Annexure 10.1

Avinashilingam Institute for Home Science and Higher Education for Women

(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category 'A' by MHRD
Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC
Coimbatore - 641 043, Tamil Nadu, India

Department of Botany

B.Sc., Botany

Programme Outcomes

1. Attain and apply fundamental knowledge to identify major groups of plants and compare the characteristics of lower and higher plants.
2. Gain knowledge and skills for further higher studies, competitive examinations and employment.
3. Acquire research skills and integrate the fundamental concepts with modern tools.
4. Understand the fundamental concepts and their applications of scientific principles and acquire problem solving capabilities.
5. Attain team workmanship in order to serve efficiently in institutions, industry and society
6. Acquire research skills to inquire, synthesize and articulate solution for community development.
7. Apply appropriate techniques, software and modern tools for learning and research
8. Strengthen ethical and moral values and enable to deal with psychological weaknesses.
9. Implement acquired knowledge in basic sciences for self directed and lifelong learning
10. Promote entrepreneurial skills

Programme Specific Outcomes

1. Acquire knowledge of plants from primitive to advanced forms with its structure, reproduction and life cycle patterns of different groups
2. Master the current knowledge of scientific tools and biological methodologies in all subject aspects
3. Develop the skills for employment, entrepreneurship opportunities and research careers

Scheme of Instruction & Examinations
(for students admitted from 2023-2024 & onwards)

Part	Subject Code	Name of paper / Component	Hours of instruction/ week	Scheme Examination				
				Duration of exam	CIA	CE	Total	Credit
First Semester								
I	23BLT001/ 23BLH001/ 23BLF001	பொதுத்தமிழ் தாள் I – இக்கால இலக்கியம் / Prose and Non Detailed Texts / French I	2	3	50	50	100	2
II	23BAEEC1	**Ability Enhancement Compulsory Course - I** English for Communication	4	3	50	50	100	4
	Generic Electives							
		Generic Elective - I	5+1/4+4	3	50	50	100	6
III	**Discipline Specific Core Courses**							
	23BBOC01	Phycology and Microbiology	4	3	50	50	100	4
	23BBOC01P	Phycology and Microbiology -Practical	4	3	50	50	100	2

	23BBOC02	Biomolecules and Cell Biology	4	3	50	50	100	4	6
	23BBOC02P	Biomolecules and Cell Biology- Practical	4	3	50	50	100	2	
IV	23BVBNC1/ 23BVBNS1/ 23BVBSP1	**Skill Enhancement Courses Value Based Course Elective I** – NCC / NSS / Sports	3/2	2	60	40	100		4/1/1
		Games – Practical	1		-	-	-		
							Total		**28/25**
		Second Semester							
I	23BLT002/ 23BLH002/ 23BLF002	பொதுத்தமிழ் தாள் II – அற இலக்கியம் / Grammar, Translation and General Essay / French II .	2	3	50	50	100		2
II	23BAEES1	**Ability Enhancement Compulsory Course - II** Environmental Studies	4	3	50	50	100		4
	Generic Electives								
	23BENGE2A/ 23BENGE2B/ 23BENGE2C/ 23BENGE2D	**Generic Electives – II** Introduction to Literature/ British Literature/ Modern Indian Literature/ New Literatures in English	5+1	3	50	50	100		6
III	**Discipline Specific Core Courses**								
	23BBOC03	Mycology and Phytopathology	4	3	50	50	100	4	6
	23BBOC03P	Mycology and Phytopathology- Practical	4	3	50	50	100	2	
	23BBOC04	Archegoniate: Bryophytes, Pteridophytes, Gymnosperms	4	3	50	50	100	4	6
	23BBOC04P	Archegoniate: Bryophytes, Pteridophytes, Gymnosperms – Practical	4	3	50	50	100	2	
IV	23BVBNC2/ 23BVBNS2/ 23BVBSP2	**Skill Enhancement Courses Value Based Course Elective I** – NCC / NSS / Sports	3/2	2	60	40	100		4/1/1
		Games – Practical	1		-	-	-		
							Total		**28/25**
		Third Semester							
I	23BLT003/ 23BLH003/ 23BLF003	பொதுத்தமிழ் தாள் III – சமய இலக்கியம் / Ancient and Modern Poetry / French III	2	3	50	50	100		2
II	**Generic Electives**								
		Generic Elective III	5+1/4+4	3	50	50	100		6
III	**Discipline Specific Core Courses**								
	23BBOC05	Anatomy of Angiosperms	4	3	50	50	100	4	6
	23BBOC05P	Anatomy of Angiosperms -Practical	4	3	50	50	100	2	
	23BBOC06	Economic Botany and Plant Resource Utilization	4	3	50	50	100	4	6
	23BBOC06P	Economic Botany and Plant Resource Utilization - Practical	4	3	50	50	100	2	
IV	**Skill Enhancement Courses**								
	23BSBCS1	**Skill Based Compulsory Course – I** Communication Skill	4P	3	50	50	100		2
		Skill Based Elective Course - II	4P	3	50	50	100		2
	23BVBNC3/ 23BVBNS3/ 23BVBSP3	**Value Based Course Elective I** – NCC / NSS / Sports	3/2	2	60	40	100		4/1/1

		Value Based Course Elective II	2	-	100	-	100		2
							Total		**30/27**
		Fourth Semester							
I	23BLT004/ 23BLH004/ 23BLF004	பொதுத்தமிழ் தாள் IV – சங்க இலக்கியம் / Introduction to Functional Hindi and Journalism / French IV	2	3	50	50	100		2
II	**Generic Electives**								
		Generic Elective IV	5+1/4+4	3	50	50	100		6
III	**Discipline Specific Core Courses**								
	23BBOC07	Genetics and Cytogenetics	4	3	50	50	100	4	6
	23BBOC07P	Genetics and Cytogenetics -Practical	4	3	50	50	100	2	
	23BBOC08	Molecular Biology	4	3	50	50	100	4	6
	23BBOC08P	Molecular Biology- Practical	4	3	50	50	100	2	
IV	**Skill Enhancement Courses**								
	23BSBSS1	**Skill Based Compulsory Course III** Soft Skill	4P	3	50	50	100		2
		Skill Based Elective Course - IV	4P	3	50	50	100		2
	23BVBNC4/ 23BVBNS4/ 23BVBSP4	**Value Based Course Elective I** – NCC / NSS / Sports	3/2	2	60	40	100		4/1/1
		Value Based Course Elective III	2	-	100	-	100		2
							Total		**30/27**
		Internship during Summer Vacation for 20 days							
		Fifth Semester							
III	**Discipline Specific Core Courses**								
	23BBOC09	Plant Ecology and Phytogeography	4	3	50	50	100	4	6
	23BBOC09P	Plant Ecology and Phytogeography - Practical	4	3	50	50	100	2	
	23BBOC10	Plant Systematics	4	3	50	50	100	4	6
	23BBOC10P	Plant Systematics - Practical	4	3	50	50	100	2	
	Discipline Specific Elective Courses								
	23BBODE1	**DSE - I** - Project /Internship	1	-	50	50	100		4
	23BBODE2- 6	**DSE - II** Theory + Practical	3+4	3	50	50	100		5
	23BBODE7 - 11	**DSE - III** Theory + Practical	3+4	3	50	50	100		5
IV	**Skill Enhancement Courses**								
	23BVBNC5/ 23BVBNS5/ 23BVBSP5	**Value Based Course Elective I** – NCC / NSS / Sports	3/2	2	60	40	100		4/1/1
							Total		**28/25**
		Sixth Semester							
III	**Discipline Specific Core Courses**								
	23BBOC11	Plant Physiology	4	3	50	50	100	4	6
	23BBOC11P	Plant Physiology- Practical	4	3	50	50	100	2	
	23BBOC12	Plant Metabolism	4	3	50	50	100	4	6
	23BBOC12P	Plant Metabolism - Practical	4	3	50	50	100	2	
	Discipline Specific Elective Courses								
	23BBODE12 -16	**DSE - IV** Theory + Practical	3+4	3	50	50	100		5

	23BBODE17 -21	**DSE – V** Theory + Practical	3+4	3	50	50	100	5
IV	**Skill Enhancement Courses**							
	23BVBNC6/ 23BVBNS6/ 23BVBSP6	**Value Based Course Elective I –** NCC / NSS / Sports	3/2	2	60	40	100	4/1/1
							Total	**28/25**
					Over all Total			**172/154**

- **Ability Enhancement Compulsory Courses**
  - English for Communication
  - Environmental Studies

- **Skill Enhancement courses**, are Skill Based and / or Value Based which are aimed at providing hands on training, competencies, skills etc. and may be opted by the students from the electives offered by the departments or from SWAYAM MOOCs / NPTEL

Skill Based Compulsory Courses

- **Skill Based course I – 23BSBCS1 – Communication Skill** during 3rd semester
- **Skill Based course III - 23BSBSS1 – Soft Skill** during 4th semester

- **Skill Based Elective Courses** offered by Botany Department

S. No.	Skill Based Elective Courses (II & IV)	Semester	Hours of Instruction Practical	Credits
1.	23BBOSE1 - Agriculture and Food Microbiology	III	4	2
2.	23BBOSE2- Botanical Garden and Landscaping		4	2
3.	23BBOSE3 - Plant Propagation		4	2
4.	23BBOSE4 - Herbal Technology	IV	4	2
5.	23BBOSE5 - Nursery and Gardening		4	2
6.	23BBOSE6 - Biofertilizers		4	2

- **Value Based Courses - Elective I**

Value Based Courses Elective I	Subject Code	Semester	No of .Credits
NCC/ NSS/ Sports	**23BVBNC1-6/ 23BVBNS1-6/ 23BVBSP1-6**	**1-6**	24 Credits/ 6 Credits/ 6 Credits

* **Discipline Specific Elective Courses** should be related to their own core which may be from SWAYAM MOOCs / NPTEL also
  - All the courses have 4/5 credits with 3 hours of theory and 4 hours of practicals

S. No.	DSE Courses	Semester	Hours of Instruction Theory + Practical	Credits
Discipline Specific Elective Courses I				
1.	23BBODE1 - Project / Internship	V	1	4
Discipline Specific Elective Courses II				
2.	23BBODE2 - Aquatic Botany	V	3+4	5
3.	23BBODE3 - Algal Cultivation		3+4	5
4.	23BBODE4 - Horticulture		3+4	5
5.	23BBODE5 - Dendrology and Arboriculture		3+4	5
6.	23BBODE6 - Agronomy		3+4	5
Discipline Specific Elective Courses III				
7.	23BBODE7 - Pomology	V	3+4	5
8.	23BBODE8 - Bio-Analytical Techniques		3+4	5
9.	23BBODE9 - Bioinformatics		3+4	5
10.	23BBODE10 - Stress Biology		3+4	5
11.	23BBODE11 - Elements of Plant Breeding		3+4	5
Discipline Specific Elective Courses IV				
12.	23BBODE12 - Natural Resource Management	VI	3+4	5
13.	23BBODE13 - Horticultural Practices		3+4	5
14.	23BBODE14 - Industrial and Environmental Microbiology		3+4	5
15.	23BBODE15 - Biostatistics		3+4	5
16.	23BBODE16 - Plant Biochemistry		3+4	5
Discipline Specific Elective Courses V				
17.	23BBODE17 - Research Methodology	VI	3+4	5
18.	23BBODE18 - Horticultural Post-harvest Practices		3+4	5
19.	23BBODE19 - Environmental Microbiology and Biotechnology		3+4	5
20.	23BBODE20 - Plant Biotechnology and Genetic Engineering		3+4	5
21.	23BBODE21 - Reproductive Biology of Angiosperms		3+4	5

* **Generic Elective Courses** offered for other disciplines / departments
A Core Course offered in a Discipline / Subject may be offered as a Generic Elective for other departments

S. No.	Generic Elective Courses	Semester	Hours of Instruction Theory + Practical	Credits
1.	23BBOGE1- Environmental Protection	I	4+4	6
2.	23BBOGE2 - Mushroom Culture Technology		4+4	6
3.	23BBOGE3 - Indian Agriculture		4+4	6
4.	23BBOGE4 - Industrial Microbiology	III	4+4	6
5.	23BBOGE5 - Global Environmental Issues		4+4	6
6.	23BBOGE6 - Biodiversity (Microbes, Algae, Fungi and Embryophytes)		4+4	6
7.	23BBOGE7 - Plant Diversity and Human Welfare	IV	4+4	6
8.	23BBOGE8 - Medicinal Botany		4+4	6
9.	23BBOGE9 - Phytochemistry		4+4	6

Total credits to earn the degree

1. Part I components - 8 Credits (Languages)
2. Part II components – 32 Credits [Ability Enhancement Compulsory Courses – 8 Credits and Generic Elective Courses – 24 Credits]
3. Part III components - 96 Credits (Discipline Specific Core Courses – 72 Credits and Discipline Specific Elective Courses - 24 Credits)
4. Part IV Components - 36 /18 Credits (Skill Enhancement Courses – Skill Based Courses – 8 credits, Value Based Courses Elective I (NCC/NSS/Sports) –24 / 6 / 6, Value Based Elective Courses II &III – 4 credits)
5. **Minimum One Course should be from SWAYAM MOOCs/ NPTEL.**

One to 4 Courses may be from SWAYAM MOOCs/NPTEL for Credit Transfer in DSE, Generic Elective

Phycology and Microbiology

Semester I
23BBOC01

Hours of Instruction/week: 4
No. of credits: 4

Objectives:

- To gain knowledge in the diversification and significance of microbes.
- To acquire knowledge about the lower and primitive groups of plants and their evolutionary trends
- To attain knowledge on the classification and phylogentic systematic of algae
- To understand the thallus organization, reproduction and life history of algae

Key Words:
Eubacteria, Archebacteria, Chlorophyta, Rhodophyta, Chromista, Diatom

Unit I: Introduction to microbial world

Microbial nutrition, nutritional types, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine). **10 hrs**

Unit II: Viruses and Bacteria

General characteristics; classification (Baltimore), structure and replication of DNA virus (T4 and λ), lytic and lysogenic cycle; RNA virus (TMV), viroides and prions. General characteristics; Archaebacteria, Eubacteria, wall-less forms (mycoplasmas); Cell structure; Reproduction and recombination (conjugation, transformation and transduction). Binary fission and endospore **10 hrs**

Unit III:Genral account of Algae and Cyanophyta

Life histories of algae, commonly found algae of India, Classification (by Fritsch), Algal cultivation methods, Algal cell structure, Phylogenetic systematics of red, brown and green algae, Dinoflagellates, Diatoms, Cryptomonads and other unicellular algae, Algal evolution, Algal bioprospecting. Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and reproduction of *Spirulina* and *Nostoc*. **10 hrs**

Unit IV: Xanthophyta and Chlorophyta

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Vaucheria*. General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Volvox, Trebouxia, Ulva, Oedogonium* and *Chara*. Red tides and other algal adaptations. Commercial cultivation and economic importance of green algae. **15 hrs**

Unit V: Phaeophyta and Rhodophyta

General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus* and red algae (*Porphyra* and *Polysiphonia*). Commercial cultivation and economic importance of brown and red algae. **15hrs**

Total Hours **60 hrs**

Suggested Readings

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Algae. S Chand and Co, New Delhi.
4. Campbell, N.A., Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V. and Jackson, R.B. (2008). Biology, 8th edition. Pearson Benjamin Cummings,USA..
5. Pandey S.N./ Misra S.P. & Trivedi P.S (2015) A Textbook of Botany Volume - II, 13th Edition. (n.d.). (n.p.): Vikas Publishing House.
6. Vashishta, B. R., Sinha, A. K., Kumar, A. (2016). Botany for Degree Students: Fungi. India: S. Chand and Co, New Delhi.
7. Handbook of Algal Science, Technology and Medicine. (2020). United Kingdom: Elsevier Science.

Course Outcomes

On completion of this course, the students will be able to:

1. Develop understanding on the concept of microbes
2. Examine the general characteristics of bacteria and viruses, their reproduction/ recombination
3. To gain knowledge on general account of Algal diversity and Cyanophyceae members based on their structure and reproduction
4. To gain knowledge on Chlorophyceae and Xanthophyceae members based on their structure and reproduction
5. To understand the structure and reproduction of Phaeophyceae and Phodophyceae

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	M	L	H	H	M	M	M	H	M	H	H	H
CO 2	H	L	L	H	H	H	M	H	M	L	H	H	H
CO 3	H	L	M	H	M	H	M	H	H	H	H	H	H
CO 4	H	L	L	M	M	M	H	H	L	L	H	H	H
CO 5	H	L	L	M	M	M	H	H	L	L	H	H	H

Phycology and Microbiology- Practical

Semester I
23BBOC01P

Hours of Instruction/week: 4
No. of credits: 2

Objectives:

- To identify the microbes using electron micrographs
- To develop skill in staining techniques
- To help in the identification of the algal diversity

Unit I : Microbiology

- Electron micrographs/Models of viruses – T4 and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle. **10hrs**
- Types of Bacteria from temporary/permanent slides/photographs.

Unit II : Microbiology

- Water bloom. Electron micrographs or charts of bacteria, binary fission, endospore, conjugation. **15hrs**
- Gram-staining of root nodule and curd.
- Micrometry and counting of cells by Haemocytometer

Unit III Phycology

- Study of phototactic isolation of zoids of *Ulva* through a chart.
- Microscopic observation of vegetative and reproductive structures of *Nostoc, Chlamydomonas, Volvox, Oedogonium, Coleochaete, and Chara.* **15hrs**

Unit IV Phycology

- Microscopic observation of vegetative and reproductive structures through temporary preparations and permanent slides of. *Vaucheria, Sargassum/ Ectocarpus and Fucus* **10hrs**

Unit V Phycology

- Microscopic observation of vegetative and reproductive structures through temporary preparations and permanent slides of *Polysiphonia and Procholoron* **10hrs**

Total Hours 60 hrs

Suggested Readings

1. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
2. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Algae. S Chand and Co, New Delhi.
3. B. P. Pandey (2010). Modern *Practical Botany Vol*-IS.Chand and Company LTD. Ram Nagar, New Delhi
4. Kumar, Ashok (2005). A textbook of practical botany.Vol. I.Rastogi Publications, Meerut

5. Ashok Bendre and Ashok Kumar (2009). Practical Botany 1.Rastogi Publications, Meerut
6. Vashishta, B. R., Sinha, A. K., Kumar, A. (2016). Botany for Degree Students: Fungi. India: S. Chand and Co, New Delhi.
7. Pandey, B. P. (2022). College Botany Volume–III. India: S CHAND & Company Limited.

Course Outcomes

On completion of this course, the students will be able to:

1. Increase awareness on the structure and reproduction of viruses and bacteria
2. Ability to identify the reproduction types in bacteria and gram staining
3. To identify members of Cyanophyceae and Chlorophyceae
4. To identify the algal members belonging to Phaeophyceae
5. To identify the algal members belonging to Rhodophyceae

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	L	M	M	H	M	M	H	H	H	H	H	H
CO 2	H	L	M	M	H	M	M	H	H	H	H	H	H
CO 3	H	L	M	M	H	M	M	H	H	H	H	H	H
CO 4	H	L	M	M	H	M	M	H	H	H	H	H	H
CO 5	H	L	M	M	H	M	M	H	H	H	H	H	H

Biomolecules and Cell Biology

Semester I
23BBOC02

Hours of Instruction/week: 4
No. of credits: 4

Objectives:

- To explore the different types of biomolecules and their importance.
- To understand the theoretical aspects to enzymes, their nomenclature, kinetics and functions
- To understand the external membranous structure and function of living cell.
- To gain knowledge about the primary functional organelles of plant cell.

Key Words:

Nucleic Acids, Amino Acids, Proteins, Lipids, Fatty Acids, Signal Transduction

Unit I: Bioenergetics

Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as an energy currency molecule. Types and significance of chemical bonds; Structure and properties of water; significance of pH and buffers. **5 hrs**

Unit II: Biomolecules

Carbohydrates: Nomenclature and classification and isomeric form; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides. Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerides. Proteins: Structure of amino acids; Levels of protein structure- primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins. Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA **20 hrs**

Unit III: Enzymes

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, Lineweaver–Burk equation, enzyme inhibition and factors affecting enzyme activity. **10 hrs**

Unit IV: Cell Biology and Cell membranes

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Plant and animal cells; Origin of eukaryotic cell (Endosymbiotic theory). Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis. **10 hrs**

Unit V: Cell organelles and Signal transduction

Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament; Intracellular trafficking. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Lysosomes and Vacuoles. Endomembrane system: Endoplasmic Reticulum – Types and Structure. Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle - checkpoints and regulation; role of protein kinases. Signal Transduction: Receptors and primary and secondary signal transduction **15 hrs**

Total Hours **60 hrs**

Suggested Readings

1. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
2. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
3. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
4. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
5. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nded., W.H.Freeman.
6. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman andCompany
7. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
8. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
9. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8th edition. Pearson Education Inc. U.S.A.
10. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5 th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
11. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
12. Cell Biology (Cytology, Biomolecules and Molecular Biology). (2022). India: S CHAND & Company Limited.

Course Outcomes

On completion of this course, the students will be able to:

1. Develop understanding on chemical bonding among molecules
2. Acquire knowledge on properties and nature of macromolecules
3. Classify the enzymes and explain mechanism of action and structure
4. Identify the concept that explains chemical composition and structure of cell wall and membrane
5. Acquire knowledge on the structure and function of cells organelles

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	L	H	H	H	H	H	H	H	L	H	H	H
CO 2	H	L	H	H	H	M	H	H	H	L	H	H	H
CO 3	H	L	H	H	H	L	H	L	H	L	H	H	H
CO 4	H	L	H	H	H	M	H	L	H	L	H	H	H

Biomolecules and Cell Biology- Practical

Semester I
23BBOC02P

Hours of Instruction/week: 4
No. of credits: 2

Objectives

- To identify the presence of Phytochemical compounds in plant cell
- To estimate the amount of Phytochemical present in plants
- To demonstrate the physiological activities in plants
- To understand the separation techniques of proteins

Unit I : Phytochemical analysis and Cell Biology

- Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
- Study of plant cell structure with the help of epidermal peel mount of Onion/ *Rhoeo/ Crinum.* **15 hrs**
- Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.

Unit II : Cell Biology

- Measurement of cell size by the technique of micrometry.
- Counting the cells per unit volume with the help of haemocytometer. (Yeast / pollen grains). **10 hrs**

Unit III : Cell Biology

- Study of cell and its organelles with the help of electron micrographs.
- Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique. **10 hrs**

Unit IV : Cell Biology

- Study the phenomenon of plasmolysis and deplasmolysis.
- Study the effect of organic solvent and temperature on membrane permeability. **10 hrs**
- Study different stages of mitosis and meiosis.

Unit V : Cell Biology

- Acid/ Alkaline phosphatase or amylase: Enzyme characteristics: pH/temperature/ kinetics
- Immobilization of whole cell and isolated oraganelle. **15 hrs**
- Separation of protein by SDS-PAGE (only demonstration to class by the instructor.

Total Hours 60 hrs

Suggested Readings

1. J. Wallis (2013) Practical Botany Fifth Edition, Elsevier Ltd.
2. Debarati Das (2017). Essential Practical Handbook Of Cell Biology & Genetics, Biometry, Academic publishers, Kolkata
3. Pandey, B. P. (2022). College Botany Volume–III. India: S CHAND & Company Limited.

Course Outcomes

On completion of this course, the students will be able to:

1. Analyse the phytochemical compounds in a plant
2. Obtain skill in micrometry and haemo-cytometer.
3. Understands the different staining techniques
4. Identify the physiological process and the factors responsible for their process.
5. Identification of cell organelles, its staining and separation techniques

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	M	H	H	H	M	H	H	H	H	H	H	H
CO 2	H	M	H	H	M	H	H	M	H	H	H	H	H
CO 3	H	M	H	H	H	M	H	H	H	H	H	H	H
CO 4	H	M	H	H	M	H	H	M	H	H	H	H	H
CO 5	H	M	H	H	H	M	H	H	H	H	H	H	H

Mycology and Phytopathology

Semester II **Hours of Instruction/week: 4**

23BBOC03 **No. of credits: 4**

Objectives:

- To gain knowledge on the characteristic features and industrial significance of fungi.
- To ensure understanding on plant pathogens and their impact
- To enrich the knowledge on the causative organisms of various plant diseases and their control measures.

Key Words:

Ascomycota, Zygomycota, Basidiomycota, Etiology, Chytridiomycota, Oomycota

Unit I: Introduction to fungi and its classification

General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification. **5 hrs**

Unit II : Zygomycota and Ascomycota

Chytridiomycota and Zygomycota: Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to *Synchytrium, Rhizopus* **Ascomycota:** General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to *Saccharomyces, Aspergillus*, *Penicillium, Alternaria, Neurospora* and *Peziza.* **15 hrs**

Unit III: Basidiomycota, Allied fungi and Oomycota

General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat *Puccinia* (Physiological Specialization), loose and covered smut (symptoms only), *Agaricus*; Bioluminescence, Fairy Rings and Mushroom Cultivation. Allied fungi: General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies. **Oomycota:** General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora, Albugo.* **15 hrs**

Unit IV: Symbiotic associations and applied Mycology

Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza- Ectomycorrhiza, Endomycorrhiza and their significance. Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides);Medical mycology **10 hrs**

Unit V: Phytopathology

Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers. **15 hrs**

Total Hours 60 hrs

Suggested Readings

1. Agrios, G.N. (1997). Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology. 4thedition.John Wiley & Sons (Asia) Singapore.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi. 3rd edition. CambridgeUniversity Press, Cambridge.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, MacmillanPublishers India Ltd.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

Course Outcomes

On completion of this course, the students will be able to;

1. Develop understanding on the classification and general concepts of fungi
2. Understand the structure, reproduction and life cycle of Zygomycota and Ascomycota.
3. Understand the structure, reproduction and life cycle of Basidiomycota and Oomycota.
4. Develop an understanding of fungi and their economic importance
5. Identify the common plant diseases according to geographical locations and device control measures

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 2	H	L	H	H	H	L	H	M	M	H	H	H	H
CO 3	H	L	H	H	H	H	H	H	H	H	H	H	H
CO 4	H	L	H	H	H	H	H	H	H	H	H	H	H
CO 5	H	L	H	H	H	H	H	H	H	H	H	H	H

Mycology and Phytopathology- Practical

Semester II **Hours of Instruction/week: 4**

23BBOC03P **No. of credits: 2**

Objectives:

- To know the morphological structure and reproductive mechanism of fungi
- To identify the causative organisms of various plant diseases with their control measures.

Unit I : Fungi (Unicellular, coenocytic/septate mycelium)

- *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. **10 hrs**

Unit II : Fungi (ascocarps)

- Study of Sexual stage from permanent slides/photographs. *Peziza*: sectioning through ascocarp. *Alternaria:* Specimens/photographs and temporary mounts. **10 hrs**

Unit III : Fungi basidiocarps)

- ***Puccinia*:** Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
- ***Agaricus*:** Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
- Study of phaneroplasmodium from actual specimens and /or photographs. Study of *Stemonitis* sporangia. **20 hrs**
- *Albugo:* Study of symptoms of plants infected with *Albugo*; asexual phase study through section/temporary mounts and sexual structures through permanent slides.

Unit IV : Lichen and Mycorrhiza

- Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs). **10 hrs**

Unit V : Phytopathology

- Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers. **10 hrs**

Total Hours **60 hrs**

Suggested Readings

1. B. P. Pandey (2010). Modern *Practical Botany Vol*-IS.Chand and Company LTD. Ram Nagar, New Delhi
2. Kumar, Ashok (2005). A textbook of practical Botany.Vol. I.Rastogi Publications, Meerut
3. Ashok Bendre and Ashok Kumar (2009). Practical Botany 1.Rastogi Publications, Meerut
4. Vashishta, B. R., Sinha, A. K., Kumar, A. (2016). Botany for Degree Students: Fungi. India: S. Chand and Co, New Delhi.
5. Pandey, B. P. (2022). College Botany Volume–III. India: S CHAND & Company Limited.

Course Outcomes

On completion of this course, the students will be able to;

1. Identify of fungi based on its structure and reproduction
2. Demonstrate skills in laboratory and field related to mycology
3. Prepare temporary slides to study the reprocutive structures of plants
4. Identify the different types of lichens and Mycorrhiza
5. Identify the causal organisms based on their symptoms

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	M	M	H	H	H	H	H	H	H	H	H	H
CO 2	H	M	H	H	H	H	L	H	H	H	H	H	H
CO 3	H	M	H	H	H	H	L	H	H	H	H	H	H
CO 4	H	M	H	H	H	H	L	H	H	H	H	H	H
CO 5	H	M	H	H	H	H	L	H	H	H	H	H	H

Archegoniate: Bryophytes, Pteridophytes, Gymnosperms

Semester II
23BBOC04

Hours of Instruction/week: 4
No. of credits: 4

Objectives:

- To gain knowledge about the primitive forms of plants and their distribution.
- To know about the evolutionary trends of the primitive forms.
- To gain knowledge on the economic importance of the archegoniates
- To identify the plants based on its Morphology, anatomy and reproduction

Key Words:

Moss, Hornworts, Liverworts, Fern, Pine

Unit I: Introduction

Unifying features of archegoniates; Transition to land habit; Alternation of generations. **5 hrs**

Unit II: General Characters of Bryophytes

General characteristics; Adaptations to land habit; Classification (up to family); Range of thallus organization. Common mosses of India, Ecological and economic importance of bryophytes with special reference to *Sphagnum*. **15hrs**

Unit III: Bryophytes

Morphology, anatomy, reproduction and evolutionary trends in *Riccia, Marchantia, Anthoceros, Sphagnum and Funaria*; **15 hrs**

Unit IV: Pteridophytes

General characteristics; Classification (up to family); General account of early land plants. Morphology, anatomy and reproduction of *Psilotum, Selaginella, Equisetum* and *Pteris* (Developmental details not to be included). Apogamy and apospory, heterospory and seed habit, telome theory, stellar evolution; Common ferns of India, Ecological and economic importance **10 hrs**

Unit V: Gymnosperms

General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum* (excluding developmental details); *Cycas* and *Pinus* of India, Ecological and economic importance. **15 hrs**

Total Hours 60 hrs

Suggested Readings

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age InternationalPublishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot, Allahabad.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGrawHill, New Delhi.
5. Vanderpoorten, A. and Goffinet, B. (2009). Introduction to Bryophytes. Cambridge University Press, Cambridge

Course Outcomes

On completion of this course, the students will be able

1. Develop understanding on the concepts and life cycle of archegoniates.
2. Understand the general characters of Bryophytes
3. Know the morphology, anatomy and reproductionand evolution of Bryophytes
4. Develop Understanding on morphology, anatomy and reproduction,evolution and their transition to land habitat of Pteridophytes
5. Understand on morphology, anatomy and reproduction, evolution and their transition to land habitat of Gymnosperms

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 2	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 3	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 4	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 5	H	L	H	H	H	H	H	M	H	H	H	H	H

Archegoniate: Bryophytes, Pteridophytes, Gymnosperms - Practical

Semester II **Hours of Instruction/week: 4**

23BBOC04P **No. of credits: 2**

Objectives:

- To identify the primitive groups of plants
- To gain knowledge on morphological and anatomical Structure of archegoniates
- To develop skills on sectioning the plant specimens
- To develop skills on preparing the permanent slides

Unit I : Bryophytes

- *Riccia* – Morphology and anatomy of thallus, longitudinal section of Sporophyte.
- *Marchantia*- Morphology of thallus, whole mount of rhizoids and Scales, vertical section of thallus through Gemma cup (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides). **10 hrs**

Unit II : Bryophytes

- *Anthoceros*- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).*Sphagnum*- Morphology of plant, whole mount of leaf (permanent slide only). **10 hrs**
- *Funaria*- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule; whole mount of protonema.

Unit III : Pteridophytes

- *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).
- *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide). **10 hrs**
- *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, whole mount of sporangiophore, whole mount of spores (temporary slide), transverse section of rhizome (permanent slide).

Unit IV : Pteridophytes and Gymnosperms

- *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
- *Cycas*- Morphology (coralloid roots, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide). **10 hrs**

Unit V : Gymnosperms

- *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section and radial longitudinal sections stem (permanent slide). **20hrs**

- *Gnetum*- Morphology (stem, male and female cones), transverse section of stem, vertical section of ovule (permanent slide)
- Botanical excursion.

Total Hours 60 hrs

Suggested Readings

1. B. P. Pandey (2010). Modern *Practical Botany Vol*-IS.Chand and Company LTD. Ram Nagar, New Delhi.
2. Kumar, Ashok (2005). A textbook of practical Botany.Vol. I.Rastogi Publications, Meerut
3. Ashok Bendre and Ashok Kumar (2009). Practical Botany 1.Rastogi Publications, Meerut

Course Outcomes

On completion of this course, the students will be able to:

1. To identify the species belonging to Hepaticopsida
2. To identify the species belonging to Anthocerotopsida and Bryopsida
3. Section and identify the anatomical characters of Pteridophytes
4. Identify the morphological and anatomical features of Pteridophytes and Gymnosperms
5. Exposure to field and laboratory techniques of Bryophytes, Pteridophytes and Gymnosperms.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 2	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 3	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 4	H	L	H	H	H	H	H	M	H	H	H	H	H
CO 5	H	L	H	H	H	H	H	M	H	H	H	H	H

Anatomy of Angiosperms

Semester III **Hours of Instruction/week: 4**

23BBOC05 **No. of credits: 4**

Objectives:

- To understand the adaptive nature of plants
- To gain knowledge on various tissue systems in plants.
- To understand the concept of meristem and internal structure
- To gain knowledge on wood anatomy.

Key Words:

Tissue, Tunica Corpus, Cambium, Secondary Growth, Korper-Kappe, Quiescent, Endodermis

Unit I: Adaptive and Protective Systems

Introduction to Epidermal tissue system, cuticle, trichomes, stomata (structure, function and classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes, mesophytes and hydrophytes. Applications in systematics, forensics and pharmacognosy **12 hrs**

Unit II: Introduction to plant anatomy and plant body

Internal organization of plant body: tissue system, types of cells and tissues. Classification of tissues; Simple and complex tissues, cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers. **12 hrs**

Unit III: Apical meristems

Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation); Types of vascular bundles; Organization of root apex (Apical cell theory, Histogen theory, Korper- Kappe theory); Quiescent centre; Root cap **12 hrs**

Unit IV Internal structure

Structure of dicot and monocot stem. Structure of dicot and monocot leaf, Kranz anatomy. Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root **12 hrs**

Unit V Vascular Cambium and Wood

Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Anomalous secondary growth; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels **12 hrs**

Total Hours **60 hrs**

Suggested Readings

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the PlantBody: Their Structure, Function and Development. John Wiley and Sons, Inc.
5. Pandey, B. P. (2022). Botany for Degree Students - Semester III [BSc. Programme]. India: S. Chand Publishing.
6. Haberlandt, G. (2023). Physiological Plant Anatomy. (n.p.): LEGARE STREET Press.

Course Outcomes

On completion of this course, the students will be able to:

1. Understand the various tissue system present in plants
2. Develop an understanding on fundamentals of plant anatomy
3. Examine the internal anatomy of plant tissue systems
4. Develop critical understanding on the evolution of concept of organization of shoot and root apex.
5. Analyze the composition of different parts of plants and their relationships

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	H	L	M	H	H	H	H	H	H	H	H	H
CO 2	H	H	L	M	H	H	H	H	H	H	H	H	H
CO 3	H	H	H	H	H	M	H	M	H	H	H	H	H
CO 4	H	H	H	M	L	L	L	L	H	H	H	H	H
CO 5	H	H	H	H	L	M	M	H	H	H	H	H	H

Anatomy of Angiosperms – Practical

Semester III **Hours of Instruction/week: 4**
23BBOC05P **No. of credits: 2**

Objectives:

- To study the anatomical details of various plant tissues
- To gain knowledge on sectioning and staining techniques

Unit I : Microtomy and Staining techniques

- Study of stomata through peal method and replica method
- Simple microtomy – hand sections and / or using microtome- handheld or rotary microtome **15 hrs**
- Staining techniques

Unit II : Tissues

- Apical meristem of root, shoot and vascular cambium.
- Distribution and types of parenchyma, collenchyma and sclerenchyma. **10 hrs**
- Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforationplates; xylem fibres.

Unit III : Wood anatomy

- Wood: ring porous; diffuse porous; tyloses; heart- and sapwood. **10 hrs**
- Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.

Unit IV : Tissue System

- Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular **10 hrs**
- Secretory tissues: cavities, lithocysts and laticifers

Unit V : Anatomical features and adaptations

- Root: monocot, dicot, secondary growth.
- Stem: monocot, dicot - primary and secondary growth; anomalous secondary growth in *Achyranthes*, *Boerhaavia* and *Dracaena;* periderm; lenticels. **15 hrs**
- Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
- Adaptive Anatomy: xerophytes, hydrophytes.

Total Hours 60 hrs

Suggested Readings

1. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
2. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the PlantBody: Their Structure, Function and Development. John Wiley and Sons, Inc.
3. Any local/state/regional flora published by BSI or any other agency
4. Pandey, B. P. (2022). Botany for Degree Students - Semester III [BSc. Programme]. India: S. Chand Publishing.

Course Outcomes

On completion of this course, the students will be able to:

1. Gain knowledge on microtomy and staining techniques.
2. Understand the types of cell in plant organ system.
3. Gain knowledge on wood anatomy
4. Understand the various tissue system in plants
5. Gain knowledge on the internal structure and adaptation in plants

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	H	H	M	H	H	H	H	H	H	H	H	H
CO 2	H	H	H	H	H	H	H	M	H	H	H	H	H
CO 3	H	H	H	H	H	H	H	M	H	H	H	H	H
CO 4	H	H	H	H	H	H	H	M	H	H	H	H	H
CO 5	H	H	H	H	H	H	H	M	H	H	H	H	H

Economic Botany and Plant Resource Utilization

Semester III
23BBOC06

Hours of Instruction/week: 4
No. of credits: 4

Objectives:

- To acquire knowledge in the diversification, significance, and conservation
- To obtain knowledge about the economic important of Food crops
- To acquire knowledge in medicinal plant and their utilization
- To understanding of spices, beverages ,oil seeds and Timber plants

Keywords:

Quarantine, germplasm, Cryopreservation, Transgenics, Timber, Aromatic Plants, Cereals

Unit I: Origin and conservation of Cultivated Plants

Origin, Importance and domestication : Origin of Agriculture and ancient economic botany, Vavilov's Centres of Origin and diversity of crop plants, domestication, evaluation, bioprospection, Major plant introductions; Crop domestication and loss of genetic diversity;
Germplasm augmentation and conservation : History and importance of germplasm collection; Overview of: Ecogeographical distribution of diversity, General account of Biotechnology in plant germplasm acquisition, plant tissue culture in disease elimination, in-vitro conservation and exchange, cryopreservation, transgenics–exchange and bio-safety issues, **14 hrs**
Plant Quarantine: Principles, objectives and relevance of plant quarantine; Introductory regulations and plant quarantine set up in India; economic significance of seed borne pests, pathogens and weeds ;detection and post entry quarantine operations.

Unit II : Botany, Utilization of Plant Wealth (Cereals and Millets, Pulses and Legumes, Sources of Sugars and Starches)

Origin,evolution and bio systematics, morphology, and uses of some selected crops: Cereals: Wheat, Rice, maize, sorghum, pearlmillet and minor millets. Pulses: Origin, morphology, uses, Importance to man and ecosystem of pulses (Pigeonpea, Chickpea, Blackgram ,Greengram, Cowpea, Soyabean, Pea, Lentil, Horsegram),and Legumes (lab-lab bean, rice bean, winged bean, French bean, lima bean, sword bean). Morphology and processing of sugarcane, products and by-products. Morphology, propagation & uses of Sugar beet, Sugar palm and sweet sorghum. Potato, Sweet Potato and Tapioca. **12hrs**

Unit III: Botany, Utilization of Plant Wealth (Spices, Beverages and Oil seeds fats)

Spices: Listing of important spices (Saffron, Cloves, Cardamom, Cinnamon, Tejpat, Nutmeg and Mace, Anise, Cumin, Celery, Tamrind, Vanilla, Asafoetida, Dill, Fenugreek, Fennel, Coriander),their botanical name,family and part used. Origin, distribution, ecology, botany, cultivation practices, processing of economic plant part / product , main chemical constituents and economic Importance of the Major spices, namely Turmeric, Ginger, Capsicum, Black Pepper , Coriander. **Beverages:** Tea and Coffee : History, origin ,growing countries, Botany, cultivation practices, common diseases and pests, major chemical constituents, processing and quality control of economic product, **Oil seeds and fats:** General description, classification, extraction and uses of groundnut, coconut, linseed, soybean, mustard.. **12hrs**

Unit IV: Botany, Utilization and Processing of Plant Wealth (Essential oils, Drug-yielding and Medicinal plants)

Essential Oils: General description, uses extraction / distillation of essential oil, chemical constituents of major essential oil yielding aromatic plants, namely Rose, Geranium, Lemongrass / Palmarosa / Citronella, Vetiver, Menthol mint, Basil, Lavender, Eucalyptus, Clove, Camphor and Sandalwood

Drug-yielding and Medicinal plants: Fumitories and Masticatories :Processing, therapeutic uses, and health hazards of habit-forming drugs, Botany and cultivation /regulatory practices of such drug yielding plants with special reference to Papaver ,Cannabis and Tobacco. Major Medicinal Plants: Botany, Uses, Cultivation and Processing of major medicinal plants, namely : Ashwagandha, Kalmegh, Satavar, Ghrit Kumari (*Aloe vera),* Quinghao (*Artemisia annua*), Isabgol, Senna, Bhui Amla (*Phyllanthus*), Stevia,Sarpagandha, Atropa, Digitalis, Licorice, Gilloi (*Tinospora*), **12hrs**

Unit V: Botany, Utilization and Processing of Plant Wealth (Natural rubber, Timber plants and sea weeds)

Natural Rubber: Para-rubber: tapping, processing and uses. **Timber plants and Fibres:** General account and Botany of the Tree, wood structure and quality characteristics, and timber processing with special reference to, Saal (*Shorea robusta*), Teak and Pine. General account of the Fiber yielding plants, Classification based on the origin of fibers, Extraction processing, morphology and uses of fibers, with special reference to Cotton, Sunhemp, flax, Coir, Jute. **Seaweeds:** Economically important seaweed resources of India, Production of carrageenan, algin, agar and agarose, seaweeds as fertilizers, edible seaweeds, seaweeds as fodder, drugs from algae, cosmetics and neutraceuticals from algae, algae based biofuel. **10hrs**

Total Hours 60hrs

Suggested Readings

1. Chrispeels, M. J.and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett Publishers.
2. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow (2016). Aush Gyanya: Hand book of Medicinal and Aromatic Plant Cultivation.
3. Kochhar,S. L.(2016).Economic Botany: A Comprehensive Study. 5thEdition.Cambridge
4. Samba Murty, AVSS and Subrahmanyam, N.S. (1989). A Text book of Economic Botany. Wiley Eastern Ltd., NewDelhi
5. Verma V. (2009). Textbook of Economic Botany. Ane Books Pvt Ltd, Chennai
6. B. P. Pandey (2014). Economic Botany. S. Chand & company Ltd. New Delhi.
7. Pandey, B. P. (2022). College Botany Volume–III. India: S CHAND & Company Limited.

Course Outcomes

On completion of this course, the students will be able to:

1. Develop a critical understanding of the evolution, importance of germplasm diversity, and importance of plant quarantine
2. Comprehend core concepts of Economic Botany and relate to environment, populations and communities
3. Understand the taxonomic diversity and important families of useful plants
4. Upsurge the awareness of economically important plants and their products for human wealth
5. Appreciate the diversity of plants and the plant products in human use

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	M	L	H	H	M	M	M	H	M	H	H	H
CO 2	H	L	L	H	H	H	M	H	M	L	H	H	H
CO 3	H	L	M	H	M	H	M	H	H	H	H	H	H
CO 4	H	L	L	M	M	M	H	H	L	L	H	H	H
CO 5	H	L	M	M	M	H	M	H	L	L	H	H	H

Economic Botany and Plant Resource Utilization - Practical

Semester III
23BBOC06P

Hours of Instruction/week: 4
No. of credits: 2

Objectives:

- To understand basic knowledge on anatomical features
- To identify the morphological features of economic important plants
- To gain knowledge on micro nutrients in food crops
- To acquire knowledge on economic important of plant and their by products

Unit I Cereals and Pulses

Cereals: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests)Rice(habit sketch, study of paddy and grain, starch grains ,micro-chemical tests). **Legumes:** Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests). **12 hrs**

Unit II Sugar, Spices and beverages

Sources of sugars and starches : Sugarcane (habit sketch; cane juice-micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains,w.m. starch grains, micro-chemical tests) **Spices :** Blackpepper, Fennel, Curcuma and Clove (habit and sections). **Beverages:** Tea (plant specimen, tea leaves), Coffee (plant specimen, beans). **12 hrs**

Unit III Oils, Fats and Woods

Sources of oils and fats : Coconut- T.S. nut, Mustard– plant specimen, seeds; tests for fats in crushed seeds. **Essential oil** -yielding plants: Habit sketch of *Rosa, Vetiveria, Santalum* and *Cymbopogons* spp., Mint, Basil, *Eucalyptus* (specimens/ photographs).. **Woods:** *Tectona, Pinus*: Specimen, Section of young stem. **12 hrs**

Unit VI Rubber and Drug-yielding plants

Rubber: specimen, photograph / model of tapping, samples of rubber products. **Drug-yielding plants**: Specimens of Ashwagandha, Artemisia, Kalmegh, Phyllanthuds, Satavar, Gilloi, *Digitalis, Papaver* and *Cannabis.* **Tobacco:** specimen and products of Tobacco **12 hrs**

Unit V Fiber-yielding plants

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

Total Hours 60hrs

Suggested Readings

1. Sambamurty, AVSS and Subrahmanyam, N.S.(2008). A Textbook of Modern Economic Botany.1st Edition, Paperback . CBS Publishers & Distributors Pvt. Ltd.; 1st edition (4 September 2008)
2. Wickens,G.E.(2001).Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands
3. Mathew, K.M. (1983) The flora of Tamil Nadu Carnatic, Parts (1-3). *Rapient Herbarium, Tirudhirapalli.*
4. Gamble J S. (1986). Flora of the Presidency of Madras. Bishen Mahendra Pal Singh, Dehradun, India,
5. Kochhar, S. L. (2016). Economic Botany: A Comprehensive Study. India: Cambridge University Press.

Course Outcomes

On completion of this course, the students will be able to:

1. Develop a basic knowledge on identification of cereals and pulses
2. Increase the awareness and importance of plants and their micronutrients
3. Gain knowledge on plant based product and their biochemical constituent
4. Develop a critical understanding on plant based drugs and its uses
5. Understand economic important plants in day to day life

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	M	H	H	H	M	H	H	H	H	H	H	H
CO 2	H	M	L	L	M	H	H	M	H	H	H	H	H
CO 3	H	L	M	H	M	H	M	H	H	H	M	H	H
CO 4	M	M	L	M	M	L	L	H	L	L	H	H	H
CO 5	H	M	M	M	M	H	M	H	L	L	H	H	H

Genetics and Cytogenetics

Semester IV **Hours of instruction/week: 4**

23BBOC07 **No. of credit: 4**

Objectives

- To understand the basic principles of genetics.
- To gain knowledge on the non-mendelian inheritance.
- To learn about Chromosome morphologyand the ploidy levels of organism
- To acquire knowledge on mutations and evolution of gene concept.

Keywords

Mendelism, Linkage, gene mapping, Crossing over, Ploidy, Hardy-Weinberg, Genetic Drift, Natural Selection

Unit I

Mendelism: History; Mendel's Laws of inheritance; Chromosome theory of inheritance and linkage; Incomplete dominance and co-dominance; Interaction of Genes; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Mendelian segregation and gene interaction: Numericals; Polygenic inheritance; Mitosis and Meiosis in plants, animal and human; Cell cycle and cell division. **12 hrs**

Unit II

Determining non-Mendelian Inheritance; Maternal effects and cytoplasmic inheritance; Chloroplast mutation: Variegation in Four O'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in *Paramecium.* Linkage and crossing over; Cytological basis of crossing over; Recombination frequency, two-factor and three-factor crosses; Interference and coincidence; Linkage and Gene mapping, and numerical based on gene mapping **12 hrs**

Unit III

Chromosome morphology and Karyotype concept, Deletion, Duplication, Inversion, Translocation, Position effect; Euploidy, Aneuploidy and Amphiploidy and their implications; FISH and GISH in chromosome and genome identification. **12 hrs**

Unit IV

Mutations - Types of mutations; Molecular basis of Mutations; Induction of mutations and Mutagens–physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method. Role of Transposons in mutation. DNA repair mechanisms. **12 hrs**

Unit V

Evolution of Gene Concept–Classical vs molecular concepts of gene: One gene one character; One gene – one enzyme, one gene – one polypeptide hypothesis and beyond; Cis-trans-complementation test for functional allelism and gene as a unit of function, mutation and recombination, non-coding RNA. Concept of sex determination and Sex chromosomes; Patterns of Sex determination in plants and animals (human, Drosophila and other animals); Sex-linked, sex-limited and sex-influenced characters; Dosage compensation. Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation. **12 hrs**

Total Hours 60 hrs

Suggested Readings

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

Course outcomes

On completion of this course, the students will be able to:

1. Have a conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
2. Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
3. Develop a critical understanding of ploidy and their identification using various methods.
4. Analyze the effect of mutations on gene functions and dosage.
5. Develop a critical understanding the interactions at population and evolutionary levels.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO 1	L	H	M	H	H	L	L	L	L	M	L	H	H
CO 2	L	H	H	H	H	H	M	M	M	M	L	H	H
CO 3	L	H	H	H	H	H	H	H	M	L	L	H	H
CO 4	L	H	H	H	H	H	H	M	M	H	L	H	H
CO 5	L	H	H	H	H	H	H	L	L	L	L	H	H

Genetics and Cytogenetics – Practical

Semester IV **Hours of instruction/week: 4**

23BBOC07P **No. of credit: 2**

Objectives

- To visualize the mitosis ad meiosis stages through experiments
- To understand the laws of inheritance through laboratory exercices

Unit I

- Mitosis, and study of chromosome morphology through squash preparation, including effect of chemicals on mitosis. **12 hrs**
- Meiosis and study of chiasma frequency through temporary squash preparation.

Unit II

- Laws through seed ratios. Laboratory exercises in probability and chi-square.
- Chromosome mapping using point test cross data.
- Pedigree analysis for dominant and recessive autosomal and sex-linked traits. **12 hrs**
- Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
- Blood Typing : ABO groups & Rh factor.

Unit III

- Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
- Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge. **12 hrs**

Unit IV

- Study of human genetic traits : Sickle cell anaemia, Xeroderma Pigmentosum, Albinism, red-green Colorblindness, Widow'speak, Rolling of the tongue, Hitchhiker's thumb and Attached ear lobe. **12 hrs**

Unit V

- To test PTC tasting ability in a random sample and calculate gene frequencies for the taste randnon – taster alleles. **12 hrs**
- Identification of inactivated X chromosome as Barr body and drumstick

Total Hours **60 hrs**

Suggested Readings

1. Bineeta Singh and Lal, G.M. (2021) Practical manual of genetics and plant breeding. Satish Serial Publishing House.
2. Aru Chandra Sahu. (2018) Cell Biology, Genetics and Plant Breeding with Practicals (for botany degree sem V of AP universities. Kalyani Publications
3. Singh, R. J. (2017). Practical Manual on Plant Cytogenetics. United States: CRC Press..

Course Outcomes

On completion of this course, the students will be able to:

1. Understand the process of cell ad nuclear division in a cell
2. Understand the laws of inheritance
3. Develop a critical understanding of ploidy and chromosomal aberations
4. Understand human genetic traits
5. Study to calculate the gene frequencies and identification of Barr body and drumstick

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO 1	L	H	M	H	H	L	L	L	L	M	L	H	H
CO 2	L	H	H	H	H	H	M	M	M	M	L	H	H
CO 3	L	H	H	H	H	H	H	H	M	L	L	H	H
CO 4	L	H	H	H	H	H	H	M	M	H	L	H	H
CO 5	L	H	H	H	H	H	H	L	L	L	L	H	H

Molecular Biology

Semester IV **Hours of instruction/week: 4**

23BBOC08 **No. of credit: 4**

Objectives

- To gain recent knowledge about structure and components of Nucleic acid.
- To know the enzymes involved in Molecular Biology.
- To understand the concept involved in transcriptional regulations.
- To know the mechanism of protein synthesis.

Keywords

Central Dogma, DNA Replication, Post-translational modification, Wobble hypothesis, Exons, Cistrons

Unit I

Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & Mc Carty, Fraenkel-Conrat's experiments). DNAStructure: Miescherto Watson and Crick-historic perspective, DNA structure, Salient features of double helix, Types of DNA, ,denaturation and renaturation, cot curves; Organization of DNA- Prokaryotes, Viruses, Eukaryotes. RNA Structure Organelle DNA—mitochondria and chloroplast DNA. The Nucleosome Chromatin structure - Euchromatin, Heterochromatin-Constitutive and Facultative heterochromatin **12 hrs**

Unit II

Chemistry of DNA synthesis (Kornberg's discovery) ; General principles – bidirectional, semi-conservative and semi-discontinuous replication, RNApriming; Various models of DNA replication, including rolling circle, θ(theta) mode of replication, replication of linear ds-DNA, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication. DNA proof reading. Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Central Dogma Reverse (RNA viruses etc.) **12 hrs**

Unit III

Genetic code (deciphering & salient features) and wobble hypothesis. Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Concept of operon Prokaryotes: lac operon. Regulation of lactose metabolism and tryptophan synthesisin *E.coli.* Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing. **12 hrs**

Unit IV

Splitgenes concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNAprocessing (5'cap,3'polyAtail); Ribozymes; RNA editing and mRNA transport. **12 hrs**

Unit V

Translation: Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNAsynthetases; Various steps in protein synthesis, proteins involved ininitiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins, Protein targeting **12 hrs**

Total Hours 60 hrs

Suggested Reading

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007).Molecular Biology of the Gene, 6th edition. Pearson Benjamin Cummings, CSHL Press, New York,U.S.A.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, 5th edition. John Wiley and Sons Inc., U.S.A.
3. Klug, W.S., Cummings, M.R., Spencer, C.A.(2009). Concepts of Genetics, 9thedition.BenjaminCummings.U.S.A.
4. Russell, P. J.(2010). i-Genetics- A Molecular Approach, 3rd edition. Benjamin Cummings, U.S.A.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J.(2010). Introduction to Genetic Analysis,10th edition. W.H. Freeman and Co.,U.S.A.
6. J. E. Krebs, E.S. Goldstein and S.T. Kilpatrick. (2017). Lewin's Genes XII. 12th Edition:Jones and Bartlett.

Course Outcomes

On completion of this course, the students will be able to:

1. Analyse the structures and chemical properties of DNA and RNA through various historic experiments.
2. Differentiate the main types of prokaryotes through their grouping abilities and their characteristic
3. Evaluate the experiments establishing central dogma and genetic code.
4. Understand the mechanism involved in the splicing of genes.
5. Gain an understanding of various steps in transcription, protein synthesis and protein modification.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO 1	L	H	H	M	M	H	H	H	10	M	L	H	H
CO 2	M	H	H	H	H	M	M	M	H	L	L	H	H
CO 3	L	H	H	H	H	M	H	M	H	H	L	H	H
CO 4	L	H	H	H	H	L	M	H	H	L	L	H	H
CO 5	M	H	H	H	M	H	H	H	H	M	L	H	H

Molecular Biology - Practical

Semester IV **Hours of instruction/week: 4**

23BBOC08P **No. of credit: 2**

Objectives

- To gain hands-on training in the isolation and quantification of DNA.
- To gain knowledge on DNA replication mechanisms
- To acquire the knowledge of structure of RNA polymerases.
- To gain experimental knowledge to prove nucleic acid as genetic material

Unit I

- Preparation of LB medium and raising *E.Coli.*
- Isolation of genomic DNA from *E.Coli.* **12 hrs**
- DNA isolation from cauliflower head.
- DNA estimation by diphenyl amine reagent /UV Spectrophotometry.

Unit II

- Study of DNA replication mechanisms through photographs
  a. Rolling circle, **12 hrs**
  b. Theta replication
  c. semi-discontinuous replication

Unit III

- Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs. **12 hrs**

Unit IV

- Photographs establishing nucleic acid as genetic material
  a. Messelson and Stahl's experiments
  b. Averyetal, Griffith's experiments **12 hrs**
  c. Hershey & Chase's experiments
  d. Fraenkel & Conrat's experiments

Unit V **12 hrs**

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

Total Hours **60 hrs**

Suggested Readings

1. Deepak som. 2018. Practical manual of molecular biology. KAAV Publications
2. Pranab Paul. 2022. Molecular biology with practical. Mahaveer Publications
3. Surzycki, S. (2012). Basic Techniques in Molecular Biology. Germany: Springer Berlin Heidelberg.
4. Chaitanya, K. V. (2013). Cell and Molecular biology: A Lab Manual. India: PHI Learning.
5. Saxena, J., Baunthiyal, M., Ravi, I. (2015). Laboratory Manual of Microbiology, Biochemistry and Molecular Biology. India: Scientific Publishers.

Course Outcomes

On completion of this course, the students will be able to;

1. Study the experiments establishing central dogma and genetic code.
2. Study the replication mode of DNA through photographs.
3. Understand the working mechanism of RNA Polymerase II
4. Understand through photographs the experiments proving nucleic acids as genetic material.
5. Gain an understanding of various steps in isolation and estimation of DNA.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO 1	L	H	H	H	H	H	H	M	M	M	L	H	H
CO 2	L	H	H	H	H	M	H	H	H	M	L	H	H
CO 3	L	H	H	H	H	M	H	H	H	M	L	H	H
CO 4	L	H	H	H	H	M	H	H	H	M	L	H	H
CO 5	L	H	H	H	H	H	H	M	M	H	L	H	H

Plant Ecology and Phytogeography

Semester V
23BBOC09

Hours of instruction/week: 4
No. of credit: 4

Objectives:

- To understand origin, types and components of soil and water
- To learn biotic interactions, ecological adaptations and population ecology
- To gain knowledge on plant communities and ecosystem
- To analyse the functional aspects of ecosystem and phytogeography of India

Keywords:

Soil, Community, Ecotone, Succession, Competition, r and k selection, ecological pyramids, Climax community

Unit I: Introduction and soil

Basic concepts; Levels of organization. Abiotic and biotic Components and their inter-relationships and dynamism, homeostasis. **Soil:** Origin, Types and Formation; Composition; Physical, Chemical and Biological components; Soil profile. Types of soils inIndia. **10 hrs**

Unit II Water

States of water in the environment; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Atmospheric moisture; Water in soil; Ground water table. Water resources of India. **10 hrs**

Unit III: Ecological adaptations, Population ecology

Variations in adaptation of plants in relation to light, temperature, water, wind and fire. **Biotic interactions:** Competition: Inter- and intraspecific competition; Ammensalism, heterotrophy; mutualism, commensalism, parasitism; herbivory, carnivory, protocooperation, **Population ecology:** Characteristics and population growth, population regulation, life history strategies; *r* and *k* selection. Ecological Speciation. **13 hrs**

Unit IV: Plant Communities and Ecosystem

Community characteristics: analytical and synthetic; Concept of ecological amplitude;Habitat and niche; Ecotone and edge effect; Succession: processes, types; climax concept. Primary vs Secondary succession. **Ecosystem:** Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Ecosystems of India **12 hrs**

Unit V: Functional Aspects of Ecosystem and Phytogeography

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles of carbon, nitrogen and phosphorus. **Phytogeography:** Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phyto-geographical division of India; Local Vegetation. **15 hrs**

Total Hours **60 hrs**

Suggested Readings

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., NewDelhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India.8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth SystemsApproach. Oxford University Press. U.S.A.
5. Upen Deka and Tapan Dutta (2023). Plant Ecology and Phytogeography. ARB Publication, New delhi. India.
6. Edward A. Johnson, Kiyoko Miyanishi (2020) Plant Disturbance Ecology: The Process and the Response. Netherlands: Elsevier Science.

Course outcomes

On completion of this course, the students will be able to:

1. Understand core concepts of biotic and abiotic components and types and components of soil
2. Classify the water on the basis of physical, chemical and biological components
3. Gain knowledge on ecological adaptations and population ecology
4. Evaluate the basic concepts of plant communities and ecosystem
5. Analyse the phytogeography or phytogeographical divisions of India and energy sources of ecological system

PO/CO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	H	H	H	H	H	H	M	M	H	M	M	H	H
CO2	H	H	H	H	H	H	L	M	M	M	H	M	M
CO3	H	H	H	H	H	H	H	M	H	H	H	H	H
CO4	H	H	H	H	H	H	H	M	H	H	M	H	H
CO5	H	H	H	H	H	H	H	M	H	H	M	H	H

Plant Ecology and Phytogeography - Practical

Semester V
23BBOC09P

Hours of instruction/week: 4
No. of credit: 2

Objectives:

- To evaluate physical, chemical and biological components of soil and water samples
- To determine the quality of water samples
- To analyse different types of plants based on ecology
- To familiarize with plants present in different ecological sites

Keywords:

Soil, Thermometer, Hygrometer, Anemometer, Water, pH, Organic matter, Bulk density, Porosity, Dissolved Oxygen, Parasites, Vegetation, Phytogeography

Unit I: Soil Physical Components — **10 hrs**

Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter. Determination of pH of various soil and water samples (with pH meter, universal indicator/Lovibond comparator and/or pH paper strip)

Unit II : Soil Chemical Components — **10 hrs**

Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests. Determination of organic matter of different soil samples by Walkey & Black rapidtitration method.

Unit III : Water Components — **10 hrs**

Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.

Unit IV : Plant Communities and Ecosystem — **10 hrs**

Study of morphological adaptations of hydrophytes and xerophytes (four each). Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants). Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).

Unit V: Ecology — **20 hrs**

Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law. Quantitative analysis of herbaceous vegetation for density and abundance in thecollege campus.
Field visit to familiarise students with ecology of different sites.

Total Hours 60 hours

Suggested Readings

1. S Sadasivam, A. Manickam (2002). Biochemical methods. New age international publishers
2. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A
3. Swarajya, G. L., Prasadini, P. P. (2018). Environmental Science: A Practical Manual. India: BS Publications.

4. Bendre, A. (2008). Practical Botany. India: Rastogi Publications.

Course outcomes

On completion of this course, the students will be able to:

1. Gain knowledge in measuring physical components of soil and water with instruments
2. Analysis of soil chemical and organic components
3. Evaluate properties of water based on habitats and pollution
4. Study ecological adaptations of plants and their ecology
5. Familiarize with ecology of different sites in campus and field visit

PO/CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	M	H	H	H	H	H	H	M	H	H	L	H	H
CO2	M	H	H	H	H	H	H	M	H	H	L	H	H
CO3	H	H	H	H	H	H	H	L	M	H	H	H	H
CO4	H	H	H	H	H	H	H	L	H	H	M	H	H
CO5	H	H	H	H	H	H	H	L	H	M	H	M	M

Plant Systematics

Semester V
23BBOC10

Hours of Instruction/week: 4
No. of credits: 4

Objectives:

- To understand the principles of identification, nomenclature and classification of flowering plants
- To understand the biometrics and numerical taxonomy
- To learn herbarium technique, flora and monographs
- To Know the evolutionary terms and concept of angiosperms

Keywords:

Monophyly, paraphyly, polyphyly, apomorphy, plesiomorphy ,homoplasy

Unit I: Significance of Plant systematic and Taxonomic hierarchy

Introduction to systematic; Plant identification, Classification, Nomenclature. Evidences from palynology embryology, cytology, phytochemistry and molecular data. Field inventory; Importance of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: intended (yolked) and bracketed keys. Phenetics vs. Cladistics, **12 hrs**

Unitr II: Taxonomic Hierarchy:

Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concepts (biological, morphological, evolutionary).Modes of speciation. Problems with species concepts. Rankles system of phylogenetic systematics **10 hrs**

Unit III: Botanical Nomenclature and System of Classification

Principles and rules (ICN); Ranks and names; Typification, authorcitation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids. **System of classification**: Natural system of classification (Bentham and hooker),Takhtajan classification of Angiosperms ,Principles of Angiosperm Phylogeny Group (APGIV) classification. **14 hrs**

Unit IV: Biometrics, Numerical Taxonomy and Cladistics

Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences). **12 hrs**

Unit V: Phylogenetic Systematics

Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly, clades, synapomorphy, symplesiomorphy, apomorphy, lineagesorting, serialhomology, etc). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram). **12 hrs**

Total Hours 60hrs

Suggested Readings

1. Singh,(2012).*Plant Systematics:* Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Pandey, A. K., Kasana, S. (2021). Plant Systematics. United States: Narendra Publishing House..
3. Judd,W.S., Campbell, C.S.,Kellogg,E.A.,Stevens,P.F.(2002).Plant Systematics A Phylogenetic Approach. Sinauer Associates Inc., U.S.A.2nd edition.
4. Sambamurty A.V.S.S. (2005). Taxonomy of Angiosperms. I. K. International Pvt. Ltd., New Delhi.
5. Singh, G. (2021). Plant Systematics: An Integrated Approach, Fourth Edition. United Kingdom: CRC Press.
6. Hall, B.G. (2011). Phylogenetic Trees Made Easy: A How-To Manual. Sinauer Associates ,Inc. USA

Course Outcomes

On completion of this course, the students will be able to:

1. Classify Plant systematic and recognize the importance of herbarium and Virtual herbarium
2. Know the rules of ICN in botanical nomenclature and different types of classification
3. Evaluate and classify the organisms using numerical methods
4. Assess terms and concepts related to Phylogenetic Systematics
5. Generalize the characters of the families according to classification

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	L	H	H	H	H	H	H	H	L	H	H	H
CO 2	H	L	H	H	H	M	H	H	H	L	H	H	H
CO 3	H	L	H	H	H	L	H	L	H	L	H	H	H
CO 4	H	L	H	H	H	M	H	L	H	L	H	H	H
CO5	H	L	H	H	H	L	H	L	H	L	H	H	H

Plant Systematics - Practical

Semester V **Hours of Instruction/week: 4**

23BBOC10P **No. of credits: 2**

Objectives:

- To understand the morphological characters and systematic position of selected plant species
- To gain knowledge about taxonomical features of selected species
- To Learn about the collection, preservation techniques of angiosperms
- To acquire Knowledge on phylogenetic tree construction methods

Unit I Plant Description :

Study of vegetative and floral characters of the following families (Description, V.S.flower, section of ovary, floral diagram/s, floral formula and systematic position according to Bentham & Hooker's system of classification): **10hrs**

Ranunculaceae - *Ranunculus, Delphinium*
Brassicaceae - *Alyssum / Iberis*
Papaveraceae - *Argemone*
Myrtaceae - *Eucalyptus, Callistemon*

Unit II Plant Description :

Study of vegetative and floral characters of the following families (Description, V.S.flower, section of ovary, floral diagram/s, floral formula and systematic position according to Bentham & Hooker's system of classification): **10hrs**

Umbelliferae - *Coriandrum /Anethum / Foeniculum*
Asteraceae - *Sonchus / Launaea,/ Vernonia /Ageratum / Eclipta /Tridax*
Solanaceae - *Solanum nigrum /Physalis*
Lamiaceae - *Salvia/Ocimum*

Unit III Plant Description :

Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula and systematic position according to Bentham & Hooker's system of classification): **10hrs**

Euphorbiaceae - *Euphorbia hirta /Jatropha / Croton*
Liliaceae - *Asphodelus / Lilium / Allium*
Poaceae - *Triticum/Hordeum/Avena*

Unit IV Herbarium Preparation Technique: Mounting of a properly dried and pressed specimen of any 20 wild plants with Herbarium label (to be submitted in the record book). **10hrs**

Unit V Phylogenetic Tree Preparation : Construction of plant phylogenetic trees using various loci (rbcL, ITS, trnL etc) with various phylogenetic methods (Neibour Joining, Maximum Likelihood etc). Field visit (local or outside depending on situation) **20hrs**

Total Hours 60hrs

Suggested Readings

1. R K Sinha (2010). Practical Taxonomy of Angiosperms I.K. International Publishing House Pvt. Limited,
2. Gamble J S. (1986).Flora of the Presidency of Madras.
3. Kumar, Ashok (2005). A textbook of practical botany. Vol. I.Rastogi Publications, Meerut
4. Ashok Bendre and Ashok Kumar (2009). Practical Botany 1.Rastogi Publications, Meerut

Course outcomes

On completion of this course, the students will be able to:

1. Generalize the characters of the families according to Bentham &Hooker' system of classification
2. Evaluate the taxonomical features of particular families
3. Expertise in identification, characterization and classification of plant species
4. Recognize the Herbarium preparation and preservation methods
5. Construct the Phylogenetic tree using various technique

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	M	M	H	H	H	H	H	H	H	H	H	H
CO 2	H	M	H	H	H	H	L	H	H	H	H	H	H
CO 3	H	H	H	M	M	L	L	L	M	L	H	H	H
CO 4	H	H	M	H	H	L	H	H	M	L	H	H	H
CO5	H	L	H	H	M	L	H	L	H	L	H	H	H

Plant Physiology

Semester VI
23BBOC11

Hours of Instruction/week: 4
No. of credits: 4

Objectives :

- To gain knowledge about recent advance in the field of plant physiology.
- To know about the biochemical and metabolic aspects of plants
- To understand the role of light in Plant development
- To acquire knowledge on the plant hormones and their role in plant development

Keywords:

Hydroponics, Nitrogenase, Photosynthesis, Photorespiration, CAM, Phytochrome, Phytohormone

Unit I: Water Potential and Other Potential Physiological Aspect of Plant

Water relation of plants, unique physic chemical properties of water; water absorption, uptake and bulk movement of water, stomatal regulation of transpiration, antitranspirants; Inorganic nutrition, (macro and micro), deficiency symptoms, hydroponic studies; mineral absorption, translocation and assimilation. (including explanation onactive passive uptake, Channels, carriers and pumps). **15 hrs**

Unit II: Nitrogen Nutrition

Metabolism: Nitrogen nutrition, organic nitrogen, nitrogen fixation in microbes / legumes, nif genes and NOD factors, nitrate and ammonia assimilation, interrelationship between photosynthesis and nitrogen metabolism. (Emphasis on various enzymes specially nitrogenase). **10hrs**

Unit III : Photosynthesis

Photosynthesis:Importance of photosynthes is for food security and environment. (a)Light reaction: Radiant energy, photosynthetic apparatus, pigments and their biosynthesis; light harvesting complex; light absorption and composition and characteristics of two photosystems, photosynthetic electron transport, (b) Dark reaction: Carbon dioxide fixation in C3, C4 and CAM plants, photorespiration and its significance, environmental factors affecting photosynthesis. (Explain RUBISCO). **10 hrs**

Unit IV : Respiration

Respiration: Aerobic and anaerobic respiration; cyanide independent respiration; fermentation; cytochrome system; carbohydrate and lipid metabolism; high energy compounds and factors affecting respiration. **10 hrs**

Unit V : Phytochrome, Phytohormone and Plant Cycle

Growth and development (a) Phytochromes and light control, role of phytochrome in tropism, flowering and fruiting. (b) Phytohormones: Auxin; cytokinin; Gibberellins; ethylene; ABA. Synthesis, distribution and physiological effects. Application of hormones in agriculture and horticulture. Polyamines, brassinosteroids and their functions. Seed dormancy and germination, senescence, circadian rhythms in plants (exogenous factors and physiological mechanism). **15hrs**

Total Hours 60 hrs

Suggested Reading

1. Buchanan,B.B. and Gruissem,W. (2015). *Biochemistry and molecular biology of plants.* Willy Black well ASPBUSA.
2. Campbell,M.K. and Farrell,S.O.(2007).*Biochemistry.*Thomson Brooks/ cole,USA.
3. Lincoln Taiz, Eduardo Zeiger, Ian M. Moller, and Angus Murphy (2015) *Plant Physiology and Development,* Sixth Edition , Sinauer Associates, Oxford University.
4. Goodwin,T.W.and Mercer,E.I.(2003). *Introduction to plant biochemistry.* CBS Publishers & Distributors, NewDelhi,India.
5. Ross and Salisbury.(2009).*Plant Physiology.*Cengage Learning (Thompson),New Delhi,In
6. Kochhar (2016). Plant physiology- Theory and applications. Cambridge India.
7. Taiz,L.,Zeiger,E.Mollar,I.M.and Murphy,A.(2023).Plant physiology and Development 6th edition..Sinauer Associates Inc.,USA.

Course outcomes

On completion of this course, the students will be able to;

1. Understand Water relation of plants with respect to various physiological processes.
2. Explain the nitrogen fixation, forms of Nitrogen and its assimilation
3. Explain the various mechanisms of Photosynthesis and its significance
4. Understand the types of Respiration and its significance
5. Explain the Plant growth and physiological effects of plant hormones and seed germination in plants

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	H	H	H	M	H	H	L	L	M	H	H	H
CO 2	H	H	H	H	M	H	H	L	H	L	H	H	H
CO 3	H	H	H	H	M	H	H	L	L	H	H	H	H
CO 4	H	H	H	H	M	H	H	L	L	H	H	H	H
CO5	H	H	H	H	M	H	H	L	L	H	H	H	H

Plant Physiology – Practical

Semester VI **Hours of Instruction/week: 4**

23BBOC11P **No. of credits: 2**

Objectives:

- To perform experiments and observations on physiological processes taking place in plants.
- To identify and estimate the phytochemical compounds present in the plant
- To analyze the macro and micro nutrients and seed viability in plants

Unit I

- Analysis of plant tissue for water, organic and inorganic content determination of a few macronutrient (K / Na) by Flame photometer **10 hrs**
- Quantitative and qualitative estimation of sugars

Unit II

- Qualitative and quantitative determination of amino acids
- Quantitative estimation of protein
- Determination of ascorbic acid content of tissue (DCIP red) **15 hrs**
- Pigments extraction, separation through solvent partitioning and chromatographic techniques

Unit III

- Spectrophotometric estimation of chlorophyll
- Enzyme activity with respect to temperature, pH and substrate concentration. **15 hrs**
- Effect of inorganic nutrients on plant growth

Unit IV

- Assay of photosynthetic electron transport activity from isolated chloroplast / Algae using DCIP reduction **10 hrs**
- Assay of respiratory electron transport activity from potato using DDCP dye oxidation.

Unit V

- Estimation of nitrate/nitrite reductase activity in leaves/algae
- Seed viability–TTC test **10 hrs**
- Estimation of transpiration through different implemethods.

Total Hours 60 hrs

Suggested Readings

1. Segel,I.H. and Segel,E. (1993).*Enzyme kinetics: Behavior and analysis of rapid equilibrium and steady- state enzyme systems.* Wiley-Inter science,USA.
2. Taiz ,L.,Zeiger ,E. Mollar,I.M.and Murphy, A. (2015). Plant physiology and Development 6th edition.. Sinauer Associates Inc., USA.
3. Pandey, B. P. (2022). Botany for Degree Students - Semester III [BSc. Programme]. India: S. Chand Publishing.

Course Outcomes

On completion of this course, the students will be able to:

1. Know to perform experiments on various aspects of physiological processes in plants
2. Quantify the Phytochemical compounds present in the plants
3. Isolate the pigments using the chromatographic techniques
4. To analyse the photosynthetic and respiratory electron transport activity
5. To estimate the assimilation and analyze the seed viability

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	H	M	H	H	H	M	H	H	H	H	H	H	H
CO 2	H	M	H	H	H	M	H	H	H	H	H	H	H
CO 3	H	M	H	H	H	M	H	H	H	H	H	H	H
CO 4	H	M	H	H	H	M	H	H	H	H	H	H	H
CO 5	H	M	H	H	M	H	H	M	H	H	H	H	H

Plant Metabolism

Semester VI
23BBOC12

Hours of Instruction/week: 4
No. of credits: 4

Objectives:

- To understand the role of pigments and enzymes in metabolism
- To gain knowledge on various metabolic pathways in plants.
- To understand the mechanism of ATP synthesis and signal transduction
- To gain knowledge on lipid and nitrogen metabolism.

Key Words:

Anabolism, catabolism, Pentose phosphate pathway, ATP synthesis, Electron Transport Chain, MAP kinase cascade

Unit I: Concept of Metabolism

Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes). Historical background, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres. **10 hrs**

Unit II: Carbon Assimilation

Photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO_2 reduction/ Carbon assimilation: C_3 and C_4 pathways; photorespiration; Crassulacean acid metabolism; Factors affecting CO2 reduction. Synthesis and hydrolysis of sucrose and starch. **10 hrs**

Unit III: Metabolism and Oxidation

Glycolysis and its regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration **10 hrs**

Unit IV: ATP-Synthesis

Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers. **10 hrs**

Unit V: Lipid and Nitrogen Metabolism, Mechanism of Signal Transduction

Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation. Biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Nitrate and Ammonia assimilation; Transaminase reactions. Receptor- ligand interactions; Secondary messengers concept, Calcium- calmodulin, MAP kinasecascade **20 hrs**

Total Hours **60 hrs**

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. 4th edition.John Wiley and Sons.U.S.A.
2. Taiz, L., Zeiger Emeritus Author, E. (2022). Plant Physiology and Development. United Kingdom: Sinauer Associates.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
4. H. W. Heldt and B. Piechulla.(2019). Plant Biochemistry. 4th Edition. Paperback.Academic Press.
5. Bowsher, C., Tobin, A. K. (2021). Plant Biochemistry. United Kingdom: CRC Press.
6. B. Buchanan, W. Gruissem and R. L. Jones (Eds) (2015) Biochemistry and Molecular Biology of Plants. Second Edition. Paper back. Wiley-Blackwell

Course Outcomes

On completion of this course, the students will be able to;

1. Develop understanding on the anabolic and catabolic pathways in plant metabolism
2. Understand the carbon assimilation
3. Understand the phenomenon of oxidation and metabolism in plants.
4. Understand the mechanism of ATP synthesis
5. Understand the lipid and nitrogen metabolism including signal transduction in plants

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	L	H	H	L	H	H	L	L	H	H	L	L	L
CO 2	M	H	H	L	M	M	L	M	H	H	H	H	H
CO 3	L	L	H	M	H	L	H	H	H	H	H	H	H
CO 4	M	H	H	L	M	M	L	M	H	H	H	H	H
CO 5	M	H	H	L	M	M	L	M	H	H	H	H	H

Plant Metabolism – Practical

Semester VI
23BBOC12P
Objectives:

Hours of Instruction/week: 4
No. of credits: 2

- To separate pigments by solvent partitioning
- To gain knowledge on various physiological activities taking place in plants
- To understand the various factors affecting the rate of photosynthesis
- To study the activity of enzymes involved in germination

Unit I — **15 hrs**

- Solvent partitioning of photosynthetic pigments.
- Demonstration of fluorescence by isolated chlorophyll pigments.
- Demonstration of absorption spectrum of photosynthetic pigments

Unit II — **15 hrs**

- Experimental demonstration of Hill's reaction.
- To study the effect of light intensity on the rate of photosynthesis.
- Effect of carbon dioxide on the rate of photosynthesis.

Unit III — **10 hrs**

- To compare the rate of respiration in different parts of a plant.

Unit IV — **10 hrs**

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

Unit V — **10 hrs**

- To study the activity of lipases in germinating oilseeds and demonstrate mobilizationof lipids during germination.

Total Hours **60 hrs**

Suggested Readings

1. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
2. H. W. Heldt and B. Piechulla.(2019). Plant Biochemistry. 4th Edition. Paperback.Academic Press.
3. B. Buchanan, W. Gruissem and R. L. Jones (Eds) (2015) Biochemistry andMolecular Biology of Plants. Second Edition. Paper back. Wiley-Blackwell.
4. Pandey, B. P. (2022). Botany for Degree Students - Semester III [BSc. Programme]. India: S. Chand Publishing.

Course Outcomes

On completion of this course, the students will be able to:

1. Analyze the pigments using various techniques.
2. Study the factors affecting the rate of photosynthesis.
3. Study the rate of respiration in different parts of plants
4. Gain knowledge on germination related enzyme analysis
5. Study the activity of lipases and lipid mobilization.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO2	PSO 3
CO 1	M	H	H	L	H	H	H	H	H	H	H	H	H
CO 2	M	H	H	H	H	H	H	H	H	H	H	H	H
CO 3	M	H	H	H	H	H	H	H	H	H	H	H	H
CO 4	M	H	H	H	H	H	H	H	H	H	H	H	H
CO 5	M	H	H	H	H	H	H	H	H	H	H	H	H