Department of Studies and Research in Microbiology
Karnataka State Open University
Mukthagangotri, Mysuru-570006

M.Sc. in Botany

Revised Syllabus as per Choice Based Credit System

CBCS Course Matrix

Course Code	Semester and Course	Credits	Counselling/PCP hours*	Maximum Marks			Examination duration
				Internal Assessment	Term-End Examination	Total	
	Semester - I						
HC 1.1	Course 1	4	12	20	80	100	3
HC 1.2	Course 2	4	12	20	80	100	3
HC 1.3	Course 3 (Practical)	4	120	20	80	100	3
SC 1.1	Course 1	3	09	20	80	100	3
SC 1.2	Course 2	3	09	20	80	100	3
EL-1	Inter Disciplinary course – I	2	06	10	40	50	$1^{1/2}$
	Semester - I Total	20	168	110	440	550	
	Semester - II						
HC 2.1	Course 1	4	12	20	80	100	3
HC 2.2	Course 2	4	12	20	80	100	3
HC 2.3	Course 3 (Practical)	4	120	20	80	100	3
SC 2.1	Course 1	3	09	20	80	100	3
SC 2.2	Course 2	3	09	20	80	100	3
EL-2	Inter Disciplinary course – II	2	06	10	40	50	$1^{1/2}$
	Semester - II Total	20	168	110	440	550	
	Semester - III						
HC 3.1	Course 1	4	12	20	80	100	3
HC 3.2	Course 2	4	12	20	80	100	3
HC 3.3	Course 3 (Practical)	4	120	20	80	100	3
SC 3.1	Course 1	3	09	20	80	100	3
SC 3.2	Course 2	3	09	20	80	100	3
SEC-T	Skill Enhancement course – T	2	06	10	40	50	$1^{1/2}$
	Semester – III Total	20	168	110	440	550	
	Semester - IV						
HC 4.1	Course 1	4	12	20	80	100	3
HC 4.2	Course 2	4	12	20	80	100	3
HC 4.3	Course 3 (Practical)	4	120	20	80	100	3
HC 4.4	Dissertation	5	15	20	80	100	3
SC 4.1	Course 1	3	09	20	80	100	3
SEC-P	Skill Enhancement course – P	2	06	10	40	50	$1^{1/2}$
	Semester – IV Total	22	174	110	440	550	
Semester I to IV Grand total		**82**	**678**	**440**	**1760**	**2200**	

Note: The Students shall study mandatory course, for which no assessment in III semester only
*10% of credits on total learning hours
#during 3rd and 4th Semester the department concerned may offer specialized soft courses with limited mobility.
HC-Hard Core, SC-Soft Core, EL-Interdisciplinary Elective, SEC-Skill Enhancement Course.

Karnataka State Open University

MASTER OF SCIENCE IN BOTANY

DETAILED SYLLABUS

M.Sc. Botany - First Semester

Course Code	Course	Course Title	Credits
HC 1.1	Course 1	Cell and Molecular Biology of Plants	4
HC 1.2	Course 2	Biology and Diversity of Viruses, Bacteria and Fungi	4
HC 1.3	Course 3	Practical 1 and Practical 2	4
SC 1.1	Course 4	Biology and Diversity of Algae, Bryophytes and Pteridophytes	3
SC 1.2	Course 5	Biology and Diversity of Gymnosperms	3
SC 1.3	Course 6	Paleobotany	3
SC 1.4	Course 7	Lichenology and Mycorrhizal Technology	3
IE -1	Course 8	Interdisciplinary Elective 1	2
	Total		20

Note: Of the four Soft Core (SC) courses, the student may choose any two soft core courses.

M.Sc. Botany - Second Semester

Course Code	Course	Course Title	Credits
HC 2.1	Course 1	Plant Physiology and Biochemistry	4
HC 2.2	Course 2	Taxonomy of Angiosperms	4
HC 2.3	Course 3	Practical 3 and Practical 4	4
SC 2.1	Course 4	Cytogenetics	3
SC 2.2	Course 5	Plant Breeding	3
SC 2.3	Course 6	Economic Botany	3
SC 2.4	Course 7	Pharmacognosy	3
IE -2	Course 8	Interdisciplinary Elective 2	2
	Total		20

Note: Of the four Soft Core (SC) courses, the student may choose any two soft core courses.

M.Sc. Botany - Third Semester

Course Code	Course	Course Title	Credits
HC 3.1	Course 1	Plant Development	4
HC 3.2	Course 2	Plant Reproduction	4
HC 3.3	Course 3	Practical 5 and Practical 6	4
SC 3.1	Course 4	Plant Ecology	3
SC 3.2	Course 5	Plant Propagation	3
SC 3.3	Course 6	Genetic Engineering	3
SC 3.4	Course 7	Bioinformatics	3
SEC 1	Course 8	Skill Enhancement Course-1	2
	Total		20

Note: Of the four Soft Core (SC) courses, the student may choose any two soft core courses.

M.Sc. Botany - Fourth Semester

Course Code	Course	Course Title	Credits
HC 4.1	Course 1	Plant Biotechnology	4
HC 4.2	Course 2	Plant Pathology	4
HC 4.3	Course 3	Practical 7 and Practical 8	4
SC 4.1	Course 4	Dissertation/project work	5
SC 4.2	Course 5	Plant Resource Conservation	3
SC 4.3	Course 6	Ethno-Botany and Intellectual Property Rights (IPR)	3
SEC 2	Course 7	Skill Enhancement Course-2	2
	Total		22

Note: Of the two Soft Core (SC) courses, the student may choose any one soft core courses. Dissertation/project work is compulsory.

Interdisciplinary Electives

Plant Biotechnology

Plant-Microbe Interactions

Plant Diversity and Human Welfare

FIRST SEMESTER

HC 1.1 Course 1 Cell and Molecular Biology of Plants 4 Credits

The Dynamic cell: structural organization of the plant cell, specialized plant cell types, chemical foundation, chemical bioenergetics. The cell wall: structure and function, biogenesis and growth. Plasma membrane: structure, models, functions; sites for ATPases, ion carriers, channels and pumps, receptors

Plasmodesmata: structure, role in movement of molecules and macromolecules, comparison with gap junctions. Chloroplast: structure, genome organization; gene expression, RNA editing, nucleo-chloroplastic interactions

Mitochondria: Structure, genome organization, biogenesis. Plant vacuole: Tonoplast membrane, ATPases, transporters, as storage organelle

Nucleus: Structure, nuclear pores, nucleosome organization, DNA structure, A, B and Z forms, replication, damage and repair, transcription, plant promoters and transcription factors, splicing, mRNA transport, nucleolus, rRNA biosynthesis.

Ribosomes: structure, site of protein synthesis, mechanism of translation, initiation, elongation and termination, structure and role of tRNA. Protein sorting: Targeting of proteins to organelles.

Cell shape and motility: The cytoskeleton, organization and Role of microtubules and microfilaments, motor movements, implications in flagellar and other movements

Cell cycle and apoptosis: control mechanisms, role of cyclins and cyclin dependent kinases, retinoblastoma and E2F proteins; Cytokinesis and cell plate formation, mechanisms of programmed cell death.

Other cellular organelles: structure and functions of microbodies, golgi apparatus, lysosomes, endoplastic reticulum.

Techniques in cell biology: Immunotechniques, in situ hybridization to locate transcripts in cell types, FISH, GISH, Confocal microscopy

Nucleic Acids: Carriers of Genetic Information and Structure Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiments).

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves;

Organization of DNA- Prokaryotes, Viruses, Eukaryotes. RNA Structure Organelle DNA -- mitochondria and chloroplast DNA. The Nucleosome Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Central dogma and The replication of DNA Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi- conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5'end of linear chromosome;

Enzymes involved in DNA replication. DNA proofreading. Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Central Dogma Reverse (RNA viruses etc.),

Genetic code and transcription Genetic code (deciphering & salient features) and wobble hypothesis. Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation;

Concept of operon Prokaryotes: lac operon. Regulation of lactose metabolism and tryptophan synthesis in E.coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing.

Processing and modification of RNA and translation 15 lectures Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing(5' cap, 3' polyA tail); Ribozymes; RNA editing and mRNA transport.

Translation: Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins, Protein targeting.

References

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, 6th edition. Pearson Benjamin Cummings, CSHL Press, New York, U.S.A.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, 5th edition. John Wiley and Sons Inc., U.S.A.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics, 9th edition. Benjamin Cummings. U.S.A.
4. Russell, P. J. (2010). i-Genetics- A Molecular Approach, 3rd edition. Benjamin Cummings, U.S.A.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, 10th edition. W. H. Freeman and Co., U.S.A.
6. J. E. Krebs, E.S. Goldstein and S.T. Kilpatrick. (2017). Lewin's Genes XII. 12th Edition: Jones and Bartlett.
7. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
8. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
9. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
10. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
11. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H.Freeman.
12. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company
13. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
14. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.

15. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8th edition.Pearson Education Inc. U.S.A.
16. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
17. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

HC 1.2 Course 2 Biology and Diversity of Viruses, Bacteria and Fungi 4 Credits

Microbiology

Archaebacteria and eubacteria: general account; ultrastructure, nutrition and reproduction; biology and economic importance;

Cyanobacteria – salient features and biological importance.

Viruses: characteristics and ultrastructure of virions; isolation and purification of viruses; chemical nature, replication, transmission of viruses; economic importance.

Phytoplasma: general characteristics and role in causing plant diseases.

Mycology: General characters of fungi; substrate relationship in fungi;

Cell ultrastructure; unicellular and multicellular organization; cell wall composition;

Nutrition (saprobic, biotrophic, symbiotic);

Reproduction (vegetative, asexual, sexual);

Heterothallism; heterokaryosis; parasexuality;

Recent trends in classification.

Phylogeny of fungi: general account of Mastigomycotina, Zygomycotina, Ascomycotina;

Phylogeny of fungi: general account of Basidiomycotina, Deuteromycotina;

Fungi in industry, medicine and as food;

Fungal diseases in plants and humans;

Mycorrhizae;

Fungi as biocontrol agents.

References

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.

3. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Algae. S Chand and Co, New Delhi.
4. Sharma T.A., Dubey, R.C. and Maheshwari, D.K. (1999). A Text Book of Microbiology. S Chand and Co, New Delhi.
5. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
6. Campbell, N.A., Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky P.V. and Jackson, R.B. (2008). Biology, 8th edition. Pearson Benjamin Cummings, USA..
7. Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

HC 1.3 Course 3(Practical) Practical 1 and Practical 2 4 Credits

Practical 1

1. Study of plant cell structure with the help of epidermal peel mount of Onion/ Rhoeo/ Crinum.

2. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.

3. Measurement of cell size by the technique of micrometry.

4. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
5. Study of cell and its organelles with the help of electron micrographs.

8. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.

9. Study the phenomenon of plasmolysis and deplasmolysis.

10. Study the effect of organic solvent and temperature on membrane permeability. 11. Study different stages of mitosis and meiosis.

11. Separation of protein by SDS-PAGE (only demonstration to class by the instructor.

12. Preparation of LB medium and raising *E. coli.*

13. Isolation of genomic DNA from *E. coli.*

14. DNA isolation from cauliflower head.

15. DNA estimation by diphenylamine reagent/UV Spectrophotometry.

16. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).

17. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.

18. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)

19. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Practical 2

1. Phycology: Gloeocapsa, Lyngbya, Pediastrum, Pithophora, Bulbochaete, Nitella, Padina, Turbenaria, Batrachospermum, Ceramium, Amphiroa and Gelidium.

2. Mycology: Albugo, Saprolegnia, Phyllochora, Alternaria and Puccinia. Slide culture technique, fungal spore count using Haemocytometer.

3. Microscopical analysis of a) Spoiled food stuffs b) Spoiled vegetables c) Spoiled fruits

4. Bacteriology, Virology and Lichenology: Bacteriophage-Books / Photographs TMV Viruses-Books/ Photographs. Antibiotic disc assay.

5. Isolation of soil microbes (Bacteria and Fungi) by dilution plating method using selective media and plate counting. Gram staining. Usnea.

6. Bryophytes: Lunularia, Reboulia, Targonia, Aneura, Sphagnum, Bryum.

7. Pteridophytes: Psilotum, Selaginella, Angiopteris, Osmunda, Dicranopteris, Lygodium, Trichamanes, Alsophila, Nephrolepis, Salvinia, Azolla.

8. Gymnosperms: Cupressus, Podocarpus, Araucaria, Pinus, Ephedra .

9. Fossils: Rhynia, Asteroxylon, Sphenophyllum, Ankyropteris, Botryopteris, Heterangium, Lagenostoma, Pentoxylon, Medulosa, Cycadeoidea, Cordaites .

10. Collection techniques for planktonic, epiphytic, and benthic algae

11. Preservation of marine algae and preparation of permanent slides for algae Study of vegetative and reproductive features of important algal groups with the available representatives Chlorophyta Charophyta Euglenophyta Chrysophyta Cryprtophyta , Pyrrhophyta Phaeophyta Rhodophyta

12. Study of vegetative and reproductive features of important bryophytes groups with the available representatives Hepaticae, Anthocerotae and Musci

13. Study of vegetative and reproductive features of important Pteridophyta groups with the available representatives: Psilotales Lycopodiales, Selaginallales Isoetales, Equisetales, Ophioglossales, Marattiales, Osmundales, Filicales, Marsileales and Salviniales

14. Vegetative and reproductive reproductive features of Gymnospermopsida and Gnetopsida with available representatives. Also some paliobotany specimans

15. Study of microbiological lab techniques; preparation of agar culture media; Sterilizations techniques: dry and wet;

16. Methods of isolation and culturing of fungi; colony characters; microscopic observations; mounting fluids; morphology of hyphae and spores; reproductive structures of different genera of fungi. Bacterial cultures;

17. Observation of different fungal substrates on sterile moist chamber incubation (e.g. herbivore dung; decomposing leaf-litter); Observations on ecological succession of fungi; Terrestrial, marine and freshwater fungi.

18. Particle-plating, endophyte isolation and serial dilution techniques (e.g. soil, dung and leaf-litter); Qualitative and quantitative estimation of fungi.

19. Collection of infected specimens in the field; Observation of symptoms; Laboratory studies; Hand sections and tease mounts;

20. Study of as many as possible viral, bacterial and fungal diseases of crop plants (cereal, vegetable, fruit, plantation) from surroundings in Goa.

21. Bacterial staining by using simple and Gram stain.

22. Isolation and observation of Rhizobium from root nodule of leguminous plant.

23. Observations on enzyme and antibiotic production in fungi.

24. Submission of 10 dried herbarium specimens of infected plant materials [fungal (4)+ bacterial (3) + viral (3)] collected from nearby habitats and 10 pure cultures of different fungi on slants isolated from various substrates.

25. Electron micrographs/Models of viruses – T4 and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.

26. Types of Bacteria from temporary/permanent slides/photographs. Water bloom. Electron micrographs or charts of bacteria, binary fission, endospore, conjugation.

27. Gram-staining of root nodule and curd. 4. Micrometry and counting of cells by Haemocytometer

28. Study of phototactic isolation of zoids of Ulva through chart.

29. Microscopic observation of vegetative and reproductive structures of Nostoc, Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara, Vaucheria, Sargassum/ Ectocarpus, Fucus and Polysiphonia, Procholoron through temporary preparations and permanent slides.

30. Structural details of the following fossil types: Lyginopteris, Medullosa. Rhynia, Lepidodendron, Sphenophyllum, Calamites.

31. Survey of lichen vegetation in the study area: Frequency, density and abundance.

32. Determination of species richness and species diversity.

33. Isolation and maintenance of cyanobionts and phycobionts

34. Isolation and maintenance of mycobionts

35. Analysis of secondary metabolites of lichens.

36. Biological activity of secondary metabolites of the lichens.

37. Culture methods for lichens and lichen symbionts.

38. Root clearing and staining technique to study arbuscular mycorrhizal fungi.

39. Assessment of % root colonization of arbuscular mycorrhizal fungi.

40. Isolation and identification of arbuscular mycorrhizal fungi.

SC 1.1 Course 1 Biology and Diversity of Algae, Bryophytes and Pteridophytes 3 Credits

Phycology: Algae in diversified habitats (terrestrial, freshwater, marine); thallus organization; cell ultrastructure; reproduction (vegetative, asexual, sexual);

Criteria for classification of algae; pigments, reserve food, flagella;

Classification, salitent features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta,

Classification, salient features of Bacillariophyta, Phaeophyta and Rhodophyta;

Algal blooms, algal biofertilizers; algae as food, feed and uses in industry.

Bryophyta: Morphology, structure, reproduction and life history; distribution; classification;

General account of Marchantiales, Junger-maniales, Anthoceratales, Sphagnales, Funariales and Polytrichales; economic and ecological importance.

Pteridophyta: Morphology, anatomy and reproduction;

Classification; evolution of stele;

Heterospory and origin of seed habit;

General account of fossil petridophyta;.

Introduction to Psilospida, Lycopsida, Sphenopsida and Pteropsida

References

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
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7. Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

SC 1.2 Course 2 Biology and Diversity of Gymnosperms 3 Credits

Gymnosperms

Introduction: Gymnosperms, the vessel-less and fruitless seed plants

Structure of their sperms, pollen grains, pollen germination

Complexity of their female gametophyte; evolution of gymnosperms

Classification of Gymnosperms and their distribution in India.

Brief account of the families of Pteridospermales and Lyginopteridaceae

Brief account of the families of Medullosaceae and Caytoniaceae

Brief account of the families of Glossopteridaceae

General account of Cycadeoidales and Cordaitales

Structure and reproduction in Cycadales

Structure and reproduction in Ginkogales

Structure and reproduction in Coniferales and Ephedrales

Structure and reproduction in Welwitschiales and Gnetales

References

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Algae. S Chand and Co, New Delhi.
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7. Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

SC 1.3 Course 3 Paleobotany 3 Credits

Progymnospermopsida:- Free sporing plants with Gymnosperm Wood Anatomy.

Concept of Progymnosperm,Aneurophytales and Archaeopteridales, Protopytiales, Origin of Progymnospermosida

Gymnospermopsida: Heterospory and evolution of seed habit i) Isopory to Heterospory ii)Megasporangium to ovule and seed (Archeosperma, Elkinsia, and Morentia).

Palaeozoic Gymnosperm:- Plants with fern like leaves .

i) Pteridosperms:-

a) Lyginopteridales:Lyginopteridaceae, Medullosaceae,

b)Cycadeoidales-Cycadeoidaceae, Williamsoniaceae,

c) Cycad foliage (Nilssonia, Baenia).

More Diversification in Primitive Gymnosperm: Cordaitales, Glossopteridales, Pentoxylales, General characters of Coniferales(Voltziaceae represented by Ultrichia)Caytoniales, and phylogenenetic consideration of all the orders.

Study of Deccan Intertrappean flora of India. Formation of Deccan traps and Intertraps, age and its floristic composition in relation to Pteridophytes(Azolla, Salvinia,Surangea),Gymnosperms(Mohgaostrobus,Harrisostrobus,Takliostrobus) and Angiosperms (Palmoxylon, Palmocarpon, Triccoccites, Enigmocarpon, Daberocarpon, Sahnianthus, Sahnipushpam).

Introduction; Plant fossils- Preservation, preparation, age determination, geological time scale;

Fossil record- systematics, reconstruction and nomenclature

Paleopalynology-Important features of spores and pollen morphology, their role in stratigraphy and in exploration of coal and oil.

Palaeopalynological studies, microfossils and its application. Paleoecology and paleogeography.

Indian Gonwana-Its stratigraphy and classification (Two fold and three fold). Index fossil.

Applied aspects of paleobotany

References

1. Alam, A. 2015. Text book of Bryophyta. 1/e, I.K. International Publishing House, New Delhi
2. Sporne, KK. 1991. The Morphology of Pteridophytes. BI Publishing, Bombay.
3. Sporne, KR.1965. The Morphology of Gymnosperms. BI Publications, New Delhi.
4. Sharma, OP. 2014. Bryophyta. McGraw Hill Education, New Delhi
5. Parihar, N. S. 1991. Bryophyta. Central Book Department, Allahabad
6. Bhatnagar, SP and Moitra, A.1996.Gymnosperms. New Age International, New Delhi.
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8. Boid, H. C. 1982. Bryophyta. Wiley-Eastern.
9. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5th Edition.).
10. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition)
11. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science, (1st Edition).

SC 1.4 Course 4 Lichenology and Mycorrhizal Technology 3 Credits

Introduction: Photobionts- identification, reproduction, and taxonomy of photobionts; Occurrence within lichens; Mycobionts- Lichenized versus nonlichenized fungi; Bryophilous and folicolous lichens;

Thallus morphology and anatomy; Growth forms - crustose lichens, foliose lichens, fruticose lichens; Vegetative structures- Homoiomerous thallus, stratified thallus, cortex, epicortex, and epinecral layer, photobiont layer and medulla, lower cortex, Attachment organs and appendages; Cyphellae and pseudocyphellae; Cephalodia (Photosymbiodemes);

Reproductive structures- sexual reproduction in lichen-forming ascomycetes; Mating systems, dikaryon formation, Ascomal ontogeny, Ascosporogenesis; Ascus structure and function;

Generative reproduction: ascoma, perithecia, apothecia, Thallinocarpia, Pycnoascocarpia, Hysterothecia, Asci, Basidioma;

Vegetative reproduction- aposymbiotic propagules, symbiotic propagules; Systematics of lichenized fungi- History, classification and phylogeny.

Morphogenesis- Acquisition of a compatible photobiont; Recognition and specificity; Structural and functional aspects of the mycobiont–photobiont interface; Genotypes and phenotypes, growth patterns;

Biochemistry and secondary metabolites- intracellular and extracellular products; The fungal origin of the secondary metabolites; Major categories of lichen products; Application to pharmacology and medicine; Harmful properties of lichen substances, lichens in perfume, lichens in dyeing;

Stress physiology and the symbiosis- stress tolerance, limits to stress tolerance; harmful effects of stress, constitutive and inducible stress tolerance, evolution of stress tolerance in lichens; Modes of water uptake, light, temperature, carbon dioxide; The carbon economy of lichens.

Nitrogen, its metabolism and potential contribution to ecosystems, Methods of determination of nitrogen fixation; Nutrients- chemical and physical properties of nutrients and metals; Nutrient requirements, sources of nutrients, accumulation mechanisms, compartmentalization of elements within lichens; Metal toxicity, metal tolerance;

Environmental role of lichens- dispersal, establishment, pedogenesis and biodeterioration; Community structure, succession, ecosystem dynamics; Animal and lichen interactions; Forest management, conservation, environmental monitoring; Lichen sensitivity to air pollution- lichens in relation to sulfur dioxide, oxidants and lichens, hydrogen fluoride and organopollutants

Mycorrhizal fungi: Introduction and classification; Types of mycorrhizas- Arbutoid mycorrhizas, ectomycorrhizas, vesicular arbuscular mycorrhizas or arbuscular mycorrhizas, ectendomycorrhizas, ericoid mycorrhizas, monotropoid mycorrhizas and orchid mycorrhizas; Phoshate solubilisation; Ecological significance of AM fungi; Importance of mycorrhiza in evolution of land plants; Role of mycorrhiza in agriculture, horticulture and forestry.

References

1) Thomas H. Nash , 2008. Lichen Biology, 3rd edn. Cambridge University Press, The Edinburgh Building, Cambridge CB2 8RU, UK
2) Awasthi D.D. 2000. Lichenology in Indian subcontinent: A supplement to "A hand book of lichens". Publisher: M/s Bishen Singh Mahendra Pal Singh, Dehra Dun.
3) Awasthi D. D. 2013). A hand book of lichens , Publisher: M/s Bishen Singh Mahendra Pal Singh, Dehra Dun.
4) Sally E. Smith and David J. Read (2008). Mycorrhizal Symbiosis. 3rd edn. Academic Press, New York.
5) Larry Peterson R., Hugues B. Massicotte, Lewis H. Melville, 2004. Mycorrhizas: Anatomy and Cell Biology, CAB International, UK.

SECOND SEMESTER

HC 2.1 Course 1 Plant Physiology and Biochemistry 4 Credits

A general discussion on phytohormones and plant growth regulators: Definitions; members of phytohormone family; growth promoting and retarding chemicals;

General mode of hormone action; hormone binding proteins; second messengers; gene activation; examples of target cells for hormone action;

Modern techniques for hormone assay.

Auxins : Biosynthesis and degradation/deactivation of IAA; a brief account of the auxin structure and activity relationship; antiauxins and auxin antagonists; mechanism of auxin action – acid growth theory, auxin mutants.

Gibberellins : Chemical and structural characteristics of gibberellins; biosynthesis of GAs, antigibberellins and their site of action, role of gibberellins in cereal seed and gene mediated action. germination, dwarfism and flowering; mode of action of gibberellins, gibberellin mutants.

Cytokinins: Chemical and structural characteristics, biosynthesis and degradation; role of cytokinins in cell division, organogenesis, embryogenesis; mode of action, cytokinin mutants.

Abscisic acid : Chemical and structural characteristic, biosynthesis and degradation; role of ABA in seed maturation, germination, gravitropism and stomatal closure; mode of action, ABA mutants.

Ethylene : Hormonal status; chemical characteristics, biosynthesis and metabolism; Yang cycle; factors regulating ethylene biosynthesis; mode of ethylene action; its role in higher plants, ethylene mutants.

Seed dormancy : Types, control mechanism, chemical and physical manipulative methods of breaking seed dormancy; ecological significance of dormancy.

Flowering : Photoperiodic control, hormonal regulation; nature of floral stimulus; experimental evidence to prove the mobile nature of floral stimulus,ABC model of flowering, second messenger and flowering.

Senescence : Types of senescence, biochemical indices of senescence, physiobiochemical changes occurring during leaf senescence, senescence regulatory genes.

Fruit ripening : Climacteric and nonclimacteric fruits; hormonal regulation of fruit ripening, biochemical changes occurring during fruit ripening.

Stress physiology: Plant responses to biotic and abiotic stress,

Mechanisms of biotic and abiotic stress tolerance,

HR and SAR,

Water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress

References

1. Buchanan, B.B. and Gruissem, W. (2015). Biochemistry and molecular biology of plants. Willy Blackwell ASPB USA.
2. Campbell, M.K. and Farrell, S.O. (2007). Biochemistry. Thomson Brooks/cole, USA.
3. Dey, P.M. and Harborne, J.B. (2000). Plant biochemistry. Academic Press, UK.
4. Goodwin, T.W. and Mercer, E.I. (2003). Introduction to plant biochemistry. CBS Publishers & Distributors, New Delhi, India.
5. Ross and Salisbury. (2009). Plant Physiology. Cengage Learning (Thompson), New Delhi, India.
6. Segel, I.H. and Segel, E. (1993). Enzyme kinetics: Behavior and analysis of rapid equilibrium and steady-state enzyme systems. Wiley-Interscience, USA.
7. Taiz, L., Zeiger, E. Mollar, I. M. and Murphy, A. (2015). Plant physiology and Development 6th edition. . Sinauer Associates Inc., USA.
8. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. 4th edition. John Wiley and Sons.U.S.A.
9. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
10. Heldt, H. W. and Piechulla, B. (2010). Plant Biochemistry. 4th Edition. Paperback. Academic Press.

HC 2.2 Course 2 Taxonomy of Angiosperms 4 Credits

Origin of intrapopulation variation: Population and the environment; ecads and ecotypes

Evolution and differentiation of species – various models.

The species concept: Taxonomic hierarchy, species, genus, family and other categories

Principles used in assessing relationship, delimitation of taxa and attribution of rank.

Salient features of the International Code of Botanical Nomenclature.

Taxonomic evidence: Morphology, anatomy, palynology, embryology, cytology; phytochemistry' genome analysis and nucleic acid hybridization.

Taxonomic tools: Herbarium, floras, histological, cytological, phytochemical, serological, biochemical and molecular techniques; computers and GIS.

Systems of angiosperm classification: Phenetic versus phylogenetic systems;

Cladistics in taxonomy; relative merits and demerits of major systems of classification;

Relevance of taxonomy to conservation, sustainable utilization of bio-resources and ecosystem research.

Concepts of phytogeography: Endemism, hotspots and hottest hotspots; plant explorations; invasions and introduction;

Local plant diversity and its socio-economic importance.

References

1. Nalk, V.N.., 1984. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company Ltd., New Delhi. 304pp.
2. Singh, G 1999. PlantSystematics – Theory and Practice. Oxford and IBH Publishing Co. Pvt Ltd., New Delhi. 35pp.
3. Sharma, O.P. 1958. Plant Taxonomy. Tata McGraw Hill Publishing Company Ltd., New Delhi.482pp.
4. Gurucharan Singh. 2008. Plant Sytematics – Theory and Practices. Oxford and IBH Publishing Co. Pvt. Td. New Delhi.
5. Michael G. Simpson. 2010. Plant Systematics. Elsevier Academic Press.USA.
6. Pandey S.N. and Mishra. S.P. 2009. Taonomy of Angiosperms. Ane Books Pvt. Ltd. New Delhi.
7. Pandey, B.P. 2012. Taxonomy of Angiosperms. S.Chand and Company Ltd., New Delhi.
8. Rajkumar Gupta. 2006. Text book of Systematic Botany. CBS Publishers. New Delhi.
9. Subrahmanyam, N.S. 1995. Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd. NewDelhi.
10. Gurucharan Singh. 2010. Plant Sytematics – An Integrated Approach. IIIrd ed. Science Publishers.US.
11. Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York. Plant Taxonomy and Biosystematics. Edward Arnold, London. STUESSY, T. F. 2002.
12. Pandey.B.P. (1987) – Economic Botany.
13. Verma. V(1984) – Economic Botany.
14. Porter.C.L., 1982 – Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi
15. Bensen, 1957. Plant Classification. Oxford & IBH Publishing Co., NewDelhi.
16. Cronquist, A. 1968. Evolution and Classification of Flowering Plants. Thomas & Nelson (Pvt.) Ltd.,London.
17. Davis, P.H. and Heywood , V.M.1963. Principles of Angiosperm Taxonomy. Oliver & Boyed –London.
18. Henry, A.N. and Chandra Bose, 1980 . An aid to the International Code of Botanical Nomenclature, Today & Tomorrow's Printers & Publishers, Delhi.

19. Lawerence, G.H.M. 1961, Taxonomy of Vascular Plants. MacMillan and Co., New Delhi.
20. Street, H.E., 1978. Essay in Plant Taxonomy, Academic press, London.
21. Bentham, G. 1988. Handbook of British Flora. (7th Ed., revised by A.B. Rendle in 1930). Ashford,Kent.
22. Cronquist, A. 1988. The Evolution and Classification of Flowering Plants. (2nd Ed.) New Delhi.482pp.
23. Darlington, C.D. and A.P.Wylie. 1955. Chromosome Atlas of Cultivated Plants. Allen and Unwin,London.
24. Hutchinson, J. 1973. The Families of Flowering Plants. (3rd Ed.) Oxford Univ. Press.
25. Lawerence, G.H.M. 1951. Taxonomy of Vascular Plants. MacMillan, NewYork.
26. Rendle, A.B. 1904. Classification of Flowering plants. Cambridge , England. 2nd. Vol.1 930.
27. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd Ed.). Edward Arnold. London.
28. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia Univ. Press. New York, 642 pp.
29. Woodland , D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.
30. Pullaiah, T. 2007. Plant Taxonomy. Regency Publications, New Delhi.

HC 2.3 Course 3(Practical) Practical 3 and Practical 4 4 Credits

Practical 3

1. Analysis of plant tissue for water, organic and inorganic content determination of a few macronutrient (K/Na) by Flame photometer

2. Quantitative and qualitative estimation of sugars

3. Qualitative and quantitative determination of amino acids

4. Quantitative estimation of protein

5. Determination of ascorbic acid content of tissue (DCIP red)

6. Pigments extraction, separation through solvent partitioning and chromatographic techniques

7. Spectrophotometric estimation of chlorophyll

8. Enzyme activity with respect to temperature, pH and substrate concentration.

9. Effect of inorganic nutrients on plant growth

10. Assay of photosynthetic electron transport activity from isolated chloroplast/Algae using DCIP reduction

11. Assay of respiratory electron transport activity from potato using DDCP dye oxidation.

12. Estimation of nitrate/nitrite reductase activity in leaves/algae

13. Seed viability – TTC test

14. Estimation of transpiration through different simple methods.

15. Demonstration of Hill reaction.

16. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.

17. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.

18. Comparison of the rate of respiration in any two parts of a plant.

19. Separation of amino acids by paper chromatography.

20. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.

21. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.

22. Demonstration of fluorescence by isolated chlorophyll pigments.

23. Demonstration of absorption spectrum of photosynthetic pigments.

24. Study the taxonomical descriptions for all plant parts Root, Stem, Leaves, Flowers, Fruits and seeds.

25. Study of the morphological and floral characteristic and economic importance of Magnoliaceae, Menispermaceae, Polygalaceae, Caryophyllaceae, Oxalidaceae, Meliaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Lythraceae, Aizoaceae, Rubiaceae, Oleaceae, Gentianaceae, Boraginaceae, Bignoniaceae, Podestemaceae, Loranthaceae, Orchidaceae, Liliaceae, Commelinaceae, Musaceae, Arecaceae, Cyperaceae,Poaceae.

26. Preparation of Artificial keys Herbarium techniques, preparation and submission of 50 herbarium

27.. Floristic studies of selected area

28. To study the economic importance of Cereals, Legumes, Fruits, Spices and Condiments, Fibres, Timber and Vegetable Oil.

Practical 4

1. Mitosis, and study of chromosome morphology through squash preparation, including effect of chemicals on mitosis.

2. Meiosis and study of chiasma frequency through temporary squash preparation.

3. laws through seed ratios. Laboratory exercises in probability and chi-square.

4. Chromosome mapping using point test cross data.

5. Pedigree analysis for dominant and recessive autosomal and sex linked traits.

6. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).

7. Blood Typing: ABO groups & Rh factor.

8. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.

9. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.

10. Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Color blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached earlobe.

11. To test PTC tasting ability in a random sample and calculate gene frequencies for the taster and non–taster alleles.

12. Identification of inactivated X chromosome as Barr body and drumstick.

13. Emasculation; preparation of the inflorescence for crossing

14. Estimation of pollen sterility and fertility percentage

15. Pollen germination: in vitro and in vivo viability tests

16. Study of pollen types using acetolysed and non-acetolysed pollens

17. Developmental stages of anther, ovule, embryo and endosperm.

18. Study of floral biology of crops- typical examples of self and cross pollinated plants.

19. Germination test and TTC test.

20. Budding, Grafting and layering.

1. Cereals: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests) Rice(habit sketch, study of paddy and grain, starch grains, micro-chemical tests).

2. Legumes: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).

3. Sources of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato(habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).

4. Spices: Black pepper, Fennel, Curcuma and Clove (habit and sections).

5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).

6. Sources of oils and fats: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.

7. Essential oil-yielding plants: Habit sketch of Rosa, Vetiveria, Santalum and Cymbopogon spp., Mint, Basil, Eucalyptus (specimens/photographs).

8. Rubber: specimen, photograph/model of tapping, samples of rubber products.

9. Drug-yielding plants: Specimens of Ashwagandha, Artemisia, Kalmegh, Phyllanthuds, Satavar, Gilloi, Digitalis, Papaver and Cannabis.

10. Tobacco: specimen and products of Tobacco.

11. Woods: Tectona, Pinus: Specimen, Section of young stem.

12. Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

13. Demonstration and practice of cultural practices for seed / vegetative / clonally propagated medicinal plants (Mentha arvensis, Satavar, Artemisia, Aloe vera, Stevia, Ashwagandha).

14. Harvesting, drying, storage (Stevia, Kalmegh and Satavar),

15, Harvesting and distillation of Mints, Basil ,

16. Extraction of alkaloids / Withanaloids (Belladona, Ashwagandha)

SC 2.1 Course 1 Cytogenetics 3 Credits

Chromatin organization: chromosome structure and packaging of DNA, molecular organization of centromere and telomere; nucleolus and ribosomal RNA genes; euchromatin and heterochromation; karyotype analysis; banding patterns; karyotype evolution;

Specialized types of chromosomes; polytene, lampbrush, B-chromosomes and sex chromosomes, molecular basis of chromosome pairing

Structural and numerical alteratins in chromosomes: origin, meiosis and breeding behavior of duplication, deficiency, inversion and translocation heterozygotes; origin, occurrence, production and meiosis of haploids, aneuploids and euploids; origin and production of autopolyploids; chromosome and chromatid segregation; allopolyploids, types, genome constitution and analysis;

Evolution of major crop plants; inductin and characterization of trisomics and monosomics.

Genetics of prokaryotes and eukaryotic organelles: Mapping the bacteriophage genome; phage phenotypes; genetic recombination in phage;

Genetic transforamtino, conjugatin and transduction in bacteria; genetics of mitochondria and chloroplasts; cytoplasmic male sterility.

Gene structure and expression: Genetic fine structure; cis-trans test; fine structure analysis of eukaryotes; introns and their significance;

RNA splicing: regulation of gene expression in prokaryotes and eukaryotes.

Genetic recombination and genetic mapping: Recombination; independent assortment and crossing over; molecular mechanism of recombination; role of RecA and RecBCD enzymes; site-specific recombination;

Chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps; somatic cell genetics – an alternative approach to gene mapping.

Mutations: Spontaneous and induced mutations; physical and chemical mutagens; molecular basis of gene mutations; transposable elements in prokaryotes and eukaryotes; mutations induced by transposons; site-directed mutagenesis;

DNA damage and repair mechanisms; inherited human diseases and defects in DNA repair;

References

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics. 8th edition. John Wiley & sons, India.
2. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. 10th edition. W. H. Freeman and Co., U.S.A.
3. Gupta, P.K. (2018) Genetics. 5th Edition, Rastogi Publications, Meerut.
4. Hartl, D.L. and Jones, E.W. (1999). Essential Genetics, 2nd Edition, Jones and Barlett Publishers, Boston.
5. Jain, H.K. (1999). Genetics: Principles, Concepts and Implications. Science Pub Inc.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.
7. Singh, R. J. (2016). Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA.
8. Singh, R.J. (2017). Practical Mannual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.
9. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. 5th edition. John Wiley & Sons Inc., India.
10. Strickberger, M.W. (1985) Genetics, 3rd Edition. Pearson Printice Hall (printed in India by Anand Sons).

SC 2.2 Course 2 Plant Breeding 3 Credits

Definition, Objectives. Importance of floral biology in plant breeding.

Methods of crop improvement a. Plant Introduction: Definition, types and procedure. Sources of germplasm. Centres of genetic diversity.

Concepts of de Candolle and Vavilov. Primary, secondary and microcenters.

Genetic erosion. Preservation and utilization of germplasm. Gene banks. NBPGR.

Selection: Principles, genetic basis and methods: Mass selection, pure line selection, clonal selection.

Hybridization: Objectives. Procedure. Major achievements. Problems and causes of failure of hybridization. Handling of hybrids - Bulk method and pedigree method of selection. Distant hybridization - Role of interspecific and intergeneric hybridization in crop improvement.

Role of incompatibility and sterility in crop improvement.

Backcross breeding: Theory and procedure.

Inbreeding: inbreeding consequences. Heterosis- Definition. Genetic and physiologic basis. Application in plant breeding.

Steps in the production of single cross, double cross, three way cross, synthetic cross, multilines.

Idiotype breeding: Concept, Achievements: (Wheat – Asana, Donald. Rice – Super Rice).

Polyploidy breeding: induction of autopolyploidy and allopolyploidy. Role of chromosome manipulation. Chromosome addition and substitution lines. Achievements.

Mutation breeding: Principles, objectives, procedure. Induction of mutations: Physical and chemical mutagens - Recurrent irradiation, Split dose irradiation, Combination treatment. Achievements.

Resistance breeding: Principles. Methodology. Basis of resistance: structural biochemical, physiological and genetic. Gene for gene systems of plants. Vertical and horizontal resistance.

Artificial production of epiphytotic conditions and screening procedures for resistance.

Seed production and certification

Centres of crop breeding: International and National.

Plant breeder's rights Act. National Biodivesity Policy.

References

1. Arnold, R.W. (1960). Principles of Plant Breeding. Jolin Wily & Sons, Inc, New York.
2. Sing, D.D.Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
3. Swaminathan, M.S. And Jana.S (1992). Biodiversity. Mac Millan, India Press, Madras.
4. Chopra, V.L. 2000. Plant Breeding- theory and practices. Oxford and IBH Publishing Co. Pvt. Ltd.
5. Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of Plant Breeding. Narosa Publishing House, New Delhi.

SC 2.3 Course 3 Economic Botany 3 Credits

Plants for man: cereals and pulses,

Fibres, and oils,

Spices, condiments,

Beverages,

Timber,

Fruit and vegetables

Aromatic and medicinal plants,

Ornamental plants (scientific names and families of at least three

Plants of each category and the parts used);

Origin of cultivated plants & domestication of crop

Plants with case studies (millets rice, finger millets, jute, mustard, potato)

Ethnobotany and its significance in Eastern Himalayass;

Wild edible plants consumed by the ethnic people of Sikkim Himalayas; folk-medicine of the Sikkim Himalayas.

Indian system of medicine (Ayurveda, Unani, Siddha, Homeopathy); Ethnomedicine of Eastern Himalayan communities.

References

1. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett Publishers.
2. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow (2016). Aush Gyanya : Handbook of Medicinal and Aromatic Plant Cultivation.
3. Kochhar, S.L. (2016). Economic Botany: A Comprehensive Study. 5th Edition. Cambridge
4. Samba Murty, AVSS and Subrahmanyam, N.S. (1989). a text book of Economic Botany. Wiley Eastern Ltd., New Delhi
5. Sambamurty, AVSS and Subrahmanyam, N.S. (2008). A Textbook of Modern Economic Botany. 1st Edition, Paperback . CBS Publishers & Distributors Pvt.Ltd.; 1st edition (4 September 2008)
6. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
7. Any local/state/regional flora published by BSI or any other agency.

SC 2.4 Course 4 Pharmacognosy 3 Credits

History and Traditional Systems of Medicine History, Scope and Importance of Medicinal Plants; Traditional systems of medicine; Definition and Scope-

Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments,

Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.

Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.

Conservation and Augmentation Conservation of Eendemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens.

Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.

Ethnobotany and Folk Medicine Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India.

Brief description of selected plants and derived drugs, namely Guggul (Commiphora) for hypercholesterolemia, Boswellia for inflammatory disorders, Arjuna (Terminalia arjuna) for cardioprotection, turmeric (Curcuma longa) for wound healing, antioxidant and anticancer properties, Kutaki (Picrorhiza kurroa) for hepatoprotection, Opium Poppy for analgesic and antitussive, Salix for analgesic, Cincona and Artemisia for Malaria, Rauwolfia as tranquilizer, Belladona as anticholinergic, Digitalis as cardiotonic, Podophyllum as antitumor.

References

1. Akerele, O., Heywood, V. and Synge, H. (1991). The Conservation of Medicinal Plants. Cambridge University Press.
2. AYUSH (www.indianmedicine.nic.in). About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
3. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow (2016). Aush Gyanya: Handbook of Medicinal and Aromatic Plant Cultivation.
4. Dev, S. (1997). Ethnotherapeutics and modern drug development: The potential of Ayurveda. Current Science 73:909–928.
5. Evans, W.C. (2009). Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd.
6. Jain, S.K. and Jain, Vartika. (eds.) (2017). Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi
7. Kapoor, L. D. (2001). Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press.
8. Saroya, A.S. (2017). Ethnobotany. ICAR publication.
9. Sharma, R. (2003). Medicinal Plants of India-An Encyclopaedia. Delhi: Daya Publishing House.
10. Sharma, R. (2013) Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.

11. Thakur, R. S., H. S. Puri, and Husain, A. (1989). Major medicinal plants of India. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.

THIRD SEMESTER

HC 3.1 Course 1 Plant Development 4 Credits

Introduction: Unique features of plant development; differences between animal and plant development.

Seed germination and seedling growth: Metabolism of nucleic acids, proteins and mobilization of food reserves;

Tropisms

Hormonal control of seedling growth; gene expression;

Use of mutants in understanding seedling development.

Shoot development: Organization of the shoot apical meristem (SAM);

Cytological and molecular analysis of Sam;

Control of cell division and cell to cell communication; control of tissue differentiation, especially xylem and phloem;

Secretory ducts and laticifers;

Wood development in relation to environmental factors.

Leaf growth and differentiation: Determination; phyllotaxy; control of leaf form;

Differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

Root development: Organization of root apical meristem (RAM);

Cell fates and lineages;

Vascular tissue differentiation; lateral roots; root hairs;

Root-microbe interactions.

References

1. Ray F. Evert. 2006. Esau's Plant anatomy- Meristems, Cells and Tissue of the Plant Body- their structure, Function and development,. John Wiley Edition, Hoboken, NewJersy.
2. Pijushroy, (2010).Plant Anatomy, New central Book Agency, Pvt Lit, NewDelhi.
3. LarryPeterson,R.,Peterson,C.A.andMelville,L.H.2008.Teaching plant anatomy through creative laboratory exercises. NRC, Canada.
4. Charles B. Beck. 2010. An Introduction to plant structure and development. 2010. Cambridge University Press. NewYork.
5. Pandey, S.N. and Chadha, A. 1996.Plant anatomy and Embryology.Vikas Publications, NewDelhi.
6. Pandey, B.P. (1978). Plant Anatomy, S. Chand & Co., New Delhi.

HC 3.2 Course 2 Plant Reproduction 4 Credits

Reproduction: Vegetative options and sexual reproduction;

Flower development; genetics of floral organ differentiation; homeotic mutants in Arabidopsis and Antirrhinum; sex determination.

Male gametophyte: Structure of anthers; microsporogenesis, role of tapetum; pollen development and gene expression;

Male sterility; sperm dimorphism and hybrid seed production; pollen germination, pollen tube growth and guidance; pollen storage; pollen allegry; pollen embryos.

Female gametophyte: Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells.

Pollination, pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms and vectors; breeding systems; commercial considerations;

Structure of the pistil; pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects); double fertilization; in vitro fertilization.

Seed development and fruit growth: Endosperm development during early, maturation and dessication stages;

Embryogenesis, ultrastructure and nuclear cytology;

Cell lineages during late embryo development; strogate proteins of endosperm and embryo; polyembryony; apomixes; embryo culture;

Dynamics of fruit growth; biochemistry and molecular biology of fruit maturation.

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

Senescence and programmed cell death (PCD): Basic concepts,

Types of cell death, PCD in the life cycle of plants,

Metabolic changes associated with senescence and its regulation;.

Influence of hormones and environmental factors on senescence

References

1. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd. New Delhi.
2. Johri, B.M. 1984. 1984. Embryology of Angiosperms. Springer Verlag. Berlin.
3. Maheswari, P. 1980. Recent Advances in the Embryology of Angiosperms.
4. Pandey, A.K. 1997. Introduction to Embryology of Amngiosperms. CBS Publishers and Distributors, New Delhi.

5. Pandey, S.N. and Chadha, A. 2000. Embryology. Vikas Publishing House Pvt. Ltd. New Delhi.

HC 3.3 Course 3(Practical) Practical 5 and Practical 6 4 Credits

1. Study the structures of various Microscopes

2. Study the structure of Microtome

3. Staining methods(Simple/Permanent)

4. Student should submit two number of Permanent slides for practical Examination

5. Study the anomalous, primary and secondary features in selected Monocot and Dicot plants Detailed study of TS, TLS and RLS from various wood for to identify the soft and hardwood

6. Study the anatomical abnormality of C4 and CAM plants (Leaf/Stem).

7. Embryology: Study of pollen morphology Pollen germination experimental study Identify the different types of embryos, polyembryony, endosperm types, types of pollen grains.

8. Any stage of embryo excision from Cucumber seeds.

1. Pollen germination: in vitro and in vivo viability tests

2. Study of pollen types using acetolysed and non-acetolysed pollen

3. Developmental stages of anther, ovule, embryo and endosperm.

4. Study the structures of various Microscopes

5. Study the structure of Microtome

6. Staining methods(Simple/Permanent)

7. Student should submit two number of Permanent slides for practical Examination

8. Study the anomalous, primary and secondary features in selected Monocot and Dicot plants Detailed study of TS, TLS and RLS from various wood for to identify the soft and hardwood

9. Study the anatomical abnormality of C4 and CAM plants (Leaf/Stem).

10. Embryology: Study of pollen morphology Pollen germination experimental study Identify the different types of embryos, polyembryony, endosperm types, types of pollen grains.

11. Any stage of embryo excision from Cucumber seeds.

1. Pollen germination: in vitro and in vivo viability tests

2. Study of pollen types using acetolysed and non-acetolysed pollen

3. Developmental stages of anther, ovule, embryo and endosperm.

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.

2. Determination of pH of various soil and water samples (with pH meter, universal indicator/Lovibond comparator and/or pH paper strip)

3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.

4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.

5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.

6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.

7. Study of morphological adaptations of hydrophytes and xerophytes (four each).

8. Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants).

9. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).

10. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.

11. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.

12. Field visit to familiarise students with ecology of different sites.

1. Vegetative propagation: Types of Cuttings

2. Vegetative propagation: Types of Grafting

3. Vegetative propagation: Types of Budding

4. Vegetative propagation: Types of Layering

5. Propagation by modified stems and

6. Propagation by modified Roots

7. Micropropagation: Preparation of media, preparation of explants, culture, initiation of shoot, multiplication (demonstration)

8. Pot & green house implants (demonstration)

1. Isolation of Plasmid DNA from E.coli

2. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis

3. Ligation of DNA fragments

4. Interpretation of sequencing gel electropherograms

5. Designing of primers for DN Aamplification

6. Amplification of DNA by PCR

7. Demonstration of Southern blotting

1. Nucleic acid and protein databases.

2. Sequence retrieval from databases.

3. Sequence alignment.

4. Sequence homology and Gene annotation.

5. Construction of phylogenetic tree.

6. Comparative analysis of different databases in metabolomics

7. More Practical may be added depending on the local habitats and available facilities

SC 3.1 Course 1 Plant Ecology 3 Credits

Climate, soil and vegetation patterns of the world: Life zones; major biomes and major vegetation and soil types of the world.

Vegetation organization: Concepts of community and continuum; analysis of communities (analytical and synthetic characters); community coefficients; interspecific associations, ordination; concept of ecological niche.

Vegetation development: Temporal changes (cyclic and non-cyclic); mechanism of elcological succession (relay floristics and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession.

Ecosytem organization: Structure and fucntions;

Primary production (methods of measurement, global pattern, controlling factors);

Energy dynamics (trophic organization, energy flow pathways, ecological efficiencies);

Litter fall and decomposition (mechanism, substrate quality and climatic factors);

Global biogeochemical cycles of C, N, P and S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystem.

Biological diversity: Concept and levels;

Role of biodiversity in ecosystem functions and stability;

Speciation and extinction; IUCN categories of threat; distribution and global patterns;

Terrestrial biodiversity hot spots; inventory.

References

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

SC 3.2 Course 2 Plant Propagation 3 Credits

Propagation of horticultural plants- by seeds- Seed development and viability,

Seed dormancy, seed health, seed testing and certification

Growing seedlings in indoor containers and field nurseries, seed bed preparation, seedling transplanting;

Advantages and disadvantages of seed propagation.

Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation;

Methods- cutting, layering, grafting and budding;

Advantages and disadvantages of vegetative propagation;

Micropropagation

Plant disorders including nutrition, pests and diseases, and chimaeras

Ornamental ferns and their propagation;

Herbaceous perennials, Annuals & Biennials:

Important Genera and Species, their importance in garden designs.

References

1. Lewis, Hill. (1985). Secrets of Plant Propagation. American Horticultural Society. Storey Books,
2. Dirr, M.A. (2009). Manual of Woody Landscape Plants. (6th ed) Champsign, Il: Stipes Pub.
3. Kock, H., Arid, Paul., Ambrose, J. and Waldron G.(2008). Growing Trees from Seeds. Richmomd Hill : Firefly Books Publ.

4. Toogood ,A. R. (1999). Plant Propagation. American Horticultural Society Practical Guides. DK Publ, pp 320.
5. Hartmann, H.I. and Kester, O.T. (2015). Plant Propagation: Principles and Practices. 8th Edition. Pearsons
6. Sadhu, M. K. (1994). Plant Propagation. First edition .John Wiley & Sons.
7. Phillips, Harry R. (1995). Growing and Propagating wild Flowers. The University of North Carolina Press,

SC 3.3 Course 3 Genetic Engineering 3 Credits

DNA replication: DNA replication in prokaryotic organism– Initiation, elongation, and termination,

DNA replication in eukaryotes – origin, replication form, replication proteins, Comparative account of DNA replication in prokaryotes and eukaryotes, DNA replication proteins

DNA damage and repair: Types of DNA damage, factors for DNA damage, Repair system: Single base change, direct repair, mismatch repair, SOS response.

Gene expression and regulation: Transcriptional, translational and post-translational regulation

Tools of rDNA technology: DNA manipulation enzymes- Nucleases, polymerases, ligases, kinases and phosphatases

Methods of gene isolation.

Molecular probing: Recombinant DNA libraries (gDNA and cDNA, oligonucleotide probes)

Nucleic acid hybridization (southern, northern, dot-blot and slot-blot); antibodies as probe for proteins (immunoblotting or western blotting, immunoprecipitation, southwestern screening).

Splicing of foreign DNA into cloning vector: Vectors for prokaryotes; ligation.

Introduction of foreign DNA into host cell: Transformation; transfection; transgenesis

Isolation of genes or protein products from clones: Expression vectors-Characteristics; vectors producing fusion proteins

Polymerase chain reaction: The basic techniques and its modifications; applications of PCR in molecular biology

Sequence alignment and phylogenetic trees: Pairwise (dot-matrix method, dynamic programming method, Word or k-tuple method) and

Multiple alignment, Local and global alignment, significance of alignment, phylogeny and phylogenetic trees.

Genomics: Definition; Structural, functional and comparative genomics.

Proteomics: Description of protein structure; classification of proteins on the basis of structure and sequence similarity; prediction of a protein structure.

References

1. Benjamin Lewin, Gene VII, Oxford University Press, (2000).
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Molecular biology of the Cell, 4th Edition. Garland publishing Inc. (2002).
3. Darnell, Lodish and Baltimore, Molecular Cell Biology, Scientific American Publishing Inc. (2000).
4. Watson. J.D, Baker.T.A, Bell.S.P, Gann.A. Levine.M. Losick.R, Molecular Biology of Gene, 5th Edition. The Benjamin/Cummings Pub.Co.Inc. (2003).
5. David Frifielder, Stanely R. Maloy, Molecular biology and Microbial genetics. 2ndEdition, Jonesand Barlett Publishers. (1994).
6. BrownT.A., Gene Cloning and DNA analysis. 2nd Edition, ASM press. (2004).
7. Sandy Primrose. Principles of Gene Manipulation and Genomics. 7th Ed., Blackwell Publishers. (2006).
8. Glick BR and Pasternak JJ, Molecular Biotechnology, 2nd Ed.ASM press. (2003).
9. Uldis N. Streips, Ronald E. Yasbin. Modern Microbial Genetics. 2nd Edition Wiley-Liss, Inc.(2002).
10. Desmond S. T. Nicholl. An Introduction to Genetic Engineering. Cambridge University Press; (2008)

SC 3.4 Course 4 Bioinformatics 3 Credits

Introduction to bioinformatics, over view and exploring and querying (search and retrieval) available bioinformatics resources NCBI, PUBMED, EBI, EMBL, gene bank etc.

Pair wise alignment of protein and DNA sequences using algorithm software to deduce homology nd interpretation of data.

Database searches for homology using BLAST and FASTA and interpretation of the results to derive biological significance of the queried DNA/protein sequences.

Prediction of structure of proteins by homology modeling approach using SWISSMODEL and SWISS-PDB.

Models of molecular Evolution, Selection of best-fitting models,

Methods of Phylogeny reconstruction: Phenetic vs. Cladistic, Neighbor Joining, UPGMA, Maximum Parsimony, Maximum Likelihood, Bayesian Inference,

Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design,

Microbial genome applications, Crop improvement.

References

1. Arthur M. Lesk. (2003). Introduction to Bioinformatics, Oxford University Press, Indian edition.
2. Des Higgins and Willie Taylor. (2000). Bioinformatics, Sequence, structure and databanks. A practical approach. Oxford University Press, Indian edition, Second impression, New Delhi.

3. Imtiaz Alam Khan. (2005). Elementary bioinformatics. Pharma Book Syndicate, Hyderabad.
4. Irfan Ali Khan and Attiya Khanum (eds.). (2005). Basic concepts of Bioinformatics, Ukaaz Publications, Hyderabad.
5. Irfan Ali Khan and Attiya Khanum (eds.). (2004). Introductory Bioinformatics. Ukaaz Publications, Hyderabad.
6. Krane Dan, E. and Raymer M.L. (2004). Fundamental concepts of Bioinformatics. Pearson education. New Delhi. Second Indian reprint.
7. Rastogi, S.C., Mediraттta, N. and Rastogi. P. (2004). Bioinformatics, methods and applications, genomics, proteomics and drug discovery, Prentice hall of India, pvt. Ltd., New Delhi.
8. Baxevanis, A. D. and Ouellettee, B. F. F. (2002). Bioinformatics: A Practical Guide to the analysis of Genes and Proteins. (2nd Ed.), New York, John Wiley & Sons, Inc. Publications.
9. Attwood, T. K. and Parry-Smith, D. J. (2001). Introduction to Bioinformatics Delhi. Pearson Education (Singapore) Ptd. Ltd.

SEC-1: Biofertilizers **2 Credits**

General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.

Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

Organic farming – Green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

References:

1. Dubey, R.C. (2005). A Text book of Biotechnology S.Chand & Co, New Delhi.

2. John Jothi Prakash, E. (2004). Outlines of Plant Biotechnology. Emkay Publication, New Delhi.

3. Kumaresan, V.(2005). Biotechnology, Saras Publications, New Delhi.

4. NIIR Board. (2012). The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.

5. Sathe, T.V. (2004) Vermiculture and Organic Farming. Daya publishers.

6. Subba Rao N.S. (2017). Biofertilizers in Agriculture and Forestry. Fourth Edition. Medtech.

7. Vayas,S.C, Vayas, S. and Modi, H.A. (1998). Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

FOURTH SEMESTER

HC 4.1 Course 1 Plant Biotechnology 4 Credits

Recombinant DNA technology: Gene cloning- Principles and technique; vectors- types (cloning & expression; plasmid & viral) and their properties;

Construction of DNA libraries (gDNA and cDNA); splicing of insert into the vector; screening of DNA libraries and introduction of the recombinant DNA into the host cells.

Genetic engineering of plants: Aims, strategies for development of transgenics (with suitable examples);

Agrobacterium-the natural genetic engineer; T-DNA and transposon mediated gene tagging.

Microbial genetic manipulation: Bacterial transformation, selection of recombinants and transformants,

Genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Genomics and proteomics: Molecular markers for introgression of useful traits; high throughput sequencing; functional genomics; Protein profiling and its significance.

DNA synthesis; DNA sequencing; basic polymerase chain reaction and applications of PCR; DNA fingerprinting.

Plant tissue culture: Basic concepts; Principles and scope; tissue culture media; callus induction and cell suspension; aspects of morphogenesis; haploid and triploid production; production of somatic embryos

Applications of plant tissue culture; protoplast isolation and culture; production of cybrids

Transgenic production: Methods to introduce gene in plants; selection of transformed plants/explants

Salient achievements in crop biotechnology

Bioinformatics: Introduction, History, Definition and applications of bioinformatics;

Database: Sequences (nucleotide and amino acid); nomenclature- IUPAC symbols,

Nomenclature of DNA & protein sequences, directionality of sequences, types of sequences used in bioinformatics;

Definitions, types and classification of databases- Primary Databases, Secondary databases, Literature database and Taxonomy database.

References

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. A. Slater, N.W. Scott and M.R. Fowler (2008). Plant Biotechnology. Second Edition. Oxford.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K.
5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
6. Chrispeels, M.J. and Sadava, D.E. (1994). Plants, Genes and Agriculture. Jones & Bartlett Publishers.
7. N. Santosh and A. Madhavi. (2010). Practical Book of Biotechnology and Plant Tissue Culture. S. Chand & Co.

HC 4.2 Course 2 Plant Pathology 4 Credits

History:Milestones in phytopathology with particular reference to India. Major epidemics and their social impacts.

Historical developments of chemicals, cultural and biological protection measures.

Altered metabolism of plants under biotic and abiotic stresses. Koch's Postulates

Epidemiology and forcasting of plant diseases

Principles of Plant pathology
i. Principles of plant pathology-Importance, nature, classification and general symptoms of plant diseases.
ii. Pathogenecity of microorganisms and pathogenesis.
iii. Host parasite relationship and Interaction; Signal transduction.
Defence mechanism in host plants against pathogens -morphological or structural defence mechanism;Biochemical defence mechanisms - role of phenolic compounds, enzymes and toxins

Principles and methods of plant disease control -cultural methods, chemical methods, Biological control, transgenic approach for plant disease control, integrated pest management (IPM), Biopesticides.

A Detailed study of the Diseases of the following crops caused by fungal pathogens with effective control measures.

Diseases of Cereals: Seedling blight of cereals, Smut of wheat, Foot rot of wheat, Covered smut of Barley, False smut of rice, Downey mildew of jowar, Green ear disease of Bajra, Ergot of Bajra, Downey mildew of maize.

Diseases of Vegetable crops with special reference to the important diseases of thefollowing: Chilli, Brinjal, Tomato, Onion, Bhindi. General knowledge of post harvest diseases of fruits and vegetables and their control.

Diseases of Oil Seed Crops viz. Linum, Seasamum, Groundnut, Mustard and Sunflower

Diseases of Fruit Trees-With special reference to important diseases of the following Citrus, Apple, Mango, Banana and Grapes.

Bacterial diseases of plants - Bacterial blight of rice, Tundu disease of wheat, Angular leaf spot of cotton, stalk rot of maize, Fire blight of Apple, Bacterial soft rot of fruits and Vegetables.

Viral Diseases of Plant: Bunchy top of Banana, Leaf curl of Papaya, Yellow vein mosaic of Bhindi. Mosaic of Cucurbits, Viral diseases of Tobacco, Potato and Tomato.

Mycoplasma/Phytoplama (PPLO) Diseases of Plants: Citrus greening, Rice yellow dwarf: Little leaf of Brinjal, Sandal Spike.

Nematode Diseases of Plants: General knowledge of plant parasitic nematodes and important nematode diseases viz.Root knot of Vegetables, Ear cockle of wheat. .

References

1. Agrios, G.N. (1997). Plant Pathology, 4th edition, Academic Press, U.K.
2. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.
3. Mehrotra R S and Ashok Agrawal. Plant Pathology. Tata Mc Graw Hill ,6th reprint (2006).
4. K. S. Bilgrami, H. C. Dube. A textbook of modern pathology. 6th Edition,Vani Educational Books, a division of Vikas, (1984).
5. Plant Pathology.Elsevier Science Publishing Co Inc 2005.George Nicholas Agrios
6. K.R. Aneja Experiments in Microbiology, Plant Pathology and Biotechnology . New Age Publications 2017

HC 4.3 Course 3 (Practical) Practical 7 and Practical 8 4 Credits

1. (a) Preparation of liquid and solid MS medium. (b) Demonstration of in vitro sterilization of seeds and germination in MS media containing petri plates. (c) in vitro selection and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.

2. Callus formation in tobacco and rice using MS medium containing phytohormones.

3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.

4. Isolation of protoplasts and protoplast culture using photographs

5. Construction of restriction map of circular and linear DNA from the data provided.

6. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.

7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.

8. Isolation of plasmid DNA.

9. Restriction digestion and gel electrophoresis of plasmid DNA.

1. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
2. Study of important diseases of crop plants by cutting sections of infected plant material- Albugo, Puccinia, Ustilago, Fusarium, Colletotrichu
3. Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton,
4. Viral diseases: TMV, Vein clearing,
5. Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

1. Visit any unattended area with natural vegetation

2. Use Quadrat method to evaluate the minimum size of the quadrat required for vegetation study

3. Find out the minimum number of quadrats need for analyzing the vegetation structure in the study area

4. Find out the alpha-diversity of plants in the area

1) Survey and collection important ethno botanical plants by using questionnaire and interview.

2) Preliminary phyto- chemical analysis of medicinal plants.

3) Study of biological functional properties of crude drugs – Anti microbial activity.

4) Study of methods of in-situ or ex-situ conservation of important medicinal plants.

5) Study of techniques used in Pharmacognosy – organoleptic, anatomy and chemical methods.

6) A visit to a Tribal area to conduct field work and collect ethno botanical information / data.

7) Listing of Crude drugs in Pansali shops (local crude drugs shops) and their identification (little known drugs only).

8) Visit to nearby Western Ghats and Sacred Groves.

SC 4.1 Course 1 Dissertation/project work 5 Credits

SC 4.2 Course 2 Plant Resource Conservation 3 Credits

Biosystematics principles, practice, limitations and scope ;phenotypic plasticity ;

Biodiversity: general concept, importance, assessment of variation and isolation.

Distribution of endemic plant families in the southern hemisphere of the globe.

Conservation: Principles, categories of threatened plants (IUCN),

Strategies of conservation,

Red Data Book.

Protected areas- Sanctuaries, National parks, Biosphere reserves.

Wetlands and Mangroves

Coral Reefs- Types, importance, artificial reefs,

Botanic Garden, Herbaria and Botanical Survey of India.

Seed Banks; In-vitro repositories; Cryobanks,

Molecular markers in Plant Systematics and phylogenetic analysis: Nuclear ribosomal DNA, Chloroplast DNA and Mitochondrial DNA.

Ethics of Conservation – Values of Biodiversity, Biopiracy, Hybridized plants, GM crops (benefits& criticism),

Economic Value of Biodiversity & Legal, Ethical and Conservation issues related to uses of biodiversity, Global Conservation Issues.

References

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices.Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2. Singh, J.S., Singh, S.P. and Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Reddy, K.V. and Veeraiah, S. (2010). Biodiversity and Plant Resources. Aavishkar publication, New Delhi.
4. Heywood, V. H. and Watson, R. T. (1995). Global biodiversity and Assessment. Cambridge University Press.

5. Akerele, O., Heywood, V. and Synge, H. (1991). The Conservation of Medicinal Plants. Cambridge University Press.

SC 4.3 Course 4 Ethno-Botany and Intellectual Property Rights (IPR) 3 Credits

Ethno-botany: Introduction, concept, scope and objectives; Ethno-botany as an interdisciplinary science; The relevance of ethno-botany in the present context;

Ethnic groups; Ethno-botany- Major and minor ethnic groups of India and their life styles; Forest Vs. ethnic groups; Plants in tribal life with reference to Magico-religious rituals and social customs; Sacred groves.

Methodology used in the study of Ethnobotany and Ethno pharmacology: Field work, Herbarium, Ancient Literature, Archaeological findings, temples and sacred places, protocols.

Preliminary phytochemical analysis of ethno-botanical important medicinal plants.

Role of ethno-botany in modern Medicine with special examples; Medico-ethno- botanical Sources in India with special reference to Karnataka; Tribals Vs. Agriculture: Shifting, Podu and Jhum cultivation; Role of ethnic groups on surrounding environment;

Crop genetic sources; Endangered taxa and forest management (participatory forest management); Ethno- botany as a tool to protect interests of ethnic groups; Sharing of wealth concept with few examples from India.

Study of Intellectual Property Rights – patents, trademark, geographical indication, copyright; IPR and Traditional Knowledge; Bio-piracy of traditional knowledge;

Ethno botany and legal aspects; National and international organizations and treaty related to traditional knowledge – WIPO, TKDL, TRIPS, CBD, Nagoya protocol etc.,

Ethno botany as a source (recent) of already known drugs: a) Withania as an antioxidant and relaxant b) Sarpagandha in brain ailments c) Becopa and Centella in epilepsy and memory development in children d) Phyllanthus fraternus in diabetic and viral jaundice e) Artemisia as a powerful cerebral anti malarial agent and its possible use in tuberculosis.

References

1) Jain, S.K. 1995. Manual of Ethno-botany, Scientific Publishers, Jodhpur.
2) Jain, S.K. 1981. Glimpses of Indian. Ethno-botany, Oxford and I B H, New Delhi
3) S.K. Jain 1989. Methods and approaches in ethno-botany. (ed.) Society of ethno botanists, Lucknow, India.
4) Jain, S.K. 1990. Contributions of Indian ethno-botany. Scientific Publishers, Jodhpur.
5) Colton C.M. 1997. Ethno botany – Principles and applications. John Wiley and sons –
6) Rama Ro, N and A.N. Henry (1996). The Ethno-botany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
7) Rajiv K. Sinha – Ethno-botany The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur-1996
8) Faulks, P.J. 1958. An introduction to Ethno-botany, Moredale pub. Ltd. London

SEC-2: Herbal Technology **2 Credits**

Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.

Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmeticals and biopesticides, their Botanical names, plant parts used, major chemical constituents.

Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, Catharanthus roseus, Withania somnifera, Centella asiatica, Achyranthes aspera, Kalmegh, Giloe (Tinospora), Saravar. Herbal foods, future of pharmacognosy.

lectures Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds). Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation. of some medicinal plants (Withania somnifera, neem and tulsi),

References:

1. Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. (2013). Current scenario of Herbal Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105-17.

2. Arbe r, Agnes. (1999). Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.

3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. (2016). Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5 : 88.

4. Aburjai, T. and Natsheh, F.M. (2003). Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000.

5. Patri, F. and Silano, V. (2002). Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.

6. AYUSH (www.indianmedicine.nic.in). About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.

7. Evans, W.C. (2009): Trease and Evans PHARMACOGNOSY. 16th Edition, SAUNDERS / Elsevier.

8. Sivarajan, V.V. and India, B. (1994). Ayurvedic Drugs and Their Plant Sources.. Oxford & IBH Publishing Company, 1994 - Herbs - 570 pages.

9. Miller, L. and Miller, B. (2017). Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. Motilal Banarsidass,; Fourth edition .

10. Kokate, C.K. (2003). Practical Pharmacognosy. Vallabh Prakashan, Pune.

INTERDISCIPLINARY ELECTIVES

Plant Biotechnology

Recombinant DNA technology: Gene cloning- Principles and technique; vectors- types (cloning & expression; plasmid & viral) and their properties;

Construction of DNA libraries (gDNA and cDNA); splicing of insert into the vector; screening of DNA libraries and introduction of the recombinant DNA into the host cells.

Genetic engineering of plants: Aims, strategies for development of transgenics (with suitable examples);

Agrobacterium-the natural genetic engineer; T-DNA and transposon mediated gene tagging.

Microbial genetic manipulation: Bacterial transformation, selection of recombinants and transformants,

Genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Genomics and proteomics: Molecular markers for introgression of useful traits; high throughput sequencing; functional genomics; Protein profiling and its significance.

DNA synthesis; DNA sequencing; basic polymerase chain reaction and applications of PCR; DNA fingerprinting

Plant tissue culture: Basic concepts; Principles and scope; tissue culture media; callus induction and cell suspension; aspects of morphogenesis; haploid and triploid production; production of somatic embryos

Applications of plant tissue culture; protoplast isolation and culture; production of cybrids

Transgenic production: Methods to introduce gene in plants; selection of transformed plants/explants

Salient achievements in crop biotechnology

Bioinformatics: Introduction, History, Definition and applications of bioinformatics;

Database: Sequences (nucleotide and amino acid); nomenclature- IUPAC symbols,

Nomenclature of DNA & protein sequences, directionality of sequences, types of sequences used in bioinformatics;

Definitions, types and classification of databases- Primary Databases, Secondary databases, Literature database and Taxonomy database.

References

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Plant-Microbe Interactions

Overview of plant microbes interactions,

Introduction, beneficial microbes, Rhizobium bacterium and nitrogen fixation, mycorrhizal fungi.

Plant pathogens, Agrobacterium tumefaciens and crown gall disease,

Mechanisms of plant disease mechanism, some bacterial plant diseases,

Plant viruses and mechanism of plant against viruses attacks.

Fungal pathogen- mechanism of plant disease,

Oomycete pathogens, Fungal mediated plant.

General concept of plant immunity,

PAMP-triggered immunity (PTI) and effectors-triggered immunity (ETI).

Transcription activator like effector and their role in virulence and disease resistance.

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Plant Diversity and Human Welfare

Plant Diversity and its Scope Levels of biodiversity: Genetic, Species and Ecosystem; Agrobiodiversity and cultivated plant taxa and related wild taxa.

Values and uses of Biodiversity, Methodologies for valuation, Ethical and aesthetic values, Uses of plants; Ecosystem services.

Loss of Biodiversity Loss of biodiversity- causes and implications, Hot spots of biodiversity, extinction of species, projected scenario for biodiversity loss.

Management of Plant Biodiversity Organizations associated with biodiversity management, IUCN, UNEP, WWF, UNESCO, NBPGR; Methodology for execution;

Biodiversity legislation; Information management and communication.

Conservation of Biodiversity, Role of Plants in Relation to Human Welfare Conservation of genetic, species and ecosystem diversity,

In situ and ex situ conservation strategies, India's biodiversity and its conservation Social approaches to conservation,

Biodiversity awareness programmes, Sustainable development.

Importance of forestry their utilization and commercial aspects; Avenue trees; Ornamental plants of India; Alcoholic beverages; Fruits and nuts; Wood and its uses; their commercial importance.

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