M. Sc. BOTANY – Syllabus

Syllabus as Per the Choice Based Credit System (CBCS)

(Curriculum Effective From July 2020 Onwards)

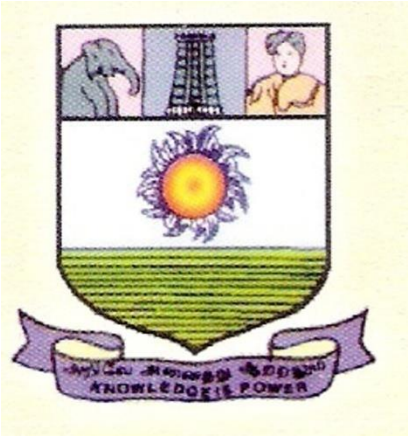
Submitted by

Dr. P. RAVICHANDRAN

Professor & Head and Chairperson

Placed in the 51st SCAA 2020-21(Semester – I)

Placed in 52nd SCAA Aug. 08 2021(Semester II-IV)



Board of Studies in Plant Science

DEPARTMENT OF PLANT SCIENCE

Manonmaniam Sundaranar University, Tirunelveli

August 2021

Introduction

Botany is a vital branch of science deals with the study of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms, their classification, structure, growth, reproduction, metabolism, development, diseases, chemical properties, uses and ecological & evolutionary relationships among the different groups. The continued investigations of plants are fundamental in this post-industrial, knowledge-based modern era because they provide countless precious goods and services that underpin almost all life on the planet Earth. A greater understanding and knowledge of plants and their unique processes is inevitable to the future of human societies as it will enable us to overcome the challenges posed and reap benefits from the opportunities offered in this century.

The constantly updated curriculum, continuous performance appraisal and feedbacks, and regular career counseling are ideally designed to help the aspiring students to get through the SLET/ NET/IFS and many other competitive exams. To make the students more competent and confident, the multidisciplinary approach as well as the scope for training in personality development and communication skills are given importance.

Outcome of the Program

The program focuses on the unified nature of Plant Science and aims to generate young minds through competent teaching, and training on key technologies. Students will be encouraged to participate in research providing them opportunity to experiment their understanding and to reveal the relationship between the conventional education and research.

Eligibility:

- Undergraduate (B. Sc.) Botany, Plant Biology & Plant Biotechnology with a minimum of 55 % Marks and for reserved categories 50 %.
- Admission will be based on an entrance test for 50 marks and UG marks will be taken for another 50 %. The average of both shall be above 50.
- Total number of seats sanctioned is 20 (twenty only).

M. Sc. BOTANY REVISED COURSE STRUCTURE – July 2020 onwards

Semester I - Core Theory 4, Practical 2, Elective 1						
					Int. 25	Ext. 75
	Code	**Name of Course Papers**	**Hrs/ wk**	**Cre dits**	**Marks**	
CORE 1	NBYC11	Plant Diversity-I – Algae, Fungi and Lichens	4	4	100	
CORE 2	NBYC12	Plant Diversity- II –Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	4	4	100	
Practical – 1	NBYL11	Plant Diversity I & II	5	4	100	
CORE 3	NBYC13	Microbiology	4	4	100	
CORE 4	NBYC14	Cell and Molecular Biology	4	4	100	
Practical – 2	NBYL12	Microbiology and Cell and Molecular Biology	6	4	100	
Elective -1	NBYEA	Evolutionary Biology	3	3	100	
	NBYEB	Plant Diseases and Insect Pest Control				
	NBYEC	Aquatic and Marine Plants				
		Total	**30**	**27**	**700**	
Semester II- Core theory 3, Practical 2, Elective1 and Supportive course 1						
	Code	**Name of Course Papers**	**Hrs/ wk**	**Cre dits**	**Marks**	
CORE 5	NBYC21	Plant Developmental Anatomy	4	4	100	
Practical – 3	NBYL21	Plant Developmental Anatomy	4	2	100	
CORE 6	NBYC22	Instrumentation and Research Methodology	4	4	100	
CORE 7	NBYC23	Phytochemistry and Traditional Medicine	4	4	100	
Practical - 4	NBYL22	Instrumentation and Phytochemistry	8	4	100	
Elective – 2	NBYED	Plants in Tamil Culture	3	3	100	
	NBYEE	Horticulture and Plant Breeding				
	NBYEF	Plants for Bio-energy and Space Research				
Supportive course – I *		Online MOOCS Course Offered by other Departments	3	3	100	
		Total	**30**	**24**	**700**	
Semester III- Core theory 3, Practical 3, Supportive 1						
	Code	**Name of Course Papers**	**Hrs/**	**Credits**	**Marks**	

			wk		
CORE 8	NBYC31	Plant Physiology and Biochemistry	4	4	100
Practical - 5	NBYL31	Plant Physiology and Biochemistry	5	2	100
CORE 9	NBYC32	Angiosperm Taxonomy	4	4	100
Practical - 6	NBYL31	Angiosperm Taxonomy	5	2	100
CORE 10	NBYC33	Ecology and Conservation Biology	4	4	100
Practical - 7	NBYL33	Ecology and Conservation Biology	5	2	100
Supportive course –II *		Online MOOCS course Offered by other departments	3	3	100
		Total	**30**	**21**	**700**
Semester IV- Core theory 2, Practical 2 and Dissertation 1					
	Code	**Name of Course Papers**	**Hrs/ wk**	**Credits**	**Marks**
CORE 11	NBYC41	Genetics, Genomics and Bioinformatics	4	4	100
CORE 12	NBYC42	Plant Biotechnology	4	4	100
Practical - 8	NBYL41	Plant Biotechnology	8	4	100
Practical - 9	NBYI 41	Field Study	2	2	100
Dissertation	NBYP41	Project and Viva – Voce	12	8	100
		Total	**30**	**22**	**500**

Distribution of Credits	**Total Credits**	**Total grade points**
Core Theory - 12 x 4	48	4800
Practical papers - 4 x 4	16	1600
Practical papers - 4 x 2	8	800
Field Study (Practical) - 1 x 2	2	200
Electives - 2 x 3	6	600
Supportive course - 2 x 3	6	600
Dissertation/Project and Viva-Voce – 1 x 8	8	800
Grand Total Credits/ Marks	94	9400
Cumulative Grade Points Average (CGPA) = Grade Points /Total Credits	**9400/94**	**100%**

*Students of M.Sc. Botany will study supportive courses from MOOCS platform offered by other departments during II & III semesters

** Supportive course for other departments will be offered by Plant Science faculty during II & III semesters from courses available in MOOCS platform

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. For internal marks, the split up is 20 marks for test, 5 marks for seminar and assignment. The average of two tests will be taken for internal marks. Passing minimum for external is 50 % and the total passing minimum including internal & external is 50 %.
3. For Field study 50 marks maximum for internal will be based on periodical submission of study reports, field note books and 50 marks maximum for external for submission a summary study report, field note book and viva-voce examination and thereby the total maximum marks field study is 100.
4. For Project work maximum 50 marks is for internal assessment based on periodical review of the progress made. Submission of dissertation and appearance of viva-voce at the final semester will carry 50 marks, will be evaluated by both internal and external examiners.

   Grant Total for Project (50 marks internal) + Dissertation submission and Viva Voce (50 marks external) = 100 marks.

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

   Section - A MCQ – 10 x 1 mark = 10 marks

   (Two questions from each unit)

   Section - B – 5 x 5 marks = 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

6. Practical Examinations - Question Paper Pattern

QUESTIONS	INTERNAL 50 Marks	EXTERNAL 50 Marks	TOTAL Marks
1. MAJOR	20	20	
2. MINOR	10	10	
3. SPOTTERS	15 (5 x 3 marks)	15 (5 x 3 marks)	
4. RECORD	5	Submission of Completed Record is Eligibility to appear for the practical examination	
5.VIVA-VOCE	-	5	
TOTAL	**50**	**50**	**100**
Field study	**50** Field study Field note book, submission of regular field study reports	**50** Summary report, Field note book and viva-voce examination	**100**

Course completion Requirements

Students should have a minimum of 85% attendance in each course to appear in every semester examinations.

To complete the PG Program students should earn a minimum of 90 credits over a period of two years. Carrying out a project during the fourth semester and submission of dissertation within the date fixed by the department is a must. A minimum of three hard copies of dissertation should be submitted. Field study is also a compulsory course for which students should prepare a periodical field study report from first year onwards. All one day field collection trips and long study tour reports should be individually submitted immediately after the completion of such events with the approval of the course teacher. A summary of field study report should be submitted at the end semester and appear for a viva-voce examination.

NBYC11:PLANT DIVERSITY-I: ALGAE, FUNGI AND LICHENS

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-1]

Objectives

- To understand the occurrence, basic structure, organization and reproduction of non vascularcryptogams.
- To understand the reproduction and commercial value of non vascular cryptogams

Outcome: Gain Knowledge on the morphology, organization of the thallus, characteristic features, classification and distribution of algae, fungi and lichens. Students will understand the interrelationship of algae, fungi andlichens. Will be acquainted on the ecological and economic importance of algae, fungi, and lichens.

L	T	P	C
4	0	0	4

UNITI:Algae (12hours)

Origin and evolution of algae; General characteristics of algae; Diversity and Habitats-Terrestrial, Freshwater and Marine. Phylogeny and interrelationship of algae. Thallus organization - cell and chloroplast structure. Reproduction: vegetative- asexual- sexual-life cycle patterns Classification (FE. Fritsch, 1945; Chapman and Chapman, 1973); pigments, reserve food, flagella (criterions). Phylogeny and molecular evolution of the green algae.Contributions of Indian Phycologists: T. V. Desikachary, M.O.P.Iyengar, V.K. Krishnamurthy, M.S. Balakrishnan, V.S.S. Sundaralingam.

UNIT II: Algae –Type studies (12 hours)

Salient features of Protochlorophyta (*Spirulina*), Chlorophyta (*Ulva, Chaetomorpha*), Charophyta (*Chara*), Xanthophyta (*Botrydium*), Bacillariophyta (*Cyclotella*),Phaeophyta(*Sargassum*) and Rhodophyta (*Ceramium*). Algal blooms, Algae as biofertilizer, food and feed;industrial (commercial)products from algae.

UNITIII:Fungi (12hours)

Origin and evolution of fungi; General Characteristics;cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotropic and symbiotic); reproduction (vegetative, sexual andasexual); life cycle patterns: Homothallism, heterothallism; heterokaryosis;parasexuality.

UNIT IV: Classification and Type studies of Fungi (12 hours)

Classification: Alexopoulus and Mims (1979) and recent trends. General account of Mastigomycotina (*Phytopthora*), Zygomycotina (*Rhizopus*), Ascomycotina (*Taphrina)*, Basidiomycotina (*Polyporus)*, and Deuteromycotina (*Trichoderma, Fusarium)*; Phylogeny and interrelationships of major groups of fungi. Fungi in industry, medicine and as food; fungal diseases in plants (*Magnaportheoryzae* and *Puccinia* spp. In plants;Red rust of tea) mycorrhizae; as biocontrol agents. Contributions of IndianMycologists.

UNITV: Lichens (12hours)

Origin and evolution of lichens; General characteristics of lichens; Classification (Hawksworth and Hill, 1984; 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 Wile SonsInc.
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. (8thEdition).
4. Urry LA, Cain ML, Wasserman SA, Minorsky PV, Reece JB. 2016. Campbell Biology, Pearson, USA (11th Edition).

References

5. Kumar, HD. 1988. Introductory Phycology. Affiliated East-West Press,New Delhi.
6. Mehrotra, RS. & Aneja, RS. 1998.An Introduction to Mycology. New Age InternationalPress.
7. Rangaswamy, G. and A. Mahadevan. 1999. Disease of Crop Plants in India (4th Edition). Prentice Hall of India Pvt. Ltd., NewDelhi.
8. Webster, J. 1985. Introduction to Fungi. Cambridge UniversityPress.
9. Sharma, O.P. Text book of Algae. Tata McGraw Hill, NewDelhi.
10. Raven, P. H. and G. B. Johnson. 2002. BIOLOGY 6th ed. McGraw-Hill. Boston.
11. Leliaert F et al. 2012. Phylogeny and Molecular Evolution of the Green Algae. Critical Reviews in Plant Sciences. 31:1-46.
12. Lee RE. 2008. Phycology. Cambridge University Press. (4th Edition).
13. Watkinson SC, Boddy L, Nicholas PM. 2015. The Fungi. Academic Press, Elsevier. (Third Edition).
14. Ranker TA, Haufler CH. 2008. Biology and Evolution of Ferns and Lycophytes. Cambridge University Press.
15. Nash TH. 2008. Lichen Biology. Cambridge University Press (2nd Edition).

NBYC12: PLANT DIVERSITY- II: BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-2]

Objectives: (1) To understand the classification and evolution of Bryophytes, Pteridophytes and Gymnosperms with special reference to Indian taxa; (2) To get an insight in to the life histories of embryophytes, tracheophytes and seed plants; (3) To get an understanding of the past history of the biosphere and evolution of plants through fossils.

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

L	T	P	C
4	0	0	4

UNIT I: Bryophytes (12 hours)

Origin and evolution of bryophytes; General characteristics of bryophytes; Morphology, structure, reproduction and life history; distribution; classification (Watson/ Rothmaler); phylogeny. General account of Hepaticopsida: Marchantiales, Jungermaniales; Anthocerotopsida: Anthoceratales;Bryopsida: Sphagnales, Funariales and Polytrichales. Economic and ecological importance.

UNIT II: Pteridophytes (12 hours)

Origin and evolution of Pteridophytes; General characteristics of Pteridophytes; Morphology, distribution, anatomy and reporduction; classification (Reimer/ Sporne);Phylogeny. Evolution of stele; heterospory and origin of seed habit.Characteristics features of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

UNIT III: Gymnosperms (12 hours)

Origin andevolution of gymnosperms and angiosperms; General characters; the vessel-less and fruitless seed plants, variations in reproductive structures (cones), pollen germination and the complexity of their female gametophyte. Economic importance.

UNIT IV: Gymnosperms – Classification & Type studies (12 hours)

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: Paleobotany (12 hours)

Geological time scale;Fossilization process;Fossils and Types: general account. Fossils:algae, fungi, bryophtes and pteridopytes.Study of fossil forms: *Lyginopteris, Heterangium, Medullosa, Cycadeoidea, Pentaxylon*, *Williamsonia* and *Cordaites.* Major

fossil sites of India: Thiruvakkarai, Sriperumbudhur, Rajmahal Hills. Paleobotany in phylogeny;Indian Paleobotanists: Birbal Sahni, D.D. Pant, M. Ramanujam.

Text books

1. Alam, A. 2015. Text book of Bryophyta. 1/e, I.K. International Publishing House, New Delhi
2. Sporne, KK. 1991. The Morphology of Pteridophytes. BI Publishing, Bombay.
3. Sporne, KR.1965. The Morphology of Gymnosperms. BI Publications, New Delhi.
4. Sharma, OP. 2014. Bryophyta. McGraw Hill Education, New Delhi

References

5. Parihar, N. S. 1991. Bryophyta. Central Book Department, Allahabad
6. Bhatnagar, SP and Moitra, A.1996.Gymnosperms. New Age International, New Delhi.
7. Parihar, NS. 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
8. Boid, H. C. 1982. Bryophyta. Wiley-Eastern.
9. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5th Edition.).
10. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition)
11. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science, (1st Edition).

NBYL11: PLANT DIVERSITY I& II- PRACTICAL

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/PRACTICAL-1]

Objectives: (1) To understand the classification and evolution of Bryophytes, Pteridophytes and Gymnosperms through morphology and internal structures; (2) To get an understanding of the past history of the biosphere and evolution of plants through fossils.

Outcome: After successfully completing this course, the student will be able to differentiate Bryophytes, Pteridophytes and Gymnosperms from other plant groups both morphologically and anatomically. The student will understand the evolutionary history of Bryophytes, Pteridophytes and Gymnosperms.

L	T	P	C
0	0	3	4

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

2. Study of morphology and reproductive features of following Fungi: *Albugo, Aspergillus, Peziza, Polyporus, Puccinia, Colletotrichum, Fusarium, Cercospora; Parmelia* and *Usnea* (Lichens). Root section of grasses for localization of ecto and endomycorrhizae

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

4. Structural details of the vegetative and reproductive parts of the following types: *Psilotum*, *Lycopodium, Selaginella*, *Isoetes, Equisetum, Lygodium, Adiantum, Marsilea, Salvinia.*
5. Comparative Morphological and anatomical studies of vegetative and reproductive parts of *Cycas, Cupressus, Araucaria, Podocarpus, and Gnetum.*

6. Structural details of the following fossil types: *Lyginopteris, Medullosa. Rhynia, Lepidodendron, Sphenophyllum, Calamites*.Demonstration of sectioning of plant fossiles by vedio clippings. Visit to National Fossil sites – Thiruvakkarai.

NBYC13: MICROBIOLOGY

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-3]

Objectives

To understand the nature, physiology, and interactions of microorganisms in nature, the nutritional behavior and methods to cultivate the microbes, how the microbes exchange genetic information, the human immunological response to microbial infections

Outcome: Students will recognize the role and importance of various microbes in nature; and learn how they can be exploited for beneficial uses or controlled to prevent diseases caused by microbes.

L	T	P	C
4	0	0	4

UNIT I: Historical Developments & Classification (10 hours)

Introduction: 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: Microbial Techniques & Physiology (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 estimation methods. Microbial Physiology**:** Bacterial growth, multiplication, nutritional requirements, growth inhibitors, bacteriostatic and antibiotic agents.

UNIT III: Microbial Genetics (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:virulence, mechanism of pathogenesis, pathogenic properties. Microbial Toxins- types, structure and properties.

UNIT IV: Virology and microbial interactions (12 hours)

Virology: Structure and Classification of viruses; Bacterial, Plant, Animal viruses, bacteriophages, λphage life cycle, RNA /retroviruses, severe acute respiratory syndrome corona virus 2 (SARS-CoV-2); satellite viruses, Viroids, Virusoids, control of virus - antiviral drugs. 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.

UNIT V : Immunology (12 hours)

Basic concepts, cells and organs of immune system, adaptive and innate immunity, production and properties of T & B cells, types, structure & functions of immunoglobulins, antigen-antibody interactions, MHC, agglutination, monoclonal and polyclonal antibodies, biological allergens, hypersensitivity, autoimmunity, immunodeficiency. Active and passive immunizations, vaccines types including Covid - 19, production and uses.

Text Books

1. Tortora, G.J., Funke, B.R. and Case, C.L. 2016. Microbiology: An Introduction. Pearson Education, Inc., USA, 12th Edition.
2. Willey, J., Sandman, K. and Wood, D. 2019. Prescott's Microbiology. McGraw Hill, 11thEdition.
3. Pelczar, M.J. Jr, Chan, E.C.S and Kreig, N.R. 2006. Microbiology. Tata Mc Graw-Hill INC. New Delhi. 5th Edition
4. Dubey, R. C. and Maheswari, D. K. 2012. A text of Microbiology (Revised edition)**.** S. Chand and Company Ltd., New Delhi.
5. Parija, S.C. 2012. Textbook of Microbiology and Immunology, Reed Elsevier India Private Limited, 2nd Edition

References

6. Madigan, M.T., Martinko, J.M., Stahl, D.A. and Clark, D.P. 2012. Brock Biology of Microorganisms. Pearson Education, Inc., publishing as Benjamin Cummings, San Francisco, 13th Edition.
7. Black, J.G. and Black, L.J. 2017. Microbiology: Principles and Explorations, Wiley, 10th Edition.
8. Alexander, A. M. 1974. Microbiology Ecology, John Willy & Sons.
9. Hyde, D.R. 2010. Genetics and Molecular biology: With Fundamentals of Biostatistics. Special Indian edition, Tata Mc Graw Hill P.Ltd., New Delhi.
10. Sumbali, G. and Mehrotra, R.S. 2009. Principles of Microbiology. First edition, Tata Mc Graw Hill P. Ltd., New Delhi.
11. Moat, A.G., Foster, J.W. and Spector, M.P. 2002. Microbial physiology. 4th edition, John Wiley sons, Inc., New Delhi

12. Ramawat, K.G. and Goyal, S. 2010. Molecular biology and Biotechnology. S. Chand & Co. Ltd., New Delhi.
13. Robert F Boyd. 1984. General microbiology. Times Mirror and Mosby College Publishers.
14. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12thEdition.

NBYC14: CELL AND MOLECULAR BIOLOGY

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-4]

Objectives:

To understand the structure and function of basic components of prokaryotic and eukaryotic cells, especially its membrane organization and organelles.

To introduce to rapid contemporary changes witnessed in plant molecular biology.

Basic organization of genetic material and the realms of events associated with replication and gene expression will be examined.

Outcomes:

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

L	P	T	C
4	0	0	4

UNIT I: Cell structure (10 hours)

Cell theory, Cell structure, prokaryotic and eukaryotic cells. Structure and functions of cytoplasmic organelles – Mitochondria and Chloroplast; Golgi apparatus, Ribosomes, Lysosome, Glyoxysome and Vacuoles. Cytoplasm: physicochemical properties and chemical composition.

UNIT II: Membrane Organization and Cell Signaling (10 hours)

Plasma membrane: structure, chemical nature, models and functions, transport across cell membranes.Signal transduction**:** Overview, cell surface receptors, signal transduction cascades-second messengers and pathways. Regulation of signal transduction- e.g. two-component sensor-regulator system in bacteria and plants, bacterial chemotaxis and quorum sensing.

UNIT III: Nucleus and Cell Division (10 hours)

Structure and functions of nucleus, nuclear envelope and nucleolus. Chromosome structure and packaging of DNA, organization of centromere and telomere. Phases of cell cycle and its regulation role of cyclins and Cdks. Cell divisions: Mitosis, Meiosis - Chromosomal aberrations-, duplications, inversions (paracentric and pericentric) and translocation. Euchromatin and heterochomatin; banding patterns; specialized types of chromosomes; polytene, lamp brush, sex chromosomes; Physical mapping of genes on chromosomes, Karyotype analysis.

UNIT IV: Nucleic Acids (15 hours)

Nucleic acids: Physical and chemical properties of DNA & RNA, Types of DNA & RNA, Watson and Crick model, Methylation of DNA and mismatch repair; C-value paradox; cot curve. Genetic code. Central Dogma of Molecular Biology; DNA as genetic material, DNA synthesis and replication, semi-conservative, DNA replication enzymes, replication in prokaryotic and eukaryotic cells.

UNIT V: Transcription and Translation (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.

Text Books

1. Karp, G., Iwasa, J. and Marshall, J. 2019. Karp's Cell and Molecular Biology, Wiley, 9th Edition.
2. Hyde, D.R. 2010. Genetics and Molecular biology: With Fundamentals of Biostatistics. Special Indian edition, Tata Mc Graw Hill P.Ltd., New Delhi.
3. Kleinsmith, L.J. and Kish,V.M. 1995. Principles of Cell and Molecular Biology (2nd edition). Harper Collins College Publishers, New York, USA.
4. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
5. Rastogi, S.C. 2020. Cell and Molecular Biology, New Age International Publishers.

References

6. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K. and Walter, P.2014. Molecular Biology of the Cell. Norton Publishers, 6th Edition.

7. *David Freifelder*. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi.
8. Krishnamurthy, K. V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
9. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2018. Lewin's Genes XII. Oxford University Press, New York, 12th Edition
10. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Martin, K.C. 2016. Molecular Cell Biology. 4th Edition. WH Freeman and Co., 8thEdition.
11. Wolfe. S. L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.

NBYL12: MICROBIOLOGY, CELL AND MOLECULAR BIOLOGY- PRACTICAL

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/PRACTICAL-2]

Objectives

- To prepare sterile nutrient media and conduct experiments to understand the physiology of bacteria.
- To determine microbial populations from soil and water matrices.
- To study cell division types - mitosis and meiosis in plants
- To extract DNA from plants for analysis and other experiments

Outcome: Students will understand (i) how to cultivate, maintain microbial cultures; (ii) manipulate microbes for beneficial activities; and (iii) extract DNA, analyze and manipulate for industrial processes.

L	T	P	C
0	0	8	4

1. Methods of sterilizationand preparation of culture media for microbial growth.
2. Determination of bacterial growth & Growth curve by turbidimetric method.
3. Simple and Differential staining for bacteria
4. Isolation of bacteria and achieving pure cultures from soil and water; and maintenance of organisms by plating, streaking and serial dilution methods.
5. Effect of temperature, pH and carbon and nitrogen sources on bacterial growth.
6. Assay of antibiotics and demonstration of antibiotic resistance.
7. Analysis of water for potability and determination of MPN.
8. Preparation of alcohol from fruit juice(s).
9. Isolation and observation of genomic and plasmid DNA from microorganisms.
10. Screening for amylase/ cellulase producing organisms.
11. Transformation of *E. coli*.
12. Study of mitosis - onion root tip squash for chromosomal examination – Haematoxylin staining
13. Study of meiosis – *Tradescantia/Rheo* for chromosomal examination – acetocarmine staining

References

1. Willey, J., Sandman, K. and Wood, D. 2019. Prescott's Microbiology. McGraw Hill, 11thEdition.
2. Pelczar, M.J. Jr, Chan, E.C.S and Kreig, N.R. 2006. Microbiology. Tata Mc Graw-Hill INC. New Delhi. 5thEdition
3. Cappuccino, G., and Sherman, N. 2014. Microbiology: a laboratory manual, 10th ed., Pearson Education, Inc
4. Glick, B. R. and J. E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.

5. 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.
6. Gunning, B. E. S. and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.
7. 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.
8. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
9. Harris, N. and K. J.Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
10. Shaw, C. H (Ed). 1988. Plant Molecular Biology: A Practical Approach. IRL Press, Oxford.

NBYEA: EVOLUTIONARY BIOLOGY

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/Elective - 1]

Objectives:

- Evolutionary biology is to teach past history & origin of living organisms.
- Describe concepts, theories & experimental evidences that support origin of higher order organism from primitive ones.

Outcome: Learners will understand how biological organisms including human beings have evolved, survived with natural adaptations, possibilities of destruction for the survival of human beings & other organisms.

L	T	P	C
4	0	0	4

Unit I: Origin and Early History of Life (5 hours)

Definition of Life, Fundamental properties of life. Theories about origin of Life - special creation, extraterrestrial origin, spontaneous origin. Scientific view point – Miller Urey experiment, chemical evolution, RNA world, protein world, a peptide nucleic acid world, Microevolution – Endosymbiois, Prokaryotes,Protists, Fungi, Plants. Geological time scale, Macroevolution.

Unit II: Origin of Species and Selections (10 hours)

Nature of species, Species concept, Natural selection and speciation, Geography of speciation; levels of selection. Darwin and theory of evolution. Units and Types of selection; sexual selection genetic drift; gene flow; adaptation; convergence. Human

evolution – Earliest Primates, Prosimians, Anthropoids, Apes and Hominoids, Australopithecines, Early Homo, Modern Human evolution – Homo sapiens.

Unit III: Evolutionary Genetics (10 hours)

Origin of genetic variation; Mendelian genetics; quantitative and polygenic traits, linkage and recombination; epistasis, gene-environment interaction; heritability; population genetics; molecular evolution. Mutation and migration; phylogenetic analysis and comparative methods; extinction and diversity of life forms.

Unit IV:Evolutionary History of plants (10 hours)

Origin of plants, Early plant life cycles. Non vascular plants – Mosses, Liverworts, Hornworts. Features of vascular plants. Seedless vascular plants. Seed plants – Gymnosperms and Angiosperms.

Unit V: Fossil Records and Evidences of Evolution (10 hours)

Role of environment in development and evolution; major transition in evolution; co-evolution; Evidences for Evolution -from fossils, anatomical and embryological evidences, homologous and analogous organs.

Text books

1. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
2. Futuyma, D.J. and Kirkpatric, M.2017. Evolution. Sinauer Associates, U.S.A, 4thEdition

References

1. Hartl, D. L. 1988.A primer of population genetics (2nd Edition).
2. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5th Edition.).
3. Mark Ridley. 2004. Evolution (3rd Edition). Blackwell Publishing Ltd., UK
4. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science.
5. Sean, BC, Grenier J Kand Weather Bee, S D. From DNA to Diversity (2nd Edition).
6. Sober, E. 1994. Conceptual issues in evolutionary biology.
7. Steven Gaulin & Donald Mc Burney. 2004. Evolutionary Psychology (2ndEdition).

NBYEB: PLANT DISEASES AND INSECT PEST CONTROL

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/Elective - 1]

Objectives:

This paper deals about plant diseases caused by bacteria, fungi & viruses.

To understand mechanism of infection, diagnosis procedure and control measures.

Outcome:

Learner will definitely realize how food production is severely is affected by pathogens. They will participate in food production by eliminating major threats that affect plants and management practices.

L	T	P	C
4	0	0	4

Unit I: Concept of Plant Diseases and Diagnosis (9 hours)

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: Fungal &Bacterial Diseases (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: Viral Disease (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: Insects (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.

Unit V: Classification of Insect Pests and Biological Control (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.

Text Books

1. Agrios, G.N. Plant Pathology. 2004 (5th Edition). Academic Press.
2. Larry P. Pedigo. Entomology and pest management.
3. Tarr, S. A. J. 1972. Principles of plant pathology.

References

4. Atwal, A. S. Agriculture pest of India and South East Asia.
5. Green, M. B. Chemical for crop improvement and pest management.
6. Maniloff, J.1992. Mycoplasma molecular biology and pathogenesis.
7. Mundkar, B. B. 1972. Fungi and plant diseases.
8. Paul and Khurana, S. M. 1998. Pathological problems of economic crop plant and their management.
9. Raychandhuri, S. P. and Anupamvarma. 1989. Plant diseases caused by fastidious Prokaryotes.
10. Srivastava, K. P. A textbook of applied entomology.
11. Thurston, H. D. 1993. Tropical plant diseases.

NBYEC: AQUATIC AND MARINE PLANTS

[2020-2021/MSU 51ST SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/Elective - 1]

Objectives: This subject concentrates on distribution, morphology, reproduction, growth & life cycle of aquatic & marine plants.

This paper aims at understanding about culture techniques that add revenue to farmers.

Outcome: Techniques learned from this subject makes a common man into an entrepreneur. They act as key player in conservation of aquatic and marine plants.

L	T	P	C
4	0	0	4

Unit I: Plant Aquaculture (5 hours)

History, principles, scope and importance. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques of twosea weeds. Important cultivable species of aquatic plants, sea weeds, micro algaeand their systematic position. Biodiversity of Seaweeds along the coast of India. Products from seaweeds.

Unit II: Freshwater Algae Higher Vascular Plants (10 hours)

Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques and Importance of *Spirulina* and *chlorella*. Application of microalgae in water treatment and bioremediation. Biodiversity of freshwater macrophytes in India. Taxonomy of economically important macrophytes. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques of freshwater higher vascular plants (*Trapa*,*Typha*), products of aquatic macrophytes.

Unit III: Phytoplankton (Freshwater and Marine) (10 hours)

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: Storage and Structural Components in Algae (10 hours)

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. Carbon fixation in

CAM plants. Membrane transport under salinity. Effect of salinity on growth and phytohormones.

Unit V: Biodiversity of Mangroves (10 hours)

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, Sonneratiaceae, Avicenniaceae, Myrsinaceae, Acanthaceae. Methods of natural and artificial regeneration in mangroves.Carbon sequestration potential of mangrove ecosystem.

Text Book

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

References

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.
10. Subramanyam, K. 1962. Aquatic Angiosperms. A systematic account of common Indian aquatic angiopsperms. Council of Scientific and Industrial research, New Delhi, India.
11. Lucas JS, Southgate PC, Tucker CS. Aquaculture: Farming Aquatic Animals and Plants. 2019. John Wiley and Sons. (1st Edition).

NBYC21 – PLANT DEVELOPMENTAL ANATOMY

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/CORE-5]

Objectives: (1) This course intends to provide an insight into the internal structure and reproduction of the most evolved group of plants, the Angiosperms; (2) Understand the origin, structure, growth, development and reproduction of angiosperms through molecular biology; and (3) Get an insight in to the histochemistry with special reference to various stains and staining procedures

Outcome : After completing this course, the students will be able to recognize the anatomical differences between monocotyledons and Eudicots. In addition, they will clearly understand the seed-to-seed developmental biology of angiosperms.

UNIT I : Basic concepts of development: (15 hours)

Cell structure and its components, ergastic substances; potency, commitment, specification, induction, competence, determination and differentiation; cell fate and cell lineages; classification of tissues, origin, development and functions of simple and complex tissues. 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; nutrient resorption during senescence; influence of hormones and environmental factors on senescence.

UNIT II: Morphogenesis and organogenesis in plants: (15 hours)

Structure, development and functions of root hairs; types of vascular bundles; Meristem and types, theories on root and shoot apical meristems; Organization of shoot and root apical meristem; molecular biology of SAM and RAM; leaf initiation and development, types of phyllotaxy; tropisms; internal structures of root, stem, leaf, petiole and node; epidermal zone, types of trichomes; oil glands, latex cells and vessels; cambium, secondary thickening, anomalous secondary thickening; ecological anatomy: mesophytes, hydrophytes and xerophytes; transition to flowering, floral meristems and floral development in *Antirrhinum*, sex determination; genes involved in growth and development; Unique features of plant development; difference between plant and animal development.

UNIT III: Reproduction: (10 hours)

Vegetative and sexual reproduction; Male gametophyte: anther structure; microsporogenesis; role of tapetum; pollen development and gene expression; sperm dimorphism; pollen germination, pollen tube growth and guidance; pollen embryos; Female gametophyte: Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells; establishment of symmetry in plants.

UNIT IV: Pollination and fertilization: (10 hours)

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. Embryogenesis: dicot and monocot, polyembryony, apomixes. Endosperm development and types; storage proteins of endosperm; anatomy of seed, seed types, seed germination types, biochemistry of seed germination, genes involved in seed development and germination; Dynamics of fruit growth, biochemistry and molecular biology of fruit maturation, seed to seed lifecycle of angiosperm.

UNIT V : Histological staining and procedures: (10 hours)

Usage and Preparation of common lab stains and reagents: Basic stains (Safranin, Crystal violet, Basic fuchsine, Cotton blue); Acidic stains (Fast green, Orange G, Erythrosine, Eosin, and Toluidine 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 and lipids.

Text Books

1. Dickson, W.C. 2000. Integrative Plant Anatomy, Elsevier, USA.
2. Crang, R., Lyons-Sobaski, S and Wise, R. 2019. Plant Anatomy: A Concept Based Approach to the Structure of Seed Plants. Springer Nature, Switzerland.
3. Beck, C.B. 2010. An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century. 2nd Edition. Cambridge University Press, United Kingdom.
4. Bhojwani, S. S. and S. P Bhatnager. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
5. James D. Mauseth. 2003. Botany: An Introduction to Plant Biology. Jones & Bartlett Learning.

6. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
7. 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

1. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
2. Fageri, K. and L. Van der Piji. 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford.
3. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.
4. Fosket, DE.1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
5. Howell, S. H. 1998. Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
6. Leins, P. and S. C. Tucker, P. K. Endress. 1988. Aspects of Floral Development. J. Cramer, Germany.
7. Raven P.H. and G.B. Johnson, J.B. Losos, K.A. Mason, S.R. Singer. 2008. Biology 8th ed. Mc Graw Hill, Higer Education. Boston, Madison, New Delhi.
8. Proctor, M. & Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
9. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
10. Shivanna, K. R. and B. M. Johri. 1985. The Angiosperm Pollen: Structure and Function. Wiley Eastern Ltd., New York.

NBYL21: PLANT DEVELOPMENTAL ANATOMY -PRACTICAL

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- II/Practical -3]

Objectives: Studying plant anatomy and developmental botany allows a student to conceptually integrate organismal structure, function and development. Further, it helps to reveal the relationships between structure, function, taxonomy, ecology, and developmental genetics.

Outcome : After completing this course, the students will be able to recognize the anatomical differences between monocotyledons and dicotyledons. In addition, they clearly understand the origin, structure, development and maturation of reproductive organs of angiosperms.

1. Study of seed germination processes (monocotyledon and dicotyledon)
2. Estimation of moisture content of seeds and its relation to loss of viability
3. Anatomy of monocotyledon root, stem, leaf and C_3,C_4 leaf anatomy in grasses
4. Anatomy of dicotyledon root, stem, leaf and petiole
5. Leaf epidermal peelings to study types of stomata, stomatal index
6. Study of living shoot apices by dissection using aquatic plants such as *Ceratophyllum* and *Hydrilla.*
7. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
8. Anomalous secondary thickening in stem of *Achyranthes*, *Bougainvillaea* and *Dracaena*
9. Leaf Anatomy of hydrophyte and xerophyte
10. Estimation of wood density and carbon content
11. Study of leaf area, specific leaf area and leaf dry matter content
12. Study of flower diversity in tropical dry forest
13. Acetolysis of pollen grains
14. *In vitro* germination of pollen grains
15. Morphology and anatomy of stigma, style ovary and embryo and tracing different stages of embryos
16. Single and double staining Methods using fresh hand sections

NBYC22:INSTRUMENTATION AND RESEARCH METHODOLOGY

[[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-6]

Objectives

- To understand the knowhow's on principles and practical knowledge about the advanced instruments used in modern biology
- To understand the principles of data management and statistical analysis.
- To Understand the theory of microtome, sectioning and staining
- To understand the research ethics relevant to research and publications

Outcome: Students will understand the basics of biochemical reagent preparations, analysis of compounds using conventional and advanced instruments, and analyze the data statistically and the ethical guidelines to be followed during research.

L	T		P	C
4	0		0	4

UNIT I: Buffering, spectroscopy and chromatography (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 spectrophotometer, AAS, GC-MS, IR, NMR andRaman spectroscopy. Chromatography: Principles and applications; Paper, Thin Layer, Column and HPLC.

UNITII: Electrophoresis, Microscopy and Centrifugation (15 hours)

Electrophoresis: principles and applications, support media and buffers, electrophoresis of proteins and nucleic acids, and capillary 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.Centrifugation: principles;types: low-speed, High speed, Micro and Ultra centrifuges.Sedimentation coefficient, Svedberg (S) unit, RPM, RCF, g; rotor types (fixed angle, swinging bucket, vertical, zonal), Preparative centrifugation: differential &density gradient centrifugations.

UNIT III: Biostatistics (15 hours)

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 in MS-Excel.

Unit IV: Microtome sectioning (10 hours)

Microtome types: Rotary, Sledge, and Cryostat. Micro preparation 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: Research Methodology (10 hours)

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.

Textbooks:

1. Boyer, R.F. 2000. Modern Experimental Biochemistry. 3rdedn. Prentice Hall Publ. ISBN 0 8053 31115.
2. Gurumani, N.2014. Research Methodology for Biological Sciences. MJP publishers, Chennai.
3. Kothari, C.R. and Garg, G. 2019. Research Methodology: Methods and Techniques. New Age International Publications, New Delhi.
4. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.

References:

1. Jensen, W. A. 1962. Botanical Histochemistry. WH Freeman & Company.
2. Johansen, D. A. 1940. Plant Micro technique. McGraw Hill.

3. Khasim, S. M. 2002. Botanical Microtechnique: Principles and Practice. Capital Publishing Company.
4. Miksche, J. P. 1976. Botanical Microtechnique and Cytochemistry. Dowa StateUniversity Press.
5. Panse and Sukhatme. 1992. Statistical Methods for Agricultural workers. ICAR, New Delhi.
6. Sanderson, J. B. 1994. Biological Micro technique. Bios Scientific Publishers.
7. Sandhu, G.S. 1990. Research techniques in biological sciences. Anmol Publications, New Delhi.
8. Jeyaram, J.1998. Laboratory Manual in Biochemistry. New Age InternationalPublishers Ltd.
9. Raven P.H. and G.B. Johnson, J.B. Losos, K.A. Mason, S.R. Singer. 2008. Biology 8th ed. Mc Graw Hill, Higer Education. Boston, Madison, New Delhi.

NBYC23: PHYTOCHEMISTRY AND TRADITIONAL MEDICINE

[[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- II/CORE-7]

Objectives: This subject elaborates plantconstituents and its quantification measures, biosynthetic pathways and ecological role.

It also covers history of herbalism and traditional system of medicine.

Outcome: Learner will witness the role of plants in survival of human beings and other organism. They will also well verse with contribution made by our primitive people in exploration of plant knowledge to alleviate common diseases and development of system of medicine.

L	T	P	C
4	0	0	4

Unit I: Secondary Metabolites and Classification (15 hours)

Phytochemistry: Definition, history, principles. Secondary metabolites: definitions, classification, occurrence and distribution in plants, their functions, chemical constituents. Alkaloids, Terpenoids, Flavonoids, Steroids, and Coumarins. Qualitative tests for the detection of different classes of phytochemicals

Unit II: Isolation and Quantification of phytochemicals (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: Biosynthetic pathways and Application of phytochemicals (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: Herbalism and Ethnobotany (8 hours)

Herbs and healing: Historical perspectives: local, national and global level; Herbal cultures: origin and development of human civilizations; Ethnobotany: Concept, Scope and objectives; Ethnobotany as an interdisciplinary science, Tribals of India; Methodology of ethnobotanical studies; Medico-ethnobotanical sources in India; Benefit sharing with examples; Traditional Knowledge Digital Library (TKDL); Conservation practices of biodiversity - Sacred groves. Ethnopharmacology: Importance of ethnopharmacological studies.

Unit V : Traditional Systems of Medicine (15 hours)

Classical health traditions: Systems of medicine: origin and development of biomedicine; Indian Systems of Medicine (Ayurveda, Siddha, Unani, Tibetan, Yoga and Naturopathy) Ayurveda: Historical perspective, Fundamental principles of Ayurveda: Panchabhootha theory, Thridosha theory, Saptadhatu theory and *Mala* theory; Siddha: Origin and Concept of Siddha system of Medicine; Plants used in Siddha medicine, Siddha formulations; Unani: History, Concept: *Umoor-e-tabiya*, tumors treatment of therapy, polyherbal formulations.

Text books

1. Shah, B., Seth, A.K. 2010. Textbook of Pharmacognosy and Phytochemistry, Elsevier India.
2. Wallis T. E. 2005. Textbook Of Pharmacognosy, CBS, New Delhi, 5th EditionBannerman, R. H., J. Burton and C. Wen Chen (eds). 1983. Traditional medicine and health care coverage. WHO, Geneva.
3. Harborne, J.B. 1998. Phytochemical Methods: A guide to Modern Techniques of Plant Analysis, Chapman &Hall, London, 3rdEdition.
4. Shah, B., Seth, A.K. 2010. Textbook of Pharmacognosy and Phytochemistry, Elsevier India.

5. Wallis T. E. 2005. Textbook Of Pharmacognosy, CBS, New Delhi, 5th Edition

References

6. Gingauz, A. 2001.Medicinal Chemistry. Oxford University Press & Wiley Publications.
7. Mann J. Davidson, R. S and J. B. Hobbs, D. V. Banthorpe, J. B. Harborne. 1994. *Natural Products*. Longman Scientific and Technical Essex.
8. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.
9. Cotton, CM. 1996. Ethnobotany:Principles& Applications. John Wiley & Sons, New York.
10. Kameswara Rao, C. 2000. Database of Medicinal Plants. KSCST, Bangalore
11. Knight, R. L and L. White. 2009. Conservation for a new generation redefining natural resourcesmanagement. Island Press.
12. Crozier, A., Clifford, M.N. and Ashihara, H. 2006. Plant Secondary Metabolites: Occurrence, Structure and Role in the Human Diet. Blackwell Publishing Ltd, UK.
13. Saroya, A.S. 2011. Herbalism, Phytochemistry and Ethnopharmacology. CRC Press, Boca Raton, FL.
14. Handa, S.S., Khanuja, S.P.S., Longo, G. and Rakesh, D.D. 2008. Extraction Technologies for Medicinal and Aromatic Plants. ICS-UNIDO, Earth, Environmental and Marine Sciences and Technologies, International Centre for Science and High Technology, Italy.

NBYL22: INSTRUMENTATIONAND PHYTOCHEMISTRY - PRACTICAL

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- II/PRACTICAL – 4]

Objectives: This practical content covers three important field includes instrumentation, phytochemistry & anatomy.

The paper provides hands on training on handling of instruments commonly used for research purpose, study about phytoconstituents and plant specimen.

Outcome: Students will gain experience in handling common instruments and techniques. They will also be familiar in extraction & quantification of phytoconstituents. In addition they will learn anatomy of plants in depth through sectioning and visualization of specimens.

L	T	P	C
0	0	4	4

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. Isolation of some natural products: Piperine, caffeine, flavone, coumarin, triterpenoids
7. Spectroscopic estimation of some natural products.
8. Preparation of stains.
9. Microtomy – Preparation of thin sections and permanent slides.
10. Staining starch, cell wall, lipids, proteins and nucleic acids using bright field dyes
11. Preparation of double stained free hand sections and identification of the tissues with reasons (Normal or anomalous secondary thickening).
12. Free-hand sections showing localization of soluble components-Proteins, Sugars and Lipids.
13. Preparation of serial sections, from the given block and identification of the tissues with histological reasoning.
14. Preparation of squashes and smears. Maceration of tissues for separating cell types.
15. Students are expected to get a thorough understanding on reagents and buffers for the tissue processing and they should submit 20 slides (10 microtome sections, 10 hand sections for permanent and semi-permanent slides) for valuation.

Optional Elective 2: Any one of the Following Three Courses

NBYED: PLANTS IN TAMIL CULTURE

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/ELECTIVE -2]

Objectives: This subject elaborates antiquity of Tamil land.

It emphasizes relationship between Tamil people and plants.

Usage of plants is supported by Tamil literature.

Outcome : Learner will continue to understand and manage plants based on earlier literature. They will conserve plants as sacred and would utilize plants in a sustainable manner thereafter.

L	T	P	C
4	0	0	4

UNIT I: Land, People and Literature (9 hours)

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

UNIT II: A Brief Introduction to Sangam Literature (9 hours)

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

UNIT III: Plants in Tholkkapiaym (9 hours)

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

UNIT IV: Sacred Plants (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: Plants Relevant to Astrological Importance (9 hours)

Constellation (Rasi) and star plants. The continuing influence of plants present-day Tamil culture.

Text books:

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.

References:

1. Samy, P.L. 1967. *SangaIllakkiathilSedikodiVilakkam*. Saiva Siddhanta Publishing Society. Thirunelveli.

2. Samy, P.L. 1972. *Plants in KurinjiPattu*. Journal of Tamil Studies.
3. Sasivalli, V.C. 1989. *PandaiTamilarTolilkal*. International Institute of Tamil Studies. Madras.
4. Sobidhraj, K.K.S. 1993. ThalaMarangal. Sobitham. Tambaram East. Madras.
5. Srinivasan, C. *Sanga IlakiaThavarangal*, Tamil University Publication. Thanjavur.
6. Thaninayagam, X.S. 1966.Landscape and Poetry: A study of Nature in Classical Tamil Poetry. Asia Publishing House, Madras.
7. Varadarajan, M. 1957. The treatment of Nature in Sangam literature. S.I.S.S.W Publishing Society, Madras.
8. WWW. Thavarathagavalmaiyam.com
9. WWW.plantinfocentre.com

NBYEE: HORTICULTURE AND PLANT BREEDING

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/ELECTIVE -2]

Objective: To emphasize the three components of horticulture, the science, craft and an art of growing common ornamental and horticultural plants

To enlighten students on practical problems of plant breeding and the ways and means of solving genetic crossing and problems.

Outcome: Students will know the methods of plant propagation and and importance of improving aesthetics of the surrounding. By knowing the elementary principles in plant breeding students will understand the importance and value of producing high yielding, disease and insect resistant plants.

L	T	P	C
4	0	0	4

UNIT I: Horticulture (9 hours)

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 II:Plant Propagation (9 hours)

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 top garden/Terrace garden, Vertical garden, Fruit garden, Kitchen garden. Bonsai.

UNIT III: Plant Breeding (9 hours)

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 IV: Hybridization (9 hours)

Objectives, choice of parents, pure lines, 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 V: Back-cross breeding (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.

Text Books

1. Adams, C.R., Bamford, K.M. and Early, M.P. 2012. Principles of horticulture. Routledge, 6th Edition.
2. Acquaah, G. 2009. Horticulture : principles and practices. Pearson Prentice Hall, 4th edition.
3. Orton, T.J. 2020. Horticultural plant breeding. Academic Press
4. Schlegel, R.H.J. 2018. History of Plant Breeding. CRC Press.
5. Allard, RW. 1999. Principles of Plant Breeding. John Wiley & Sons, New York.

References

6. Kumar, N. 1990. Introduction to Horticulture. Rajalakshmi Publication, Nagercoil.

7. Christopher, E. P. 1981. Introductory Horticulture, McGraw Hill, New Delhi.
8. Manibhushan Rao, K. 1991. Text book of Horticulture. Macmillan India Pvt. Ltd. New Delhi.
9. Arnold, R. W. 1960. Principles of Plant Breeding. John Wily & Sons, New York.
10. Darbeswhar Roy. 2000. Plant Breeding. Narosa Publishing House, New Delhi.
11. Edmond, J. B. *et al.*1977. Fundamentals of Horticulture. Tata McGraw Hill, New Delhi.
12. Fred. W. Briggs and Knorotes, P.F. 1967. Introduction to Plant Breeding. Reinhold Publishing Corporation. New York.
13. Graf, A.B. 1981. Tropica (2nd Edition). Roehrs co., USA.
14. Mandal, A. K. 2000. Advances in Plant Breeding. CBS Publishers and Distributors, New Delhi.
15. Rao, A.B. 1991. Text Book of Horticulture. Mac-Millan India Ltd., New Delhi.
16. Sadhu, MK. 1996. Plant Propagation Methods. New Age International, New Delhi.
17. Sing, D.D. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
18. Singh, B. D. 1999. Plant Breeding. Kalyani publishers, New Delhi.

NBYEF: PLANTS FOR BIO ENERGY AND SPACE RESEARCH

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/ELECTIVE – 2]

Objectives: This subject deals role of plants in generation of energy & space research. This subject also covers interesting physics part like GPS, remote sensing etc.

Outcome: Scarcity in energy needs for growing population is met out by this alternative type of energy generation. One can simplify physical process by plants.

L	T	P	C
4	0	0	4

UNIT I: Energy Sources - General Account (8 hours)

Energy sources - General account. Bio energy-energy plantations, social forestry and Silviculture energy farms. Bio energy sources: Petroleum plants (petro plants)-hydrocarbons for higher plants like *Hevea*and*Euphorbia.* Algal hydrocarbons. Alcohols: Alcohol as a liquid fuel-Hydrolysis 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: Biomass Conversion (8 hours)

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

UNIT III: Gaseous Fuels (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: Photo biological process of hydrogen production. Hydrogenase and hydrogen production. Halobacteria.

UNITIV: Principles and Concepts of Remote Sensing (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.

UNITV: Geographical Information System (GIS) (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.

Text Books

1. Chen, H. and Wang, L. 2016. Technologies for Biochemical Conversion of Biomass. Academic Press.
2. Hood, E., Nelson, P. and Powell, R. 2011. Plant Biomass Conversion. Wiley.
3. Borst, W.L. and Fricke, J. 2013. Essentials of energy technology : sources, transport, storage, and conservation. Wiley-VCH.

4. Reddy, M.A. 2012. Text Book of Remote Sensing and Geographical Information Systems, BS Publications, 4th Edition
5. Sahu, K.C. 2008. Textbook of Remote Sensing and Geographical Information Systems. Atlantic Publishers and Distributors, New Delhi

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. Floyd, F. and W. H. Jr. Sabins. 1987. Remote Sensing, Principles and Interpretation (2nd Edition). Freeman & Company.
4. International Encyclopedia of Ecology and Environment, Volumes1 – 30. Indian Institute of Ecology & Environment, New Delhi.
5. Kerry Turner, R. 1988. Sustainable Environment Management. Westview Press, Colorado.
6. Lilles, T. M. and R. F. Kiefer. 1994. Remote Sensing and Image interpretation. John Wiley & Sons.
7. Maguire, D. and M. Batty. 2005.GISSpatial Analysis &Modelling. Esri Press.
8. Meadows, D. & Randers, J. 2004. Limits to Growth*:* The 30 Year Update*.* EarthScan Publications, London.
9. Michael, L. and McKinney, Robert M Schoch. 2012. Environmental Science-Systems and Solutions. 5th edition. Jones & Bartlett Learning. Massachusetts.
10. Mittal, K. M. 1996. Biogas systems: Principles and Applications. New Age International Publishers (P) Ltd. New Delhi.
11. Simon Dresner. 2008. The Principles of Sustainability Solutions. Earth Scans.
12. *The Ecological Footprint Atlas* 2010. Oakland: Global Footprint Network.
13. Venkataramana, P. & Srinivas, SN. 1996. Biomass Energy Systems. Tata Energy Research Institute, New Delhi.

NBYC31:PLANT PHYSIOLOGY AND BIOCHEMISTRY

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/ CORE – 8]

Objectives

- To understand water and nutrient absorption and translocation in plants
- To comprehend the processes involved in photosynthesis.
- To know the metabolic pathways of respiration and energy flow.
- To comprehend the influence of plant growth regulators on plant functions

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

L	T	P	C
4	0	0	4

UNIT I: Thermodynamics and enzymology (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: Translocation of water and solutes (8 hours)

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: Photosynthesis (15 hours)

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, C_4 cycle; the CAM pathway; biosynthesis of starch &sucrose, physiological &ecological considerations.

UNIT IV: Respiration (15 hours)

Overview of plant respiration, glycolysis, TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylatecycle, alternative oxidation systems. Lipid metabolism: Structures and functions of lipids, structural & storage lipids, biosynthesis of fatty acid and membrane lipids, catabolism of lipids. Nitrogen 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: Plant Growth and Development (14 hours)

Plant hormones and growth regulators: physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid, brassinosteroids, polyamines, jasmonic acid and salicylic acid, hormone receptors. Signal transduction and gene expression. 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, 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, photo physiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.

Text books

1. Bhatla, S.C., Lal, M.A. 2018. Plant Physiology, Development and Metabolism. Springer Singapore.
2. Taiz, l., Zeiger, E., Møller, I.M. and Murphy, A. 2018. Plant Physiology and Development. Sinauer, 7th Edition.
3. Kochhar, S.L. and Gujral, S.K. 2020. Plant physiology : theory and applications. Cambridge University Press, 2nd Edition.
4. Nelson, D.L. and Cox, M.M. 2021. Lehninger Principles of Biochemistry. MacmMillan publishers, 8th Edition.
5. Hopkins, W.G. and Hüner, N.P.A. 2008. Introduction to Plant Physiology. Wiley, 4th Edition.

References

6. Buchanan, B. B., W. Gruissem and R. L. Jones. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.
7. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology (4^{th} edition). Wadsworth Publishing Co., California
8. Willey, N. 2016. Environmental plant physiology. Garland Science Publishers, New-York.
9. Dennis, D. T., Turpin, D. H., Lefebvre, D. D and D. B. Layzell (eds). 1997. Plant Metabolism (second edition).Longman, Essex.
10. Galston, A. W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
11. Hooykaas, P. J. J., M. A. Hall and K. R. Libbenga (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam, the Netherlands.
12. Nobel, P. S. 2020. Physiochemical and Environmental Plant Physiology.Academic Press, San Diego, 5^{th} Edition.
13. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
14. Thomas, B. and D. Vince-Prue. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego.
15. Westhoff, P. 1998. Molecular Plant Development: from Gene to Plant. Oxford University Press, Oxford.

NBYL31: PLANT PHYSIOLOGY AND BIOCHEMISTRY - PRACTICAL

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/PRACTICAL - 5]

Objectives

- To understand water and nutrient absorption and translocation in plants
- To understand the processes involved in photosynthesis.
- To understand the metabolic pathways of respiration and energy flow.
- To Understand the influence of plant growth regulators on plant functions

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

L	T	P	C
0	0	4	2

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 K_m 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 and 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.
11. Determination of seed viability by tetrazolium chloride test (TTC).
12. Effect of plant growth regulators on seed germination and seedling growth of monocot and Eudicots
13. Estimation of the protein content in extracts of plant material by Lowry's or Bradford's method.

14. Determination of the presence of IAA from plant tissues and quantification by Salkowski test.
15. Demonstration of respiration in flower buds by enzyme peroxidase activity.

References

1. Inam, A. 2012. A Laboratory Manual of Plant, Physiology, Biochemistry and Ecology. Agrobios Publications, Jodhpur, India.
2. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.
3. Harborne, J.B. 1998. Phytochemical Methods: A guide to Modern Techniques of Plant Analysis, Chapman &Hall, London, 3rd Edition.
4. Bajracharya, D. 1999. Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi.
5. Copeland, R. A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis. VCH Publishers, New York.
6. Dennison, C. 1999. A Guide to Protein Isolation. Kluwer Academic Publishers, Dordrecht, Netherland.
7. Devi, P. 2000. Principle and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios , Jodhpur, India.
8. Dryer, R. L. and G. F. Lata. 1989. Experimental Biochemistry. Oxford University Press, New York.
9. Ninfa, A. J. and D. P. Ballou. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc., Maryland, USA.
10. Plummer, D. T. 1988. An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
11. Scott, R. P. W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.

NBYC32: ANGIOPSERM TAXONOMY

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/Core - 9]

Objectives: (1) To acquire knowledge on range of morphological structures of angiosperms; (2) To get an understanding of the history and theories underlying different approaches to plant taxonomy and classification; (3) To become familiar with major taxa and their characteristics, and to build up profound knowledge of the current taxonomy of most important plant families; (4) To widen a knowledge and fluency with scientific names and the rules governing their application; and, (5) To make use of diverse taxonomic resources, reference materials, herbarium collections and publications; (6) To become familiar with economically important plants, their parts and uses.

Outcome : After successfully completing this course, the student will be able to recognize common and major families of flowering plants, ability to identify a taxonomically diverse array of native plants, and have better observational and classification skills and field experience.

L	T	P	C
4	0	0	4

UNIT I - Morphology: (10 hours)

Habitat, Habit, Root system, Rootless plants, Root modifications; Shoot system, Shootless plants, Buds, Branching, Shoot classification, Stems specialized for reproduction, Stem modifications; Phyllotaxy, Heterophylly, Simple and compound leaves, Parts of leaf, Leaf base, apex, margin and surface, Venation, Leaf modifications; Inflorescence and fruit classifications.

UNIT I- Evolution and nomenclature of angiosperms: (13 hours)

The origin and evolution, Cradles of angiosperms, Abominable mystery, Pre-cretaceous presumed angiosperms, Lower and mid-cretaceous records, Rules of nomenclature, ICBN to ICN, Botanical congress, Fundamental and guiding principles, Binomial nomenclature, Hierarchy in nomenclature, Author citation, Type method, Rule of priority; Bracketed and Indented keys; Botanic gardens and herbaria, Preparation of herbarium specimen - methods and techniques, virtual herbarium; Icones, Monographs and Floras; BSI and NBRI.

UNIT III - Classical and modern taxonomy: (12 hours)

Types of botanical classification, Hutchinson's principles, Modern concept of primitive and advanced characters, Artificial and Natural system of classification, Hutchinson's classification, History and development of APG system and detailed study on APG IV, Cladistics and molecular taxonomy; Numerical and chemotaxonomy; Taxonomic evidences: Morphology, Anatomy, Cytology, Palynology and Embryology.

UNIT IV - Families: (15 hours)

Study on range of characters of following families: Magnoliaceae, Nymphaeaceae, Capparidaceae, Tiliaceae, Meliaceae, Rhamnaceae, Anacardiaceae, Mimosaceae, Combretaceae, Ebenaceae, Oleaceae, Boraginaceae, Bignoniaceae,Acanthaceae, Nyctaginaceae, Orchidaceae, Amaryllidaceae, Commelinaceae, Arecaceae, Poaceae.

UNIT V - Economic botany: (10 hours)

Perspectives in economic botany, Cereals, Millets, Pulses, Vegetables, Tubers, Fruits and nuts, Oil seeds, Plantation crops, Spices and condiments, Fumitories and masticatories, Fibers, Wood, Medicinal plants, Ornamental plants, Weeds, Resins and Gums, Beverages, Rubber, Forage crops, Plant insecticides, Dyes and tannins.

Text Books

1. Singh G. 2019. Plant Systematics: An Integrated Approach. Fourth Edition, Oxford & IBH, New Delhi.
2. Pandey AK, Kasana S. 2021. Plant Systematics, Om Publications, New Delhi.
3. Simpson, M. G. 2019. Plant Systematics. Third Edition, Elsevier Academic Press, California.
4. Sinha SK. 2013. Taxonomy of Angiosperms. Anmol Publications, New Delhi.
5. Stuessy, TF. 2009. Plant Taxonomy: The Systematic Evaluation of Comparative Data. Second Edition, Columbia University Press, New York.
6. Heywood, V. H. and D. M. Moore. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
7. Naik, VN. 2000. Taxonomy of Angiosperms. Tata McGraw – Hill Publishing Company Limited, New Delhi.
8. Subramaniam, NS. 1997. Modern Plant Taxonomy. Vikas Publishing, New Delhi.

References

9. Gamble, J. S. and C. E. C. Fischer. 1967. Flora of the Presidency of Madras. Vols. I - III. Botanical Survey of India, Calcutta.
10. Grant, W. F. 1984. Plant Biosystematics. Academic Press, London.
11. Greuter, W (Ed.). 2000. International Code of Botanical Nomenclature. (St. Louis Code). KoeltzVesentific Books, Germany.
12. Harrison, H. J. 1971. New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
13. 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.
14. Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. The Macmillan Company, New York.
15. Moore, R. and W. D. Clark, K. R. Stern, D. Vodopich. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers, London.
16. Nordenstam, B. and E. l. Gazaly, M. Kassas. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.
17. Raven, P. H. and R.F. Evertand S. E. Eichhon. 1992. Biology of Plants. 5th Edition. Worth Publishers. New York.
18. Soltis, D. E. and P. S. Soltis, P. K. Endress, M. W. Chase. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc., Massachusetts, USA.

Takhtajan, A. 1997. Diversity and Classification of Flowering Plants. Bishen Singh and Mahendrapal Singh, Dehra Dun.

NBYL32: ANGIOPSERM TAXONOMY - PRACTICAL

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/PRACTICAL - 6]

Objectives: (1) To gain knowledge about how plant specimens are collected, identified, curated, and documented for a permanent record; (2) To understand technical terminologies of taxonomical studies through live specimens; (3) To become familiar with diagnostic features of major plant families and economically important plants

Outcome : After completing thiscourse, the student will be able to differentiate angiosperms from other group of plants. Become familiar with characteristic features of major plant families.

L	T	P	C
0	0	4	4

1. Qualitative plant survey in M.S. university campus and record flora
2. Study on range of leaf shape, apex, margin and base and their uses in plant identification.
3. Study on plant organ modifications.
4. Study on fruit types and its significance in plant identification.
5. Description of a specimen from representative, locally available families.
6. Description of various species of genus; location of key characters and preparation of keys at generic level (indented or bracketed)
7. Identification of key characters and use of keys at family level using Standard Flora.
8. Estimation of simple matching and Jaccard coefficients (Numerical taxonomy)
9. Resemblance and sortex matrices (Numerical taxonomy)
10. Phytochemical analyses for the presence of alkaloids, fixed oil, fats, saponins, gums and mucilages
11. 8. Study of advanced and primitive characters (Hutchinson’s dicta)
12. Solving nomenclatural problems.
13. 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.
14. Collection of at least 10 economically important plants from local markets and study on their origin, distribution and cultivation.

NBYC33: ECOLOGY AND CONSERVATION BIOLOGY

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/ CORE –10]

Objective:

- To understand the local climate, soil and its fertility.
- To know the conversion of radiant solar energy into chemical potential energy.
- To know the flow of solar energy first in plants and then in human beings.
- To emphasize the importance of conserving rare plants and animals.

Outcome: Students will understand the importance of nature surrounding us and their role. Students will know the disturbance of climatic changes on human beings. Students will understand the evil effect of global warming and UV radiation. Students will know the position of India in conserving rare plants and animals.

L	T	P	C
4	0	0	4

UNIT I : Environment, habitat and niche (15 hours)

Climatic (light, temperature and water), soil, physiographic and biotic factors (producers, consumers, decomposers); Ecosystem: structure, components and functions; types of species interactions, interspecific competition (consumers-resource models of competition), herbivory, carnivory, pollination, symbiosis. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource allocation in plants; character displacement.

UNIT II: Population Ecology (15 hours)

Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); semelparity and iteroparity; keystone species; concept of metapopulation (Levins metapopulation model) – demes and dispersal, interdemic extinctions, age structured populations; ecological indicators; ecotype formation and its significance; industrial melanism; endemism and endemic plant species of India.

UNIT III: Community Ecology (15 hours)

Nature of communities; community structure and attributes; levels of species diversity and its measurement – Shannon and Simpson indices; meta communities in homo and heterogeneous environments, edges and ecotones. Ecological Succession: Causes, types, mechanisms, changes involved in succession; concept of climax (mono and polyclimax theories); invasive species and process of invasion; phenology and its importance.

UNIT IV: Ecosystem Ecology and biogeography (15 hours)

Ecosystem structure; food chain and web (trophic cascades); ecological pyramids; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and

decomposition of litter (process, chemistry, organisms involved); structure and function of ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India; Indian forest types.

UNIT V: Applied Ecology and Conservation Biology (15 hours)

Environmental pollution; global environmental change; biodiversity: alpha, beta and gamma diversity, status, monitoring and documentation; major drivers of biodiversity change; better indicators of biodiversity conservation; biodiversity conservation and climate change; management approaches (reserve selection and reserve size); *in situ* and *ex situ* conservation; IUCN and threat categories; Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Text books

1. Ambasht, R.S. 2017. A Text Book of Ecology, 15th Edition, CBS Publishers, New Delhi.
2. Keddy, P.A. 2017. Plant Ecology: Origins, Processes, Consequences, 2nd Edition, Cambridge University Press, United Kingdom.
3. Shukla, R.S and Chandel P.S. 2015. A Textbook of Plant Ecology. S. Chand & Co. Ltd. New Delhi.
4. Heywood, V. H. and R. T. Watson. 1995. Global Biodiversity Assessment. Cambridge University Press.
5. Odum, E. P. 1983. Basic Ecology. Saunders, Philadelphia.
6. Smith, R. L. 1996. Ecology and Field Biology. Harper Collins, New York.

References

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

NBYL33: ECOLOGY AND CONSERVATION BIOLOGY – PRACTICAL

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/PRACTICAL – 7]

Objectives: Students will be emphasized to analyze the different forms of ecosystem. Standardized procedures, field observation & statistical analysis are performed

Outcome: Students will aware about current status of different forms of ecosystem includes factors affecting the functions of ecosystem. They will be promoted to develop strategies to conserve ecosystem for current scenario

L	T	P	C
0	0	3	2

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 estimate C, N, P and K from soil samples of natural ecosystem.

3. To find out size, moisture content and water holding capacity of soil types.

4. To prepare ombrothermic diagram for different sites on the basis of given data set and to comment on climate.

5. To find out species density, richness, abundance and frequency through plot method

6. To construct species-area curve for woody plant community

7. To find species and family important value indices for plant community/communities from grassland or forest

8. To estimate Shannon and Simpson diversity indices for plant community

9. To estimate Jaccard community coefficient index for determining the similarity among plant communities

10. To findthe population structure of woody plant community using basal area, tree size and density

11. To quantify height and volume of trees non-destructively using mathematical formulas

12. To estimate accumulated above ground dry biomass of tree using allometric formula developed for tropical forests

13. To find relationship among important leaf and wood plant functional traits (plants from tropical dry forests)

14. To find reproductive allocation ofselected herbs and trees

15. To record diversity of woody plants in tropical dry forest located in and around Tirunelveli.

Field visits/scientifictours

The students should be taken to one of the following:

i. A protected area (biosphere reserve, national park, or a sanctuary), wet lands, mangroves
ii. Head Quarters of the Botanical Survey of India or one of its Regional circles.
iii. A CSIR laboratory doing research on plants and their utilization.
iv. An ICAR Research Institute or a field station dealing with one major crop or crops (ICRISAT).
v. 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 students by teachers will be added to the final assessment of credits for Field study/tour.

References

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.

NBYC41: GENETICS, GENOMICS AND BIOINFORMATICS

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-IV/ CORE – 11]

Objectives

- The basic objective introduces the newly emerging and rapidly evolving field that integrates biological data and computer calculations.
- This course provides the details of dry lab conditions and analysis of macromolecules and genetic material and help the students to have a knowledge about analysis of sequence of the same.
- To understand the principles, rules of Mendelian genetics, cytoplasmic inheritance, mutation and gene mapping.

Outcome:

- After completion of this course students can explore the information on biological data collection, comparison and analyses to find the interrelation between them for solving structural, functional and evolutionary problems using computational technologies.
- Comprehensive exposure acquired on completion of this course would boost up confidence in students to take up a higher order tertiary research in contemporary avenues of bioengineering and biotech research.

L	T	P	C
4	0	0	4

Unit I : Mendelian Genetics (10 hours)

Laws of inheritance, modified Mendelian ratios: complementary and supplementary genes. Lethal genes, alleles, multiple alleles, pseudoallels. Quantitative genetics: Polygenic inheritance (kernel colour in wheat, ear head length in maize), QTL mapping.. Behavior of chromosomes during meiosis, non-disjunction, chiasma formation, linkage and crossing over – theories. Ploidy types and significance - haploids, aneuploids and euploids, auto and allopolyploids.. Self-incompatibility in *Nicotiana*. Population genetics; Hardy-Weinberg Equilibrium. Extra-chromosomal or Cytoplasmic inheritance: male sterility.

Unit II: Mutation and Repair of DNA (8 hours)

Nature of Mutations, types of mutations, methods of detection of mutation: Ames test, CIB method and attached-X method, Molecular mechanism of spontaneous and induced mutations, site directed mutagenesis. Mutagenic effects of food additives and

drugs. DNA damage and repair. Homeotic mutants in *Arabidopsis* and *Antirrhinum*. Transposons and types.

Unit III : Genomics and Proteomics (15 hours)

Modern Concept of gene. Genomes: definition, size, approximate number of genes in sequenced organisms (viral, bacterial, fungal, plant, animal, and human genomes), plastomes & chondriomes. 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; Specialized genomic data bases**:** *Arabidopsis* Information Resource; crop genomes: rice (INE, RGAP, and 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-translation modification prediction, and metabolomics.

Unit IVI: Bioinformatics (12hours)

History, introduction and scope; role of computers in biology. The internet, World Wide Web, search engines, meta search engines, metadata; Boolean searching, search engine algorithms, iterative searches. Search and Retrieval in literature databases (Pubmed). Bioinformatics Workstations. 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 V: Biological Databases (15 hours)

Primary nucleotide sequence databases: Genbank, European Nucleotide Archive, DDBJ. Primary protein sequence databases: NCBI, PIR, EMBL, ExPAsy, Uniprot, Data submission and retrieval with: Entrez, DBGET/Link, and SRS. Sequence Alignment and Analysis: Structural databases (PDB, CSD). Gene expression databases and transcriptomes, DNA microarray. Molecular modeling and visualization tools; docking and drug designing. Phylogenetics: phylogenetic trees and clades, software and online tools; inference methods (UPGMA). Biodiversity informatics: Plant list, Kew list.

Text Books

1. Hartl, D.L. 2020. Essential genetics and genomics. Jones & Bartlett Learning, 7th Edition.
2. Mishra, N. and Blobel, G. 2010. Introduction to Proteomics: Principles and Applications. Wiley.

3. Sangeetha, J. and Thangadurai, D. 2015. Genomics and proteomics : principles, technologies, and applications. Apple Academic Press.
4. Pevsner, J. 2015. Bioinformatics and Functional Genomics. Wiley Blackwell, 3rd edition
5. Campell and Heyer. 2003. Discovering Genomics, Proteomics and Bioinformatics. Cold Spring Harbor Laboratory.

References

6. Bergeron BP. 2002. Bioinformatics Computing. Prentice Hall.
7. Brown, T. A. 2002. Genomes. Wiley-Liss Publications.
8. Herron J.C. and Freeman, S. 2014. Evolutionary analysis (5th Edition.).
9. Lesk, AM. 2002. Introduction to Bioinformatics. Oxford University Press.
10. Liebler. 2001. Introduction to Proteomics: Tools for the new biology. Humana Press.
11. Pennington, S. and Dunn, MJ. 2001. Proteomics: From protein sequence to function 2ndEd. Ed Bios Scientific Publications Ltd.
12. Jolles, O. and H. Jornvall (eds.). 2000. Proteomics in Functional Genomes. BirkhauserVerlag, Basel, Switzerland.
13. Primrose, SB.1995. Principles of Genome Analysis. Blackwell Science, Oxford.
14. Westhead, D.R., Parish, J.H. 2002. Bioinformatics Instant notes. Bios Scientitfic Publishers Ltd. ISBN 1 85996 272 6.
15. Gardner, E.J., Simons, M.J. Snustard, D.P. 2006. Principles of Genetics. John Wiley and Sons Inc. ISBN: 81 -265- 1043 -9.
16. Sinnott, E.W., Dunn, L.C and Dobzhansky, T. 2004. Principles of genetics. Tata Mc Graw Hill. ISBN: 0-07-099-413-7
17. Mount, D. 2004. Sequence and Analysis. Cold Spring Harbor Laboratory Press. New York.
18. JinXiong. 2006. Essential Bioinformatics. Cambridge University Press.
19. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.

NBYC42 – PLANT BIOTECHNOLOGY

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-IV/ CORE – 12]

Objectives:

- To train the students in the aspects of innovative applications and techniques in plant tissue culture to conserve endemic, endangered plants and improve the quality of the economically important plants.
- To learn the recent advances in genetic engineering and production of transgenic plants.

Outcomes:

- Systematic training given in the different branches of Plant biotechnology will enhance the confidence in students to take up entrepreneurial ventures in

developing bio tagged products, and provide services in national and multinational industries dealing with bio utility and bio resource management.

L	P	T	C
4	0	0	4

UNIT I: Basics of Tissue culture (14hours)

History and scope; concept of totipotency. Culture room and lab facilities. Sterilization methods. Types of media, medium components and preparation; plant growth regulators, adjuvants, antioxidants. Callus induction and types. Cellular differentiation, dedifferentiation, redifferentiation and regeneration. Organogenesis - caulogenesis, rhizogenesis, Cell line, somaclones. Cell Suspension culture: Culture vessels and bioreactors, culture initiation, growth curve, cell aggregates, secondary metabolites synthesis, increased production, use of precursors and elicitors, cell immobilization, biotransformation.

UNIT II: Techniques in Plant Tissue Culture (10 hours)

Micropropagation **-** Preparative stage: Germplasm acquisition and explant selection. Establishment stage: Axenic and viable cultures. Multiplication stage: plantlet production. Conservation by Slow or retarded growth. Rooting and Field Transfer: induction of roots and acclimatization/hardening of plantlets in greenhouse condition. Somatic embryogenesis, process, essential factors and synthetic seed production. Anther, pollen culture and production of gametoclones, haploid plants. Embryo rescue in hybrid plants.

UNIT III: Somatic hybridization & Cryopreservation (10 hours)

Protoplast isolation and culture methods, Somatic hybridization - fusion types, hybrid selection and regeneration, cybrids,possibilities, achievements and limitations of protoplast research. Principles, Cryoprotection, Freezing and long-term cryogenic storage, protocols and recovery of germplasm.

UNIT IV: Mechanism of Recombination (10 hours)

Role of RecA and RecBCD enzymes chi-sequences. Site specific recombination. Genetic markers, construction of molecular maps, correlation of genetic and physical maps. Applications of PCR in cloning genes, probes and DNA sequencing. PCR in molecular marker technology - RAPD, ISSR, AFLP, SCAR. Stern's and McClintock-Creighton experiments.

UNIT V: Transgenic plants (12 hours)

Transgenic plants - 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, construction of genomic and cDNA libraries. Production of transgenic insect-resistant, virus-resistant, salinity and drought tolerant, herbicide-resistant plants. Hybrid seeds and Terminator gene technology.

Text Books

1. Bhojwani, S.S. and Dantu, P.K. 2013. Plant Tissue Culture: An Introductory Text. Springer India.
2. Chawla, H.S. 2009. Introduction To Plant Biotechnology, CRC Press.
3. Bubey, R.C. 2013. A textbook of Biotechnology. S. Chand & Company Private Ltd., Revised Edition.
4. Adrian Slater, Nigel W.Scott, Mark R. Fowler. 2008. Plant Biotechnology: An Introduction to Genetic Engineering. Oxford University Press.

References:

5. Bhojwani, SS. 1990. Plant tissue Culture: application and Limitations. Elsevier Science Publishers, New York.
6. Collins, HA & Edwards S.1998. Plant Cell Culture. Bio Scientific Publishers, Oxford.
7. Dixon, R.A. 1994. Plant cell culture, A Practical Approach. IRL Press. Oxford, London.
8. Erica E.Benson.1999.Plant Cconservation Biotechnology. Taylor & Francis.
9. Freifelder. D. 1990. Molecular Biology. Narosa Publishing, New Delhi.
10. George, E. F. 1994. Plant Propagation by Tissue culture. Exegetics Ltd.
11. Lindsay. 1992. Plant Tissue Culture Manual. Kluwer Academic Publishers, Netherlands.
12. Narayanasamy, S. 1994. Plant cell and tissue culture. Tata McGraw-Hill Publishing Co., New Delhi.
13. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
14. Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York.
15. Vasil, IK. and Thorpe, TA. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

NBYL41: PLANT BIOTECHNOLOGY- PRACTICAL

[2021-2022/MSU 52nd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-IV/PRACTICAL – 8]

Objectives:

- The main objective of this lab component of Plant biotechnology is designed to provide a hands-on experience for students to carry out independent as well as group investigations in plant cell, tissue and organ culture.
- Students will also understand the molecular techniques essential for DNA, isolation, genetic diversity analysis and gene transfer programs.

Outcomes:

After completion of this course students will be technically and critically trained with good practical exposure to perform plant tissue culture and genetic recombination This paper promotes the students to take up micro propagation business with small investment for entrepreneurship.

L	P	T	C
0	6	0	4

1. Sterilization of culture vials, equipment, and culture room and Surface sterilization of explants.
2. Preparation of Culture media stock solutions and working media: solid and liquid medium.
3. *In vitro* germination of Orchid seeds.
4. Callus induction in carrot or any other plant material.
5. Regeneration through callus and somatic embryogenesis.
6. Clonal Propagation by shoot tip/axillary bud culture.
7. Whole cell immobilization/Encapsulation of somatic embryos and production of synthetic seeds.
8. Demonstration of protoplast isolation, culture and fusion.
9. Demonstration of haploid plant production in *Datura.*
10. Isolation of DNA and identification of DNA by AGE.
11. Restriction digestion and estimation of the size of various DNA fragments
12. Polymerase Chain Reaction amplification of DNA and analysis of the products
13. Cloning of DNA fragments in a plasmid vector.
14. Transformation of the given bacterial population and selection of recombinants
15. Visit to Germplasm centers and CommercialPlant Biotechnology laboratories.

Text Books

1. Bhojwani, S.S. and Dantu, P.K. 2013. Plant Tissue Culture: An Introductory Text. Springer India.
2. Dixon, R.A. 1994. Plant cell culture, A Practical Approach. IRL Press. Oxford, London.
3. Lindsay. 1992. Plant Tissue Culture Manual. Kluwer Academic Publishers, Netherlands Adrian Slater, Nigel W.Scott, Mark R. Fowler. 2008. Plant Biotechnology: An Introduction to Genetic Engineering. Oxford University Press.

References:

4. Bhojwani, SS. 1990. Plant tissue Culture: application and Limitations. Elsevier Science Publishers, New York.
5. Collins, HA & Edwards S.1998. Plant Cell Culture. Bio Scientific Publishers, Oxford.
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. Exegetics Ltd.
9. Narayanasamy, S. 1994. Plant cell and tissue culture. Tata McGraw-Hill Publishing Co., New Delhi.