Sequences, Structure of Nucleotide Sequence Databases, GenBank format, Gene expression Databases.

Unit IV

PROTEOMICS

Proteomics - Classification based on shape, composition function; Nomenclature of Protein Sequences

Unit V

NING

Gene finding, protein prediction, biomolecular visualization, phylogenetic analysis & Drug designing.

Recommended Texts:

1. Arthur, M.L. (2005). Introduction to Bioinformatics (Ed:2). Oxford University Press, New York
2. Mani, K and N. Vijayaraj. 2002. Bioinformatics for beginners. Kalaikathir Achakam, Coimabtoe.
3. Attwood, T.K. and Parrysmith, D.J. (2001). Introduction to Bioinformatics. Pearson Education, New Delhi.
4. David W. Mount. 2001. Bioinformatics sequence and Genome analysis, Cold spring Harber Laboratory press

Reference Books :

1. A.D. Baxevanis and B.J. Francis (Eds) "Bio-informatics"- A practical guide to the analyzing of gene protein"-john wiley and sons(1998).
2. A.D. Baxevains and B.J. Franchis (Eds.). 1998. Bioinformatics- A practical guide to the analyzing of gene protein. Joha Wiley and Sons.
3. Bioinformatics- A biologists guide to bio-computing and the internet 2000. Stuart M. Brown.
4. Bioinformatics"Sequence and Genome analysis.2001. David W. Mount.
5. Missener and A.S. Krawetg, "Bio-informatics to bio-informatics" Addison Wesley Longman Ltd (1999).

Web Resources :

1. <http://www.ii.uib.no/~inge/list.html>
2. <https://www.researchgate.net/>
3. <https://www.bioinformatics.org/>
4. http://bioinfbook.com/bioinformatics/bioinf14_mainbioinf.htm
5. [tps://en.wikipedia.org/wiki/Bioinformatics](https://en.wikipedia.org/wiki/Bioinformatics)

SEMESTER – III
CORE PAPER - X

Hours : 6 Credits : 5 Code :

TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Learning Objectives	Course Outcome
To be familiar with the basic concepts and principles of plant systematics.	Recollect the basic concepts of morphology of leaves and flowers.
To develop a suitable method for the correct characterization and identification of plants	Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Group Activity – Construct key preparation
To understand the importance of taxonomic relationships in research of plant systematics	Explain the various types of classification. Distinguish its advantages and disadvantages. Construction of floral formula and floral diagram
To provide information on different families of plants	Illustrate and explain the characteristic features and list out the economic importance of the families Field trip to local botanical garden and regional botanical garden
To know about the economic importance of plants.	Illustrate and explain the characteristic features and list out the economic importance of the families.

Unit I

Botanical exploration and contribution with special reference to India by William Roxburgh, J.D. Hooker, Robert Wright, Nathaniel Wallich and Gamble, J.S. Principles of classification as proposed – Artificial – Linnaeus, Natural – Bentham and Hooker, Phylogenetic system - Hutchinson, Modern – Takhtajan. Botanical gardens and herbaria of world, preparation and maintenance of Herbarium, Botanical survey of India – its organization and role.

Unit II

Modern trends in taxonomy, chemotaxonomy, numerical taxonomy, biosystemics. ICBN uninominal systems- genesis binomial nomenclature, importance and principle. Flora, Monographs, Keys, typification, principles of priority, effective and valid publication, author citation, recommendations and amendments of code. Glossaries and dictionaries, Taxonomic literature (Index Kewensis)

Unit III

Detailed study of some families under Polypetalae – Menispermaceae, Cruciferae, Polygalaceae, Caryophyllaceae, Meliaceae, Rhamnaceae, Vitaceae, Aizoaceae, Lythraceae, Combretaceae.

Unit IV

Detailed study of some families under Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae, Verbenaceae.

Detailed study of some families under Monochlamydeae – Loranthaceae, Nyctaginaceae, Aristolochiaceae, Casuarinaceae. Detailed study of some families under Monocots – Orchidaceae, Amarylidaceae, Commelinaceae, Cyperaceae

Unit V

ECONOMIC BOTANY: General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram), (iii) Drug yielding plants (*Withaniasomnifera* and *Coleus aromaticus*) (iv) Oil yielding plants (Groundnut, sunflower). (v) Sugar yielding plants (sugarcane and sugar beet), (vi) Spices and condiments (cardamom, cinnamon). (vii) Commercial crops - fibre (jute), (viii) Timber (Teak and red sanders wood), (ix) Resins and gums (Asafoetida and gum arabic) – (x) Essential oils (lemon grass and menthol), (xi) Beverages (tea, coffee).

Recommended Texts:

1. Pandey, B.P. 2013. Taxonomy of Angiosperms, S. Chand Publishing, New Delhi.
2. Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw Hill Companies.
3. Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co.
4. Jain, S.K and Rao R.R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ.
5. Pandurangan, A.G., Vrinda, K.B and Mathew Dan. 2013. Frontiers in plant taxonomy. JNTBGRI, Thiruvananthapuram, Kerala.
6. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
7. Subramaniam, N.S. 1997. Modern plant taxonomy. Vikas Publishing House, New Delhi.

Reference Books :

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
2. Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethnobotany.
3. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.
4. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
5. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.
6. Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.
7. Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.
8. Mohamad Ali. 2009. Pharmacognosy and Phytochemistry. CBS Publications & Distribution, New Delhi, Volume.1.
9. Lewis, W.H and M.P.F. Elwin Lewis. 1976. Medical Botany. Plants affecting Man's Health. A Wiley Inter Science Publication. John Wiley and Sons, New York.

Web Resources :

1. <https://www.ipni.org/>

2. <http://www.theplantlist.org/>
3. <https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592>
4. <https://www.tropicos.org/home>
5. <http://apps.kew.org/herbcat/gotoHerbariumGrowthPage.do>
6. <https://www.absbooksindia.com/shop/science/botany/textbook-of-economic-botany>

SEMESTER – III

CORE PAPER - XI

GENETICS AND EVOLUTION

Hours :5
Credits `: 4
Code :

Learning Objectives	Course Outcome
The students will be able to have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.	Understand the Mendel's Law of inheritance and gene interactions.
Develop critical understanding of bio chemical basis of genes and their interactions at population and evolutionary levels.	Analyze the various factors determining the heredity from one generation to another
Understand the process of replication	Explain Gene mapping methods: Linkage maps
Understand what are transposons and their role	Understand the mutation methods and the role of various mutagens
Know about the process of evolution and its significance	Understand the process of evolution Appreciate the various theories of Evolution

Unit I

Genetics of Eukaryotes: Basic concepts – gene as a concept. Linkage, Crossing over - homologous recombination - model and mechanism - three point cross, and chromosome mapping. Organisation of chromosomes, specialized chromosomes, quantitative inheritance, population genetics - Hardy Weinberg equilibrium.

Unit II

Identification of DNA as genetic material. Gene as the unit of mutation and recombination. Mutations: Molecular nature; Mutagens. Origin of spontaneous mutations and control. Reversion and Suppression - suppression of nonsense, missense and frameshift mutations. Chromosomal aberrations. Para sexual process in bacteria: transformation, transduction and conjugal gene transfer: phenomena & mechanisms. Hfr mapping - time of entry technique.

Unit III

Gene as the unit of expression. Colinearity of gene and polypeptide. DNA damage and repair: DNA damage by UV, alkylating agent, cross linkers. Mechanism of repair - photo reactivation, excision repair, recombinational repair, SOS.

Unit IV

Transposable genetic elements - Identification of transposition - IS elements, composite transposons, Tn3 and Tn5. Mechanism of transposition. Transposable elements in eukaryotes: Maize - Ac & Ds, Spm&dspm, Drosophila - P elements. Retro-transposons.

Unit V

Inorganic chemical and molecular evolution and Origin of life, Origin of Species. Evidences in favour of evolution (Morphology and Anatomy, Embryology, Paleontology). Theories of Lamarck and Charles Darwin with Merits and Demerits - Contributions of Weismann, Hugo de Vries and Sewall Wright and Modern Synthetic Theories.

Recommended Texts:

1. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
2. Stansfield, W.D. 1969. Theory and problems of Genetics. McGraw-Hill
3. Sinnott, E.W. Dunn, L.E and Dobzhansky, T. 1973. Principles of Genetics. McGraw-Hill. New York.
4. Brown, T.A. 1992. Genetics a Molecular Approach, 2nd Ed. Chapman and Hall.
5. Gupta, P.K. 2009. Genetics. Rastogi publications, Meerut, New Delhi

Reference Books :

1. Watson, J.D. *et al.* 2003. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
2. Lewin, B. 2003. Genes VIII. Oxford University Press.
3. Friefelder, D. 2005. Molecular Biology. Second Edition. Narosa Pub. House.
4. Sobtir, C. and Gobe. 1991. Eukaryotic chromosomes. Narosa Publishing house.
5. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.

Web Resources :

1. <https://www.cdc.gov/genomics/about/basics.htm>
2. <https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/>
3. <https://www.britannica.com/science/evolution-scientific-theory>
4. <https://www.britannica.com/science/cell-biology>
5. <https://medlineplus.gov/genetics/understanding/basics/cell/>

SEMESTER – III
DISCIPLINE SPECIFIC ELECTIVE - II
HERBAL TECHNOLOGY

Hours :4 Credits `: 3 Code :

Learning Objectives	Course Outcome
To understand various plants based drugs used in ayurvedha,unani, homeopathy, siddha etc.	Recollect the importance of herbal technology.
To apply the knowledge to cultivate medical plants	Understand the classification of crude drugs from various botanical sources.
To know the pharmacological importance of medicinal plants.	Analyze on the application of secondary metabolites in modern medicine.
To enlist phytochemicals and secondary metabolites of market and commercial value.	Create new drug formulations using therapeutically valuable phytochemical compounds for the healthy life of society.
To design and develop their own business propositions such as the in the making of herbal insecticides	Comprehend the current trade status and role of medicinal plants in socio economic growth

Unit I

Medicinal Plants - Scope and importance; Traditional system of medicine (Siddha, Ayurvedha and Unani), Source and Classification of Crude Drugs (Taxonomical, Morphological, Chemical, Pharmacological); Cultivation and utilization of medicinal and aromatic plants in India. National Medicinal Plants Board of India.

Unit II

Cultivation, Collection, processing, phyto-constituents and medicinal uses of *Withaniasomnifera*, *Rauwolfiaserpentina*, *Catharanthusroseus*, *Andrographispaniculata* and *Gymnemasylvestre*.

Unit III

Pharmacological action of herbal drugs - Carbohydrates and derived products: Glycosides - (*Digitalis purpurea*); Tannins (*Terminaliachebula*); Volatile oils (Clove, Mentha), Alkaloids (*Cinchona*); Terpenoids (), Flavonoids (*Allium sativum*) and Resins (*Commiphoramyrrrha*).

Unit IV

Herbal cosmetics – Pimple and Acne, leucoderma, hair care and tooth care. Role of plant tissue culture in enhancing secondary metabolite production- Elicitation - Biotransformation, Hairy root culture. Factors affecting secondary metabolites production.

Unit V

Drug adulteration - Types of adulterants. Detection of Adulterants. Methods of Drug evaluation (morphological, microscopic, physical and chemical). Standardization and quality control of herbal drugs.

Recommended Texts:

1. Kokate, C.K., Purohit, A.P and S.B. Gokhale. 1996. Pharmacognosy. NiraliPrakashan, 4th Ed.
2. Roseline, A. 2011. Pharmacognosy. MJP publishers, Chennai.
3. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.
4. Natural Products in medicine: A Biosynthetic approach. 1997. Wiley.
Hornok, L. (ed.).
5. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons.
Treaseand Evans.
6. Mukherjee, P.K. 2008. Quality control of herbal drugs. 3rd edition. Business Horizons
Pharmaceutical Publishers, New Delhi, India.
7. Kirthikar and Basu. 2012. Indian Medicinal Plants. University Bookstore, Delhi. India
8. Biswas, P.K. 2006. Encyclopedia of Medicinal plants (Vol. I-VII). Dominant Publishers, New
Delhi.
9. Chaudhuri, A.B. 2007. Endangered Medicinal Plants. Daya Publishing House, New Delhi.
10. Tilgner, SharolMarie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.

Reference Books :

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
2. Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany,
Economic Botany, Botany & Ethnobotany.
3. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National MedicinalPlants Board,
Govt. of India, New Delhi.
4. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
5. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.
6. Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh
Mahendra Pal Singh.
7. Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology.
Pharmacy Council of India New Delhi.

Web Resources :

1. <https://www.kopykitab.com/Herbal-Science>
2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurCIUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQA_vD_BwE
3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu
4. <https://www.dattanibookagency.com/books-herbs-science.html>

5. <https://www.springer.com/gp/book/9783540791157>

SEMESTER – IV
DISCIPLINE SPECIFIC ELECTIVE - III
FORSTRY AND WOOD TECHNOLOGY

Hours :5 Credits `: 3 Code :

Learning Objectives	Course Outcome
To study various aspects of Forest Botany.	Knowledge on various aspects of Forest Botany
To understand the importance and different forests and plants species.	Understand the importance and of different forests.
To know the ecological significance of forests.	Analyze the ecological significance of forests
To enable the students to information on forests laws.	Understand the different types of wood and their importance.
To raise student awareness of the need to create a sustainable way of living and the current Global issues with forestry	Understand the present status of wood industry

Unit I

Introduction and scope of Forest Botany - General introduction to forests, natural and manmade. Types of forests - tropical, temperate, evergreen, semi evergreen, deciduous, monoculture, multipurpose, social and industrial. Forest and climate - Forest and Biodiversity - Forest and gene conservation - Forest and ecosystem - Forest and civilization. Geographical history of the forest vegetation - natural vs. artificial. Preservation of natural forestry - Pollution control.

Unit II

Identification of timber plants based on vegetative features. Seedlings, leaves, bark branching pattern architectural models of trees. Major and minor forest products, use and misuse of forests by man, direct and indirect forest wealth, Forest policies, Forest Laws- Indian Forest Act, 1927; Forest conservation Act. Wild Life Protection Act, 1972, forest protection through peoples committee.

Unit III

Silviculture: concept and scope of study, forest in general form, composition, classification of world forests and Indian forests. Classification based on its quality density, tolerance, crown .Silviculture of the economically important species- *Acacia catechu*, *Azadirachta indica* , *Eucalyptus* and *Meliadubia*.

Unit IV

Wood Technology : Nature and properties of wood – physical, chemical, mechanical and anatomy of wood. Durability of wood, Manoxylic and Pycnocylic wood, Dendrochrononology. Wood seasoning and

Preservations, Chemical processing of wood. Defects and Abnormalities of wood, Commercial wood species of South India.

Unit V

Composite wood, Wood adhesives- manufacture, properties, uses. Manufacture and uses of Plywood, Fibre boards and Particle boards. Present status of Composite wood, Paper and rayon industries, Present position and supply of raw materials to industries and wood substitution. Deterioration of Wood – Fungi, insects and other agents

Recommended Texts:

1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros.
2. Roger Sands. 2013. Forestry in a global context, CAB international.
3. Balakathiresan.S.1986.EssentialsofForestManagement.NatarajPublishers,Dehradun.
4. Agarwala,V.P.1990.ForestsIndia,EnvironmentalandProtectionFrontiers.Oxford& IBH PublishingCo.New Delhi.
5. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi.
6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat.
7. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun.
8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun.
9. WWF. 2007. Timber identification manual. TRAFFIC, New Delhi.
10. Dhiman, A.K. 2003. Sacred plants and their medicinal uses. Daya publishing house, New Delhi.
11. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.
12. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.

Reference Books :

1. Donald L. Grebner. Jacek P. Siry and Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press
2. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland.
3. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York.
4. Agarwala,V.P.1990.ForestsIndia,EnvironmentalandProtectionFrontiers.OxfordIBHPublishingCo.,New Delhi.
5. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
6. Avery, T.E. 1967. Forest Measurements. Mc Grand Hill Book Company, New York.
7. Manikandan K, Prabhu S. 2018. Indian Forestry A Breakthrough Approach To Forest Services, Jain Brothers.
8. Pathak, P.S, Ram Newaj. 2012. Agro forestry: Potentials and Opportunities. India Agrobios.
9. Powell, Baden B.H. 2004. Manual of Forest Law. New Delhi: Biotech.
10. Uthappa, A.R. 2015. SangramBhanudasChavan, Competitive Forestry, New Vishal Publications, 1st ed.
11. Chaturvedi, A.N. and Khanna, L.S. 2015. Hand Book of Forestry (5th Edition).
12. Frederick Franklin Moon, 2018. The Book of Forestry. Repro Books.
13. Parthiban, K.T. 2018. Introduction to Forestry & Agroforestry.

Web Resources :

1. http://wwwds.worldbank.org/external/default/WDServer/WDSP/IB/2006/10/19/000112742_20061019150049/Rendered/PDF/367890Loggerheads0Report.pdf.
2. <https://www.britannica.com/science/forestry>
3. <https://en.wikipedia.org/wiki/Forestry>.
4. <https://www.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its-conservation/25119>
5. <https://academic.oop.com>
6. <https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product>

SEMESTER – III
CORE PAPER - XII
CORE PRACTICAL PAPER – III

Hours : 5
Credits : 4
Code :

Practical Covering

Core Paper X

- Taxonomy
- Economic Importance

Core Paper XI

- Genetics
- Evolution

Discipline Specific Elective II

- Herbal technology

Discipline Specific Elective III

- Forestry
- Wood Technology

SEMESTER – III
SKILL ENHANCEMENT COURSER - III

Hours :2 Credits `: 2 Code :

BIOSTATISTICS

Learning Objectives	Course Outcome
To provide the student with a conceptual overview of statistical methods.	Create and interpret visual representations of quantitative information, such as graphs or charts.
To emphasis on usefulness of commonly used statistical software for analysis, research, and experimentation.	Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods
To understand and evaluate critically the acquisition of data and its representation.	Know the latest version using in statistical tools and apply the tools to interpret the results
To gain the knowledge about the probability and statistical inference	To develop their competence in hypothesis testing and interpretation
To learn more about how to organize, create, and carry out the distribution of scientific knowledge.	Understand why biologists need a background in statistics.

Unit I

INTRODUCTION TO STATISTICS : Introduction to biostatistics, basic principles, variables - Collection of data, sample collection and representation of Data - Primary and Secondary - Classification and tabulation of Data – Diagrammatic and graphical Representation.

Unit II

DESCRIPTIVE STATISTICS : Mean, Median and Mode for Continuous and Discontinuous variables. Measures of dispersion: Range of variation, Standard Deviation and Standard Error and Coefficient variation.

Unit III

PROBABILITY : Basic principles - types - Rules of probability - addition and multiplication rules.

Probability Distribution :Patterns of probability distribution; binomial - Poisson and Normal.

Unit IV

HYPOTHESIS TESTING : Chi-Square test for goodness of fit; Null hypothesis, level of Significance - Degrees of Freedom. Student ‘t’ test – paired sample and mean differences ‘t’ tests. ANOVA (One way).

Unit V

CORRELATION AND REGRESSION : Correlation - types of correlation - methods of study of correlation - testing the significance of the coefficients of correlation. Regression and types.

Recommended Texts:

1. Gurumani, N. 2005. Biostatistics, 2ndedn. MJP publications, India.
2. Datta, A.K. 2006. Basic Biostatistics and Its Applications. New Central Book Agency. ISBN 8173815038.
3. Pillai, R.S.N and Bagavathi, V.S. 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi.
4. Mahajan, B.K. 1984. Methods in Biostatistics for Medical students and Research works. Smt. Indu Mahajan, New Delhi.
5. Pillai, R.S.N and Bagavathi, V.S. 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi.
6. Khan, I.D and Khanum, A. 2004. Fundamentals of Biostatistics, Ukasz Publications, Hyderabad, India.
7. Gupta, S.C. 2013. Fundamentals of statistics, Himalaya Publishers, Mumbai.
8. Kothari, C.R and Garg, G. 2014. Research methodology –Method and techniques. New Age International (P) Ltd. New Delhi.

Reference Books :

1. Milton, J.S. 1992. Statistical method in Biological and Health Sciences. McGraw Hill Inc., New York.
2. Scheffler, W.C. 1968. Statistics for biological sciences, Addison- Wesley Publication Co., London.
3. Spiegel, M.R. 1981. Theory and Problems of statistics, Schaum's Outline series McGraw-Hill International Book Co., Singapore.
4. Pillai, R.S.N and Bagawathi, V. 1987. Practical Statistics (For B.Com. and B.A., Students) S.Chand& Co. (Pvt.) Ltd., New York.
5. Sobl. R.R and Rohif, F.J. 1969. Biometry. The principles and Practice and Statistics in Biological Research. W.H. Freeman and Co., San Francisco.
6. Zar, J.K. 2011. Biostatistical Analysis, Fourth Edition, Prentice-Hall International, New Jersey, USA.

Web Resources :

1. nu.libguides.com/biostatistics

2. <https://newonline.courses.sciences.psu.edu/>
3. <https://bookauthority.org/books/beginner-biostatistics-ebooks>
4. <https://www.amazon.com/dp/1478638184?tag=uuid10-20>
5. <https://hastie.su.domains/ElemStatLearn/>

SEMESTER – IV

CORE - XIII

PLANT PHYSIOLOGY AND BIOCHEMISTRY

Hours : 6 Credits : 4 Code :

Learning Objectives	Course Outcome
To acquire knowledge on the functional aspects of plants.	Relate understand properties and importance of water in biological system, nutrients and its translocation.
To understand the biophysical and biochemical processes of plants.	Demonstrate the importance of light in plant growth and the harvest of energy
To study the metabolism of plants and the adaptive mechanisms of plants in adverse environmental conditions.	Explain the energy requirement and nitrogen metabolism
To learn the basic structure of biomolecules in plants.	Compare the various growth regulators that influence plant growth.
To enhance the knowledge about the importance of biomolecules	Analyze the biological role of carbohydrate, proteins, lipids, enzymes and secondary metabolites.

Unit I

Water Relations: Physical and chemical properties of water –Components of water potential - Plasmolysis - water absorption by roots – Apoplast and Symplast concept - water transport through the xylem — Transpiration – mechanism of stomatal opening and closing –Mineral nutrition – essential nutrients – macro and micro nutrients – deficiencies – absorption of solutes – translocation of solutes – pathways and mechanisms. phloem loading and unloading - translocation of photosynthates – source- sink relationship – partitioning of assimilates and harvest index.

Unit II

Photosynthesis: absorption and action spectra- photoreceptors-Fluorescence and phosphorescence. Red drop and Emerson’s effect. Photo systems and reaction centres - Light Harvesting complexes - Photo system I & II and Oxidation of Water; Photosynthetic Electron Transport and Photophosphorylation (cyclic and noncyclic): Carbon metabolism: C3, C4 and CAM pathways and their distinguishing features – photorespiration (C2) and its significance. Kranz anatomy and its significance.

Unit III

Plant respiration – Glycolysis – TCA cycle– Mitochondrial Electron Transport – oxidative phosphorylation and ATP synthesis – Chemiosmotic Theory - Pentose Phosphate Pathway-Cyanide resistant respiration; Gluconeogenesis. Nitrogen fixation (Biological - symbiotic and non-symbiotic), Physiology and Biochemistry of nitrogen fixation. Adaptive mechanism to various stress (avoidance, escape, tolerance)–stress responsive proteins – anti-oxidative mechanism.

Unit IV

Classification of carbohydrates; Structure and properties of monosaccharides, Oligosaccharides, Polysaccharides – Glycoproteins. Protein and Amino acids: Structure, Classification and properties; Peptides - Structure: Primary, secondary, Ramachandran plot, tertiary and quaternary structures. Classification of Lipids: Structure and properties of fatty acids, phospholipids, glycolipids, lipoproteins, cholesterol - structure and functions.

Unit V

Enzymes- Classification and nomenclature ,chemical nature of enzymes – factors affecting enzyme action – Michaelis – Menton constant, Lineweaver Burk plot, Enzyme inhibition, co enzymes-mechanism of enzyme action, isoenzymes.

Secondary Metabolites: Structure, classification and properties of alkaloids, steroids, terpenoids, flavonoids and glycosides .

Recommended Texts:

1. Gauch, H.G.1972. Inorganic Plant Nutrition. Hutchinson & Dowd. New York.
2. Govindji. 1982. Photosynthesis. AP. New York.
3. Jacob, W.P. 1979. Plant Hormones and Plant Development. Cambridge University Press. Cambridge
4. Khan, A.A. 1982. The Physiology and Biochemistry of Seed development, Dormancy and Germination. Elsevier. Amsterdam.
5. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wawsworth Pub. Co. Belmont.
6. Ting, I.P. 1982.Plant Physiology. Addison Wesley Pb. Philippines.
7. Sage, R and R.K. Monson (eds). 1999. The Biology of C4 Plants AP New York.
8. Postgate, J. 1987. Nitrogen Fixation. 2nd Edition Cassel, London.
9. Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy. 2015. Plant Physiology. 6th Ed., Sinauer Associates.
10. Stacey, G.R.H. Burris and Evans, H.J. 1992. Biological Nitrogen Fixation. Chapman and Hall, New York
11. Mann, J. 1987. Secondary Metabolism Clarendon Press, Oxford.
12. Jain, V.K. 2017. Plant Physiology, S.Chand& Company Ltd. New Delhi.
13. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US.
14. Pandey, N.S and Pandey, P. 2016. Textbook of Plant Physiology. Daya Publishing House, New Delhi.
15. Taiz, L.Zeiger, E., Moller, I.M and Murphy, A. 2015. Plant Physiology and Development 6th Edition. Sinauer Associates, Sunderland, CT.

16. Guowei Li Veronique SantoniChristopheMaurel. 2014. Plant aquaporins: Roles in plant physiology. BiochimicaetBiophysicaActa (BBA) - General Subjects Volume 1840, Issue 5, Pages 1574-1582.
17. Satyanarayana.U and Chakrapani.U. 2021.Biochemistry 8th Edition.

Reference Books :

1. Bidwell, R.G.S. 1974. Plant Physiology, Macmillan Publisher, Boston.
2. Devlin, R.M. 1996. Plant Physiology, PWS publisher, Boston.
3. Jain, V.K. 2017. Fundamentals of Plant Physiology. Chand & Company Ltd., New Delhi.
4. Gontia. 2016. A textbook of Plant Physiology. Satish Serial publishing House, New Delhi.
5. Leopold, A.C, 1994. Plant Growth and Development, McGraw Hill, New York.
6. Lincoln Taiz et al., 2014. Plant Physiology and Development. Sinauer Associates Inc. Publishers, Sunderland, Massachusetts.
7. Lehninger, 2017 Principles of Biochemistry 7th Edition
8. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd Edition). SpringerVerlag, New York, USA.
9. Noggle, R.G and Fritz, G.J. 2010. Introductory Plant Physiology, PHI Learning Pvt Ltd, New Delhi.
10. Park S. Nobel. 2005. Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, New York.
11. Panda, S.K, 2005. Advances in Stress Physiology of Plants. Scientific Publishers India, Jodhpur.
12. Salisbury, F.B and Cleon Ross, 2007. Plant Physiology, Wadsworth Publishing Company, Belimont.
13. Shinha. R.K. 2007. Modern Plant Physiology. Ane Books India, New Delhi.
14. William G. Hopkins, 1999. Introduction to Plant Physiology, John Wiley and sons, INC, New York.
15. Heldt, H.W. 2005. Plant Biochemistry, 3rd Edition. Elsevier Academic Press

Web Resources :

1. <https://www.sciencedirect.com/topics/agriculture-and0biological-sciences/plant-physiology>.
2. <https://learn.careers360.com/biology/plant-physiology-chapter/>
3. <https://www.biologydiscussion.com/plants/plant-physiology/top-6-processes-of-plant-physiology/24154>.
4. <https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf>
5. <https://basicbiology.net/plants/physiology>
6. <https://learn.careers360.com/biology/plant-physiology-chapter/4>
7. https://swayam.gov.in/nd2_cec20_bt01/preview
8. <https://www.nature.com/subjects/plant-physiology>

SEMESTER – IV

DISCIPLINE SPECIFIC ELECTIVE - IV

RESEARCH METHODOLOGY & BIOLOGICAL TECHNIQUES

Hours :5
Credits : 3
Code :

Learning Objectives	Course Outcome
To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.	Be able to choose a problem, scientifically collect, analyse and interpret data that they generate through their personal enquires.
To learn the art of presenting and writing research papers and parameters for assessing the quality of a journal	Independently design and execute experiments, collect information and handle the data collected during research studies
To understand the impacts and ethics of conducting a research and tools to identify plagiarism	Conduct research with due ethical guidelines and protecting research outcomes
To learn the principles and methodology of various instruments used in biological research	Provide an overview on modern instrumentation that they would help students gain confidence to instantly commence research career and/or start entrepreneurial ventures
To gain knowledge on the cytological techniques	Appropriately use instruments for specific research analysis

Unit I

INTRODUCTION & TYPES OF RESEARCH : Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Choosing the problem for research - Review of Literature - Primary, Secondary and Tertiary sources.

Unit II

REPORTING RESEARCH RESULTS & METRICS: Reporting the results of research in conference - Oral and Poster presentation. Planning and preparation of thesis - Research journals - National and International – Monographs - Reprints - Proof correction - Full paper - Short Communication – Review Paper – UGC recommended journals. Citation index – Impact factor – H index – i20 index, SNIP – SJR.

Unit III

ETHICAL ISSUES & PLAGIARISM: Ethical issues – Ethical committees – Commercialization Royalty ,Reproduction of published material – Plagiarism – Citation and Acknowledgement – Reproducibility and Accountability.

Unit IV

PRINCIPLES AND METHODOLOGY OF VARIOUS INSTRUMENTS: Principles, methodology and the types of Microscopy –Light, Dark field, Phase contrast, TEM and SEM. Spectrophotometer (UV and NMR); Centrifugation –Differential and Density gradient.

Unit V

Chromatography – TLC, HPLC and GC-MS; Electrophoresis- AGE and PAGE. Microtechniques – fixation,Dehydration,Clearing ,embedding and Microtomy (Rocking,Rotary) and staining.

Recommended Texts:

1. Kothari C. R. 2004. Research methodology: Methods and techniques. New Age International.
2. Palanivelu P. 2009. Analytical biochemistry and separation techniques –A laboratory manual for B.Sc. and M.Sc. students, 21st Century Publications. Madurai.
3. Habib M.M., Pathik B. B. and Maryam H. 2014. Research methodology-contemporary practices: guidelines for academic researchers. Cambridge Scholars Publishing.
4. L.Veerakumar (2006). Bioinstrumentation. MJP Publisher, Chennai
5. Jayaraman, J. Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New D

Reference Books :

1. SreeRamalu, V.S., Thesis Writing, Oxford & IBH pub., New Delhi 1988.
2. Misra R.P., 1981, Research Methodology a hand Book, Concept Publishing Company, New Delhi
3. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
4. Skoog, A. and West, M. (1980). Principles of Instrumental Analysis - W. B. Saunders Co., Philadelphia, USA.
5. Christian, G. D. (1979). Atomic Absorption Spectroscopy - John Fredric, J. Fieldman Wiley & Sons, New York

Web Resources :

1. https://onlinecourses.swayam2.ac.in/cec20_bt22/preview
2. https://www.swayam.gov.in/explorer?category=BIO_TECH
3. https://onlinecourses.nptel.ac.in/noc20_bt31/preview
4. https://onlinecourses.nptel.ac.in/noc20_bt31/preview
5. https://edutechwiki.unige.ch/en/Research_methodology_resources

SEMESTER – IV
CORE PAPER - XII
CORE PRACTICAL PAPER – IV

Hours : 5 Credits : 4 Code :

Practical Covering

Core Paper XIII

- Plant Physiology
- Biochemistry

Discipline Specific Elective IV

- Research Methodology
- Biological Techniques

SEMESTER – IV
SKILL ENHANCEMENT COURSE - IV
PLANT TISSUE CULTURE

Hours :2 Credits : 2 Code :
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Learning Objectives	Course Outcome
To comprehend the basic principles and methodologies of plant tissue culture.	Recall the principles and culture techniques of cells, callus, organs, pollen, anthers, embryos and protoplasts.
To acquire knowledge on <i>in vitro</i> cultivation techniques to develop protocols targeted towards commercialization	Understand the techniques used in plant growth and regeneration under <i>in vitro</i> conditions.
To gain understanding of the various techniques of tissue culture for secondary metabolites production.	Apply the role plant tissue culture techniques in the production some secondary metabolites .
To recognize the worth of traditional germplasm and receive training in preserving and enhancing crop varieties to meet consumer demand and global legal policies	Analyze the conditions that are suitable for direct and indirect plant regeneration.
To impart practical information on plant tissue culture in order to produce labour suitable for the demands of the industry and research facilities	Evaluate the self-skills obtained during the course thorough internal and external assessment systems

Unit I

Totipotency and concepts of plant tissue culture – Laboratory organization –Aseptic techniques - Plant culture media – Inorganic nutrients – Macronutrients – Micronutrients - Carbon and energy sources – Organic supplements – Growth regulators – Solidifying agent – MS medium– Explant preparation - Methods of sterilization

Unit II

Micropropagation, Organogenesis and somatic embryogenesis – Multiplication and Rooting - Hardening - Somaclonal variation – synthetic seed technology - Meristem culture for virus free plants.

Unit III

Single cell and cell suspension culture – Applications - Protoplast culture: Protoplast isolation, purification – regeneration – culturing. Protoplast fusion techniques – somatic hybridization and cybridization - Applications.

Unit IV

Application of cell culture systems in metabolic engineering - advantages of cell, tissue and organ culture as a source of secondary metabolites

Unit V

Germplasm storage and conservation- Lyophilization and Cryopreservation Applications of tissue culture in agriculture, Horticulture and forestry.

Recommended Texts:

1. Narayanaswamy, S. 1999. Plant cell and tissue culture. 8th edn. Tata McGraw Hill Publ. ISBN 0074602772.
2. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd. ISBN 818147 3256.
3. Trigiano, R.N and D.J. Gray (eds.). 2000. Plant tissue culture concepts and laboratory exercises. CRC Press. (Textbook). 2nd Edition.
4. Kyte, M and Kleyn, J. 1996. Plant from test tubes. Timber Press. Auge, R. et al., 1995. In vitro culture and its applications in horticulture. Science Publishers, Inc.
5. Auge, R. 1995. In vitro culture and its applications in horticulture. Science Publishers, Inc.
6. Gamborg, O.L. and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual.
7. Khasim, S.M. 2002. Botanical Microtechnique: Principles and Practice, Capital Publishing Company, New Delhi.
8. Srivastava, P.S. 1998. Plant Tissue Culture and Molecular Biology. N.R. Book Distributors, New Delhi.
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10. [Pullaiah, E., Rao, T., M.V. Subba, Sreedev.](#) 2017. Plant Tissue Culture: Theory and Practicals. Scientific Publishers.
11. Chawla, H.S. 2009. Introduction to plant biotechnology, 3rd edition, Oxford and IBH publishing, New Delhi.
12. Gupta, S.D and Ibaraki, Y. 2006. Plant tissue culture engineering (Vol. 6). Springer Science & Business Media, Germany.
13. Razdan, M.K. 2015. Introduction to Plant Tissue Culture, 3rd edition. Oxford and IBH publishing, New Delhi.
14. Rober, H. Smith. 2013. Plant Tissue Culture: Techniques and Experiments, Academic Press, Elsevier.
15. Robert, N. Trigiano and Dennis, J and Gray (Eds.). 2011. Plant Tissue Culture, Development, and Biotechnology, CRC Press, Taylor & Francis Group.

Reference Books :

1. Bhojwani, S. S and Dantu, P.K. 2013. Plant tissue culture: an introductory text (Vol. 318). New Delhi, India: Springer.
2. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture, Kluwer Academic Press, The Netherlands.
3. Loyola-Vargas, V.M. Ochoa-Alejo, N. 2016. Somatic embryogenesis: Fundamental aspects and applications, Springer international publishing, Switzerland.

4. Elhiti, M., Stasolla, C and Wang, A. 2013. Molecular regulation of plant somatic embryogenesis. *In Vitro Cellular & Developmental Biology-Plant*, 49(6), 631-642
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7. Kartha, K.K. 1985. *Cyropreservation of plant cells and organs*. CRC Press, Boca Raton, Florida.
8. Rihan, H.Z., Kareem, F., El-Mahrouk, M.E., and Fuller, M.P. 2017. Artificial seeds (principle, aspects and applications). *Agronomy*, 7(4), 7.
9. Pullaiah, T. 2009. *Plant Tissue Culture: Theory and Practicals*, Scientific Publishers Journals Dept.TimirBaranJha and Biswajit Ghosh. 2016. *Plant Tissue Culture: Basic and Applied*, Platinum Publishers; 2nd Edn.
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11. Loyola-Vargas, V.M and Vázquez-Flota, F. 2006. *Plant cell culture protocols* (Vol. 318). USA: Humana Press, New Jersey.
12. Mba, C., Afza, R., Bado, S., and Jain, S.M. 2010. *Plant Cell Culture: Essential Methods*, John Wiley & Sons, UK.
13. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.). 2017. *Plant Biotechnology: Principles and Applications*, Springer publishers.
14. Fett-Neto, Arthur Germano (Ed.). 2016. *Biotechnology of Plant Secondary Metabolism: Methods and Protocols*, Springer publishers.
15. Smith, R.H. 2012. *Plant tissue culture: techniques and experiments*. Academic Press, UK.
16. Trigiano, R. N., and Gray, D. J. 2011. *Plant tissue culture, development, and biotechnology*. CRC Press, US.

Web Resources :

1. <https://nptel.ac.in/courses/102/103/102103016/>
2. <http://ugcmoocs.inflibnet.ac.in/ugcmoocs/spoc.php?coordinator=574>
3. <https://www.youtube.com/watch?v=bi755vQVNx8>
4. <https://www.elsevier.com/books/plant-tissue-culture/park/978-0-12-821120-5>
5. <https://onlinelibrary.wiley.com/doi/book/10.1002/9780470686522>

**SEMESTER – II
NON MAJOR ELECTIVE– I**

**APPLIED PLANT BIOECHOLOGY
(For I M.Sc. Zoology Students)**

Hours : 3 Credits : 2 Code :

Learning Objectives	Course Outcome
To understand the basics of Plant tissue culture, types of regeneration and applications of plant tissue culture	Understand the significance of plant tissue
To understand the mechanism of gene transfer to plants	Understand the mechanisms of <i>Agrobacterium</i> mediated DNA transfer
To know the various methods of Direct DNA transfer into plants	Explain the different methods of DNA transfer
To understand the implications of plant genetic engineering in human welfare	Compare the benefits of plant genetic engineering with normal breeding
To learn the basic concepts in IPR	Discuss and understand the various components of IPR

Unit I

Plant tissue culture: Introduction, totipotency. Culture media – types, role of hormones. Callus induction, subculture. Regeneration – organogenesis and embryogenesis. Types of cultures – callus, cell suspension, protoplast. Applications of plant tissue culture.

Unit II

Agrobacterium and crown gall tumours. Mechanisms of T-DNA transfer to plants. Ti-plasmid based vectors for plant transformation – *Agrobacterium* mediated transformation.

Unit III

Genetic engineering in plants: Methods of transformation - Direct DNA transfer - Particle bombardment (biolistics), electroporation and micro injection. Selectable markers and reporter genes.

Unit IV

Application of Plant genetic Engineering: Insect resistance – Bt. cotton. Golden Rice. Introduction to Biosafety and Bioethics.

Unit V

Intellectual property rights: Introduction – Types of protection: Patent, Trade mark, Copy right, Trade secret and GI. Case studies – Neem and Turmeric. The Protection of Plant Varieties and Farmer's Rights Act 2001

Recommended Texts:

1. Slater, Scott and Fowler. 2008, Plant Biotechnology, Oxford University Press.
2. S. Ignacimuthu: Plant Biotechnology, Oxford & IBM Publishing Co., New Delhi.
3. P. Parihar. 2015. A text book of Biotechnology, Argobios Publications, Jodhpur

Reference Books :

1. R.C. Dubey. 2015. A text book of Biotechnology, S.Chand& Co., New Delhi.
2. Chrispeels, M.J. and Sadava, D.F. 1994. Plants, Genes and Agriculture, Jones and Bartlett.
3. Primrose, S.B. 1999, Molecular Biotechnology, Panima publishing corporation, New Delhi

Web Resources :

1. <https://nptel.ac.in/courses/102/103/102103016/>
2. <http://ugcmoocs.inflibnet.ac.in/ugcmoocs/spoc.php?coordinator=574>
3. <https://www.youtube.com/watch?v=bi755vQVNx8>
4. <https://www.elsevier.com/books/plant-tissue-culture/park/978-0-12-821120-5>

**SEMESTER - III
NON MAJOR ELECTIVE – II**

**Hours: 3
Credits:
2 Code:**

(For II M.Sc Zoology Students)

PLANT PHYSIOLOGY

Course Objectives	Learning Outcomes
The fundamental processes involved in plant metabolism were included	Students can appreciate and understand a plant by knowing its intricate working mechanisms.
The principles of plant functioning will be taught	Students will get research interest by studying the aspects in depth.
Environmental physiology is also included to understand stress physiology	The syllabus incorporates the content of various competitive exams and will enable the students to face them effectively

Unit I

Absorption of water – Ascent of sap – Transpiration, factors affecting transpiration.

Unit II

Photosynthesis: Light reaction – Cyclic and Non-cyclic photo phosphorylation. C₃, C₄ cycles and CAM pathways and their distinguishing features – Pentose Phosphate Pathway and its significance.

Unit III

Photoperiodism. Phytochrome and its action on flowering. Vernalization: mechanism and its practical application. Fruit ripening. Plant senescence.

Unit IV

Nitrogen metabolism – source of nitrogen, nitrogen assimilation in higher plants – Nitrate Reductase and Nitrite Reductase.

Unit V

Stress physiology – water stress, salt stress, heavy metals and heat stress.

Recommended Text Books

1. Jain V.K. (1990) – Plant Physiology – S. Chand & Co. New Delhi.

2. Malik. C.P., and Srinivastra, (1995) – Plant Physiology.
3. Verma,S.K., 1999, A Text book of Plant Physiology, S. Chand & Co, New Delhi.

Reference Books

1. Delvin. R.M. (1969) – Plant Physiology – Holt, Rinehart & Winston & Affiliated eastwest, Press (P) Ltd., New Delhi.