UNIVERSITY OF CALICUT

DRAFT OF THE REVISED SYLLABUS FOR

BSc PLANT SCIENCE PROGRAMME

(Effective from 2014 admissions)

COURSE STRUCTURE

(Total Credits: 120)

Credits for common courses ……..……..38

Credits for core courses including project and elective.....…….....54

Credits for complimentary courses…….....24

Credits for open course…….....04

Semester I

Exam: 3 hrs (Internal 25%; External 75%); Total Credits: 16

Sem.	Course Code	Course Title	Total Hours	Hours/ week	Credits
I	A01	Common course –I Communication Skills in English	72	4	3
	A02	Common course –II Academic writing and presentation skills	90	5	3
	A 07	Common course –III Language other than English	72	4	4
	PS1B01	Core course I- Methodology and perspective of science	36	2	2
	PS1B02(P)	Core course I- Practical	36	2	_
	CH1C01	General Chemistry	36	2	2
	CH1C02(P)	Inorganic Volumetric Analysis	36	2	_
	ZO1C01	Zoology- Animal diversity and wild life	36	2	2
	ZO1C02 (P)	Zoology Practical- I	36	2	_
		Total	450	25	16

Semester II
Exam: 3 hrs (Internal 25%; External 75%); Total Credits: 18

Sem.	Course Code	Course Title	Total Hours	Hours/ Week	Credits
II	A03	Common course –IV Reading literature in English	72	4	4
	A04	Common course –V Readings on Indian constitution, secularism and sustainable environment	90	5	4
	A 09	Common course –VI Literature in language other than English (Malayalam/Hindi/Arabic)	72	4	4
	PS2B03	Core course II- Plant Anatomy and Embryology	36	2	2
	PS2B04(P)	Core course II- Practical	36	2	_
	CH2C03	Physical Chemistry –I	36	2	2
	CH2C04(P)	Volumetric Analysis Chemistry Practical- II	36	2	_
	ZO2C03	Economic Zoology	36	2	2
	ZO2C04 (P)	Zoology Practical- II	36	2	_
		Total	450	25	18

Semester III
Exam: 3 hrs (Internal 25%; External 75%); Total Credits: 15

Sem.	Course Code	Course Title	Total Hours	Hours/ Week	Credits
III	A06	Common course –VII History and philosophy of science	90	5	4
	A12	Common course –VIII General Informatics	90	5	4
	PS3B05	Core Course-III Algae, Fungi, Lichens, Bacteria, viruses & Plant Diseases	54	3	3
	PS3B06(P)	Core Course-III-Practical	36	2	_
	CH3C05	Organic and Biochemistry	54	3	2
	CH3C06(P)	Gravimetric Analysis	36	2	-
	ZO3C05	Physiology, Toxicology and Ethology	54	3	2
	ZO3C06(P)	Zoology Practical III	36	2	-
		Total	450	25	15

Semester IV
Exam: 3 hrs (Internal 25%; External 75%); Total Credits: 27

Sem.	Course Code	Course Title	Total Hours	Hours/ week	Credits
IV	A15	Common Course IX : Academic writing and presentation	90	5	4
	A16	Common Course X : Intellectual property rights	90	5	4
	PS4B07	Core Course-IV Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany	54	3	3
	PS4B08(P)	Core Course-IV Practical Common Practical Examination for Core Course I, II, III & IV Practicals	36	2	4
	CH4C07	Physical Chemistry II	54	3	2
	CH4C08(P)	Chemistry Practical IV	36	2	4
	ZO4C07	Genetics & Immunology	54	3	2
	ZO4C08(P)	Zoology Practical IV	36	2	4
		Total	450	25	27

Semester V
Exam: 3 hrs (Internal 25%; External 75%); Total Credits: 20

Sem.	Course code	Course Title	Total Hrs	Hrs/ week	Credits
V	PS5B09	Core Course V Morphology & Taxonomy of Angiosperms	72	4	4
	PS5B10(P)	Core Course V Practical	45	2.5	--
	PS5B11	Core Course VI Phytogeography, Ethnobotany & Economic Botany	72	4	4
	PS5B12(P)	Core Course VI Practicals	45	2.5	--
	PS5B13	Core Course VII Plant Physiology & Biochemistry	72	4	4
	PS5B14(P)	Core Course VII Practical Common Practical Examination for Core Course V, VI & VII Practicals	45	2.5	-- 4
	------	Open Course I(Course offered by other Departments/streams)	54	3	4
	PS5B15(Pr)	Project	45	2.5	--
		Total	450	25	20

Semester VI
Exam: 3 hrs (Internal 25%; External 75%); Total Credits: 24

Sem.	Course code	Course Title	Total Hours	Hours/ week	Credits
VI	PS6B16	Core Course VIII Cell Biology, Molecular Biology and Bioinformatics	72	4	4
	PS6B17(P)	Core Course VIII Practicals	45	2.5	--
	PS6B18	Core Course IX Genetics, Evolution & Ecology	72	4	4
	PS6B19(P)	Core Course IX Practicals	45	2.5	--
	PS6B20	Core Course X Horticulture, Plant Breeding	72	4	4
	PS6B21(P)	Core Course X Practicals Common Practical Examination for Core Course VIII, IX & X Practicals	45	2.5	4
	PS6B22(E1/E2 /E3)	Core Course XI Elective (Biotechnology /Medicinal Plants/ Forestry)	72	4	4
	PS6B23(Pr)	Project	27	1.5	4
		Total	450	25	24

Credits for the complimentary course practical will be awarded at the end of the 4th semester. Credits for the main course practical will be awarded at the end of the sixth semester.

INSTRUCTIONS

A. Theory

The total number of core theory courses is eleven, one course each during the first four semesters, three courses each during fifth and sixth semesters and one elective course in the sixth semester.

In the sixth semester there are three elective courses offered. An institution can choose any one of the following elective courses:

PS6B22(E1). Botany of Plantation Crops &
Spices. PS6B22(E2). Medicinal Plants.
PS6B22(E3). Forestry.

B. Practicals

Practicals corresponding to each core course will be conducted during the corresponding semesters. There shall be three external practical examinations for the core course practicals. One external practical examination each shall be conducted for the following clusters of core course practicals:

Cluster I: Core course I Practical; Core course II Practical; Core Course III Practical & Core Course-IV Practical.

Cluster II: Core course V Practical; Core course VI Practical; Core Course VII Practical.

Cluster III: Core course VIII Practical; Core course IX Practical; Core Course X Practical.

The Cluster I Practical (External) Examination shall be conducted at the end of 4th semester and the Cluster II and Cluster III examinations shall be conducted at the end of 6th semester. All practical examinations are of three hour duration. A duly certified record of practicals should be submitted during the examination. The Board of Examiners shall decide the pattern of question papers for practical examinations.

C. Project

Project works will be carried out in fifth and sixth semesters. A group of students shall be given a combined project to minimise the work load on teachers. Each individual student should submit a copy of the project report duly attested by the supervising teacher and the Head of the Department.

D. Complementary Courses

The syllabus/Course offered by the University as per the recommendations of Boards of Studies in Chemistry and Zoology for complimentary courses (Chemistry, Zoology) shall be followed for B.Sc. Plant Science programme as the two complimentary courses.

E. Open Courses

In the 5^{th} semester, Plants Science Main students shall opt for an open course offered by other Departments/streams. A Department offering Plant Science Main courses may offer the following open courses to students other than Plant Science main students:

PS5D01 Mushroom Cultivation
PS5D02 Plant Tissue Culture
PS5D03 Biofertilisers and Organic Farming.

SEMESTER I

CORE COURSE I. PS1BO1 METHODOLOGY AND PERSPECTIVES OF SCIENCE

Total 72 hrs. Theory. 36 hrs. Practicals. 36 hrs.

Module -I: Science and science studies: 9 hrs.

Types of knowledge: Practical, theoretical and scientific knowledge, information. What is science; what is not science; laws of science. Basis for scientific laws and factual truths, Science as a human activity, scientific temper, empiricism, vocabulary of science, science disciplines, Revolutions in science, science and technology.

Module - II: Methods and tools of science (basic ideas only) 9 hrs.

Hypothesis; theories and laws in science; observations, evidence and proofs. Posing a question; formulation of hypothesis; hypothetico-deductive model, inductive model. Signification of verifications (proving) corroborations and falsification (disproving), auxiliary hypothesis, adhoc hypothesis. Revision of scientific theories and laws. Importance of models, simulations and virtual testing. Mathematical methods versus scientific methods. Significance of peer review.

Module - III: Microtechnique 9 hrs.

1. Microscopy-Principles of Microscopy. Brief account on Compound microscope. Phase contrast microscope. Fluorescent microscope. Electron microscopes-Principles and Types Transmission Electron Microscope (TEM) Scanning Electron Microscope (SEM).
2. Microtomes - Rotary and Sledge.
3. Killing and Fixation - Fixatives-Carnoys formula, Farmer's and formula-FAA.
4. Dehydration- Common Reagents.
5. Paraffin Infiltration and Embedding.
6. Serial section cutting.
7. Staining - Types of staining, Single staining and Double staining, Natural and Synthetic stains, Hematoxylin, Safranin, Fast green.
8. Free hand sections - Staining and Permanent slide preparation.
9. Whole Mounts - General description.
10. Maceration techniques -General account.

Module - IV: Biostatistics - Data handling 7 hrs.

1. General introduction and application of biostatistics.
2. Collection of data: Sampling theory and methods.
3. Presentation of data: a) Graphic representation: histogram, frequency polygon and frequency curve; b) Diagrammatic representation: Line diagram, bar diagram, pie diagram.
4. Analysis of Data: a) Measures of central tendencies Mean- Median- Mode. b) Measures of dispersion Range, mean deviation, standard deviation and standard error.

Module - V: Ethics in science 2 hrs

Scientific information, depositories of scientific information, Sharing of knowledge, transparency and honesty, Reporting of observational and experimental data; Biased

observations, Influence of observer on observations, Publications and Patents; Plagiarism.

Practical.

Microtechnique

1. Parts of microscope and operation.
2. Free hand sectioning of root, stems and leaves- Single and Double staining.
3. Demonstration of killing and fixing, dehydration, paraffin-infiltration, embedding, Microtoming, deparaffinisation and permanent slide preparation.

Biostatistics

1. Measure the length of given plants / any sample of data and calculate the mean, median and mode.

2 Measure the size of given fruits / any sample of data and represent it in a graphical form and interpret it. Construct bar diagram, histogram and pie diagram using suitable data.

REFERENCES

1. P.G. Hewitt, S. Lyons,J.A. Suchocki, J Yeh. 2006. Conceptual Integrated Science. Addison Wesley.
2. R.G. Newton - The truth of science, Viva Books, New Delhi, II Edition. Bailey, N. T. J. (1994/'95). Statistical Methods in Biology, 3e, CUP/LPE.
3. Johansen, D.A. 1940. Plant Microtehnique. Mc Graw - Hill Book Company, Inc. New York. Jasra. P.K. and Raj Gurdeep 2000. Biostatistics.
4. Kanika, S. 2007. Manual of Microbiology - Tools and Techniques. Ane's student edition. Khasim,S.K., 2002. Botanical Microtechnique; principles and Practice, Capital Publishing Company, New Delhi.
5. Khan, LA. and Khanum. Fundamentals of Biostatistics. Wraaz Publ. Hyderabad. Toji, T. 2004. Essentials of botanical microtechnique. Apex Infotec Publ.
6. Collins, H. and Pinch, T. (1993). The Golem: What Every one Should Know About Science, Cambridge University Press.
7. Gieryn, T. F. (1999). Cultural Boundaries of Science, Univ. Chicago Press.
8. Green, R. H. Sampling design and Statistical Methods for Environmental Biologists. J.W. & S.
9. Gupta, S. P. (2002). Statistical Methods. 31e, Sultan Chand & Co.
10. Holmes, D., Moody, P. and Dine, D. (2006). Research Methods for the Biosciences, Oxford university Press.
11. Norman, TJ. Bailey. Statistical methods in Biology Cambridge Univ. Press.
12. Pechenik, J. A. (1987). A Short Guide to Writing About Biology, Boston. Little Brown. Prasad, S. (2004 I '05). Elements of Biostatistics, Rastogi PubIs., Meerut.
13. Ruxton, G. D. and Colegrave, N. (2006). Experimental Design for Life Sciences, 2e, Oxford University Press.
14. Ramakrishnan, P. Biostatistics, Saras Publishers
15. Rastogi, V. Fundamentals of Biostatistics 2nd edition - Ane's student edition. Snedcor, G. W. and Cochran, W. G. Statistical Methods. Allied East-West Press, ND. Sokal, R. R. and Rohlf, F. L Introduction to Biostatistics, W.H. Freeman.
16. Steel, R.G.D. and Torrie, J.H. Principles and Practice of Statistics with special reference to Biological Science.
17. Verma, B. L. et al. (1993). Biostatistics, OBS, ND.
18. Victoria, E. McMillan. (1997). Writing Papers in the Biological Sciences, Bedford Books, Boston.

19. Yadav, K. (1993). Teaching of Life Sciences, Anmol Pubns., New Delhi. Useful websites
20. Biological methods: www.cfkeep.orglhtml/stitch.php?s=98965698293378 & id = 44650773279975.
21. Writing Papers: www.ruf.rice.edu/-bioslabs/tools/report/reportform.html.

SEMESTER II

CORE COURSE II – PS2B02 ANGIOSPERM ANATOMY AND EMBRYOLOGY

Total -72 hrs. Theory - 36 hrs., Practicals- 36 hrs.

Module – I: ANGIOSPERM ANATOMY Theory - 30 hrs., Practicals - 30 hrs.

1. Introduction: history and significance of anatomy.
2. Plant cell- structure and types.

A. Structure and composition of cell wall. Middle lamella Primary and Secondary wall thickening, Pits.

B. Growth of cell wall – apposition, intususception

C. Extra cell wall materials – lignin, cutin, suberin, callose, wax.

3. Non-living inclusions:

Reserve materials – carbohydrates (starch grains and sugars) proteins (aleuron grains) fats & oils, examples.

4. Tissues: Definition and Types

A. Meristematic tissues - classification.

Theories on apical organisation - apical cell theory, histogen theory, Tunica-Corpus theory.

B. Permanent tissues- definition, Classification- simple complex and secretory.

i. Simple tissues - parenchyma. collenchyma, sclerenchyma, - fibres and sclereids- structure, occurrence and function.

ii. Complex tissues - definition - xylem & phloem structure, origin and function

iii. Secretory tissues – glands, glandular hairs, nectaries, hydathodes, and laticifers.

iv. Protective structures: scales and trichomes.

5. Epidermal tissue system, origin and structure of stomata, classification (Metcalfe & Chalk), cuticIe.

6. Ground tissue system.

7. Cortex, endodermis, pericycle and pith.

8. Vascular tissue system: vascular bundles - origin and types - conjoint, collateraL bi-collateral, radial, concentric – amphicribal and amphivasal, protoxylem, metaxylem, protophloem, metaphloem , cambium, open and closed, endarch and exarch.

9. Primary growth of plant body-

Dicot stem - Centella and bi-collateral (*Cephalandra*, *Cucurbita*);

Dicot root - (aerial *Ficus*, *Tinospora*)

Monocot stem - (Grass, *Asparagus*)

Monocot root - *Colocasia*

Dicot leaf - *Ixora*

Monocot leaf – Grass.

10. Secondary body of the plant.

A. Normal secondary growth in dicot stem and dicot root. Formation of vascular cambial ring - structure and activity of cambium - storied and non-storied. fusiform and ray initials.

Formation of secondary wood, annual rings, porous and diffuse porous wood, heart wood. sapwood, tyloses, secondary phloem, vascular rays.

Extra stelar secondary thickening in stem and root - periderm formation. Lenticels - structure & function.

B.Anomalous secondary growth in dicot stem (*Boerhaavia*. *Bignonia*, *Piper*) and monocot stem (*Dracaena*).

MODULE – II: EMBRYOLOGY Theory - 6 Hrs. Practicals - 6 Hrs.

1. Morphology of flower - anther - structure, microsporogenesis, - dehiscence; ovule - structure, types, megasporogenesis, structure of typical embryo sac, types of megagametogenesis - monosporic (*Polygonum*), bisporic (*Allium*) tetrasporic (*Adoxa*)
2. Fertilization - pollen tube entry - types, double fertilization and triple fusion.
3. Endosperm formation - types - free nuclear, cellular and helobial haustoria.
4. Embryo - structure and development of dicot embryo. Structure of monocot embryo.
5. Apomixis types and polyembryony.

ANGIOSPERM ANATOMY - Practicals 30 Hrs.

Students are expected to

I. Study primary plant structures – stem, root and leaf (dicots and monocots).

2. Study secondary plant structures (dicot stem and root after secondary thickening)
3. Study anomalous secondary thickening -*Boerhaavia*, *Bignonia*,*Dracaena*
4. Identify at sight different cell types - tissues, vascular bundles (all types).

EMBRYOLOGY - Practicals 6 Hours

Students should identify-

I. Anther (young and mature). Types of ovules.

2. Dicot and monocot embryos of Angiosperms.
3. Demonstration of embryo mounting eg: *Tridax*, *Crotalaria*.

REFERENCES

ANGIOSPERM ANATOMY

I. Cutter, E.G. 1969. Plant Anatomy - Part 1 Cells & Tissue. Edward Arnold Ltd., London.

2. Cutter, E.G. 1971. Plant Anatomy, Part 2 Organs. Edward Arnold Ltd., London

3. Eames, A. J. & L H Mac Daniels. 1987. Introduction to Plant Anatomy. Tata-McGraw Hill Publishing Company.

4. Esau K. 1985. Plant Anatomy (2nd ed.). Wiley Eastern Ltd. New Delhi.

5. Fahn A.2000. Plant Anatomy. Permagon Press.

6. Pandey B.P. Plant Anatomy. S. Chand & Co. Delhi.

7. Sen D.N. 1974. Anatomy of Angiosperms. S. Nagini & Co.

8. Tayal M.S. Plant Anatomy. Rastogi Publishers, Meerut.

9. Vasishta P.C. 1974. Plant Anatomy, Pradeep Publication, Jalandhar.

EMBRYOLOGY

I. Bhojwani S & S. P. Bhatnagar 198. The Embryology of Angiosperms. Vikas Publishing House (P) Ltd. .

2. Davis C.L. 1965. Systematic Embryology of Angiosperms. John Wiley, New York.

3. Eames M.S. 1960. Morphology of Angiosperms. Mc Graw Hill New York.

4. Johri B.D. (ed.) 1984. Embryology of Angiosperms Springer-Verlag, Berlin.

5. Maheswari P. 1985. Introduction to Embryology of Angiosperms - McGraw Hill, New York.

6. Sharma & Aswathi. Embryology of Angiosperms.

SEMESTER III

CORE COURSE III PS3B05- Algae, Fungi, Lichens, Bacteria, Viruses & Plant Diseases

Total – 90 Hrs. Theory – 54 Hrs, Practicals- 36 Hrs.

Distribution of Hours	Theory	Practical
1) Bacteria & Viruses	9	9
2) Fungi & Lichens	18	9
3) Algae	18	9
4) Plant Diseases	9	9
Total	54	36

MODULE – I: Algae

Theory

1. Classification of Algae: van den Hoek et al.'s (1995) system.
2. General Features: Occurrence, cell morphology, range of thallus structure, reproduction and life cycles.
3. Cyanophyceae: General characters of Cyanophyceae. Type: *Nostoc.*
4. Chlorophyceae: General characteristics, occurrence, thallus structure, cell structure, flagella, reproduction, interrelationships. Types -*Chlamydomonas*, *Volvox*, *Spirogyra*, *Oedogonium*, *Chara*.
5. Xanthophyceae: General characteristics, occurrence, range of thallus structure, reproduction, interrelationships. Type- *Vaucheria*.
6. Bacillariophyceae (Diatoms): General characteristics, occurrence, thallus structure, cell structure, cell division, sexual reproduction, auxospores, classification, interrelationships. Type -*Pinnularia*.
7. Phaeophyceae: General characteristics, occurrence, range of thallus structure, anatomy, cell structure, flagella, reproduction, alternation of generations, interrelationships. Type - *Sargassum*.
8. Rhodophyceae: General characteristics, occurrence, range of thallus structure, cell structure, reproduction, life cycle, phylogeny and interrelationships. Type- *Polysiphonia*.
9. Economic Importance

Algae as food, fodder, green manure, bio-fuels, pollution indicators, research tools, medicinal uses of algae,

Commercial Products - carrageenin, agar-agar, alginates, diatomaceous earth. Harmful effects – Water bloom, eutrophication, neurotoxins, parasitic algae.

Practical

1. Identification of two Algae from Algal mixture (Microscopic algae) including *Volvox*, *Oedogonium*, *Spirogyra*, *Vaucheria* and *Polysiphonia*.
2. Identify the vegetative and reproductive structures of the types studied.
3. Algal culture of the types mentioned in the syllabus- demonstration.

REFERENCES

1. Chapman, V. J. & Chapman, D. J. 1973. The Algae. Macmillan.
2. Kumar, H. D. 1990. Introductory phycology. East West Press Pvt. Ltd.
3. Prescott, G. W.1969. The Algae. A Review. Thomas Nelson and Sons Ltd.
4. Round, F. E. 1975. The Biology of Algae. Edward Arnold.

5. Smith, G. M. 1978. Manual of Phycology. The Ronald Press Company.

6. Trainor, F. R. 1978. Introductory Phycology. John Wiley and Sons.
7.van den Hoek, C, Mann, D.G., Jahns, H.M. 1995. Algae. An Introduction to Phycology. Cambridge University Press.

MODULE – II: Fungi & Lichens

Fungi

Theory

1. General characters of fungi.
2. Distinction between true fungi and pseudofungi. Phylum-level classification of fungi proposed by Alexopoulos et al. (1996).
3. Myxomycota: General characteristics. Type: *Dictyostelium*.
4. Oomycota: General characteristics, occurrence, reproduction, and life cycle – Type: *Pythium*, *Phytophthora*.
4. Zygomycota: General characters, occurrence, reproduction, and life cycle – Type: *Mucor*, *Rhizopus*.
5. Ascomycota: General characters, occurrence, reproduction and life cycle – Type: *Peziza*, *Saccharomyces*.
6. Basidiomycota: General characters, occurrence, reproduction and lifecycle -Types: *Puccinia*, *Agaricus*
7. Mitosporic fungi (deuteromycetes): General characters, occurrence, reproduction and life cycle- Type: *Aspergillus*, *Penicillium*.
8. Economic importance of fungi: Medicinal, industrial, Agricultural, Food, and fungal toxins.

Practical

1. Examination of micropreparation/slides of the above mentioned types.
2. Isolation and culturing of fungi from soil.

REFERENCES

1. Alexopoulos, C.J. et. al. 1996. Introductory Mycology, 4th Edition, Wiley.
2. Hudler, G.W. 1998. Magical Mushrooms, Mischievous Molds. Princeton University Press.
3. Lucas, J. A. 1998. Plant Pathology and Plant Pathogens, 3rd ed. Blackwell.
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5. Kirk, P. M. et al. 2008. Dictionary of the Fungi, 10th Edition. CABI.
6. Rangaswami G. 1999. Diseases of Crop Plants of India, 4th ed. Prentice Hall of India.
7. Webster, J. and Weber, R. 2007. Introduction to Fungi. Cambridge University Press.
8. Mehrotra R.S. and Aneja K.R. 1990. An Introduction to Mycology, Wiley, Eastern Limited, New Delhi.

Lichens

Lichens as examples of mutualistic symbiosis. mycobiont and photobiont (green alga or cyanobacterium).Growth forms – crustose, filamentous, foliose, fruticose, leprose, squamulose, gelatinous. Structure of lichen thallus. Type: *Usnea*

Taxonomy and classification based on fungal partner. Reproduction and dispersal – fragmentation, isidia, soridia, cephalodia. Sexual Reproduction – Typical of fungal partner, producing spores.

Ecophysiological features of lichen: extreme endurance and longevity, drought tolerance, epiphytic adaptations, sensitivity to pollutants, chemical degradation and physical disruption of mineral surfaces

Economic Uses: Dyes, Cosmetics and perfumes, Medicinal uses, Lichens as food,

Ecological indicators, Pollution indicators, Lichen in Soil formation.

Practical

1. Morphology and anatomical features of lichen- *Usnea*
2. Identification of different growth forms of Lichen

REFERENCES

1. Gilbert, O. 2004. Lichen Hunters. The Book Guild Ltd. England
2. Kershaw, K.A. 1985. Physiological Ecology of Lichen Cambridge University Press.
3. Nash, T. H. 1996. Lichen Biology. Cambridge University Press.
4. Sanders, W.B. 2001. Lichen- interface between mycology and plant morphology.
5. Bioscience, 51: 1025-1035.

MODULE - III: Bacteria & Viruses

Theory

1. Major groups of prokaryotes, differences between Bacteria and Archaea. Major groups of Bacteria and Archaea
2. Morphology and fine structure of bacteria. Bacterial growth, Nurition, Reproduction, Economic importance of bacteria
3. Gene transfer mechanisms in bacteria: Transformation, Transduction and conjugation
5. Viruses: Structure and chemistry; architecture and multiplication of T4 phage and TMV. Brief account of retroviruses, HIV, Viroids, Prions.
6. Techniques used to study bacteria–Sterilization, isolation of pure culture by Spread plate, Streak plate and Pour plate methods, counting bacteria.

Practical

1. Simple staining – Crystal violet
2. Gram staining – Curd, root nodules
3. Culture and isolation of bacteria using nutrient agar medium

REFERENCES

1. Dubay R.C. & D.K. Maheswari 2000. A Textbook of Microbiology, S. Chand & Co, New Delhi.
2. Frazier W.C. 1998. Food Microbiology, Prentice Hall of India, Pvt. Ltd.
3. Kumar H.D. & S. Kumar. 1998. Modern Concepts of Microbiology Tata McGraw Hill, Delhi.
4. Pelzar M.J., E.C.S. Chan & N.R. Kreig. 1986. Microbiology McGraw Hill, New York.
5. Rangaswami, R & C.K.J. Paniker. 1998. Textbook of Microbiology, Orient Longman.
6. Ross, F.C. 1983. Introductory Microbiology. Charles E. Merill Publishing Company.
7. Sharma P.D., 2004. Microbiology and Plant Pathology Rastogi Publication.

MODULE - IV: Plant Diseases

Theory

1. Causative agents of plant diseases – biotic & abiotic; disease triangle; Koch's Postulates.
2. Structural & biochemical defences of plants; chemical weapons of pathogens.
3. Symptoms of plant diseases: spots, blights, wilts, rots, galls, canker, gummosis, necrosis, chlorosis, smut, rust, damping off.
4. Control measures: Regulatory, Cultural, Physical, biological and Chemical methods.
5. Brief study of Plant diseases in Kerala (Name of disease, pathogen, symptom and control measures need to be studied.): 1. Soft rot of vegetables 2. Mahali disease of Arecanut, 3.

Blast of Paddy, 4. Grey leaf spot of coconut, 5. Mosaic disease of Tapioca, 6. Bunchy top of Banana, 7. Quick wilt of pepper, 8. Rhizome rot of ginger, 9. Coffee rust, 10. Abnormal leaf fall of rubber, 11. Root wilt of coconut, 12. Nematode infection on Banana.

Practical

Identification of the disease, pathogen, symptoms and control measures of the following:

1. Grey leaf spot of coconut
2. Mahali disease
3. Tapioca mosaic disease
4. Blast of Paddy
5. Abnormal leaf fall of Rubber

REFERENCES

1. Agrios, G. N. 2005. Plant Pathology, 5th edition. Academic Press
2. Bilgrami K.H. & H.C. Dube. 1976. A textbook of Modern Plant Pathology. International Book Distributing Co. Lucknow.
3. Mehrotra, R.S. 1980. Plant Pathology – TMH, New Delhi.
4. Pandey, B.P. 1999. Plant Pathology. Pathogen and Plant diseases. Chand & Co. New Delhi.
5. Rangaswami, G. 1999. Disease of Crop plants of India Prentice Hall of India Pvt. Ltd.
6. Sharma P.D. 2004. Plant Pathology Rastogi Publishers.

SEMESTER IV

CORE COURSE VI PS4B07- Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany

Total – 90 Hrs. Theory – 54 Hrs., Practicals- 36 Hrs.

Distribution of Hours	Theory	Practicals
1) Bryophytes	9	9
2) Pteridophytes	18	12
3) Gymnosperms	18	12
4) Palaeobotany	9	3
Total	54	36

MODULE – 1. Bryophytes

Theory

1. Introduction, general characters of the three lineages: Marchantiophyta, Anthocerotophyta, Bryophyta
2. Study of distribution, structure (external and internal), reproduction, life cycle and affinities of following types (Developmental details are not required) *Riccia* (Marchantiophyta), *Anthoceros* (Anthocerotophyta), *Funaria* (Bryophyta).
3. Evolution of gametophyte and sporophyte among Bryophytes.
4. Economic importance of Bryophytes.

Practical

Riccia – habit, internal structure of thallus, V.S. of thallus through antheridium, archegonium and sporophyte.

Anthoceros- habit, internal structure of thallus. V.S. of thallus through antheridium,

archegonium and sporophyte.

Funaria- habit, structure of antheridial cluster, archegonial cluster, L.S. of sporophyte.

REFERENCES

1. Chopra R.N. and P.K. Kumar, 1988, Biology of Bryophytes. Wiley Eastern Ltd. New Delhi
2. Parihar, N.S. An Introduction to Bryophyta Central Book Depot, Allhabad, 1965.
3. Shaw.J.A. and Goffinet B., 2000, Bryophyte Biology, Cambridge University Press.
4. Sporne K.R., 1967, The Morphology of Bryophytes. Hutchinson University Library, London.
5. Vasishta B.R. Bryophyta. S. Chand and Co. New Delhi.
6. Watson E.V. 1971, The structure and life of Bryophytes. Hutchinson University Library, London.

MODULE- II: Pteridophytes

Theory

1. Introduction, general characters and classification (Pichi-Sermolli, 1977 & Smith et al., 2006 – brief outline only) .
2. Study of distribution, structure (external and internal), reproduction, life cycle and affinities of following types (Developmental details are not required): *Psilotum* (Psilopsida), *Selaginella* (Lycopsida), *Equisetum* (Sphenopsida), *Pteris* & *Marsilea* (Pteropsida). 3.. Apogamy and apospory in Pteridophytes; Stelar evolution in Pteridophytes Heterospory and seed habit; Affinities of Pteridophytes; Economic importance of Pteridophytes with special reference to biofertilizers.

Practical

Psilotum- habit, T.S. of stem, C.S. of synangium

Selaginella – habit, T.S. of stem, T.S. of rhizophore, L.S. of Strobilus

Equisetum- habit, T.S. of stem, L.S. of Strobilus

Pteris- Habit, T.S. of petiole and T.S. of sporophyll

Marsilea - habit, T.S. of rhizome. T.S. of petiole, sporocarp, sectional view of sporocarp

REFERENCES

1. Chandra S. & Srivastava M., 2003, Pteridology in New Millennium, Kluwer Academic Publishers.
2. Eames, A.J. 1979, Morphology of Vascular Plants, lower group. Wiley International edition, New Delhi.
3. Parihar, N.S. 1977, Biology and Morphology of Pteridophytes, Central Book Depot, Allhabad.
4. Pichi Sermolli, R.E.G. 1977, A tentative classification of Pteridophyte genera. Webbia (2): 313-512.
5. Rashid, A. 1976, An Introduction to Pteridophyta, Vikas publ. Co. New Delhi.
6. Smith, A., K. Pryer, E. Schuettpelz, P. Korall, H. Schneider, AND P. Wolf. 2006. A classification for extent ferns. Taxon 55: 705-731.
7. Sporne, K.R. 1967, Morphology of Pteridophytes – Hutchinson University Library, London.
8. Sreevastava, H.N. A text book of Pteridophyta.
9.Vasishta B.R. 1993, Pteridophyta – S. Chand and Co., New Delhi

MODULE – III: Gymnosperms

Theory

1. Introduction:- General characters and Classification (Sporne, 1965)
2. Distribution, structure (external and internal), reproduction, life cycle and affinities of following plants (Developmental details are not required): *Cycas*, *Pinus*, *Gnetum*
3. Evolutionary trends in Gymnosperms; affinities of Gymnosperms with Pteridophytes and Angiosperms.
4. Economic importance of Gymnosperms.

Practical

1. *Cycas*- *Cycas* seedling, coralloid root, T.S. of coralloid root, T.S. of leaflet, petiole, male cone and L.S. of male cone, microsporophyll, megasporophyll, T.S. of microsporophyll, ovule, L.S. of ovule and seed.
2. *Pinus*- branch of unlimited growth, spur shoot, T.S. of stem and needle, male cone and female cone, L.S. of male cone and female cone, seed.
3. *Gnetum*- Habit, stem T.S., leaf T.S., male and female cones, L.S. of ovule, seed.

REFERENCES

1. Coutler J.M. and C.J. Chamberlain, 1958, Morphology of Gymnosperms. Central Book Depot. Allahabd.
2. Sporne K.R. 1965. The Morphology of Gymnosperms, Hutchinson and Co. Ltd. London.
3. Sreevastava H.N. 1980, A Text Book of Gymnosperms. S. Chand and Co. Ltd., New Delhi.
4.Vasishta P.C. 1980, Gymnosperms. S. Chand and Co., Ltd., New Delhi.

MODULE-IV: Palaeobotany

Theory.

1. Fossil formation and types of fossils.
2. Geological time scale- sequence of plants in geological time.
3. Fossil Pteridophytes- *Rhynia*, *Lepidodendron*, *Lepidocarpon*, *Calamites*.
4. Fossil gymnosperms- *Williamsonia*.
5. Brief mention of fossil deposits in India.
6. Applied aspects of Palaeobotany- Exploration of fossil fuels.

Practical

Fossil Pteridophytes- *Rhynia* stem, *Lepidodendron*, *Lepidocarpon* and
Calamites Fossil gymnosperms- *Williamsonia*

REFERENCES

1. Andrews H.N. 1961, Studies in Palaeobotany. John Wiley and Sons Inc., New York..
2. Arnold C.A., 1947, Introduction to palaeobotany, Tata McGraw Hill, New Delhi.
3. Shukla, A.C. & S.P. Misra, 1975, Essential of Palaeobotany, Vikas Publishing House, Pvt. Ltd., Delhi.
4. Sreevastava H.N., 1998, Palaeobotany, Pradeep Publishing Company, Jalandhar.
5. Sewart, W.N., 1983, Palaeobotany and the Evolution of Plants. Cambridge Uni. Press, London.
6. Taylor, T.N. Paleobotany. An Introduction to Fossil Plant Biology. McGraw-Hill, New York.
7. Steward A.C.,1935, Fossil Plants Vol. I to IV.

8. Watson J. 1953. An introduction to study of fossil plants. Adams and Charles Black Ltd. London

SEMESTER V

CORE COURSE V PS509– MORPHOLOGY AND TAXONOMY OF ANGIOSPERMS

Total – 117 Hrs. Theory – 72 Hrs. Practicals - 45 Hrs.

Distribution of Hours	Theory	Practical
Morphology of Angiosperms	18	10
Taxonomy of Angiosperms	54	35
Total	72	36

MODULE- I: ANGIOSPERM MORPHOLOGY

Theory

1. Morphological description of a flowering plant- Plant Habit.
   A. Root: types - tap root, fibrous root; modifications - definition with examples - storage roots, aerial roots, pneumatophores, buttress roots.
   B. Stem: habit - acaulescent, caulescent, caespitose prostrate, repent, decumbent, arborescent, suffrutescent (definition with examples); modification - underground, aerial and subaerial with examples.
   C. Leaves: lamina, petiole, leaf tip, leaf base, stipule, pulvinus; phyllotaxy; types - simple and compound; shapes of lamina; leaf tip; leaf base; leaf margin; leaf surface features: hairiness - tomentose, glabrous, scabrous, strigose, hispid.
2. Inflorescence: racemose, cymose and specialised (cyathium, hypanthodium, coenanthium verticillaster, thyrsus)
3. Flower: flower as a modified shoot - detailed structure of flowers - floral parts -their arrangement, relative position, cohesion and adhesion - symmetry of flowers - floral diagram and floral formula.
4. Fruits - types, classification with examples; seed structure - dicot and monocot - albuminous and exalbuminous, aril, caruncle; dispersal of fruits and seeds - types and adaptations

Practical

1. Students have to identify the types mentioned in the syllabus but need not draw the diagrams in the record.
2. Students have to submit a minimum of 10 different types of specimens belonging to any one of the following categories (dry/wet) - root, stem, leaf, inflorescence, flower, fruits and seeds.
3. Examination of floral morphology of the following plants: Crotalaria, Ixora, Allamanda, Hibiscus, Calotropis and Leucas.

REFERENCES

1. Gangulee, H.C., J.S. Das & C. Dutta. 1982. College Botany (5^{th} Ed.) New Central Book Agency, Calcutta.
2. George, H.M. Lawrence. 1951. Introduction to Plant Taxonomy. Mac Milan comp. Ltd., New York.
2. Simpson, M.G. 2006. Plant Systematics. Elsevier Academic Press, London
3. Ananta Rao T. Morphology of Angiosperms.

MODULE-II: TAXONOMY OF ANGIOSPERMS

1. Introduction, objectives and importance of taxonomy.

2.Introduction to systems of classification – Artificial – Linnaeus; Natural – Bentham and Hooker; Phylogenetic – Engler and Prantl. Angiosperm Phylogeny Group system. Detailed study of Bentham and Hooker's system up to family level. Diagnostic features of families studied in practical classes viz. Annonaceae, Malvaceae, Nymphaeaceae, Rutaceae, Papilionaceae, Myrtaceae, Cucurbitaceae, Apiaceae, Amaranthaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae, Poaceae.

3. Taxonomic structure – hierarchy; concepts of taxa; species concepts – biological, phenetic and phylogenetic; genus; family.

4.Taxonomic character – concept, primitive and advanced characters, sources, comparative morphology, vegetative, reproductive, macro- and micro-morphology, brief account of modern trends in taxonomy.

5.History of taxonomy in India – Contributions of Hendrich van Rheede, William Roxburg, Robert Wight, and J. S. Gamble.

6.Plant nomenclature – limitations of common name, ICN, principles (introduction only); typification; Priority – merits and demerits; effective and valid publication; author citation.

7.Plant identification keys- construction and applications.

8. Taxonomic information resources – herbarium- principles and practices; world herbaria; BSI; Indian herbaria; botanic gardens; indexes; journals; monographs; revisions; floras; online resources and databases.

Practical

1. Learning the characters of families mentioned in the theory syllabus from demonstrations in the laboratory using one or more plants from each family, making suitable diagrams, describing them in technical terms and identifying them up to species using any standard flora.
2. Construction of taxonomic keys for the families studied.
3. Each student shall submit a minimum of 15 properly identified herbarium specimens in the standard format along with field notes (cultivars and ornamentals should be avoided)

Study Tour

Students are expected to undertake a study tour of not less than 5 days duration under the guidance of the teachers to identify plants in thee field using diagnostic characters. They are also expected to visit at least one research station/herbarium/botanical garden and should submit a duly certified study tour report along with herbarium sheets and field notes for external evaluation.

REFERENCES

1. Forman, L. & D. Bridson. 1989. The herbarium Hand Book. Royal Botanic Gardens, Kew.

2. Sivarajan, V.V. 1991. Introduction to Principles of Plant Taxonomy. Oxford & IBH, New Delhi.

3. Sporne, K.R. 1974. Morphology of Angiosperms. Hutchinson University Press London.
4. Radford, A.E. 1986. Fundamentals of plant systematics. Harper & Row Publishers, New York.
5. Naik, V.N. Taxonomy of Angiosperms. TATA McGraw Hill, New Delhi.
6. Burkill, I.H. 1965. Chapters on the History of Botany in India, Delhi.
7. Gurucharan Singh, 2001. Plant systematics - Theory and Practice. Oxford & IBH, New Delhi.
8. Davis, P.H. & V.H. Heywood, 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd Ltd., London.
9. Henry, A.N. & Chandrabose An aid to International Code of Botanic Nomenclature.
Jeffrey, C. 1968. An introduction to Plant Taxonomy, London.
10. Simpson, M.G. 2006. Plant Systematics. Elsevier Academic Press, London.
11. Stressy, T.F. 1990. Plant Taxonomy – The systematic evaluation of Comparative data. Columbia University Press, New York.
12. Sharma, B.D. et al. (Eds.) Flora of India vol. I. Botanical Survey of India, Calcutta.
13. Pandey, S.N. & S.P. Misra. 2008. Taxonomy of Angiosperms. Ane Books India, New Delhi.
14. Sharma, O.P. 1996. Plant Taxonomy. TATA McGraw Hill, New Delhi.

COURSE VI. PS5B11 PHYTOGEOGRAPHY, ETHNOBOTANY AND ECONOMIC BOTANY

Total – 117 Hrs. Theory – 72 Hrs. Practicals - 45 Hrs.

Distribution of Hours	Theory	Practical
Phytogeography	12	10
Ethnobotany	24	20
Economic Botany	36	15
Total	72	45

MODULE – I PHYTOGEOGRAPHY

Theory

1. Definition, concept, scope and significance of phytogeography.
2. Centres of origin and distribution of species.
3. Patterns of plant distribution - continuous and discontinuous distribution,distribution, vicarism, migration and extinction.
4. Continental drift - evidences and impact; glaciation; theory of land bridges
5. Endemic distribution, theories on endemism, age and area hypothesis.
6. Phytogeographical zones (phytochoria) of the world and India

Practical

1. Field visit to any National Parks or natural vegetations to study species composition and characteristics.
2. Drawing the phytogeographic zones of the world.
3. Drawing the phytogeographic zones of India.

REFERENCES

1. Ronald Good, 1947. The Geography of Flowering Plants. Longmans, Green and Co, New

York
2. Armen Takhtajan, 1986. Floristic Regions of the World. (translated by T.J. Crovello & A. Cronquist). University of California Press, Berkeley.
3. P. D. Sharma, 2009. Ecology and Environment, Rastogi Publications, Meerut.

MODULE – II ETHNOBOTANY

1. Introduction, scope and significance
2. Major tribes of South India
3. Ethanobotanic significance of the following:

1. Aegle marmalos
2. Ficus religiosa
3. Curcuma longa
4. Cynadon dactylon
5. Ocimum sanctum
6. Trichopus zeylanica

References

Jain. S. K. 1981. Glimpses of Indian Economic Botany. Oxford
Baker. H.g. 1970. Plant and Civilization.
Jain. S. K. 1995. A Manual of Ethnobotany. Scientific Publishers , Jodhpur.
Cotton, C.M. 1996. Ethnobotany – Principles AND Applications. Wiley and Sons.

MODULE – III ECONOMIC BOTANY

Classification of plants based on the economic use of the following plants. Study the binomial, family, morphology of useful part, products and uses of plants mentioned below.

1. Cereals and millets – rice, wheat, maize and ragi.

2. Pulses and legumes – green gram, Bengal gram, black gram, cow pea, winged bean, cluster bean, soya bean, and pigeon pea.

3. Sugar – Sugar cane, beet root.

4. Fruits – apple, pine apple, papaya, banana, mango, guava, jackfruit, grapes, sapota, pomegranate, mangosteen.

5. Vegetables – root – carrot, beet root, tapioca; stem – corm, potato; fruits – cucurbits-bitter gourd, cucumber, snake gourd, ridged gourd; okra; leaves – cabbage, amaranth, moringa, Boerhaavia.

6. Ornamentals – Rose, Anthurium, Jasmine.

7. Masticatories – Betel vine, Betel nut, Tobacco.

8. Beverages – Coffee, Tea, Cocoa.
9. Fibre – Coir, Cotton, Jute.
10. Timber – Teak, Rose wood, Jack, Ailanthus.
11. Fats and oils – Coconut, Sesamum, mustard, Sun flower, Oil palm.
12. Latex – Rubber
13. Gums and Resins – Dammar, Gum Arabic, Asafoetida

14. Spices – Pepper, Ginger, Cardamom, Turmeric, Clove, Mace, Allspice, Cinnamon

15. Medicinal – Adathoda, Boerhaavia, Catheranthus, Eclipta, Phyllanthus, Rauvolfia, Aloe, Aristolochia, Terminalia, Long pepper.

16. Insecticides – Neem, Tobacco, Pyrethrum.

17. Essential oil – Sandal wood oil, Clove oil, Lemon grass, Patchouli oil, Peppermint oil.

18. Perfumery – Camphor, Rose, Lemon grass, Champak, Mimusops elengi, Cananga.

19. Fuel – Jatropha.

Practical

1. Students are expected to identify plants or plant products (raw or processed) studied in theory and to know the binomial, family and morphology of the useful parts of source plants (Submit a report preferably with photos)

2. Students shall submit 10 duly preserved specimens with certified index for practical examination.

3. Diagrams of items mentioned in the Economic Botany syllabus need not be recorded

REFERENCES

1. Varma, V. 2009. Text Book of Economic Botany. Ane Books India, New Delhi.
2. A. V. S. S. Samba Murty and N. S. Subrahmanyam. 1989. A textbook of economic botany. Wiley Eastern Ltd.
3. Maiti, R.K. & Singh, Ved Pal. 2006. An Introduction to Modern Economic Botany. Eastern Book Corporation.

COURSE VII-PS5B13 PLANT PHYSIOLOGY AND BIOCHEMISTRY

Total 108 Hrs., Theory- 72 Hrs., Practical-45 Hrs.

Distribution of Hours	Theory	Practical
Physiology	45	25
Biochemistry	27	20
Total	72	45

PHYSIOLOGY

MODULE 1. BASICS OF PLANT PHYSIOLOGY

1. Plant cell and water; Water and hydrogen bonds. Properties of water. Temperature and physical state. Adsorption and dissipation of heat. Water as a solvent. Cohesion and adhesion. Diffusion, osmosis, osmotic pressure, concept of water potential, components of water potential; imbibition, Water relations of the whole plant. Transpiration. Types and process. Mechanism of guard cell movement. K+ ion mechanism. Why transpiration? Antitranspirants.
2. The ascent of xylem water: Radial movement of water through root.
Transpiration pull and cohesion of water molecules. Merits and demerits of cohesion-tension theory. Soil-plant-atmosphere continuum of water.
3. Plants and inorganic nutrients. Macro and Micro nutrients. Beneficial elements. Specific roles, deficiency and toxicity. Uptake of mineral elements. Difference between passive uptake and active uptake. Simple and facilitated diffusion. Carriers and channels. Aquaporins. Active uptake. Carrier concept. Evidences.

MODULE II. PHOTOSYNTHESIS AND TRANSLOCATION OF PHOTOASSIMILATES

1. Photosynthesis in higher plants.
General concept and equation. Photosynthetic apparatus. Electromagnetic radiation. Photosynthetically active radiation. Absorption of light. Fluorescence and phosphorescence.

Organization of light harvesting antenna pigments. Photochemical and chemical phases of photosynthesis and its evidences. Red drop and Emerson enhancement effect. Two pigment systems, components. Redox potentials of the electron carriers. Photosynthetic electron transport and photophosphorylation. Assimilatory powers- ATP and NADPH.

Photosynthetic carbon reduction cycle (PCR), RUBISCO, C3. C4, and CAM pathways. Ecological significance of C4, and CAM metabolism. Photorespiration. Law of limiting factors.

2. Translocation and distribution of photo assimilates.

Composition of phloem exudates. Source-sink relationship. Mechanism of phloem transport. Brief account of phloem loading and unloading, pressure flow hypothesis. Partitioning of assimilates among sinks.

MODULE III. PLANT GROWTH AND DEVELOPMENT.

1. The hormone concept in plants. Plant growth and development. Auxins, gibberellins, cytokinins, abscisic acid and ethylene, their physiological roles. Photoperiodism and vernalization. (Brief study).
2. Plant movements. Phototropism, gravitropism. Nyctinastic and seismonatic movements.
3. Photomorphogenesis: Phytochrome: chemistry and physiological effects. (Brief study).
4. Seed dormancy and germination. (Brief study).

Practical

Students have to record data by conducting the experiment

1. Determination of water potential by tissue weight change method.
2. Study of stomatal index.
3. Relation between water absorption and transpiration.
4. Extraction of leaf pigments.
5. Separation of leaf pigments by paper chromatography/ column chromatography/TLC.
6. Effects of light intensity on photosynthesis by Wilmot's bubbler.
7. Effect of scarification on seed germination.
8. Photomorphogenesis in seedlings grown under normal light and darkness.
9. Testing of seed viability by 2,3,5-triphenyl tetrazolium chloride test.
10. Demonstration of gravitropism using Klinostat.
11. Determination of the rate of transpiration using Ganong's photometer.

REFERENCES.

1. William G. l-lopkins,(1999). Introduction to Plant Physiology, 2nd edition, John Wiley A Sons, Inc.

2. Lincoln Taiz and Eduardo Zeiger (2002). Plant Physiology 2nd edition. Sinauer Associates, Inc. Publishers. Sunderland, Massachusetts.

3. Frank B. Salisbury and Cleon W. Ross (2002). Plant Physiology 3rd edition. CBS publishers and distributers.

4. G. Ray Noggle and George J. Fritz Introductory Plant Physiology Prentice Hall

5. Goodwin Y.W., and Mercer E.I. (2003). Introduction to Plant Biochemistry. 2nd edition. CBS Publishers and distributors.

MODULE IV. METABOLISM, CATALYSIS AND INTERMEDIARY METABOLISM

1. Enzymes Classification (IUB), Mechanism of enzyme action, optimization of weak interactions in the transition state. Co-enzymes, inhibition, regulation: allosteric enzymes, covalently modulated enzymes. Isoenzymes.

2. Plants and nitrogen metabolism. Biological nitrogen fixation, symbiotic nitrogen fixation in

leguminous plants. Biochemistry of nitrogen fixation. Export of fixed nitrogen from nodules. Ammonia assimilation, assimilation of nitrate. Biosynthesis of amino acids reductive aminatlon and transaminatlon.
3. Catabolism of hexoses. Glycolysis: Two phases of glycolysis. Overall balance sheet. Fate of pyruvate under aerobic and anaerobic conditions. Citric acid cycle: Formation of acetate, reaction of citric acid cycle, anapleurotic reactions of citric acid cycle. Glyoxylate cycle. Amphibolic nature of citric acid cycle.
4. Oxidation of fatty acids. Activation and entry of fatty acids, β oxidation of saturated fatty acids in plants.
5. Biosynthesis of saturated fatty acids in plants. Involvement of fatty acid synthase complex and acyl carrier protein.

7. Oxidative phosphorylation: Electron transport reactions in mitochondrion. Electron carriers, redox potential, electron carriers function as multienzyme complexes, ATP synthesis. Chemiosmotic hypothesis. Shuttle systems.

Practical

1. Demonstration of fermentation.
2. Colorimetric estimation of reducing sugars in germinating seeds.

REFERENCES

1. David I. Nelson and Michael M. Cox (2008). Lehninger Principles of Biochemistry, 5th edition. W. H. Freeman.
2. Geoffrey Zubay. Biochemistry. Macmillan Publishing Company, New York.
3. Trevor Palmer. Enzymes- Biochemistry, Biotechnology and Clinical Chemistry. Norwood Publishing, Chichester.
4. Donald Voet and Judith Voet. (2004). Biochemistry. 3rd edition. Wiley international edition.
5. Goodwin Y.W., and Mercer E.I. (2003). Introduction to Plant Biochemistry. 2nd edition. CBS Publishers and distributors.

BIOCHEMISTRY

MODULE- 1.

1. Biomolecules. Hierarchy of biomolecules: (organelle- supramolecular assemblies-macromolecules-building block biomolecules - metabolic intermediates-precursors).
2. Carbohydrates. Classification; structure and functions of simple sugars and compound carbohydrates.
3. Lipids. Classification. Complex lipids, Simple lipids. Storage and structural lipids, Fatty acids saturated and unsaturated, triacyl glycerols, phospholipids, sphingolipids. Lipids in membranes, the supramolecular architecture of membranes.
4. Amino acids, peptides and proteins. Amino acids: classification based on polarity; properties, zwitterions, acid base properties. Proteins: Classification based on function and physical and chemical properties. Covalent structure of proteins. Three dimensional structures of proteins. Primary, secondary, tertiary and quaternary structures of proteins. Native conformation and biological functions of proteins. Weak interactions. Denaturation and renaturation.
5. Nucleotides structure of nucleotides. Purine and pyrimidine derivative in nucleotides. Functions of nucleotides and nucleotide derivatives.
6. A brief survey of secondary metabolites and their physiological roles and significance (plant-plant interaction, plant-pathogen interaction, as defence compounds and as phytoalexins).

Practical

1. Qualitative tests for monosaccharides, and reducing non reducing oligosaccharides, starch, amino acids and protein.

a. Molisch's test for all carbohydrates
b. Benedict's test for reducing sugars
c. Barfoed's test for monosaccharides
d. Seliwanoff's test for ketoses
e. Fearson's test (methyl amine test) for reducing disaccharides
f. Iodine test for starch
g. Ninhydrin test for amino acids and protein
h. Xanthoproteic test for amino acids with aromatic R-groups

2. Quantitative estimation of protein by Biuret method.
3. Quantitative estimation of DNA and RNA by colorimetric / spectrophotometric method.

REFERENCES:

1. D. L. Nelson and M. M. Cox (2008). Lehninger Principles of Biochemistry. 5th edition. W. H. Freeman.
2. Geoffrey Zubay. Biochemistry. MacMillan Publishing Company, New York
3. David T. Plummer, An Introduction to Practical Biochemistry. Tata Mc Grow Hill.
4. Sadasivam and Manickam, Biochemical methods. New Age International Publishers. New Delhi.
5. Secondary plant products, vol.8. Encyclopaedia of Plant Physiology, 1980, Springer – Verlag, Berlin.
6. Goodwin Y.W., and Mercer E.I. (2003) Introduction to Plant Biochemistry. 2nd edition. CBS Publishers and distributors.
7. Donald Voet and Judith Voet. (2004). Biochemistry. 3rd edition. Wiley international edition.
8. Keith Wilson and John Walker.(2008). Principles and techniques of Biochemistry and
9. Molecular Biology. 6th edition. Cambridge University Press.

SEMESTER VI

CORE COURSE VIII PS6B16 CELL BIOLOGY, MOLECULAR BIOLOGY AND BIOINFORMATICS

Total – 117 Hrs. Theory – 72 Hrs., Practicals- 45 Hrs.

Distribution of Hours		Theory	Practicals
1.	Cell Biology	25	15
2.	Molecular Biology	30	15
3.	Bioinformatics	17	15
	Total	72	45

MODULE–I CELL BIOLOGY

1. Architecture of cells. Prokaryotic and Eukaryotic cells.
2. Structure and function of the following: cell membrane (fluid mosaic model), endoplasmic reticulum, Golgi complex, mitochondria, chloroplast, lysosomes, peroxisomes, glyoxisomes, ribosomes, cytoskeleton, cytosol, and vacuole.
3. Nucleus: nuclear membrane, nucleoplasm, nuclear pore complex, organisation of interphase nucleus, euchromatin and heterochromatin, nucleolus.

4. Chromosomes: morphology, centromere, telomere and its significance, chemical composition, ultrastructure (nucleosome model), chromosome banding C-banding, G-banding, N-banding, R-banding, Q-banding; special types of chromosomes - Polytene chromosomes, lampbrush chromosomes
5. Cell division: mitosis and meiosis, significance, molecular control of cell division; cell cycle and its regulation.
6. Chromosomal aberrations: structural changes like deletion, duplication, inversion, translocation - their meiotic consequences and significance.
7. Numerical aberration: definition, basic chromosome number (genomic number) aneuploidy, haploidy and polyploidy - their meiotic behaviour and significance.

Practical

1. Mitosis - acetocarmine squash preparation of onion root tip.
2. Calculation of mitotic index
3.Demonstration of meiosis in Rhoeo/Chlorophytum/Maize and identification of different stages of meiosis.

REFERENCES

1. Arumugham N. Cell Biology. Sara Publication, Nagercoil.
2. A. Upadhyaya & K. Upadhyaya 2005. Basic Molecular Biology, Himalaya Publishers.
3. De Robertis E.D.P., & De Robertis E.M.S. 1998 Cell and Molecular Biology, Lea & Febiger.
4. Geoffery M. Cooper & Robert E. Haufman. 2007. The cell - a molecular approach, A.S.S. Press Washington, U.S.A.
5. Lewis J. Kleinsmith & Valerie M. Kish 1995. Principles of Cell & Molecular Biology.
6. Lewin B. 2007. Genes IX, Jones & Bartlett Publishers.
7. Lodish H. et. al., 2000. Molecular Cell Biology, Freeman & Company.
8. Powar C.B. 1988. Essentials of Cytology, Himalaya Publishing House.
9. Rastogi S.G. Cell Biology, Tata McGraw Hill Publishing Company, New Delhi
10. Rastogi V.B. 2008. Fundamentals of Molecular Biology, Ane Books India.

Module – II. MOLECULAR BIOLOGY

1. Nucleic acids - DNA - The genetic material, discovery of bacterial transformation (Griffith's & Avery's experiments), Hershey and Chase experiment.

DNA - structure, Watson & Crick's Model, Types of DNA-(A,B,Z)

-Replication - Semi conservative replication – Meselson and Stahl's experiment -Molecular mechanism of Replication; RNA - structure, types and properties.

2. Genetic code - Characters of genetic code
3. Central dogma of molecular biology, protein synthesis, transcription, post-transcriptional modification of RNA, translation; Teminism.
4. Gene regulation in prokaryotes - operon concept Lac operon, trp. operon). Gene regulation in eukaryotes (brief account)
5. One gene-one enzyme hypothesis, one cistron-one polypeptide hypothesis, modern concept of gene- cistrons, recons and mutons
6. Genome sequencing - brief account, Human Genome Project - brief account.

REFERENCES

1. Gunther, S. Spend & Richard Calender. 1986. Molecular Genetics. CBS Publishers, Delhi.
2. Gupta, P.K. Text Book of Genetics. Rastogi Publications, Meerut.
3. John Ringo 2004. Fundamental Genetics. Cambridge University Press.

4. Lewin B. 2000. Genes VII. Oxford University Press.
5. RastogiV.B. 2008. Fundamentals of Molecular Biology, Ane Books, India.
6. Sinnot, W.L.C. Dunn & J. Dobzhansky. 1996. Principles of Genetics. Tata McGraw Hill Publishing Company Ltd., New Delhi.
7. Taylor, D.J., Green, N.P.O. and Stout, G.W. Biological Science 3rd edn. Cambridge University Press.
8. Verma, P.S. & Agarwal 1999. Text book of Genetics. S. Chand & Co., New Delhi.

MODULE – III: BIOINFORMATICS

1. Introduction to bioinformatics, importance of bioinformatics, biological databases, sequences - proteins, nucleic acids and peptides; structures - proteins, nucleic acids, ligands (including metabolites and drugs) and peptides.
2. DNA sequence data bases (GenBank, DDBJ, EMBL); Genome databases (FlyBase).
3. Protein sequence databases (PIR, SWISS-PROT, TrEMBL); protein structure databases (ModBase, PRESAGE); protein structure prediction.
4. Sequence alignment and database searches: tools for sequence alignment and comparison - multiple sequence alignment tools (CLUSTALW), tools for similarity/homology search (BLAST);
5. Genome annotation - computational search for protein-coding genes, RNA genes and other functional sequences within a genome.
6. DNA sequencing and computational evolutionary biology (phylogenetic analysis); Computer tools for phylogenetic analysis (PAUP*, PHYLIP etc).

Practicals:

1. Visit to nucleic acid and protein databases in the internet.
2. BLAST search of DNA sequences using Entrez browser of NCBI.

REFERENCES

1. V.Rajaraman, Introduction to Information Technology, Prentice Hall
2. Alexis Leon & Mathews Leon, Computers Today, Leon Vikas, Rs. 180
3. Greg Perry, SAMS Teach Yourself Open Office.org, SAMS,
4. Alexis & Mathews Leon, Fundamental of Information Technology, Leon Vikas
5. George Beekam, Eugene Rathswohl, Computer Confluence, Pearson Education,
6. Barbara Wilson, Information Technology: The Basis, Thomson Learning
7. John Ray, 10 Minute Guide to Linux, PHI, ISBN 81-203-1549-9
8. Ramesh Bangia, Learning Computer Fundamentals, Khanna Book Publishers
9. Baxevanis AD & Ouellette BFF (2001) Bioinformatics - A practical guide to the analysis of genes and proteins, Wiley Interscience , New York.
10. Dov Stekel (2005) Microrray Bioinformatics; Cambridge university press.
11. Attwood DJ and Arry Smith Introduction to Bioinformatics; Pearson education.
12. Sundararajan S & Balaji R Introduction to Bioinformatics; Himalaya publishing House.
13. D. W. Mount (2004). Bioinformatics – sequence and Genome analysis; CBS Publishers and Distributers.
14. Ignacimuthu S. (2005). Basic Bioinformatics; Narosa Publishing House.
15. Lesk AM (2005) Introduction to Bioinformatics: Oxford University Press.
16. Gautham N (2006). Bioinformatics databases and algorithms; Narosa Publication house.
17. Rastogi SC, Mendiratta N and Rastogi P (2003) Bioinformatics, Concepts, Skill and Application; CBS publishers and distributes.

CORE COURSE IX PS6B18 GENETICS, EVOLUTION AND ECOLOGY

Total – 117Hrs. Theory – 72 Hrs., Practicals- 45 Hrs.

Distribution of Hours	Theory	Practical
Genetics	35	25
Evolution	12	--
Ecology	25	20
Total	72	45

MODULE- I. GENETICS

1. Mendel's experiments - symbols terminology. Mendelian laws, monohybrid dihybrid, test cross and backcross.
2. Modification of Mendelian ratios. Incomplete dominance – Mirabilis (1 : 2: 1, 1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1, 3 : 6 : 3 : 1 : 2 : 1 Co-dominance - Blood groups in man Lethal genes - coat colour in mice.
3. Non-allelic interaction (genic) Epistasis – a) Dominant - Fruit colour in summer squashes b) Recessive epistasis - Coat colour in mouse; Complementary genes - Flower colour in sweet pea; Non-epistasis - Comb pattern in Fowls.
4. Multiple alleles - self sterility in Nicotiana. Multiple Inheritance – ear size in corn.
5. Linkage and crossing over - chromosome theory of linkage, crossing over, types of crossing over, mechanism of crossing over (Holliday model) Linkage map, 2 point and 3 point crosses, interference and coincidence.
6. Sex-linked inheritance: X-linked, Y-linked, Morgan's experiment eg. eye colour in Drosophila, sex limited and sex influenced inheritance, pedigree analysis.
7. Extra-nuclear inheritance - Plastid inheritance in Mirabilis, Coiling pattern in snails.
8. Mutation - types - mutagens - physical, chemical and molecular mechanisms of gene mutation.
9. Population genetics, Hardy-Weinberg law, factors affecting genetic equilibrium, selection, migration, meiotic drive, genetic drift.

Practical

Solving problems in dihybrid inheritance, modified ratios, and in chromosome mapping - 2 point and 3 point crosses.

Module II. EVOLUTION

1. Origin of Earth – Introduction. Evidences of organic evolution – evidences from morphology, Anatomy, Embryology, Palynology, genetics and molecular biology.
2. Origin of Life: Origin of basic biological molecules – Condensation and Polymerisation. Protenoids and Prions – Oparin concept, Miller's experiment, Evolution of prokaryotic and eukaryotic cells. Archaebacteria – Early fossilized cells. Anaerobic metabolism, Photosynthesis and Aerobic metabolism.
3. Theories on origin and evolution of species; Spontaneous generation – Lamarckism – Darwinism, Weismann and deVries. Neo-Darwinism and its objection. The arguments and support for Darwinism.
4. Genetic Constancy and Creation of Variability; Cell divisions and genetic constancy – Genetic variability by multiple allelism and recombination – Chromosomal variations – Gene mutations – Mutation rates and change in gene frequencies of population. Application of Hardy Weinberg's Principle Mutation and Selection – Random genetic drift – Genetic Polymorphism.
5. Biomolecules – Evolutionary classification based on amino acid sequences, Quantittive DNA measurements, Repetitive DNA sequences, DNA – DNA hybridization (brief),

restriction enzyme sites and nucleotide sequences – Evolutionary clocks.
6. Speciation: Isolating mechanism – Modes of speciation – sympatric and allopatric.

REFERENCES

1. Crick F., 1981. Life itself: Its origin and Nature. Simon and Schuster, New York.
2. Drake J.W., 1970. The molecular basis of mutation. Holden Day, San Francisco.
3. Dott R.H., R.L. Batten, 1981. Evolution of the earth 3rd edn. McGraw Hill New York.
4. Fox S.W. and K. Dose, 1972. Molecular evolution and the origin of life. W.H. Freeman & Co., San Francisco.
5. Gould S.J. 1977. Ontogeny and Phylogeny. Harvard Univ. Press, Cambridge, Mass.
6. Jardine N., D. McKenzie, 1972. Continental drift and the dispersal and evolution of organisms. Nature, 234. 20-24.
7. Miller, S.L. 1953. A production of amino acids under possible primitive earth conditions. Science, 117., 528-529.
8. Strickberger, 1990. Evolution, Jones and Bastlett Publishers International, England.

MODULE III. ECOLOGY

1. Ecology: definition, scope and objectives, significance.
2. Ecosystem: definition, abiotic and biotic factors, trophic structure, food chain and food web, ecological pyramids, energy flow, productivity of ecosystems, biogeochemical cycles (carbon, nitrogen, phosphorous).
3. Plant adaptations: adaptations of the following plant groups – hydrophytes, xerophytes, halophytes, epiphytes, parasites.
4. Plant succession: definition, primary and secondary succession, autogenic and allogenic succession, mechanism of plant succession, xerosere, hydrosere.
5. Biodiversity and Conservation: definition – levels of biodiversity – values of biodiversity — Biodiversity in global and Indian scenario – mega diversity nations and hotspots – Biosphere reserves – threats to biodiversity; endangered and endemic plant species – Red data book - Exotic and indigenous plant species – Keystone species – Flagship species – Conservation strategies - ex situ and in situ methods. Organizations – IUCN, UNEP & WWF

– Biodiversity centres in India (NBPGR) Biodiversity Board of Kerala (KSBDB).

6. Natural Resources: Types – Renewable and non-renewable resources – Over explored and under explored resources. Petro crops – Sustainable management of resources (brief account).

7. Pollution:–Sources and types of pollution – air, water, soil, thermal and noise – biodegradable and non-biodegradable pollutants – biomagnifications – BOD – Heavy metal contamination – Bhopal gas tragedy – Chernobyl disaster – Global environmental changes – climatic changes – global warming and greenhouse gases – acid rains – El Niño – Efforts of world organizations in the regulation of green house gases emission – Earth summit – Kyoto Protocol – World Summit on sustainable development, 2002 (WSSD), Carbon trade. Management of environmental pollution – conventional and phytotechnological approaches – solid wastes management including e-wastes-environmental legislations in India (Prevention and Control of Pollution act, 1981).

8. Autecology: Population growth – exponential and logistic – population density – Natality – Mortality - Age distribution – Ecological amplitude – Ecological indicators – Role of indicators in environmental monitoring.

9. Synecology: Ecological community – Co-evolution of populations – Association of flowering plants and honeybees – Population interactions – Symbiosis, mutualism, commensalism, predation, parasitism, herbivory – concept of species diversity - α, β, r – sampling techniques in plant community studies Quadrat and transect methods – species area curve – density, frequency, abundance, dominance of populations – importance value index – construction of phytographs.

Practical

1. Construction of a schematic food web from the given set of data (representative of a natural ecosystem).

2. Construction of schematic ecological pyramids of number, biomass, energy from the given set of data (representative of a natural ecosystem).
3. Determination of pH of soil solution by using pH meter.
4. Determination of biomass of any plant species in your locality.
5. Study of plant communities – Determination of density, abundance, dominance, frequency by quadrate method.

6. Determination of dissolved oxygen by Winkler's method.
7. Study of morphological and anatomical characteristics of plant groups – Hydrophytes, Xerophytes, halophytes, epiphytes, parasites.

REFERENCES

1. Ahluvalia V.K. Malhotra S. 2009. Environmental Science. Ane Books – New Delhi.
2. Ambasht R.S. 1988. A text book of Plant Ecology. Students Friends Co.Varanasi.
3. Beeby A. & Brennan A.M. First Ecology. Ecological Principles and Environmental Issues. International Student Edition.
4. Benon E. Plant Conservation Biotechnology. Taylor & Francis Ltd. II New Felter Lane, London. EC4P4EE.
5. Cunninghan W.P. and M.A. Cunningham 2003. Principles of Environmental Science: Inquiry and Applications. Tata McGraw Hill Pub. N.D.
6. Dash M.C. 1993. Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd.
7. Dix J.H. 1989. Environmental Pollution. Atmosphere, Land, Water and Noise. Wiley Chichester.
8. Khitoliya R.K. 2007. Environmental Pollution – Management and Control for Sustainable development S. Chand and Company Ltd., New Delhi.
9. Kumar H.D. 1977. Modern Concepts of Ecology. Vikas Publications. New Delhi.
10. Michael S. 1996. Ecology. Oxford University Press, London.
11. Mishra D.D 2008. Fundamental Concepts in Environmental Studies. S. Chand & Co.,
12. Mishra S.P. & S.N. Pandey 2008. Essential Environmental Studies. Ane Books Pvt. Ltd.Thiruvananthapuram.
13. Odum E.P. 1983. Basics of Ecology. Saunders International UN Edition.
14. Shukla R.S. & P.S. Chandel 2005. A Text Book of Plant Ecology S. Chand & Co. Ltd.
15. Wise D.L. 2005. Global Environmental Biotechnology. Ane Books. Trivandrum.
16. Bharucha E. 2005. Text Book of Environmental Studies for UG courses. University Press
(India) Private Limited Hyderabad.
17. Archibold. O.W. 1995. Ecology of World Vegetation. Chapman & Hall, London.
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21. Sharma, P.D. 2008-2009. Ecology and Environment. Rastogi Publication.

CORE COURSE X PS6B20 HORTICULTURE & PLANT BREEDING

(Theory 72 hours Practical

45 hrs)

Distribution of Hours:	Theory	Practical
Horticulture	42	30
Plant breeding	30	15
Total	72	45

MODULE – I. FUNDAMENTALS OF HORTICULTURE

1. Introduction: scope and significance, branches of horticulture.
2. Soil: components of soil, types of soil, soil analysis, soil testing,
3. Fertilizers: chemical, organic, biofertilizer, composting systems: non-container, container; vermi-composting.
4. Pots & potting: earthen, fibre, polythene bags, potting mixture, potting, repotting, top dressing.
5. Irrigation: surface-, sprinkle-, drip- and gravity irrigation.

MODULE – II. PLANT PROPAGATION METHODS

1. Seed propagation: seed dormancy, seed viability and longevity, seed quality tests, seed treatment, essential condition for successful propagation, raising of seed beds, transplanting techniques.
2. Vegetative propagation:
(a) Cutting (stem, roots, leaves)
(b) Grafting (approach, side tongue)
(c) Budding (T-budding, patch)
3. Layering (simple trench, air). Micro propagation: general account, multiple shooting, somatic embryogenesis, advantages.

MODULE – III PRINCIPLES AND PRACTICE OF GARDENING

1. Gardening: definition; site selection, propagating structure: green house, poly house, mist chamber, net frame – garden tools and implements.

Indoor gardening: principles, selection of indoor plants, care and maintenance of indoor plants; bonsai: principle, creating the bonsai.

Outdoor gardening: landscaping:- goals, types.

Cultivation and post harvest management of ornamental plants: Rose, Jasmine, Orchids and Anthurium.

Cultivation and post harvest management of vegetables: okra, bitter gourd, chilli, brinjal, pea. 2.Protection of Horticultural plants: Principles, Precautions to avoid pests and diseases. Methods of pest control: Cultural, Biological, Chemical, Mechanical, Physical and Legislative. Major pests of horticulture plants, Pest management, Diseases and disease management, Pesticides – types and preparation.

3. Mushroom cultivation – Oyster mushroom

Practical

1. Preparation of nursery bed and polybag filling.
2. Preparation of potting mixture – Potting, repotting.
3. Field work in cutting, grafting, budding, layering.

4. Identification of pest and diseases in campus.
5. Preparation and application of neem kernel suspension, tobacco decoction and Bordeaux mixture.
6. Familiarizing gardening tools and implements.
7. Training in topiary and pruning.
8. Preparation of vermi-compost.
9. Cultivation of mushroom.
10. Establishment of vegetable garden.
11. Visit to nurseries and tissue culture laboratories and preparation of notes.
12. Basic training in Vegetable carving and flower arrangement
13. Basic training in fruit preservation

REFERENCES

1. Nishi Sinha: Gardening in India, Abhinav Publications, New Delhi.
2. Andiance and Brison. 1971. Propagation Horticultural Plants.
3. Rekha Sarin. The Art of Flower Arrangement, UBS Publishers, New Delhi.
4. Katyal, S.C., Vegetable growing in India, Oxford, New York.
5. Naik, K.C., South Indian Fruits and their Culture.
6. Chanda, K.L. and Choudhury, B. Ornamental Horticulture in India.
7. Premchand, Agriculture and Forest Pest and their Management,Oxford Publication.
8. George Acquaah, Horticulture: Principles and Practices. Pearson Education, Delhi.
9. Prasad, S., and U. Kumar. Green house Management for Horticultural Crops, Agrobios, Jodhpur.
10. Kumar, U.: Methods in Plant Tissue Culture. Agrobios (India), Jodhpur.
11. Kolay, A.K. Basic Concepts of Soil Science. New Age International Publishers, Delhi.
12. Bal, J.S., Fruit growing, Kalyani Publishers, Delhi.
13. Rodgran, M.K. Plant Tissue Culture, Oxford & IBH Publishing Ltd.,New Delhi.
14. S. Nesamony, Oushadha Sasyangal (Medicinal plants), State Institute of Language, Kerala, Trivandrum.
15. R. Prakash, K. Raj Mohan, Jaivakrishi (Organic farming), State Institute of Languages, Trivandrum.
16. Hudson, T. Hartmann, Dale K. Kester, Fred T. Davies, Robert L. Geneve, Plant Propagation, Principles and Practices.

MODULE IV. PLANT BREEDING

1. Definition and objectives of plant breeding - important national and international plant breeding institutes
2. Plant genetic resources – components of plant genetic resources, significance
3. Breeding techniques- a) plant introduction; b) selection- mass selection, pure line selection and clonal selection; c) hybridization techniques, hybrid vigour, inbreeding depression; d) mutation breeding; e) polyploidy breeding; f)Breeding for disease resistance
4. Breeding techniques and achievements with reference to the following crops in India: rice, coconut.

Practical

Techniques of emasculation and hybridization of any bisexual flower.

REFERENCES

1. Allard. R.W. 1960. Principles of Plant breeding, John Wiley & Sons, Inc, New York.

2. Chaudhari. H.K. Elementary Principles of Plant breeding, Oxford & IBH Publishers.
3. Singh, B.D. 2005. Plant Breeding - Principles & methods, Kalyani Publishers, New Delhi.
4. Sinha U. & Sunitha Sinha 2000 - Cytogenetics, Plant breeding & Evolution, Vikas Publishing House.
5. Swaminathan, Gupta & Sinha - Cytogenetics of Crop plants

ELECTIVE PS6B22(E1) BIOTECHNOLOGY (Total 72hrs.)

Distribution of Hours	Theory	Practical
Biotechnology	72	45
Total	72	45

MODULE- I. TISSUE CULTURE

Introduction to biotechnology – history, definition, scope, significance.

Plant tissue culture – history, principle – totipotency, differentiation, dedifferentiation, redifferentiation. Facilities of tissue culture laboratory.

Media – MS medium composition and preparation, sterilization techniques; explant selection, sterilization and inoculation.

Types of culture – meristem culture, organ culture; callus culture; cell suspension culture; protoplast culture.

Isolation of protoplasts, somatic hybridization and its significance;

Somatic embryogenesis and synthetic seeds.

Haploid production – anther and pollen culture, its significance;

Embryo culture and embryo rescue.

Micropropagation – multiple shoot culture and large scale propagation of crop plants, Somaclonal variation – disease free plants.

Production of secondary metabolites in bioreactors.

MODULE – II. RECOMBINANT DNA TECHNOLOGY a) Tools

Enzymes: exonucleases; endonucleases; restriction endonucleases; ligases; reverse transcriptase, terminal transferase, polymerase, alkaline phosphatase.

Vectors- general account of plasmids, cosmids, bacteriophages, Plasmids –

Advantages and disadvantages; Structure of pBR 322; Artificial chromosome vectors – BAC, YAC, shuttle vectors

b) Prokaryotic expression of foreign genes

Isolation of gene of interest – artificial gene synthesis; cDNA library - cDNA synthesis, genomic DNA library- identification and isolation of the gene from cDNA, Genomic DNA or Libraries using probes, PCR, RACE.

c) Gene transfer methods in plants

Direct methods of gene transfer – biolistics, lipofection, electroporation,

microinjection – advantages and disadvantages

Vector mediated gene transfer-Agrobacterium-mediated gene transfer – T DNA,

Ti plasmid and Ri plasmid derived vector systems

Process of transfer - bacterial colonization, Induction of virulence, generation of

TDNA transfer complex, T-DNA transfer, integration of TDNA into plant genome

MODULE III. TECHNIQUES AND APPLICATIONS OF BIOTECHNOLOGY

TECHNIQUES:

a. Polymerase chain reaction – Principle, types of primers, Taq polymerase, application and problems, Reverse Transcriptase PCR.

b. DNA sequencing – Maxam-Gilbert's method, Sanger's method, Automated DNA sequencing
c. Molecular Analysis of gene and gene products – Southern, Northern and Western blotting, ELISA.
d. Molecular markers – RAPD, RFLP, AFLP, Brief account of DNA Finger printing and Bar coding of plants
e. Brief account of: Antisense RNA technology – FLAVR SAVR Tomato; Gene Silencing; RNA interference; miRNA.
APPLICATIONS:

a. Medical Biotechnology: disease diagnosis – infectious diseases and genetic diseases; therapeutics.
b. Agricultural Biotechnology: applications of plant tissue culture, production of transgenic plants - Bt cotton, Golden rice; bio-safety concern
c. Environmental Biotechnology: biodiversity and conservation; waste management and bioremediation
d. Industrial Biotechnology - pharmaceuticals, hormones.
e. Food biotechnology – SCP, improved food and food products.

Practical
1. Preparation of plant tissue culture medium.
2. Demonstration of the technique of organ culture.
3. DNA isolation.
4. Demonstration of preparation of synthetic seeds.
5. Visit to a leading biotechnology institute and submission of report.

REFERENCES
1. Brown TA (2006). Gene cloning and DNA analysis; Blackwell scientific publishers.
2. Sobti RC & Pachauri SS (2009). Essentials of Biotechnology; Ane Books, New Delhi.
3. Dubey RC Introduction to Plant Biotechnology; S Chand & Co.
4. Purohit SS (2003). Agricultural Biotechnology, Agrobios (India).
5. Chawla HS (2000). Introduction to Plant Biotechnology.
6. Ignacimuthu S (1997). Plant Biotechnology, New Hampshire Science Publishers.
7. Razdan MK (1995). Introduction to Plant Tissue Culture. Oxford & IBH publishing Co. Pvt. Ltd.
8. Gupta PK (1996). Elements of Biotechnology; Rastogi and Company, Meerut
9. Primrose SB, Twyman RM & Old RW (2001). Principles of gene manipulation : An 10. Introduction to genetic engineering. 6th Edn. Blackwell Oxford
11. Smith JE (2005). Biotechnology; Cambridge University press, UK
12. Wilson K & Walker J (2008). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press
13. Ignacimuthu S (2008). Biotechnology: An introduction, Alpha science International Ltd.

ELECTIVE COURSE PS6B22(E2) MEDICINAL PLANTS

Total Hours 72

MODULE I

Medicinal plants and traditional medicines: history, major systems of traditional medicines with particular emphasis to Ayurvedic medicines, botanical drugs used in traditional medicines which led to useful modern drugs: Adhatoda vasika, Catharanthus roseus, Gingko

biloba, Rauvolfia serpentina, Taxus buccata, Digitalis lanata. Protocol for medicinal plant drug discovery process and development.

MODULE II

A detailed study of the importance and conservation of medicinal plants – In situ, ex situ, sacred groves. Role of ICAR, IMPB, BSI, NBPGR and FRLHT in conservation and cultivation of medicinal plants. IPR issues.

MODULE III

Pharmacognosy – definition and scope – Significance of Pharmacognosy in various systems of medicines (sidha, ayurveda, unani and homeopathy); Factors influencing variability in drug activity, type of soils, fertilizers, plant hormones and their applications, polyploidy, mutation and hybridization in medicinal plants. Classification of vegetable drugs, identification of drugs (taxonomical, anatomical, and chemical). Phytoconstituents of medicinal importance: polysaccharides, mono-, di- and triterpenes, steroids, saponins, glycosides, flavonoids, phenolic compounds, tannins, carotenoides, alkaloids, iridoides and amino acids.

MODULE IV

A detailed study of the methodology of cultivation of medicinal plants. Rhizome – Curcuma, Ginger; Tuber- Allium cepa; Root – Asparagus, Hemidesmus, Acorus calamus; Twigs- Adhatoda vasica, Catharanthus roseus, Phyllanthus amarus, Andrographis paniculata; Leaves – Aloe vera, Centella asiatica. Factors influencing cultivation of medicinal plants: type of soils & fertilizers of common use - pest management & natural pest control agents - plant hormones and their applications - polyploidy, mutation & hybridization with reference to medicinal plants.

MODULE V

A detailed study of sources of vegetable drugs. Production of vegetable drugs. Deterioration of drugs and their control measures. Adulteration of drugs, common adulterants and their detection. WHO guidelines for standardisation of medicinal plants. Factors involved in the preparation of herbal drugs for market from cultivated and wild sources including collection, drying, storage and transport methods.

REFERENCES

1. Jain S K 1990. Contribution Indian ethnobotany. Scientific publishers Jodhpur
2. Jain S K.1996. Ethnobotany in human welfare. Deep publishers. New Delhi
3. Jyothiprakash E J. 2006. Medicinal botany and pharmacognosy. Emkay Publishers New Delhi.
4. Maheshwary J K2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific publishers
5.Singh G K and Anil Bhandari 2000. Textbook of Pharmacognosy. CBS publishers N.Delhi.
6. Verma V 2009. Text book of Economic Botany. Ane Books.
7. Ashwini Dutt 2008. An Introduction to Medicinal Plants. Adhyayan Publishers.
8. Anil K Dhiman.2003. Sacred Plants and their medicinal uses. Daya publishing house New Delhi.
9. Jain S K 1981. Glimpses of Indian ethnobotany. Oxford and IBH New Delhi.
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11. R.S. Thakur, H.S. Puri and Akhtar Husain, 1989. Major Medicinal Plants of India. Vedams Books, New Delhi.

12. Trivedi, P.C. 2010. Drugs from Plants. Aavishkar Publishers.
13. Trivedi, P.C. 2010. Ethnic Tribes and Medicinal Plants. Pointer Publishers.
14. Ansary, P.Y. 2005. A Hand Book on the Plant Sources of Indigenous Drugs. International Book Distributors.
15. K Janardhan Reddy; Bir Bahadur; B Bhadraiah and M L N Rao, 2007. Advances in Medicinal Plants. Universities Press.

ELECTIVE COURSE PS6B22(E3) FORESTRY

Total 72 hrs.

MODULE I

A detailed study of different types of forests: natural and man-made; tropical, temperate, evergreen semi-evergreen, deciduous; monoculture, multipurpose, social and industrial. Forests and gene conservation.

MODULE II

Silviculture: concept and scope of study of natural and artificial regeneration of forests. Clear felling, uniform shelter, wood selection, coppice and conservation systems. Silviculture of some of the economically important species in India such as Azadirachta indica, Tectona grandis, Eucalyptus, Mahogany, Dalbergia sissoo, Santalum album, jackfruit tree, Rubber.

MODULE III

A detailed study of different types of wood: homogenous and heterogeneous- spring and autumn wood- porous and non-porous wood- heart- and sap wood. Anatomical structure of wood, defects and abnormalities of wood, relevance of wood anatomical studies in Kerala.

Identification of wood- preparation of key and their uses.

MODULE IV

Agroforestry - scope and necessity; role in the life of people and domestic animals and in integrated land use, planning especially related to (i) soil and water conservation; (ii) water recharge; (iii) nutrient availability to crops; (iv) nature and eco-system preservation including ecological balances through pest-predator relationships and (v) providing opportunities for enhancing bio-diversity, medicinal and other flora and fauna. Agro forestry systems under different agro-ecological zones; selection of species and role of multipurpose trees and NTFPs, techniques, food, fodder and fuel security. Research and Extension needs. Social/Urban Forestry : objectives, scope and necessity; peoples participation. JFM - principles, objectives, methodology, scope, benefits and role of NGOs. Tribal participation in forestry programmes.

MODULE V

Seed orchards, seed dormancy- types of dormancy, physical and chemical methods to overcome seed dormancy. Forest laws - necessity, general principles, Indian forest act 1927 and its amendment.

MODULE VI

A detailed study of forest resources and their utilization. Forest products- timber, pulp wood, secondary timbers, non-timber forest products (NTFPs). Definition and scope (brief outline) -

gums, resins, fibers, oil seeds, nuts, rubber, canes and bamboos, medicinal plants, charcoal. and lac collection and marketing.

MODULE VII

Forest Protection: Injuries to forest - abiotic and biotic, destructive agencies, insect-pests and disease, effects of air pollution on forests and forest die back. Susceptibility of forests to damage, nature of damage, cause, prevention, protective measures and benefits due to chemical and biological control. General forest protection against fire, equipment and methods, controlled use of fire, economic and environmental costs; timber salvage operations after natural disasters. Role of afforestation and forest regeneration in absorption of CO2. Rotational and controlled grazing, different methods of control against grazing and browsing animals; effect of wild animals on forest regeneration, human impacts; encroachment, poaching, grazing, live fencing, theft, shifting cultivation and control.

REFERENCES

1. Anil Kumar Dhiman. 2003. Sacred plants and their medicinal uses. Daya publishing house, New Delhi.
2. Anonymous, A Hand book of Kerala Timbers- KFRI, Trichur.
3. Chundawat B.S. and S.K.Gautham. 1996. Text book of Agroforestry. Oxford and IBH Publishing house, New Delhi.
4. Kollmann and Cote 1988. Wood science and Technology. Vol.I & II Springer verlag.
5. Sagreiya, K.P. 1994. Forests and Forestry (Revised by S.S. Negi). National book trust. New Delhi.
6. Sharma P.D. 2004. Ecology and Environment. Rastogi publications, Meerut
7. Singh M.P. and Vinita Vishwakarma. 1997. Forest environment and Biodiversity. Daya publishing house, New Delhi.
8. Tiwari K.M. 1983. Social forestry in India.
9. Tribhuwan Mehta, 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.
10. N. L. Bor. 2010. A Manual of Indian Forest Botany. Asiatic Publishers.
11. Benu Singh. 2010. A Modern Book on Forestry and Horticulture. Vista International Publishers.
12. Singh, S. 2006. Encyclopaedia of Forestry. Eastern Book Corporation.
13. H. G.Champion & S.K.Seth. 2005. A Revised Survey of the Forest Types of India. Jain Book Agency.
14. A. K. Ghosh. 2006. Academic Dictionary of Forestry. Jain Book Agency.
15. K. C. Bebarta. 2004. Forest Resources and Sustainable Development - Principles, Perspectives and Practices. Jain Book Agency.

Syllabi of Open Courses offered to students from other departments/streams

SEMESTER - V

OPEN COURSE: PS5D01 MUSHROOM CULTIVATION

Total 54 hrs.

Module – I

Mushrooms: introduction, biodiversity, edible and poisonous species, systematic position, distribution and morphology. The role of mushrooms in nature: saprobes, parasites, mycorrhiza formers. Structure and life cycle of Agaricus, Pleurotus, Calocybe, Volvariella, Lentinus and Ganoderma.

Module – 2

Value of mushrooms – nutritional, medicinal, economic and environmental.

Module – 3

Raw materials for mushroom cultivation: logs, wood chips, paper products, cereal straws, grain hulls, sugar cane bagasse, banana fronds and other agro-wastes. Supplements added to substrate to enhance yields: corn meal, rice bran, oatmeal and bran, wheat grain and bran. Biological efficiency of mushroom production.

Module –4

Spawn; commercial and home-made; methods of spawn production: preparation of agar media (PDA, MEA); culturing mycelium on agar medium, preserving stock cultures; producing grain spawn: formulas for producing grain spawn; containers for spawn preparation; steps in generating first generation grain spawn masters; steps in generating second and third generation grain spawn. Spawn storage.

Module –5

Protocol for cultivating mushrooms on agricultural wastes: heat-treating the bulk substrate, submerged pasteurization, steam pasteurization, chemical treatment of straw, cropping containers, tray culture and bag culture, casing, growth parameters (incubation temperature, relative humidity, duration, CO2 concentration, fresh air exchange, light requirement) for Pleurotus and Calocybe at stages such as spawn run, primordia formation, and fruit body development; cropping cycle.

Module –6

Harvesting, storing and packaging the crop for market.

Module-7

Constraints in production: adverse environmental factors, pests and pathogens.

Module-8

Demonstration of laboratory-scale cultivation of Pleurotus and Calocybe.

References:

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2.Kaul. TN, 2001 Biology and Conservation of Mushrooms. Oxford and CBH Publishing Company.

3.Pandey. BP 1996. A Text Book of Fungi. S. Chand and Co., New Delhi.

4. P. Stamets and J.S. Chilton. 1983. The Mushroom Cultivator. Ten Speed Press.

5. Tripathi. Mushroom Cultivation. Oxford & IBH.

6. P. Stamets. 2000. Growing Gourmet And Medicinal Mushrooms. Ten Speed Press.

7. EIRI. Handbook of Mushroom Cultivation, Processing and Packaging. Engineers India Research institute.

8. Suman, B C & Sharma, V. P. 2007. Mushroom Cultivation in India. Eastern Book Corporation.

9. B. C. Suman, V. P. Sharma. 2007. Mushroom Cultivation, Processing And Uses. Agrobios.

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SEMESTER - V

OPEN COURSE PS5D02 PLANT TISSUE CULTURE

(Total - 54 hrs)

MODULE - I

Introduction, objectives and goals of plant tissue culture. Plant cell and tissue culture – laboratory design and development. Essential facilities required for a tissue culture lab. Tissue culture media – a general account, MS Medium composition, preparation, sterilization and storage.

MODULE – II

Protocols in tissue culture – explant selection, sterilization, inoculation, induction of callus, organogenesis and hardening.

MODULE – III

Application of plant tissue culture – micropropagation, somatic embryogenesis, artificial seeds, germplasm conservation and transfer, embryo rescue and culture, protoplast isolation, culture and fusion, anther, pollen and ovary culture for production of haploids, cryopreservation, DNA banks and germplasm conservation, secondary metabolite production, shoot apical meristem culture and production of pathogen-free stocks and somaclonal variation.

MODULE –IV

Plant transformation technology – transgenic plant production, gene transfer methods in plants, multiple gene transfers, vector-less or direct gene transfer techniques.

REFERENCES

1. Dixon, R.A. & R.A. Gonzales. 1994. Plant Cell Culture – A Practical Approach (2nd Ed) Oxford University Press.
2. Mantel & Smith (1983) Plant Biotechnology. Cambridge University Press.
3. Mantel, S. H, Mathew, J.A. et al. 1985 An introduction to Genetic Engineering in plants. Blackwell Scientific Publishers, London.
4. Gupta, P.K. 1996. Elementary Biotechnology. Rastogi & Company, Meerut.
5. Hammond, J., Megary, P et al. 2000. Plant Biotechnology. Springer Verlag.
6. Gamborg, O.L. & G.C. Philips (Eds.) 1995. Plant Cell, Tissue and Organ Culture Fundamental Methods. Narosa Pulishing House, New Delhi.
7. Reinert & Bajaj Plant Cell, Tissue and Organ Culture.
8. Das, H.K. (Ed) 2005. Text book of Biotechnology (2nd ed) Wiley India (Pvt.) Ltd. New Delhi.

SEMESTER - V

OPEN COURSE PS5D03 BIOFERTILIZERS AND ORGANIC FARMING

(Total - 54 hrs.)

MODULE – I

Biofertilizers - introduction , history, definition , importance of biofertilizers, ecofarming chemical fertilizers – health and the environment.

MODULE- II

Cyanobacteria as biofertilizers. Isolation of cyanobacteria, culturing of cyanobacteria, identification, characterization and selection of cyanobacteria, inoculum preparation – small

scale and large scale. Factors affecting cyanobacterial growth. Azolla as biofertilizer and other uses. Morphology and life cycle of Azolla and Anabaena azollae. Nitrogen fixation by Azolla. Growth rate and Nitrogen input. Factors affecting the growth of Azolla. Decomposition of Azolla and mobilization of its nitrogen. Methods of Azolla utilization Control of insects and diseases

MODULE – III

1. Rhizobium: Isolation of Rhizobium from nodules, classification, identification, plant tests, maintenance of culture, cultivation and mass production, quality control, methods of inoculation.

2. Azotobacter: Isolation of Azotobacter by soil dilution plating method, identification and classification, maintenance and cultivation, crop response.

3. Azospirillum: Isolation of Azospirillum from rice root, identification and classification Maintenance and cultivation crop response.

4. Isolation of phosphate-solubilizing microorganisms: Pseudomonas, Bacillus - quantitative measurement of phosphate solubilization in culture-medium, agronomic aspects.

5. Mycorrhiza: Isolation and identification of ectomycorrhizal fungi; inoculation technique for ectomycorrhizal fungi; isolation and identification of VAM fungal spores; inoculum production of VAM Fungi; field response.

MODULE – IV

Organic Farming: introduction and history.

Methods of organic farming- Biological/natural pest and weed control, Composting, Cover cropping, Crop rotation, Diversity on the farm, Do-nothing farming, Effective Microorganism (EM), Green manuring and green leaf manuring, Indigenous seeds, Intercropping, Integration of systems, Living fences, Microbial biofertilisers, Mulching, Multicropping, Multipurpose trees, Permaculture, Polyculture, Reduced tillage, Soil and water conservation, Specialised organic farming techniques, Vermi-composting.

Integrated Pest management; biological pest control; non-chemical pesticide formulations like kerosene emulsion, tobacco decoction, neem kernel suspension, and pheromone traps.

REFERENCES

1. Kanniyan.S.1990. Biofertilizer Technology for Rice. TNAU , Coimbatore

2. Lumpkin T.A and D.L. Plucknett, 1980. Azolla; Botany, Physiology and use as a green manure. Econ. Bot. 34:111-153.

3. Balasundaran, V.R, and Subha Rao , N.S. 1977. A review of development of rhizobial inoculants for soybeans in India. Fertilizer News. 22 : 42-46.

4. Subha Rao, N.S. 1993, Biofertilizers in agriculture and forestry. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

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8. Lehri, L.K and C.L. Mehrotra. 1972 . Effect of Azotobacter inoculation on the yield of vegetable crops . Indian J. Agriculture Research. 9 : 210 -204.

9. Terrand, J.J, Kreig, N.R and J. Dobereiner. 1978. A taxonomic study of Spirillum lipoferum group, with description of a new genus Azospirillum gen. nov. and two species.

Azospirillum braseilliense sp. nov., Can. J. Microbial., 24: 967 -980.
10. Trappe, J.M.1962. Fungus associates of ectotrophic mycorrhizae. Bot. Rev. 28: 538-606.