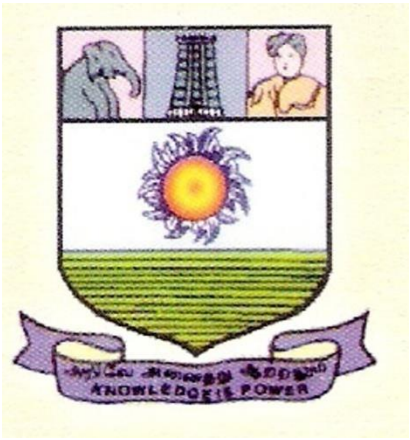

M. Sc. BOTANY – Syllabus 2017-18 onwards

SYLLABI AS PER THE CHOICE BASED CREDIT SYSTEM (CBCS)
(CURRICULUM EFFECTIVE FROM JULY 2017 -18 ONWARDS)

For Approval by SCAA

Dr. P. RAVICHANDRAN
Professor and Head and Convener,

Board of Studies in Plant Science
DEPARTMENT OF PLANT SCIENCE
Manonmaniam Sundaranar University, Tirunelveli

M. Sc. BOTANY

SYLLABI AS PER THE CHOICE BASED CREDIT SYSTEM (CBCS)
(CURRICULUM EFFECTIVE FROM JULY 2017 -18 ONWARDS)

THE FOLLOWING IS THE COURSE STRUCTURE, SCHEME AND SYLLABI

Eligibility: Undergraduate (B. Sc.) Botany, Plant Biology & Plant Biotechnology

REVISED COURSE STRUCTURE 2017-18

Semester I - Core theory 4, Practical 2, Elective 1				
			Int.	Ext.
			25	**75**
	TITLE OF THE PAPER	**Credit**	**Marks**	
CORE 1	PLANT DIVERSITY-I – ALGAE, FUNGI AND LICHENS	4	100	
CORE 2	PLANT DIVERSITY- II – BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY	4	100	
Practical - 1	PLANT DIVERSITY I & II	4	100	
CORE 3	MICROBIOLOGY	4	100	
CORE 4	CELL AND MOLECULAR BIOLOGY	4	100	
Practical - 2	MICROBIOLOGY AND CELL & MOLECULAR BIOLOGY	4	100	
Elective -1	**EVOLUTIONARY BIOLOGY** PLANT DISEASES AND INSECT PEST CONTROL AQUATIC AND MARINE PLANTS	3	100	
	Total Credits	**27**	**700**	
Semester II- Core theory 4, Practical 2, Elective 1 and Supportive course 1				
	TITLE OF THE PAPER	**Credit**	**Marks**	
CORE 5	GENETICS	4	100	
CORE 6	ANATOMY AND DEVELOPMENTAL BOTANY	4	100	
Practical - 3	GENETICS, ANATOMY AND DEVELOPMENTAL BOTANY	4	100	
CORE 7	INSTRUMENTATION AND RESEARCH METHODOLOGY	4	100	
CORE 8	PHYTOCHEMISTRY	4	100	
Practical - 4	INSTRUMENTATION & PHYTOCHEMISTRY	4	100	
Elective – 2	PLANTS IN TAMIL CULTURE **HORTICULTURE AND PLANT BREEDING** PLANTS FOR BIOENERGY & SPACE RESEARCH	3	100	
Supportive course	Offered by other departments	3	100	
	Total credits	**30**	**800**	
Semester III- Core theory 4, Practical 3, Supportive 1				
	TITLE OF THE PAPER	**Credits**	**Marks**	

CORE 9	PLANT PHYSIOLOGY AND BIOCHEMISTRY	4	100
Practical - 5	PLANT PHYSIOLOGY AND BIOCHEMISTRY	2	100
CORE 10	TAXONOMY AND MEDICINAL PLANTS	4	100
Practical - 6	TAXONOMY AND MEDICINAL PLANTS	2	100
CORE 11	ECOLOGY AND CONSERVATION BIOLOGY	4	100
Practical - 7	ECOLOGY AND CONSERVATION BIOLOGY	2	100
CORE 12	GENOMICS AND BIOINFORMATICS	4	100
Supportive course	Offered by other departments	3	100
	Total credits	**25**	**900**
Semester IV- Core theory 1, Practical 1, Field study 1 and Dissertation 1			
	TITLE OF THE PAPER	**Credit**	**Marks**
CORE 13	PLANT BIOTECHNOLOGY	4	100
Practical - 8	PLANT BIOTECHNOLOGY	4	100
Practical - 9	FIELD STUDY	2	100
DISSERTATION	PROJECT AND VIVA - VOCE	8	100
	Total credits	**16**	**400**

Distribution of Credits	**Total Credits**	**Total Marks**	**GRADE POINTS**
Core Theory - 12 x 4	48	1200	4800
Practical papers - 5 x 4	20	500	2000
Practical papers - 4 x 2	8	400	800
Electives - 2 x 3	6	200	600
Supportive course 2 x 3	6	100	600
Field Study (practical) 1 x 2	2	100	200
Dissertation/Project and Viva-Voce	8	100	800
Grand Total Credits	98	2600	9800

Cumulative Grade Points Average (CGPA) = GRADE POINTS /TOTAL CREDITS	**9800/98**	**100 %**

Elective courses offered to other department P.G. students

Supportive courses offered in Semester II. Any one of the following

1. Home Gardening By Dr. M. Udayakumar
2. Plants in Human Life Dr. A. Selvam

Supportive courses offered for Semester III. Any one of the following

1. Global Climate Change By Dr. M. Udayakumar
2. Mushrrom cultivation by Dr. A. Selvam

SCHEME - EXAMINATION AND EVALUATION

1. For each theory paper 25 marks for internal & 75 marks for External.

2. There is no passing minimum for internal examination. Passing minimum for external is 38 % and the total passing minimum including internal & external is 50 %. For internal marks, the split up is 20 marks for test, 5 marks for seminar and Assignment. The average of all three tests will be taken for internal marks.

3. For project valuation 25 marks maximum for internal and 25 marks maximum for external and thereby the total maximum for project valuation is 50. For Viva Voce maximum is 50 which will be conducted by both the internal & external examiners.

Grant Total for Project (50) + Viva Voce (50) = 100 marks.

4. The question paper pattern for theory exam is as follows:

SECTION A – 10 x 1 mark –10 marks

(Two questions from each unit)

SECTION B – 5 x 5marks – 25 marks

(One question from each unit with either or choice)

SECTION C – 5 x 8 marks – 40 marks

(One question from each unit with either or choice)

Total 75 marks

5. PRACTICAL EXAMINATIONS - QUESTION PAPER PATTERN

QUESTIONS	**INTERNAL – 50 Marks**	**EXTERNAL – 50 Marks**	**TOTAL MARKS**
1. MAJOR	20	20	
2. MINOR	15	15	
3. SPOTTERS	10 (5 x 2 marks)	10 (5 x 2 marks)	
4. RECORD	5	-	
5. VIVA-VOCE	-	5	
TOTAL	**50**	**50**	**100**

CORE – 1. PLANT DIVERSITY-I: ALGAE, FUNGI & LICHENS

UNIT I **(12 hours)**

ALGAE: Diversity and Habitats- Terrestrial, Freshwater and Marine. Phylogeny of algae. Thallus organization - cell structure. Reproduction: vegetative- asexual- sexual- life cycle patterns – five types. Classification (Sylva, 1982); pigments, reserve food, flagella (criterions).Contributions of Indian Phycologists: T. V. Desikachary, V.K. Krishnamurthy, M.S. Balakrishnan, V.S.S. Sundaralingam.

UNIT II **(12 hours)**

Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta. Algal blooms, Algae as biofertilizer, food, feed and industrial (commercial) products.

UNIT III **(12 hours)**

FUNGI: General Characteristics; substrate relationship in fungi; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotropic, symbiotic); reproduction (vegetative, sexual &asexual); life cycle patterns: heterothallism; heterokaryosis; parasexuality.

UNIT IV **(12 hours)**

Classification: Recent trends (Alexopoulus). General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; Fungi in industry, medicine and as food; fungal diseases in plantsand human; mycorrhizae; as biocontrol agents. Contributions of Indian Mycologists.

UNIT V **(12 hours)**

LICHENS: Classification (Hale, 1969). Occurrence and interrelationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolichens and Deuterolichens. Lichens as indicators of Pollution, Economic importance of Lichens.

Text Books

1. Alexopoulos, C.J. and Mims, M. Blackwel. 1996. Introductory Mycology. John Wiley & Sons Inc.
2. Morris, I. 1986. An Introduction to the Algae. Cambridge University Press, UK.
3. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition).

REFERENCES*:*

4. Clifton, A. 1958. Introduction to the Bacteria. McGraw-Hill book co., New York.
5. Kumar, HD. 1988. Introductory Phycology. Affiliated East-West Press, New Delhi.
6. Mehrotra, RS. & Aneja, RS. 1998. An Introduction to Mycology. New Age International Press.
7. Rangaswamy, G. and A. Mahadevan. 1999. Disease of Crop Plants in India (4th Edition). Prentice Hall of India Pvt. Ltd., New Delhi.
8. Webster, J. 1985. Introduction to Fungi. Cambridge University Press.
9. Sharma, O.P. Text book of Algae. Tata McGraw Hill, New Delhi.
10. Raven, P. H. and G. B. Johnson. 2002. BIOLOGY 6th ed. McGraw-Hill. Boston.

CORE – 2. PLANT DIVERSITY- II: BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

UNIT I **(12 hours)**

Bryophytes: Morphology, structure, reproduction &life history; distribution; classification (Watson/ Rothmalar), phylogeny. General account of Hepaticopsida: Marchantiales, Jungermaniales; Anthocerotopsida: Anthoceratales;Bryopsida: Sphagnales;Funariales and Polytrichales. Economic &Ecological importance.

UNIT II **(12 hours)**

Pteridophytes: Morphology, anatomy and Reporduction; classification (Reimer/ Sporne), Phylogeny. Eevolution of stele; heterospory and origin of seed habit.Characteristics features of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

UNIT III **(12 hours)**

Gymnosperms: General characters; the vessel-less and fruitless seed plants, variations in reproductive structures, pollen germination and the complexity of their female gametophyte. Evolution of gymnosperms and angiosperms.Economic importance.

UNIT IV **(12 hours)**

Gymnosperms: Classification (Sporne, Pilger&Melchoir);Distribution in India; General account of Pteridospermales: (Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae). Cycadeoidales and Cordaitales.Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales,and Gnetales.

UNIT V ` **(12 hours)**

Paleobotany: Geological time scale. Fossils &Types: general account. Fossils:algae, fungi, bryophtes. Study of fossil forms: *Lyginopteris, Heterangium, Medullosa, Cycadeoidea, Pentaxylon* and *Cordaites.*Major fossil sites (India): Thiruvakkarai, Sriperumbudhur, Neyveli lignite, Rajmahal Hills. Paleobotany in phylogeny;Indian Paleobotanists: Birbal Sahni, D.D. Pant, M. Ramanujam,Osmani.

Text books

1. Bhatnagar, SP and Moitra, A.1996.Gymnosperms. New Age International, New Delhi.
2. Parihar, N. S. 1991. Bryophyta. Central Book Department, Allahabad
3. Parihar, NS. 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
4. Sporne, KK. 1991. The Morphology of Pteridophytes. BI Publishing, Bombay.
5. Sporne, KR.1965. The Morphology of Gymnosperms. BI Publications,New Delhi.

REFERENCES

6. Boid, H. C. 1982. Bryophyta. Wiley-Eastern.
7. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5th Edition.).
8. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition)
9. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science, (1st Edition).
10. Scott, D. H. 1962. Studies in Fossil Botany.

PRACTICAL – I: PLANT DIVERSITY I & II

Study of following algal flora with special reference to morphology and anatomy of vegetative & reproductive structures: *Spirulina, Scytonema, Ulva, Chaetomorpha (*Hill streams*), Cephaleuros (*Tea and Mango leaves*) Codium, Halimeda, Chara, Padina, Sargasum, Gracliaria, Ceramium (*epiphytic)*, Cyclotella (*Diatoms- freshwater*).*

Study of morphology and reproductive features of following Fungi: *Albugo, Aspergillus, Peziza, Polyporus, Puccinia, Colletotrichum, Fusarium, Cercospora; Parmelia*and *Usnea (*Lichens*).*

Morphological and anatomical studies of the following bryophytes using whole mount preparation, dissection and sections: *Marchantia*, *Reboulia, Porella, Anthoceros, Funaria, Polytrichum.*

Structural details of the vegetative and reproductive parts of the following types: Psilotum, *Lycopodium, Selaginella*, *Isoetes, Equisetum, Ophioglossum, Lygodium, Adiantum, Marselia, Salvinia.*

Comparative study of vegetative and reproductive parts of *Cycas, Cupressus, Araucaria, Podocarpus, and Gnetum.*

Structural details of the following fossil types: *Lyginopteris, Heterangium, Medullosa. Rhynia, Lepidodentron, Sphenophyllum, Calamites*.

CORE – 3. MICROBIOLOGY

UNIT I **(10 hours)**

Microbiology: Fundamentals, definition and scope; history and recent developments. Spontaneous generation, biogenesis. Diversity of microorganisms. Classification of Bacteria according to Bergey's manual. Ultra structure of Archaea (*Methanococcus*); eubacteria (*E. coli*); unicellular eukaryotes (*Yeast*).

UNIT II **(14 hours)**

Microbial Techniques: microbial nutrition; types of culture media. Physical &chemical methods of sterilization. Cultivation of microorganisms: Pure culture,Batch, fed-batch,

continuous culture, synchronous growth. Culture enrichment methods;culture collection and maintenance. Microbial growth: growth estimation methods. Microbial Physiology**:** bacterial **c**ellular structures, bacterial grwoth, multiplication, nutritional requirements, growth inhibitors, bacteriostatic & antibiotic agents.

UNIT III **(12 hours)**

Microbial Genetics: Introduction and history of microbial genetics.Bacterial reproduction - transformation, conjugation and transduction. Plasmids: characteristics and types, Bacterial genomes (*E.coli);* recombination, transposons. Microbial Interactions and Infection: Host–Pathogen interactions; Mechanism of pathogenesis. Pathogenicity islands and bacterial virulence. Microbial Toxins- types, structure and properties. Superoxides and Pathogenesis-Related (PR) Proteins, Systemic acquired resistance, signal transduction, plant disease resistance genes ("R" genes). Mechanism of Drug resistance and Multiple Drug Resistance – examples.

UNIT IV **(12 hours)**

Virology: Structure and Classification of Bacterial, Plant, Animal viruses, bacteriophages, phageλ life cycle, RNA /Retroviruses; Satellite viruses, Viroids, Virusoids. Microbial associations: Symbiotism, Amensalism, Commensalism, Parasitism and Predation with suitable examples.Plant-microbe interactions, molecular mechanisms. Rhizosphere bacteria. Role of *Rhizobium* and related bacteria in nitrogen fixation. Plasmids: types and properties.

UNITV **(12 hours)**

Immunology: basic concepts, immune system, adaptive and innate immunity, production and properties of T & B cells, types, structure &functions of immunoglobulins, antigen-antibody interactions, agglutination, monoclonal and polyclonal antibodies, biological allergens, hypersensitivity, autoimmunity. Active and passive immunizations, vaccines types, production and uses.

Text Books

1. Prescott, L. M., J. P. Harley and D. A. Klein. 2005. Microbiology. Sixth edition, International edition, Mc Graw Hill.

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

REFERENCES

3. Alexander, A. M. 1974. Microbiology Ecology, Jhon Willy & Sons.

4. David R Hyde. 2010. Genetics and Molecular biology. Special Indian edition, Tata Mc Graw Hill P.Ltd., New Delhi.

5. Dubey, R. C. and D. K. Maheswari. 2012. A text of Microbiology (Revised edition)**.** S. Chand and Company Ltd., New Delhi.

6. GeetaSumbali and R. S. Mehrotra. 2009. Principles of Microbiology. First edition, Tata Mc Graw Hill P. Ltd., New Delhi.

7. Mahabal Ram. 2010. Fundamentals of Cytogenetics and Genetics. First edition, PHI Learning P. Ltd., New Delhi.

8. Moat, G. and John W. Foster, Michael P. Spector. 2002. Microbial physiology. Fourth edition, A John Wiley sons, Inc. publication. New Delhi.

9. Ramawat and Shaily Goyal. 2010. Molecular biology and Biotechnology. First edition S. Chand & Co. Ltd., New Delhi.

10. Robert F Boyd. 1984. General microbiology. Times Mirror and Mosby College Publishers.

CORE – 4. CELL AND MOLECULAR BIOLOGY

UNIT I **(10 hours)**

Cell structure, prokaryotic and eukaryotic cells; plant and animal cells. Origin, structure and functions of cytoplasmic organelles – Mitochondria and Chloroplast; Golgi apparatus, Ribosomes, Dictyosome, Lysosome,Sphaerosome, Glyoxisome and Peroxisome, Vacuoles. Cytoplasm: physicochemical properties and chemical composition. Cell wall: Primary, secondary and tertiary at microscopic, submicroscopic and molecular levels. Chemistry of cell wall polysaccharides, cellulose, lignin, chitin, suberin, cutin and wax.

UNIT II **(10 hours)**

Plasma membrane- structure, chemical nature, models and functions, transport across cell membranes. Signal transduction**:** Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascade, protein kinases and phosphatases,insignaling mechanisms, e.g. two-component sensor-regulator system in bacteria and plants.

UNIT III **(10 hours)**

Structure and functions of Nucleus, Nuclear envelope and Nucleolus. Chromosomes-detailed morphology. Chromosome structure and packaging of DNA, organization of centromere and telomere. Cell cycle and its regulation role of cyclins and Cdks. Cell divisions: Mitosis, Meiosis - process of meiosis in detail, Chromosomal aberrations-, duplications, inversions (paracentric and pericentric) and translocation. Euchromatin and heterochomatin; banding patterns; specialized types of chromosomes; polytene, lampbrush, B- chromosomes and sex chromosomes; molecular basis of chromosome pairing. Physical mapping of genes on chromosomes. Computer chromosome analysis, chromosome micro dissection. Karyotype analysis.

UNIT IV **(15 hours)**

Nucleic acids: Physical and chemical properties of DNA & RNA, Types of DNA & RNA, Watson and Crick model, Viral and bacterial DNA, Mitochondrial and chloroplast DNA, Methylation of DNA and mismatch repair; C-value paradox; cot curve. Genetic code. Central Dogma of Moleular Biology; DNA as genetic material, DNA synthesis and replication, semi-conservative, discontinuous replication, DNA replication enzymes, replication in prokaryotic and eukaryotic cells, termination of replication. Vectors of molecular interest: plasmids, cosmids, phagemids, BAC, YAC, PAC, shuttle vectors; salient features of ideal vector systems. Role of promoters, linkers and adapters. Gene cloning techniques. Screening and analysis of recombinants. Gene expression and production of proteins; host systems: prokaryotic and eukaryotic gene expression. Construction, comparisons and applications of genomic and cDNA libraries.

UNIT V **(15 hours)**

Transcription: prokaryotic and eukaryotic transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, elongation and termination, RNA processing (capping, polyadenylation, RNA editing, and splicing), m-RNA transport and transcription inhibitors. Translation: prokaryotic and eukaryotic translation machinery, aminoacylation of tRNA, initiation factors, formation of initiation complex, elongation and elongation factors, termination, translational proof-reading, Translational inhibitors. Post-translational modification of proteins. Recombinant DNA technology: Tools used in R-DNA Technology; Restriction enzymes, DNA Polymerases, Reverse Transcriptase, Terminal

Transferases, DNA-dependent RNA polymerases, DNA ligases, Nucleases. Sticky and Blunt ends.

Text Books

1. David R Hyde. 2010. Genetics and Molecular biology. Special Indian edition, Tata Mc Graw Hill P.Ltd., New Delhi.

2. Klein Smith, L. J. and V. M. Kish. 1995. Principles of Cell and Molecular Biology (2nd edition). Harper Collins College Publishers, New York, USA.

3. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition).

4. Wolfe. S. L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.

REFERENCES

5. Lewin, B. 2000. Genes VII. Oxford University Press, New York.

6. Alberts, B. and D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson. 1999. Molecular Biology of Cell. Garland Publishing, Inc., New York.

7. Rost, T. *et al*. 1998. Plant Biology. Wadsworth Publishing Co., California, USA.

8. Krishnamurthy, K. V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.

9. Buchanan, BB, and W. Gruissem, RL. Jones. 2000. Biochemistry and Molecular Biology of Plants. American Society of plant physiologist, Maryland, USA.

10. De, D. N. 2000. Plant cell vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.

11. Lodish, H. and A. Berk, S. L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell. 2000. Molecular Cell Biology. 4th Edition. WH Freeman and Co., New York.

References for practical

1. Glick, B. R. and J. E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
2. Glover, D. M. and B. D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd edition PAS, IRL press at Oxford University Press, Oxford.
3. Gunning, B. E. S. and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.

4. Hackett, P.B. and J. A. Fuchs, J. W. Messing. 1988. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/ Cummings Publishing Co., Inc Menlo Park, California.
5. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
6. Harris, N. and K. J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
7. Shaw, C. H (Ed). 1988. Plant Molecular Biology: A Practical Approach. IRL Press, Oxford.

PRACTICAL –2 : MICROBIOLOGY & CELL AND MOLECULAR BIOLOGY

1. Methods of sterilization.
2. Preparation of culture media and Culture of bacteria on solid and liquid medium for the growth of microorganisms
3. Determination of bacterial growth & Growth curve by turbidimetric method.
4. Simple and Differential staining
5. Isolation pure cultures from soil and water and maintenance of organisms by plating, streaking and serial dilution methods.
6. Effect of temperature, pH and carbon and nitrogen sources on growth.
7. Assay of antibiotics and demonstration of antibiotic resistance.
8. Analysis of water for portability and determination of MPN.
9. Biochemical characterization of selected microbes.
10. CO2 fixation by photosynthetic microbes.
11. Preparation of alcohol from fruit juice(s).
12. Isolation and observation of genomic and plasmid DNA from microorganisms.
13. Screening of amylase/cellulase producing organisms.
14. Identification and enumeration of white blood cells.
15. Antigen-Antibody precipitations reactions and determination of Antibody titre.
16. Transformation of E. coli.
17. Study of mitosis - onion root tip squash for chromosomal examination – Haematoxylin staining
18. Study of meiosis – *Tradescantia/Rhoeo* for chromosomal examination – Acetocarmine staining

19. Isolation of Chloroplasts and SDS-PAGE profile of proteins to demarcate the two subunits of RUBISCO.
20. Isolation of mitochondria and activity of its marker enzyme – Succinate dehydrogenase (SDH).
21. Isolation and separation and quantitation of nuclear DNA by spectrophotometric method. Preparation of 'cot' curve.

OPTIONAL ELECTIVE 1: ANY ONE OF THE FOLLOWING

Elective: EVOLUTIONARY BIOLOGY (MODIFIED)

Unit I **(5 hours)**

Origin, evolution and diversification of life. First living molecules - Microevolution - prokaryotes- Protists- Plants- Fungi. Endosymbiois and co evolution. Geological time scale.

Unit II **(10 hours)**

Natural selection; levels of selection. Darwin and the theory of evolution, quantitative traits. Types of selection; sexual selection; genetic drift; gene flow; adaptation; convergence; species concepts;life history strategies; adaptive radiation; biogeography.

Unit III **(10 hours)**

Origin of genetic variation; mendelian genetics; polygenetic traits, linkage and recombination; epistasis, gene-environment interaction; heritability; population genetics; molecular evolution - cladistics.

Unit IV **(10 hours)**

Mutation and migration; units of selection; phylogenetic analysis and comparative methods; Speciation; extinction and biodiversity; evolution of diversification.

Unit V **(10 hours)**

The Fossil Record and Life's History; The environment's role in development and evolution; Major transition in evolution; co-evolution; Macroevolution.

REFERENCES

1. Bishop, BA. and Anderson, C. Students' conceptions of natural selection and its role in evolution.
2. Douglas J. Futuyma. 2005. Evolution. Sinauer Associates, Sunderland.

3. Hartl, D. L. 1988.A primer of population genetics (2nd Edition).
4. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5th Edition.).
5. Mark Ridley. 2004. Evolution (3rd Edition.). Blackwell Publishing Ltd., UK.
6. Minkoff, E. C. 1983. Evolutionary biology.
7. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition).
8. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science.
9. Sean, BC, GrenierJK and Weather Bee, SD.From DNA to Diversity (2nd Edition).
10. Sober, E. 1994. Conceptual issues in evolutionary biology.
11. Steven Gaulin&Donald McBurney. 2004. Evolutionary Psychology (2ndEdition).

Elective: PLANT DISEASES AND INSECT PEST CONTROL

Unit I **(9 hours)**

Plant pathogens concepts of Plant diseases, Classification of plant disease based on casual organisms such as Fungi, Bacteria, Viruses, MLO's impact of plant diseases on crop production assessment, Diagnosis, Identification of casual organism by Koch postulates, Microscopic principles of plant disease control, Histochemical and Serological methods of studying plant pathogens. Molecular basis of diagnosis, Chemicals, Enzymes of pathogens in infective, Microbial toxins. Modern techniques in analysis of plant diseases.

Unit II **(9 hours)**

Fungi and fungal disease, and Storage fungi, Infectious fungi, Mechanism of infection and Dissemination of fungal diseases, Symptomology and Identification of fungal diseases. Bacteria and bacterial disease, Classification, Mechanism of infection, Dissemination, Symptomology and Identification.

Unit III **(9 hours)**

Viruses and viral disease: Mechanism of Infection and Dissemination symptoms and Methods of Identification, MLO's as diseases causing Prokaryotes, Classification of MLO'S. Diseases caused, Symptoms, Method of infection and Identification. Parasitic Green algae and parasitic higher plants – Symptoms and Identification.

Unit IV **(9 hours)**

Introduction of insects: Pests, General characters, Habitats, Damage, Economic Threshold Level, Natural enemies, Parasitoids and Predators. General description and morphology of the Insect: Head, Thorax and Abdomen. Anatomy and Physiology

of the Insect: Digestive system, Nervous system, excretory system, Reproductive system and Circulatory system. Classification of pests: Based on damage, Feeding habitat and Taxonomy etc.

Unit V **(9 hours)**

Classification of Insect pests based on Nature of damage, Mouth parts, Metamorphosis. General life cycle patterns of insect pests: Grasshopper, Aphid, Lepidopteron Borer, White grub, Red hairy caterpillar, Snails, Slug, Nematodes, Rat. Application of insecticides – Targets, Droplet size, Application equipment, rational application. Biological control - Types of biocontrol agents. Techniques of biocontrol. Genetic control and area-wide management.

REFERENCES

1. Agrios, GN. Plant Pathology. 2004. 5th Edition. Academic Press.
2. Atwal, A. S. Agriculture pest of India and South East Asia.
3. Green, M. B. Chemical for crop improvement and pest management.
4. Larry P. Pedigo. Entomology and pest management.
5. Maniloff, J.1992. Mycoplasma molecular biology and pathogenesis.
6. Mundkar, B. B. 1972. Fungi and plant diseases.
7. Paul and Khurana, S. M. 1998. Pathological problems of economic crop plant and their management.
8. Raychandhuri, S. P. and Anupamvarma. 1989. Plant diseases caused by fastidious Prokaryotes.
9. Srivastava, K. P. A textbook of applied entomology.
10. Tarr, S. A. J. 1972. Principles of plant pathology.
11. Thurston, H. D. 1993. Tropical plant diseases.

Elective: **AQUATIC AND MARINE PLANTS**

Unit I **(5 hours)**

Plant aquaculture: History, principles, scope and importance. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques of sea weeds. Important cultivable species of aquatic plants and sea weeds, micro algae. Biodiversity of Seaweeds along the coast of India. Taxonomy of economically important seaweeds. Products from seaweeds.

Unit II **(10 hours)**

Vascular plants: Biodiversity of freshwater higher vascular plants in India. Taxonomy of economically important freshwater higher vascular plants. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques of freshwater higher vascular plants (Trapa,Typha), products of higher vascular plants. Taxonomy of economically important micro algae. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques and Importance of Spirulina and chlorella. Application of microalgae in water treatment and Bioremediation.

Unit III **(10 hours)**

Phytoplankton (freshwater and marine): - methods of assessment, spatial and temporal variations, succession, diversity; Nanoplankton; Algal blooms; Role in carbon sequestration. Classifications of plankton; Primary and secondary production - estimation, significance, affecting factors; Production - biomass (P/B ratio); Indices of productivity; Community interrelationships.

Unit IV **(10 hours)**

Storage and structural components in algae: Seaweed polysaccharides- Chemical structure, properties and extraction of Agar. Nutrient requirement- Essential elements, vitamins for growth of algae. Metabolic role of essential nutrients. Salt regulation in halophytes: Salt glands and salt secretion. Significance of vivipary. Leaf succulence, selective ion absorption. Salinity and metabolism: Influence of salinity on photosynthesis of halophytes. Induction of CAM. Membrane transport under salinity. Effect of salinity on growth and phytohormones.

Unit V **(10 hours)**

Biodiversity of mangroves: Brief idea of Creek, Estuary, Lagoon and Delta. Definition - ‘mangrove’. Distribution – biogeography of Indian mangroves, East and West coast mangroves, Mangrove shores and forests. Salient features of important mangrove families such as Rhizophoraceae, SonneratiaceaeAvicenniaceae, Myrsinaceae, Acanthaceae etc. Methods of natural and artificial regeneration in mangroves.

REFERENCES

1. Chapman, V. J. 1976. Costal Vegetation 2nd edition. Pergamon Press, New York.
2. Fasset, NG.1997. A Manual of Aquatic Plants. Allied Scientific Publishers, Bikaner.
3. Jackson, D. F. 1972. Algae and Man. Plenum Press.

4. Lobban, C. S. and P. J. Harrison. 1985. Seaweed Ecology and Physiology.
5. Lund, H. C. and J. W. G. Lund. 1995. Freshwater Algae. Biopress Ltd., Bristol.
6. McConnaughey, BH.1974. Introduction to Marine Biology.CV Mosby Co, St. Louis.
7. Ring, M. 1982. The Biology of Marine Plants. Edward Arnold Publishers, London.
8. Sournia, A. 1978. Phytoplankton Manual. UNESCO Publication, Paris.
9. Tomas, C. R. 1997. Identifying Marine Phytoplankton. Academic Press, San Diego.

Supportive course – offered by other departments

CORE – 5. GENETICS

UNIT I **(8 hours)**

Mendelian Genetics: Laws of inheritance, modified Mendelian, ratios complementary and supplementary genes. Lethal genes, multiple alleles - ABO blood group system in humans, Polygenic inheritance (kernel colour in wheat, ear head length in maize, skin colour in humans).Extra-chromosomal or Cytoplasmic inheritance: genetics of chloroplasts and mitochondria.

UNIT II **(12 hours)**

Sex linked inheritance – color blindness, haemophilia.Behavior of chromosomes during meiosis, non-disjunction, chiasma formation, linkage and crossing over – theories. Ploidy types and significance, Haploids, aneuploids and euploids, auto andallopolyploids. Cytoplasmic male sterility. Self incompatibility in *Nicotiana*. Population genetics; Hardy-Weinberg Equilibrium. Gene structure and Expression: Fine structure of gene, cis – trans test, cistron, muton, recon. Gene expression in prokaryotes and eukaryotes. Regulation of gene expression in prokaryotes and eukaryotes; *Lac* operon, *Trp* operon. Repression and induction.

UNIT III **(10 hours)**

Molecular mechanism of recombination (role of RecA and RecBCD enzymes). Site specific recombination. Gene Mapping, chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps. Stern's and McClintock-Creighton experiments – transposable elements in prokaryotes and eukaryotes. Plant Genomes.

UNIT IV **(10 hours)**

Mutations: Types of mutations, methods of detection of mutations, CIB method and attached-X method, Molecular mechanism of spontaneous and induced mutations, site directed mutagenesis. Homeotic mutants in *Arabidopsis* and *Antirrhinum*. Mutagenic effects of food additives and drugs. Ames test. DNA damage and repair. Initiation of cancer at cellular level, tumor suppressor genes, proto-oncogenes and oncogenes.

UNIT V **(20 hours)**

Genetic Manipulation of Microbes: Genetic improvement of industrial microbes and nitrogen fixers; strain improvement for fermentation technology. Production of transgenic microbes: insulin synthesizing E. coli. Microbial plasmids and genes useful for bioremediation, environmental clean-up (degradation/detoxification of pollutants), metal extraction/ bioleaching, bioengergy and biocontrol. PCR Technology: basic concepts, principles and procedure. Thermal cyclers and thermo-stable DNA polymerases. Primers and designing of primers. Major factors and troubleshooting. Types of PCR. Applications of PCR in cloning genes, probes and DNA sequencing.PCR in molecular marker technology (RAPD, ISSR, AFLP, SCAR); DNA Profiling in forensics and paternity determination.

Text books

1. Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.

2. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition

REFERENCES

3. Alberts, B. and D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson. 1989. Molecular Biology of the Cell (2nd edition). Garland Publishing Inc., New York.
4. Atherly, A. G, and J. R. Girton, J. F. McDonald. 1999. The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
5. Hartl, D. L. and E. W. Jones. 1998. Genetics: Principles and Analysis (4th edition). Jones & Bartlett Publishers, Massachusetts, USA.
6. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5th Edition.).
7. Karp, G. 1999. Cells and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc., U.S.A.
8. Lewis, R. 1997. Human Genetics: Concepts and Applications (2nd edition). WCB McGraw Hill, USA.

9. Malacinski, G. M. and D. Freifelder. 1998. Essentials of Molecular Biology (3rd edition). Jones & Bartlett Publishers, Inc., London.
10.).
11. Snustad, D. P. and M. J. Simmons. 2000. Principles of Genetics (2nd edition). John Wiley & Sons, Inc.

CORE – 6. ANATOMY AND DEVELOPMENTAL BOTANY

UNIT I **(10 hours)**

Tissue systems: simple and complex. Vascular cambium: origin, structure and development. Anomalous secondary growth: *Boerhavia, Draceana*. Secretory ducts and laticifers; wood development in relation to environmental factors. Leaf anatomy: structure of dicot and monocot leaves. Unique features of plant development; differences between plant and animal development.

UNIT II **(15 hours)**

Seed germination and seedling growth: Mobilization of food reserves; tropisms; hormonal control of seedling growth. 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.Leaf growth and differentiation: Determination ofphyllotaxy; 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.

UNIT III **(15 hours)**

Reproduction: Vegetative and sexual reproduction; flower development; genetics of floral organ differentiation.Male gametophyte: anther structure; microsporogenesis; role of tapetum; pollen development and gene expression; male sterility; sperm dimorphism & hybrid seed production; pollen germination, pollen tube growth and guidance; pollen storage; pollen allergy; pollen embryos.Female gametophyte: Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells.

UNIT IV **(12 hours)**

Pollination, pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms. Structure of pistil; pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, biochemical, molecular aspects); double fertilization. Seed development and fruit growth: Embryogenesis: dicot and monocot, polyembryony, apomixes. Endosperm development and types; storage proteins of

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

UNIT V **(8 hours)**

Preparation of common lab stains and reagents: Basic (Safranin, Crystal violet, Basic fuchsine, Cotton blue); Acidic (Fast green, Orange G, Erythrosine, Eosin, and Toluidene blue O). Staining procedures: Single, double and triple staining. Staining combinations (safranin and fast green /cotton blue crystal violet/ orange-G and safranin). Histochemical analysis of plant tissues. Histochemical staining and analysis of plant metabolites. Histochemical localization of minerals, proteins, nucleic acids, insoluble carbohydrates, & lipids. Enzyme histochemistry: General account. Vital staining: principle, procedure, and applications.

TEXT BOOKS

1. Bhojwani, S. S. and S. P Bhatnager. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
2. James D. Mauseth. 2003. Botany: An Introduction to Plant Biology. Jones & Bartlett Learning.
3. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
4. Ray F. Evert. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development. John Wiley & Sons. Hoboken, New Jersey.

REFERENCES:

5. Atwell, B. J. and Kriedermann, PE, Jurnbull, CGN. (eds). 1999. Plants in Action: Adaptation in Nature, Performance in Cultivation. MacMillan Education, Sydney.Bewley, J. D. and M. Black. 1994. Seeds: Physiology of Development and Germination. Plenum Press, New York.
6. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.

7. Fageri, K. and L. Van der Piji. 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford.
8. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.
9. Fosket, DE.1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
10. Howell, S. H. 1998. Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
11. Leins, P. and S. C. Tucker, P. K. Endress. 1988. Aspects of Floral Development. J. Cramer, Germany.
12. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition).
13. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science, (1st Edition).
14. Proctor, M. & Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
15. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
16. Shivanna, K. R. and B. M. Johri. 1985. The Angiosperm Pollen: Structure and Function. Wiley Eastern Ltd., New York.
17. Shivanna, K. R. and V. K. Sawhney (Eds). 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
18. Steeves, T. A. and I. M. Sussex. 1989. Patterns in Plant Development (2nd edition). Cambridge University Press, Cambridge.
19. The Plant Cell. Special Issue on Reproductive Biology of Plants, Vol. 5(10) 1993. The American Society of Plant Physiologists, Rockville, Maryland, USA.

PRACTICAL-3: **GENETICS, ANATOMY AND DEVELOPMENTAL BOTANY**

1. Staining and localization of Nucleus – light and fluorescent microscopic methods.
2. Chromosome mapping from test cross data
3. Calculation of interference.
4. Multiple alleles and blood group inheritance - problems
5. Sex linked inheritance – problems
6. Population genetics -calculation of gene frequencies
7. Construction of molecular maps

8. Ames test
9. Role of dark and red light/far-red light on the expansion of cotyledons and epicotylar hook opening in pea.
10. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla.*
11. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as *Coleus, Kalanchoe,* tobacco.
12. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordial.
13. Study of alternate and distichous, alternate and superposed, opposite and superposed; opposite and decussate leaf arrangement.
14. Examination of rosette plants *(Mollugo, Raphanus, Hyoscyamus*)
15. Monocotyledon – leaf , stem, and root - sections
16. Dicotyledonous leaf, stem, root - sectioning
17. Anther sectioning and developmental stages
18. Acetolysis and Pollen grain staining.
19. SEM images of anatomical & morphological portions.
20. Isolation of nuclei and identification of DNA by AGE.
21. Restriction digestion and estimation of the size of various DNA fragments
22. Polymerase Chain Reaction amplification of DNA and analysis of the products
23. Cloning of DNA fragments in a plasmid vector, transformation of the given bacterial population and selection of recombinants
24. Demonstration of DNA sequencing by Sanger's dideoxy method

Core – 7. INSTRUMENTATION AND RESEARCH METHODOLOGY

UNIT I **(10 hours)**

Principles and operations: pH meter, Electrical conductivity and salinity meters.Preparation of Molar, Normal, ppm, percentage and buffer solutions. **Spectrophotometry**: Beer's Lambert law and its application, UV- visible, AAS, GC-MS, IR, NMR, Raman spectroscopy. **Chromatography: P**rinciples and applications; Paper, Thin Layer, Column and HPLC.

UNITII **(15 hours)**

Electrophoresis: principles, applications. Agarose, Starch, Acrylamide Gel Electrophoresis. Blotting Techniques: Southern, Western and Northern blots. Gel documentation systems. Radioactive and Non-Radioactive probes and uses. Autoradiography. DNA finger printing Techniques. **Microscopy:** Principles and applications of Light, Compound Phase-Contrast microscopes, Fluorescent microscopy, Electron microscopy: TEM, SEM; Confocal microscopy. Micrometry: Ocular and stage meter and Image analysis. **Centrifuges**: principles; differential &density gradient centrifugations; types: clinical/ low-speed, High speed, Micro and Ultra centrifuges. Sedimentation coefficient, Svedberg (S) unit, RPM, RCF, g; rotor types (fixed angle, swinging bucket, vertical, zonal). Advantages, applications and limitations

UNIT III **(15 hours)**

Biostatistics: Principles, practice of statistical methods in biological research; sources and presentation of data. Measures of Central Tendency: Mean, Median and Mode. Measures of Dispersion: Range, mean deviation, standard deviation, coefficient of variation and standard error. Simple correlation and linear regression analysis. Probability: Basic concepts. Theoretical distributions: Binomial, Poisson and Normal. Tests of statistical significance: Chi-square and *t*-tests. F-distribution and Analysis Of Variance (ANOVA): one way &two-way. Data presentation inMS-Excel.

Unit IV **(10 hours)**

Microtome types: Rotary, Sledge, and Cryostat. Micropreparation processing procedure; Fixing: common fixatives, preparation & specific uses; Dehydration: Dehydrating agents, Clearing – Xylol/TBA series, Paraffin infiltration; Wax embedding. Blocks Preparation: wax blocks & paper boats. Sectioning paraffin blocks in rotary microtome. Adhesives & their preparations. Mounting and spreading of paraffin ribbons on micro slides. Processing & preparation of ultrathin sections-TEM.

UNIT V **(10 hours)**

Research Methodology: Types of research, scientific research: hypothesis, experimentation, theory. Preparation of research articles: review article, research papers, online publications, thesis writing, editorial process and proof-reading symbols. Presentation of research papers in seminar, symposia and conferences. Research ethics.

REFERENCES:

1. Jensen, W. A. 1962. Botanical Histochemistry. WH Freeman & Company.
2. Johansen, D. A. 1940. Plant Microtechnique. McGraw Hill.
3. Khasim, S. M. 2002. Botanical Microtechnique: Principles and Practice. Capital Publishing Company.
4. Krishnamoorthy, K. V. 1999. Methods in Cell Wall Cytochemistry. C.R.C. Press.
5. Maniatis and Sambrook. Introduction to Gene cloning.
6. Miksche, J. P. 1976. Botanical Microtechnique and Cytochemistry. Dowa State University Press.
7. Panse and Sukhatme. 1992. Statistical Methods for Agricultural workers. ICAR, New Delhi.
8. Philippa D. Dabre. Introduction to practical molecular Biology.
9. Reed, R. and J. Holmes, J. Weyers, A. Jones. 1998. Practical Skills in Biomolecular Sciences. Longman, Essex.
10. Reid, P D&Pont-Lezica RF (Eds.).1992.*Tissue Printing*. Academic Press, New York.
11. Roberts. Plant Biotechnology (Manual).
12. Sanderson, J. B. 1994. Biological Microtechnique. Bios Scientific Publishers.
13. Sandhu, G. S. 1990. Research techniques in biological sciences. Anmol Publications, New Delhi.

CORE – 8. PHYTOCHEMISTRY

Unit I **(15 hours)**

Phytochemistry: Definition, history, principles. Secondary metabolites: definitions, classification, occurrence and distribution in plants and their chemical constituents. Alkaloids, Terpenoids, Flavonoids, Steroids, and Coumarins.

Unit II **(12 hours)**

Techniques for isolation of medicinally important biomolecules: solvent extraction, chemical separations, steam distillation, soxhlet extraction. Purification, concentration, determination and quantification of compounds(TLC, Column,HPLC). Characterization of phytochemicals: spectroscopic methods.

Unit III **(10 hours)**

Biosynthetic pathways of secondary compounds: Shikimic Acid pathway; Mevalonic Acid Pathway; Pathways for commercially important phytochemicals: Forskolin, Taxol and *Vinca* alkaloids. Applications of phytochemicals in medicine, pharmaceuticals, food,flavour and cosmetic industries.

Unit IV **(8 hours)**

Herbs and healing: Historical perspectives: local, national and global level; Herbal cultures: origin and development of human civilizations; Ethnobotany and Ethnomedicine; Development of European, South and Central American, African, Indian, Chinese, and South East Asian Herbal Cultures.

Unit V **(15 hours)**

Classical health traditions: Systems of medicine: origin and development of biomedicine; Indian Systems of Medicine (Ayurveda, Siddha, Unani, Tibetan) Ayurveda: Historical perspective, *Swasthavritta* (measures to be adopted for maintaining the health of healthy person in a positive way through prevention, promotion and correction), *Athuravritta* (disease management and treatment which involves eight specialties including Internal medicine and surgery); Fundamental principles of Ayurveda: Panchabhootha theory, Thridosha theory, Saptadhatu theory and *Mala* theory; Ayurvedic Pharmacology, Ayurvedic Pharmacopoeia; *Mrigayurveda* and *Vrikshayurveda.*

Text books

1. Bannerman, R. H., J. Burton and C. Wen Chen (eds). 1983. Traditional medicine and health care coverage. WHO, Geneva.
2. Harborne, JB. 1984. Phytochemical Methods (2nd Ed.). Chapman &Hall, London

REFERENCES:

3. Agarwal, P. K. and R. S. Thakur, C. M Bansal. 1989. Carbon-13 NMR of Flavonoids. Elsevier Science Publishers, Amsterdam.
4. AlerGingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.
5. Braithwaite, A. and F. J. Smith. 1996. *Chromatographic Methods* (5th Edition) Blackie Academic & Professional London.
6. Mann J. Davidson, R. S and J. B. Hobbs, D. V. Banthorpe, J. B. Harborne. 1994. *Natural Products*. Longman Scientific and Technical Essex.

7. Schwedt, G. 1997. The Essential Guide to Analytical Chemistry. John Wiley & Sons, New York.
8. Wilson, K. and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.
9. Cotton, CM. 1996. Ethnobotany: Principles & Applications. John Wiley & Sons, New York.
10. Gopalan, C., B. V. Ramasastri and S. C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.
11. Kameswara Rao, C. 2000. Database of Medicinal Plants. KSCST, Bangalore
12. Knight, R. L and L. White. 2009. Conservation for a new generation redefining natural resources management. Island Press.

PRACTICAL – 4: INSTRUMENTATION, PHYTOCHEMISTRY AND PLANT HISTOCHEMISTRY

1. Fractionation of proteins using gel filtration chromatography by Sephadex G100 or Sephadex G200.
2. SDS-PAGE for soluble proteins extracted from the given plant materials and comparison of their profile by staining with Coomassie Brilliant Blue or silver nitrate.
3. Verification of Beer and Lamberts law using spectrophotometry.
4. Separation of amino acids using Thin layer chromatography.
5. Separation of plant pigments using column chromatography.
6. Soxlet/steam distillation of major secondary compounds.
7. Isolation of some natural products: Piperine, caffeine, flavone, coumarin, triterpenoids
8. Spectroscopic estimation of some natural products
9. Preparation of stains.
10. Microtomy – Preparation of thin sections and permanent slides.
11. Staining starch, cell wall, lipids, proteins and nucleic acids using bright field dyes
12. Preparation of double stained free hand sections and identification of the tissues with reasons (Normal or anomalous secondary thickening).
13. Free-hand sections showing localization of soluble components-Proteins, Sugars and Lipids.

14. Preparation of serial sections, from the given block and identification of the tissues with histological reasoning.
15. Preparation of squashes and smears. Maceration of the tissues for separating cell types.
16. Students are expected to get a thorough understanding on reagents and buffers for the tissue processing and they should submit 15 permanent slides (5 serial, 5 hand sections for histology and 5 hand sections for sledge and Histochemistry) for valuation.

OPTIONAL ELECTIVE 2: ANY ONE OF THE FOLLOWING

Elective: PLANTS IN TAMIL CULTURE

UNITI **(9 hours)**

Land, People and Literature: Antiquity of Tamil land – occurrence of Paleolithic, Mesolithic, Neolithic and megalithic sites of human settlement. Landscape and vegetation and rainfall patterns.

UNIT II **(9 hours)**

A brief introduction to Sangam literature. Plants in “Kurinjipattu”.Tinai as landscape and ecosystem concept. Importance of plants in five landscapes: Mullai, Marutham, Kurinji, Neythal and Palai.

UNIT III **(9 hours)**

Plants in Tholakkapiaym. Plants used in early Tamil culture as food and economy. Plants in love and war.

UNIT IV **(9 hours)**

Sacred plants associated with gods, temple, religion and rituals. Plants and poetic convention. Recent plant introductions and their adoption in Tamil culture.

UNIT V **(9 hours)**

Plants relevant to Astrological importance – Constellation (Rasi) and star plants. The continuing influence of plants present-day Tamil culture.

REFERENCES:

1. HART, G.L. III. 1975. The Poems of Ancient Tamil. Their Milieu and Their Sanskritic Counterparts. University of California Press, Berkeley.
2. RAMANUJAM, A.K. 1975. The Interior Landscape: Love Poems from a Classical Tamil Anthology. Fitzhenry and Whiteside Limited. Ontario.

3. SAMY, P.L. 1967. *SangaIllakkiathilSedikodiVilakkam*. Saiva Siddhanta Publishing Society. Thirunelveli.
4. SAMY, P.L. 1972. *Plants in KurinjiPattu*. Journal of Tamil Studies.
5. SASIVALLI, V.C. 1989.*Pandai TamilarTolilkal*. International Institute of Tamil Studies. Madras.
6. SOBIDHRAJ, K.K.S. 1993. ThalaMarangal. Sobitham. Tambaram East. Madras.
7. SRINIVASAN, C. *Sanga IlakiaThavarangal*, Tamil University Publication. Thanjavur.
8. THANINAYAGAM, X.S. 1966.Landscape and Poetry: A study of Nature in Classical Tamil Poetry. Asia Publishing House, Madras.
9. VARADARAJAN, M. 1957. The treatment of Nature in Sangam literature. S.I.S.S.W Publishing Society, Madras.
10. www. Thavarathagavalmaiyam.com www.plantinfocentre.com

Elective: HORTICULTURE & PLANT BREEDING

UNIT I **(9 hours)**

PLANT BREEDING: Introduction, Objectives. Plant Reproduction: Mode of reproduction and breeding; Mechanisms of Self-pollinations and Cross-pollinations; Floral Biology in relation to selfing and crossing techniques. Sexual reproduction: objectives;emasculation and pollination methods;raising F1 hybrids. Asexual reproduction: Vegetative and Non-recurrent apomixes;diplospory, apospory, parthenogenesis, Role of apomixes in plant breeding.

UNIT II **(9 hours)**

Hybridization: Objectives, choice of parents, purelines, failure of hybridization-problems &causes;Incompatibility and sterility. Methods of overcoming genetic consequences of hybridization. Methods of handling, segregating hybrids for isolation of superior strains: bulk &pedigree selection methods. Role of interspecific and intergeneric hybridization and plant improvement. Selection: principles, genetic basis and methods; Mass selection, pure line selection, and clonal selection.

UNIT III **(9 hours)**

Back-cross breeding: theory &procedure for transferring various types of characters. Inbreeding depression. Hybrids &Heterosis theories – genetic and physiologic basis – Applications– steps in production of single cross, double cross, three way cross & synthetic cross; male sterility (cytoplasmic, genetic) in hybrid production.

UNIT IV **(9 hours)**

HORTICULTURE: Concepts and Scope; famous gardens in world &India. Tools &Implements. Plant growing structures: Green house, Glass house, Mist chamber,

Shade net and Poly house.Arches, Pergolas, and Topiary. Lawns and Landscapes, Hydroponics.

UNIT V (9 hours)

Plant Propagation: Cutting, Layering, Grafting& Budding. Cultural practices: Thinning, Training, Trimming &Pruning. Fertilizers, Biofertilizers, Green manures, NPK, Compost, Vermicompost. Out-door horticulture- Gardens: Vegetable garden, Medicinal plant garden, Roof garden, Fruit garden, Kitchen garden, Terrace garden; Bonsai.

REFERENCES

1. Adroamce, G. W and F. R. Brison. 2000. Propagation of Horticultural Plants. Biotech Books, New Delhi.
2. Allard, RW. 1999. Principles of Plant Breeding. John Wiley & Sons, New York.
3. AmeHagberg and Eric Akerberg. 1962. Mutations and Polyploidy in Plant breeding. Heimeman Educational Books Ltd. London.
4. Arnold, R. W. 1960. Principles of Plant Breeding. John Wily & Sons, New York.
5. Christopher, E. P. 1981. Introductory Horticulture, McGraw Hill, New Delhi.
6. Darbeswhar Roy. 2000. Plant Breeding. Narosa Publishing House, New Delhi.
7. Edmond, J. B. *et al.*1977. Fundamentals of Horticulture. Tata McGraw Hill, New Delhi.
8. Fred. W. Briggs and Knorotes, P.F. 1967. Introduction to Plant Breeding. Reinhold Publishing Corporation. New York.
9. Graf, A.B. 1981. Tropica (2nd Edition). Roehrs co., USA.
10. Hartmann, H.T and D. E. Kester. 1976. Plant Propagation: Principles and Practices. Prentice and Hall of India, New Delhi.
11. JanickJulu. 1982. Horticultural Sciences. Surjeet Publications, New Delhi.
12. Kumar, N. 1990. Introduction to Horticulture. Rajalakshmi Publication, Nagercoil.
13. Mandal, A. K. 2000. Advances in Plant Breeding. CBS Publishers and Distributors, New Delhi.
14. Manibhushan Rao, K. 1991. Text book of Horticulture. Macmillan India Pvt. Ltd. New Delhi.

15. Panse and Sukhatme. 1992. Statistical Methods for Agricultural workers. ICAR, New Delhi.
16. Rao, A.B. 1991. Text Book of Horticulture. Mac-Millan India Ltd., New Delhi.
17. Sadhu, MK. 1996. Plant Propagation Methods. New Age International, New Delhi.
18. Sing, D.D. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
19. Singh, B. D. 1999. Plant Breeding. Kalyani publishers, New Delhi.
20. Steel and Torrie. 1986. Principles and Procedures of Statistics with special reference to Biological Sciences.

Elective: PLANTS FOR BIO ENERGY AND SPACE RESEARCH

UNIT I **(8 hours)**

Energy sources - General account. Bio energy-energy plantations, social forestry and Silvi culture energy farms. Bio energy sources: Petroleum plants (petro plants)-hydrocarbons for higher plants like *Hevea*and *Euphorbia.* Algal hydrocarbons. Alcohols: Alcohols as a liquid fuel-Hydrolisis of lignocellulosic materials, Ethanol production-. Sources and processing of oils and fats for liquid fuels, Sugarcane molasses and other sources for fermentation and recovery of ethanol.

UNIT II **(8 hours)**

Biomass conversion: Non biological process- Direct combustion (hog fuel), pyrolysis, Gasification and Liquification. Bilogical process: Enzymatic digestion, aerobic and anaerobic digestion

UNIT III **(10 hours)**

Gaseous fuels: Biogas and hydrogen: Biogas technology profit from biogas plants. Biogas production: aerobic digestion solubilization, acidogenesis, methanogenesis. Biogas production from different feed stocks like *Salvinia*and *Eichornia.* Hydrogen as a fuel: Photobiological process of hydrogen production. Hydrogenese and hydrogen production. Halobacteria.

Unit IV **(10 hours)**

Principles and concepts of Remote Sensing. Electromagnetic spectrum; spectral characteristics of surface features (rocks, soils, vegetations, water). Space imaging - Landsat, SPOT, IRS, NOAA, Seasat, ERS, RADARSAT, INSAT. Satellites and their sensors, geometry and radiometry. Digital Image Processing: Principles, Image Rectification and restoration, Image enhancement and Mosaicing. Image

classification. Supervised, Unsupervised, Ground truth data and training set manipulation, Classification accuracy assessment.

Unit V (9 hours)

Geographical Information System (GIS): Basic principles and terminologies, Raster and vector data, Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography; Software used in GIS Surveying: Leveling, Triangulation, Geodetic survey; Global Positioning System (GPS): basic principles, applications to environmental studies.

REFERENCES:

1. Agarwal, N. K. 2004. Essentials of GPS. Spatial Networks Pvt. Ltd.
2. Chakraverthy, A. 1989. Biotechnology and alternative technologies for utilization of biomass or agricultural wastes. Oxford & IBA pub. Co., New Delhi.
3. Coronel, C. Morris, S., and Rob, P. 2009. Database Systems:Design, Implementation and Management (9thRevised Ed.). South-Western, Nashville.
4. Elachi, C. 1978. Introduction to Physics and Techniques of Remote sensing. John Wiley Publication.
5. Floyd, F. and W. H. Jr. Sabins. 1987. Remote Sensing, Principles and Interpretation(2nd Edition). Freeman & Company.
6. International Encyclopedia of Ecology and Environment, Volumes1 – 30. Indian Institute of Ecology & Environment, New Delhi.
7. Kerry Turner, R. 1988. Sustainable Environment Management. Westview Press, Colorado.
8. Lilles, T. M. and R. F. Kiefer. 1994. Remote Sensing and Image interpretation. John Wiley & Sons.
9. Maguire, D. and M. Batty. 2005.GISSpatial Analysis &Modelling. Esri Press.
10. Meadows, D. & Randers, J. 2004. Limits to Growth: The 30 Year Update. EarthScan Publications, London.
11. Michael, L. and McKinney, Robert M Schoch. 2012. Environmental science-systems and solutions. 5th edition. Jones & Bartlett Learning.Massachusetts.
12. Mittal, K. M. 1996. Biogas systems: Principles and applications. New Age International Publishers (P) Ltd. New Delhi.
13. Simon Dresner. 2008. The Principles of Sustainability Solutions. EarthScans.
14. *TheEcological Footprint Atlas* 2010. Oakland: Global Footprint Network.

15. VenkataRamana, P. &Srinivas, SN. 1996. Biomass energy systems. Tata Energy Research Institute, New Delhi.
16. Vepal, S. and Malik, Padma Sridahar. 1992. Industrial Biotechnology. Oxford & IBH Publishing Co., New Delhi.

CORE – 9. PLANT PHYSIOLOGY AND BIOCHEMISTRY

UNIT I **(8 hours)**

Energy flow: Thermodynamic Laws, free energy and chemical potential, redox reaction, structure and functions of ATP. **Fundamentals of enzymology:** Enzyme-Substrate properties, function and classification. Allosteric mechanism, regulatory and active sites, isozymes, kinetics of enzymatic catalysis, Michaelis-Menten equation.

UNIT II **(8 hours)**

Translocation of water and solutes: Plant-water relations, mechanism of water transport through xylem, root-microbe interactions and nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins; sucrose-sensing mechanism.

UNIT III **(15 hours)**

Photochemistry and Photosynthesis: General concepts, historical background, evolution of photosynthetic apparatus, photosynthetic pigments light harvesting complexes, photo-oxidation of water, mechanisms of electron and proton transport. Carbon assimilation: Calvin cycle; photorespiration and its significance, C4 cycle; the CAMpathway; biosynthesis of starch &sucrose, physiological &ecological considerations.

UNIT IV **(15 hours)**

Respiration and lipid metabolism: Overview of plant respiration, glycolysis, TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alternative oxidation systems. Structures and functions of lipids, structural & storage lipids, biosynthesis of fatty acid and membrane lipids, catabolism of lipids. N**itrogen and Sulphur metabolism:** Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate uptake, transport and assimilation.

UNIT V **(14 hours)**

Plant growth regulators: physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines,

jasmonic acid and salicylic acid, hormone receptors. Signal transduction and gene expression. **The flowering process:** Photoperiodism, endogenous clock and its regulation, floral induction and development – genetic and molecular analysis, role of vernalization. **Stress physiology:** Plant responses to biotic and abiotic stresses, 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. **Sensory photobiology:** History, discovery of phytochromes and cryptochromes; photochemical and biochemical properties, photophysiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.

Text books

1. Buchanan, B. B., W. Gruissem and R. L. Jones. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.
2. Hopkins, W. G. and N. P. A. Huner. 2004. Introduction of Plant Physiology. 3 rd ed. John Wiley & Sons, Inc., New York..
3. Moore, T. C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York.
4. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California.

REFERENCES*:*

5. Dennis, D. T., Turpin, D. H., Lefebvre, D. D and D. B. Layzell (eds). 1997. Plant Metabolism (second edition).Longman, Essex.
6. Galston, A. W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
7. Hooykaas, P. J. J., M. A. Hall and K. R. Libbenga (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam, the Netherlands.
8. Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P. Baltimore and J. Darnell. 2000. Molecular Cell Biology (4th edition). W.H. Freeman and Co., New York.
9. Nobel, P. S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego.
10. Raven P. H. and G.B. Johnson. 2002. BIOLOGY 6th ed. McGrawHill. Boston, Madison, New Delhi.
11. Singhal, G., S. Renger, G. Sopory, S. K. Irrgang and K. D. Govindjee. 1999. Concepts in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
12. Taiz, L. and E. Zeiger. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
13. Thomas, B. and D. Vince-Prue. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego.
14. Westhoff, P. 1998. Molecular Plant Development: from Gene to Plant. Oxford University Press, Oxford.

PRACTICAL – 5: PLANT PHYSIOLOGY AND BIOCHEMISTRY

1. Effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. acid phosphatase, nitrate reductase).
2. Effect of substrate concentration on activity of any enzyme and determination of its Km value.
3. Demonstration of the substrate inducibility of the enzyme nitrate reductase.
4. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids and demonstration of fluorescence by chlorophyll.
5. Extraction Determination of chlorophyll a /chlorophyll b ratio in C_3 and C_4 plants
6. Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.
7. To demonstrate photophosphorylation in intact chloroplasts, resolve the phosphoproteins by SDS-PAGE.
8. Extraction of seed proteins depending upon the solubility.
9. Determination of succinate dehydrogenase activity, its kinetics, and sensitivity to inhibitors.
10. Demonstration of PGR effects – photomorphogenesis, stem elongation, apical dominance, callus induction.
11. Preparation of standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by Lowry's or Bradford's method.
12. Effect of plant growth regulators on seed germination and seedling growth
13. Determination of the presence of IAA from plant tissues and quantification by Salkowski test.
14. Demonstration of respiration in flower buds by enzyme peroxidase activity.
15. Determination of seed viability by tetrazolium chloride test (TTC).

References for Practical:

1. Bajracharya, D. 1999. Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Cooper, T. G. 1977. Tools in Biochemistry. John Wiley, New York, USA.
3. Copeland, R. A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis. VCH Publishers, New York.

4. Dennison, C. 1999. A Guide to Protein Isolation. Kluwer Academic Publishers, Dordrecht, Netherland.
5. Devi, P. 2000. Principle and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios , Jodhpur, India.
6. Dryer, R. L. and G. F. Lata. 1989. Experimental Biochemistry. Oxford University Press, New York.
7. Hames, B. D. (Ed.). 1998. Gel Electrophoresis of Proteins: A Practical Approach, 3rd edition. PAS, Oxford University Press, Oxford, U.K.
8. Harborne, T. C. 1981. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Chapman & Hall, London.
9. Moore, T. C. 1974. Research Experiences in Plant Physiology: A Laboratory Manual. Springer-Verlag, Berlin.
10. Ninfa, A. J. and D. P. Ballou. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc., Maryland, USA.
11. Plummer, D. T. 1988. An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
12. Scott, R. P. W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.
13. Wilson, K. and J. Walker. 1994. Practical Biochemistry: Principles and Techniques, 4thedition. Cambridge University Press, Cambridge, UK.
14. Wilson, K. and K. H. Goulding (Eds). 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, UK.

CORE – 10. TAXONOMY AND MEDICINAL PLANTS

TAXONOMY OF ANGIOSPERMS

UNIT I **(10 hours)**

Taxonomic hierarchy: major and minor categories, genus and species concept. Principles used in assessing relationships, delimitation of taxa and attribution of rank. International Code of Botanical Nomenclature: salient features, typification, priority, publication, author citation, homonym, synonym, tautonym, autonym, basionym and conserved names. Retention, choice and rejection of names, effective and valid

publications.Taxonomic literature: floras, icones, monographs. National and international Herbaria, Role of BSI, herbarium preparation.

UNIT II **(10 hours)**

Evidences from Morphology, anatomy, palynology, embryology, cytology; phytochemistry (secondary metabolites) in relation to taxonomy. Molecular systematics. Phenetic versus phylogenetic systems; Cladistics in taxonomy; relative merits and demerits of major systems of classification - Bentham and Hooker, Engler and Prantl. A detailed study on APG - III Classification.

UNIT III **(9 hours)**

Phytogeographical regions of India. Endemism, hotspots and hottest hotspots; plant exploration; invasions and introductions; local plant diversity and its socio- economic importance, Ethnobotany (brief account); relevance of taxonomy to conservation, sustainable utilization of bio- resources and ecosystem research.

UNIT IV **(22 hours)**

Study of the following families **-**Magnoliaceae, Nymphaeceae, Menispermaceae, Rhamnaceae,Combretaceae, Melastomataceae, Rubiaceae, Ebenaceae,Convolovulaceae, Bignoniaceae, Acanthaceae, Lamiaceae, Polygonaceae, Asteraceae, Apocynaceae, Aristolochiaceae, Euphorbiaceae, Moraceae, Orchidaceae, Arecaceae, Cyperaceae, Poaceae.

UNIT V **(9 hours)**

Brief study on Medicinal and Aromatic plants -*Papaver somniferum, Atropa belladonna, Catharanthusroseus, Adhatodaceylanica* (syn. A. vasica), A*llium sativum, Rauvolffia serpentine, Withaniasomnifera, Phyllanthusamarus, (P. fraternus), Andrographispaniculata, Aloe barbadense, Menthaarvensis, Rosa sp., Pogostemoncablin, Origanum vulgare, Santalum album, Jasminum grandiflorum, Curcuma* sp*. Chrysopogonzizanioides, Cymbopogon*sp*., Pandanus odoratissimus*.

PRACTICAL –6: TAXONOMY AND MEDICINAL PLANTS

1. Description of a specimen from representative, locally available families.
2. Description of a species based on various specimens to study intraspecific variation: a collective exercise.
3. Description of various species of genus; location of key characters and preparation of keys at generic level.
4. Location of key characters and use of keys at family level.

5. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
6. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.
7. Solving nomenclatural problems.
8. Field trips within and around the forest areas; compilation of field notes and preparation of herbarium sheets of such plants (20 different sheets), wild or cultivated, as are abundant.

Text books

1. Heywood, V. H. and D. M. Moore. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
2. Naik, VN. 2000. Taxonomy of Angiosperms. Tata McGraw – Hill Publishing Company Limited, New Delhi.
3. Simpson, M. G. 2010. Plant Systematics. Elsevier Academic Press, California.
4. Subramaniam, NS. 1995. Modern Plant Taxonomy. Vikas Publishing, New Delhi.

REFERENCES:

5. Gamble, J. S. and C. E. C. Fischer. 1967. Flora of the Presidency of Madras. Vols. I - III. Botanical Survey of India, Calcutta.
6. Grant, W. F. 1984. Plant Biosystematics. Academic Press, London.
7. Greuter, W (Ed.). 2000. International Code of Botanical Nomenclature. (St. Louis Code). KoeltzVesentific Books, Germany.
8. Harrison, H. J. 1971. New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
9. Judd, W. S. and C. S. Campbell, E. A.Kellog, P. F. Stevens, N. J. Donoghue. 2008. Plant Systematics: A phylogenetic approach. 3rd edition.Sinauer Associates Inc, Massachusetts.
10. Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. The Macmillan Company, New York.
11. Moore, R. and W. D.Clark, K. R. Stern, D. Vodopich. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers, London.
12. Nordenstam, B. and E. l. Gazaly, M. Kassas. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.

13. Raven, P. H. and R.F. Evertand S. E. Eichhon. 1992. Biology of Plants. 5th Edition. Worth Publishers. New York.
14. Soltis, D. E. and P. S. Soltis, P. K. Endress, M. W. Chase. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc., Massachusetts, USA.
15. Takhtajan, A. 1997. Diversity and Classification of Flowering Plants. Bishen Singh and Mahendrapal Singh, Dehra Dun.

CORE – 11. ECOLOGY AND CONSERVATION BIOLOGY

UNIT I **(12 hours)**

Biotic and abiotic factors. Ecosystem and types. Climate, soil and vegetation patterns: Life zones; Classification of biomes, major biomes, major vegetation and soil types of the world. Concept of communities and ecological niche. Vegetation, forest types, mapping, and GIS. Population and environment; industrial melanism; bioindicators;ecads and ecotypes.Temporal changes (cyclic &non-cyclic); mechanism of ecological succession; changes in ecosystem and succession.

UNIT II **(15 hours)**

Ecosystem organization: structure and functions; ecosystem types. Primary production (methods of measurements, global pattern, controlling factors); energy dynamics (tropic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, substrate quality and climate factors); global biogeochemical cycles (C, N, P and S); mineral cycles (pathways, process, budgets) in terrestrial and aquatic ecosystems.

UNIT III **(15 hours)**

Climate change - Green house gases (CO_2, CH_4, N_2O, CFCs: sources, trends and role); ozone layer and ozone hole; consequences of climate changes (CO_2, fertilization, global warming, sea level rise, UV radiation). Ecosystem stability: Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plant ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration. Ecological management: Concepts; sustainable development; sustainability indicators.

UNIT IV **(10 hours)**

Biological diversity: Concept and levels; role of biodiversity in ecosystem functions and stability; speciation and threats, extinction. Distribution and global patterns;

terrestrial biodiversity hotspots; Inventory. International & National legislations, conventions on CBD and NBA. IUCN categories of RED listed plants; Red Data Book.

UNIT V (8 hours)

Conservation of biodiversity: conservation strategies;*in situ* conservation: International efforts &Indian initiatives; Protected Areas in India (Wildlife Sanctuaries, National Parks, Biosphere Reserves, RamsarSites, World Biodiversity Heritage sites, wetlands, mangroves and coral reefs) for conservation of wild biota. *Ex situ* conservation: principles and practices; botanical gardens, field gene banks, seed banks, *in vitro* repositories, cryobanks; National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific &Industrial Research (CSIR), Department of Biotechnology (DBT), MoEFCC, ICFRE,etc. for conservation; non-formal conservation efforts (sacred groves / sthalavrikshas / Chipko movement).

Text books

1. Heywood, V. H. and R. T. Watson. 1995. Global Biodiversity Assessment. Cambridge University Press.
2. Odum, E. P. 1983. Basic Ecology. Saunders, Philadelphia.
3. Smith, R. L. 1996. Ecology and Field Biology. Harper Collins, New York.

REFERENCES*:*

4. Barbour, M. G. and W. D. Pitts. 1987. Terrestrial Plant Ecology. Benjamin Cummings, California.
5. Begon, M., J.L. Harper and C.R. Townsend. 1996. Ecology. Blackwell Science, Cambridge.
6. Bredy, N. C. 1990. The Nature and Property of Soils. MacMillan.
7. Chapman, J. L. and M. J. Reiss. 1988. Ecology: Principles and Applications. Cambridge University Press.
8. Hill, MK.1997.Understanding Environmental Pollution. CambridgeUniversity Press.
9. Kormondy, E. J. 1996. Concepts of Ecology. Prentice Hall of India, New Delhi.
10. Ludwig, J. and J. F. Reynolds. 1988. Statistical Ecology. John Wiley & Sons.
11. Mason, C. F. 1991. Biology of Fresh Water Pollution. Longman.
12. Molden, B. and S. Billharz. 1997. Sustainability Indicators. John Wiley & Sons, New York.
13. Mullaer- Dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetative Ecology. Willey, New York.
14. Odum, E. P. 1971. Fundamentals of Ecology. Saunders, Philadelphia.
15. Raven, P. H. and G. B. Johnson. 2002. BIOLOGY 6th ed. McGraw-Hill. Boston.
16. Treshow, M.1985. Air Pollution and Plant Life. Wiley-Inter science.

PRACTICAL – 7: ECOLOGY AND CONSERVATION BIOLOGY

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use t-test and ANOVA for composing two means related to ecological data.
2. To prepare ombrothermic diagram for different sites on the basis of given data set and to comment on climate.
3. To find out the relationship between two ecological variables using correlation and regression analysis.
4. To determine minimum size and number of quadrats required for reliable estimation of biomass in grassland.
5. To find out association between important grassland species using chi-square test.
6. To compare protected and unprotected grassland stand using community coefficients (similarity indices).
7. To analysis plant communities using Bray-Curtis ordination method.
8. To determine biodiversity indices (Shannon-Wiener, Simpson index, species richness, concentration of dominance, equitability and β-diversity) for protected and unprotected grasslands.
9. Population dynamics of local forest area
10. Regeneration studies in forest species.
11. Morphological and genetic variations in any common plant species.

Field visits/scientifictours

The students should be taken to one of the following:

i. A protected area (biosphere reserve, national park, or a sanctuary)
ii. A wet land
iii. A mangrove
iv. Head Quarters of the Botanical Survey of India or one of its Regional circles.
v. A CSIR laboratory doing research on plants and their utilization.
vi. An ICAR Research Institute or a field station dealing with one major crop or crops (ICRISAT).
vii. A recognized botanical garden or museum (such as those at the Forest Research Institute, Dehra Dun: National Botanical Research Institute, Lucknow; Tropical Botanical Garden and Research Institute, Trivandrum), which has rich collection of plant products.

***Note:** the students are expected to prepare a brief illustrated narrative of the field survey and scientific visits. After evaluation, the marks/grades awarded to the students by the teachers will be added to the final assessment of the practical examination and credits for Field study/tour.

References for practical

1. APHA- Standard Methods for the Examination of Water and Waste Water. American Public Health Association, Washington, DC.
2. Krebs, C. J. 1989. Ecological Methodology. Harper and Row, New York, USA.
3. Ludwig, J. A. and J. F. Reynolds. 1988. Statistical Ecology. Wiley, New York.
4. Magurran, A. E. 1988. Ecological Diversity and Its Measurement. Chapman & Hall, London.
5. Misra, R. 1968. Ecology work Book. Oxford & IBH, New Delhi.
6. Moore, P. W. and S. B. Chapman. 1986. Methods in Plant Ecology. Blackwell Scientific Publications.
7. Mullaer- dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetative Ecology. Willey, New York.
8. Pielou, E. C. 1984. The Interpretation of Ecological Data. Wiley, New York.
9. Smith, R. L. 1996. Ecology and Field Biology. Harper Collins, New York.
10. Sokal, RR and F. J. Rohlf. 1995. Biometry. W.H. Freeman & Co., San Francisco.

CORE 12: GENOMICS AND BIOINFORMATICS

Unit I **(10 hours)**

Bioinformatics: history, introduction and scope; role of computers in biology. The internet, world wide web, search engines, metasearch engines, metadata; boolean searching, search engine algorithms, iterative searches. Search and Retrieval in literature databases(Pubmed).Software and tools: running, downloading and installation. Operating systems: Unix system, files, and directories. Scripting languages: BioPerl and BioPython, Markup languages: HTML,XML.Bioinformatics Workstations.

Unit II **(10 hours)**

Databases: Concepts, Database Management Systems (DBMS):Hierarchical, Relational and Network; database security. Biological databases; types: sequence, structures, genome and organism-specific databases; open source and web services. Data warehousing, data capture, data mining, data analysis.

Unit III **(10 hours)**

Primary **nucleotide sequence databases**: Genbank, European Nucleotide Archive, DDBJ, etc. Primary protein sequence databases: NCBI, PIR, EMBL, ExPAsy, Uniprot, signal peptide databank. Data submission and retrieval with: Entrez, DBGET/Link, and SRS. **Sequence Analysis**: Pair-wise alignment (Smith-Waterman similarity searches); BLAST & FASTA types and algorithms; Multiple sequence alignment (CLUSTAL: V,W,X,Omega;T-Coffee); gene and protein families, motif finding.

Unit IV **(15 hours)**

Structural databases (PDB, CSD). Gene expression databases and transcriptomes, DNA microarray.Molecular modeling and visualization tools; docking and drug designing. Metabolic and signalling pathways databases. Systems biology and molecular interaction networks. **Phylogenetics**: phylogenetic trees and clades, softwareand online tools; inference methods (UPGMA). **Biodiversity informatics**: introduction, global (GBIF, ITIS, Plant List, BHL, RBG,Kew) and national databases, standards, and protocols.

Unit V **(15 hours)**

Genomics and proteomics: Genomes: definition,size,aprroximate number of genes in sequenced organisms (viral, bacterial, fungal, plant, animal, and human genomes). Genome map, genome sequence - differences. EST maps and markers. Identification of protein-coding genes, determining gene functions from gene sequence; introns and exons, repetitive sequences; Accessing and annotating genomes; The Bio Project;Specialised genomic databases**:** BOLD, GOLD, *Saccharomyces* Genome Database, *Arabidopsis* Information Resource; crop genomes: rice (INE, RGAP, IRGSP). Metagenomics, functional genomics, comparative genomics, and proteomes. Genomics and ethics. Practical applications of genomics. Next (2^{nd}, 3^{rd}) Generation sequencing.Proteomes: deducing proteome from genome sequence, post-trasnslation modification prediction, metabolomics.

Text Books

1. Campell and Heyer. 2003. Discovering Genomics, Proteomics and Bioinformatics. Cold Spring Harbor Laboratory.

2. Krane, *et al.* 2002. Fundamental Concepts of Bioinformatics. Benjamin Cummings.

REFERENCES

3. Bergeron BP. 2002. Bioinformatics Computing. Prentice Hall.
4. Brown, T. A. 2002. Genomes. Wiley-Liss Publications.
5. Callow, JA, BV Ford-Lloyd and HJ Newbury. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, Oxon
6. Lesk, AM. 2002. Introduction to Bioinformatics. Oxford University Press.
7. Liebler. 2001. Introduction to Proteomics: Tools for the new biology. Humana Press.
8. Pennington, S. and Dunn, MJ. 2001. Proteomics: From protein sequence to function 2ndEd. Ed Bios Scientific Publications Ltd.
9. Jolles, O. and H. Jornvall (eds.). 2000. Proteomics in Functional Genomes. BirkhauserVerlag, Basel, Switzerland.
10. Primrose, SB.1995. Principles of Genome Analysis. Blackwell Science, Oxford.

Supportive course – offered by other departments

CORE – 13. PLANT CONSERVATION BIOTECHNOLOGY

UNIT I **(5 hours)**

Introduction: Principles of conservation; extinctions; International Union for Conservation of Nature (IUCN) Categories and Criteria for threatened plants. Red data book of Indian plants. Plant Conservation Biotechnology: Integration of biotechnology into plant conservation practices.

UNIT II **(15 hours)**

Tissue culture techniques: History and scope; concept of totipotency. Culture room and lab facilities. Sterilization methods. Types of media, media components and preparation;plant growth regulators, adjuvants, antioxidants.Cellular differentiationand morphogenesis, dedifferentiation, redifferentiation and regeneration. Callus cultures, subcultures, organogenesis,caulogenesis, rhizogenesis, cell lines;somaclones, gametoclones, somatic embryogenesis and embryoids, synthetic seeds. Cell and Suspension cultures, cell immobilization. Plant secondary metabolites: pathways and manipulation (metabolic engineering), biotransformations, industrial enzymes and therapeutic proteins.

UNIT III **(10 hours)**

Applications of plant tissues culture: Micropropagation – Preparative stage: Germplasm acquisition and explant selection. Establishment stage: Axenic and viable cultures. Multiplication stage: plantlet production. Rooting and Field Transfer: induction of roots and acclimatization of plantlets to green house condition. Anther and pollen culture and production of haploid plants. Embryo rescue and hybrid plants.

UNIT IV **(15 hours)**

Somatic hybridization. Protoplast isolation, fusion types and culture methods, hybrid selection and regeneration, cybrids, spheroplasts; possibilities, achievements and limitations of protoplast research. **Cryopreservation** and germplasm storage: Slow or retarded growth. Principles, Cryoprotection, Freezing and long-term cryogenic storage, protocols and recovery of germplasm, DNA banks.

UNIT V **(15 hours)**

Plant Genetic Engineering: Aims, transgenics development strategies (*Bt* cotton, Golden Rice, *FlavrSavr* tomato), *Agrobacterium:* Nature's genetic engineer, crown gall and hairy roots, *Ri*, *Ti*plasmid vectors, roles of virulence genes, T-DNA. Direct and indirect plant gene transfer mechanisms. Production of transgenic insect-resistant, virus-resistant, salinity and drought tolerant, herbicide-resistant plants; plants with increased shelf life of fruits and flowers. Terminator gene technology.

Text Books

1. Dodds, J. H. and L. W. Roberts. 1995. Experiments in plant tissue culture. Cambridge University press, London.
2. Bhojwani, SS. and MK Razdan. 1996. Plant tissue Culture: Theory and Practice (a revised edition). Elsevier science publishers, New York.

REFERENCES:

3. Bhojwani, SS. 1990. Plant tissue Culture: application and Limitations. Elsevier Science Publishers, New York.
4. Collins, HA&Edwards S.1998. Plant Cell Culture. Bio Scientific Publishers, Oxford.
5. Dixon, R.A. 1994. Plant cell culture, A Practical Approach. IRL Press. Oxford, London.
6. Erica E.Benson.1999.Plant Cconservation Biotechnology.Taylor& Francis.
7. Freifelder. D. 1990. Molecular Biology. Narosa Publishing, New Delhi.
8. George, E. F. 1994. Plant Propagation by Tissue culture. Exegectics Ltd.
9. Lindsay. 1992. Plant Tissue Culture Manual. Kluwer Academic Publishers, Netherlands.
10. Narayanasamy, S. 1994. Plant cell and tissue culture. Tata McGraw-Hill Publishing Co., New Delhi.

11. Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York.
12. Vasil, IK. and Thorpe, TA. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

PRACTICAL - 8: PLANT BIOTECHNOLOGY

1. Effect Plant Growth Regulators on Seed Germination &Seedling Growth.
2. Preparation of Culture media: solid and liquid medium.
3. Sterilization of culture vials, equipments, and culture room.
4. Surface sterilization of explants.
5. *In vitro* germination of Orchid seeds.
6. Callus induction in carrot or any other plant material.
7. Regeneration through callus and somatic embryogenesis.
8. Clonal Propagation by shoot tip/axillary bud culture.
9. Whole cell immobilization.
10. Immobilization of somatic embryos and production of synthetic seeds.
11. Isolation and culture of leaf mesophyll protoplasts.
12. Demonstration of protoplast fusion employing PEG.
13. Demonstration of androgenesis in *Datura.*
14. Visit to Germplasm centers and plant Biotechnology laboratories.
15. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.
16. Methods of direct transformation: PEG mediated, microinjection, particle bombardment, electroporation of protoplast and transient expression assay of the reporter gene.
17. Plant Genomes and Model Plant Genomics / Proteomics.

SUPPORTIVE COURSES OFFERED TO OTHER DEPARTMENTS

Semester II. Course 1. PLANTS IN HUMAN LIFE

L	P	T	C
2	0	0	2

Objectives

- To enlighten the students on the sources and role of plants in meeting the basic demands of the human.
- To reveal the range of products and their novel usage in human life

Unit I: Introduction (5 hours)

Expanse of the plant world; Significance of plant groups as oxygen and energy providers and a propelling force in chemical and organic evolution; Plants tapped and untapped for human consumption and peripheral needs; Importance as sources of food, fibres, wood and medicine. Check list of major and minor food crops; Types of food and its use, abuse and wastage. Staple food crops - cereals, pulses, millets, vegetables, tubers, fruits, oil seeds, nuts, beverages; Balanced diet; Perils of junk food consumption; Food as medicine.

Unit II: Cash crops (5 hours)

Oil yielding species (ground nut, rapeseed, mustard, sesamum, linseed, castor, safflower and sunflower, niger); Cash crops-Sugarcane, Sugar beet, Plantation crops (Rubber, Betel nut, Tea and Coffee, Cardamom, Palmyra, Cashew, Coconut and Oil palm); Fibres (Jute, Sisal, Flax, Cotton, Coconut)

Unit III: **Fruits,: (4 hours)**

Tropical and subtropical fruits (Banana, Mango, Citrus, Guava, Papaya, Sapota, Pomegranate, Jackfruit, Mangosteen), Arid and semi arid species (Date-palm, Custard apple, Fig, Amla, Jujube) Temperate fruits(Apple, Apricot, Cherry, Peech, Pear, Plum).

Unit IV : Timbers and other Major-Minor Forest Produce **(6 hours)**

Native trees -Teak, Sal, Sandal, Redsanders. Exotic trees Rose wood, Acacia, Eucalyptus and Casuarina); Condiments and Spices (Cardamom, Pepper, Chilli, Ginger, Turmeric, Clove, Cinnamon); Aromatic plants (Lemon grass, Citronella, Mint, Geranium, Patchouli, Vetiver, Jasmine); Gums and Resins – Gum Arabic, Oleoresins, Natural Dyes – Indigo, Annato, Turmeric.

Unit V: Medicinal plants (6 hours)

Therapeutic phytochemicals and plants used in TM (traditional medicine) and CAM (complementary alternate medicine); Common primary and secondary metabolites; Pharmacological and pharmacognosic approach in outline; Classification and notes on phytotherapeutic with at least one example in major groups (alkaloids, steroids, terpenoids, flavones, glycosides, fats and oils); Bioactive compounds in Neem, Tulsi, Turmeric, Ginger, Periwinkle, Garlic.

Tex Book

Pandey B.P. 1999. Economic Botany, Revised edition, S. Chand Publishers, New Delhi

REFERENCES

1. Verma V. 2009. Textbook of Economic Botany, First edition, Ane Books Pvt. Ltd., New Delhi

2. Patrick GL. 2017. Introduction to Medicinal Chemistry, Sixth edition, Oxford University Press, UK
3. Saroya AS. 2011. Herbalism, Phytochemistry and Ethnopharmacology, CRC Press, UK

Semester II. Course 2. HOME GARDENING

L	P	T	C
2	0	0	2

Objectives

- To understand home gardening and its significance in ever-changing world
- To prepare the students to set up gardens in their home
- To disseminate the importance of home garden and gardening techniques to students

Unit I: Garden establishment (7 hours)

Concept of gardening - History - Types of garden, Famous gardens. Gardening as a hobby and resource. Designing of vegetable garden (Garden plan - fencing, clearing the land, leveling, preparing the soil, monitoring and maintenance). Importance of soil in gardening. Compost and farmyard manure. Gardening tools. Terrace garden

Unit II: Tools and seed materials (6 hours)

Choice of plants Ornamental and horticultural attributes, selection of seeds/ propagules, seed germination tests, sowing, direct sowing, thinning, seedlings and transplants, preparation of seed bed, weeding, transplantation, plant protection measures, utility and consumption.

Unit III: Management and harvesting (5 hours)

Schedule for maintenance: Need for maintenance, species-wise specifications, watering, furrow irrigation, sprinkler watering, drip irrigation, weed control, soil tillage, pest control, disease control. Harvesting the produce, storing and processing of the vegetables.

Unit IV: Hydroponics (3 hours)

Cultivation Hydroponics, cultivation of tomato through hydroponics, advantages of hydroponics.

UNIT V. **Home garden plants (5)**

Importance of home garden, Plan of kitchen garden. Seasonal vegetables, Greens, Tomato, Brinjal, Lady's finger, Cucumbers, Beans, Drumstick, Banana. Rose, Jasmine, Crotons.

Text book

Gordon-Wells Jr, E. 2010. Successful Home Gardening, 2nd Edition, CA, USA

REFERENCE

1. FAO, 2014. A Vegetable garden for all, 5th Edition, Rome, Italy
2. Gordon-Wells Jr, E. 2010. Successful Home Gardening, 2nd Edition, CA, USA
3. Smith M. 2001. Advanced Home Gardening, Creative Homwowner, USA
4. Davis KC. 1918. School and home gardening, A Text Book for Young People, with Plans, Suggestions and Helps for Teachers, Club Leaders and Organizers, JB Lippincott Company, Philadelphia
5. Palmer I, 2014. The House Gardener, Ryland Peters & Small, UK.

Semester III. Course 3. GLOBAL CLIMATE CHANGE

L	P	T	C
2	0	0	2

Objectives

- To understand the effects of global climate change
- To create awareness among student community to conserve precious natural resources from depletion
- To publicize the importance of judicial use of natural and other resources
-

Unit 1: Introduction (7 hours)

Dynamics of the living earth, zonations in biosphere, monsoon and seasonal variations in Peninsular India. Climate change in spotlight, the spectrum of scientific opinion, the greenhouse effect, radiative balance.

Unit II: Climate and Weather Conditions in Pre and Post Industrial Revolution (7 hours)

Industrial revolution. Primary and secondary pollutants, photochemical smog, acid rain and Ozone depletion. Changing climate and weather conditions in India and Tamil Nadu. Importance of water and water cycle.

Unit III: Greenhouse Gases and Global Warming (6 hours)

Carbon source and sink, carbon sequestration, carbon cycle and foot print in developed, developing and poor countries. Different concerns of rich and poor countries towards climate change.

Unit IV: Impact of climate change (3 hours)

Impact of climate change on land, water and atmosphere with emphasis on agriculture and forests.

Unit V. Consequences of Climate Change (3 hours)

Environmental catastrophes - *El nino, La nina* and Tsunami, depletion of water resources, deterioration of soil health, agricultural crisis and forest denudation.

Tex Book

1. Maslin, M. 2014. Climate change: A Very Short Introduction, 3rd Edition, Oxford University Press, UK

REFERENCES

2. Pittock, AB. 2009. Climate Change: The Science, Impacts and Solutions, 2nd Edition, CSIRO Publishing, Collingwood, Australia
3. Lovejoy TE, Hannah LJ. 2005. Climate Change and Biodiversity, 1st edition, Yale University Press, USA
4. Leary N. 2008. Climate Change and Vulnerability, Earth scan Publishers, UK.

Semester III. Course 4. MUSHROOM CULTIVATION

L	P	T	C
2	0	0	2

Objectives

- To introduce the potential of mushroom as the dietary supplement.
- To introduce the cultivation techniques, problems faced and management of mushrooms cultivation including harvesting and processing
-

Unit 1: Introduction (5 hours)

Introduction to mushrooms and historical perspectives; classification of mushrooms, nutritional and dietary values of mushrooms as source such as protein, carbohydrates, fibre, vitamins and minerals, therapeutic properties, mushroom collections from field.

Unit 2: Mushroom cultivation techniques (5 hours)

Erections of mushroom culture sheds and maintenance (tools, equipments and prerequisites). Fungal Isolation techniques, preparation of mother culture- pure culture, selection of stock, spawn production – mother spawn production.

Unit 3. Multiplication of spawn (5 hours).

Precautions, characters, and storage of spawn; substrate production, culturing of mushrooms; harvesting, post-harvesting processes, and key machinery and equipment required.

Unit 4: Cultivation techniques for selected mushrooms (5 hours)

Cultivation techniques for commercially viable mushrooms - paddy straw mushroom, button mushroom and milky mushroom – spawning, substrate preparation, growth, packing, and maintenance of suitable environmental conditions. Factors affecting influencing mushroom cultivation and harvesting. Mushroom delights.

Unit 5: Pests management during mushroom cultivation (6 hours)

Diseases and competitor moulds of mushrooms and their management: Dry bubble disease – *Verticillium fungicola*, wet bubble disease – *Mycogone perniciosa*, Cobweb – *Cladobotryum dendroides*, and Green mould - *Trichoderma* sp. Flies and mites.

Text Book

1. Singh, M., Vijay, B., and Kamal, S., and Wakchaure, G.C. 2011. Mushrooms: Cultivation, Marketing and Consumption. Directorate of Mushroom Research, Indian Council of Agricultural Research, Solan, India, p.266.

References

1. Singh, M., Vijay, B., and Kamal, S., and Wakchaure, G.C. 2011. Mushrooms: Cultivation, Marketing and Consumption. Directorate of Mushroom Research, Indian Council of Agricultural Research, Solan, India, p.266.
2. Oei, P, and van Nieuwenhuijzen, B. 2005. Small-scale mushroom cultivation. Digigrafi, Wageningen, The Netherlands, p.86.
3. Training Manual on Mushroom Cultivation Technology. United Nations - Economic And Social Commission for Asia and the Pacific, p.139.