



**Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science & Commerce,
Baramati**

(Empowered Autonomous)

Three/Four Year Honours/ Honours with Research B. Sc. Degree

Program in Botany

(Faculty of Science)

CBCS Syllabus

T. Y. B. Sc. (Botany) Semester - VI

For Department of Botany NEP 1.0

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2025-2026

Title of the Programme: T. Y. B. Sc. (Botany)

Preamble

AES's Tuljaram Chaturchand College of Arts, Science and Commerce (Autonomous) has decided to change the syllabus of various faculties from June, 2023 by taking into consideration the guidelines and provisions given in National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. The credit structure and courses framework provided in the NEP are nationally accepted and internationally comparable.

The rapid changes in science and technology and new approaches in different areas of Botany and related subjects, the Board of Studies in Botany at Tuljaram Chaturchand College, Baramati - Pune, has prepared the syllabus of F.Y. B.Sc. Botany Sem. I and II the Choice Based Credit System (CBCS) by following the guidelines of NEP 2020, NCeF, NHEQF, Prof. R.D. Kulkarni's Report, GR of Government of Maharashtra dated 20th April, 16th May 2023 and 13th March 2024 and the Circular of SPPU, Pune dated 31st May 2023 and 2nd May, 2024.

A Botany degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Graduates in Botany find opportunities in various fields, including urban planning, teaching, environmental science, all plant sciences, organic farming, nursery management, entrepreneurship, mushroom cultivation, medicinal plant, floriculture, horticulture, propagation methods and plant tissue culture method and many other domains. Throughout their three year degree program, students explore the significance of plant in life of each and every living organism on Earth. They learn tool, techniques, process which is required to set up agencies including pickles, jam, and jelly, medicinal plant, fruit processing, vegetable processing, organic product, organic fertilizer and pesticides producing industries also they can earn the knowledge to produce natural remedies for various diseases. They become expert in discovery and development of many new therapeutic compounds which are now used in pharmaceutical herbal cosmetics and other compound based industries.

Overall, revising the Botany syllabi in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today.

It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Specific Outcomes (PSOs)

PSO1. Knowledge and understanding of: 1. The range of plant diversity in terms of structure, anatomy, function and environmental relationships. 2. The evaluation of plant diversity. 3. Identification and classification and the flora of Maharashtra. 4. The role of plants in the functioning of the global ecosystem. 5. A selection of more specialized, optional topics. 6. Application of Statistics to solve biological problem.

PSO2. Intellectual skills – able to: 1. Think logically and organize tasks into a structured form. 2. Assimilate knowledge and ideas based on wide reading and through the internet. 3. Transfer of appropriate knowledge and methods from one concept to another within the subject. 4. Understand the evolving state of knowledge in a rapidly developing research field. 5. Construct and test hypothesis. 6. Plan, conduct and write a report on an independent term project.

PSO3. Practical skills: Students learn to carry out practical work, in the field and in the laboratory, with minimal risk. They gain introductory experience in applying each of the following skills and gain greater proficiency in a selection of them depending on their choice of optional modules. 1. Interpreting plant morphology and anatomy. 2. Plant identification. 3. Vegetation study techniques. 4. Analysis of chemical compounds in plant materials in the context of plant physiology and biochemistry. 5. Analyze data using appropriate statistical methods and computational packages. 6. Plant pathology to be added for lab to land farm.

PSO4. Transferable skills: 1. Use of IT (word-processing, use of internet, statistical packages and databases). 2. Communication of scientific ideas in writing and orally. 3. Ability to co-ordinate as part of team. 4. Ability to use library resources. 5. Time

PSO5. Scientific Knowledge: Apply the knowledge of basic plant science, life sciences and fundamental process of plants to study and analyze any plant form.

PSO6. Problem analysis: Identify the taxonomic position of plants, formulate the research literature and analyze PET structure and non-reported plants with substantiated conclusions using first principles and methods of nomenclature and classification in Botany.

PSO7. Design/development of solutions: Design solutions from medicinal plants to solve health problems, disorders and disease of human beings and animals estimate the phytochemical content of plants which fulfil the specified needs to appropriate consideration for the public and animal health.

PSO8. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and development of the information to provide scientific conclusions.

PSO9. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern instruments and equipments for Biochemical estimation, Molecular Biology, Biotechnology, Bioinformatics, Biophysics, Biostatistics, Plant Tissue culture experiments, cellular and physiological activities of plants with an understanding of the application and

PSO10. The Botanist and society: Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society, health, safety, legal and environmental issues and the consequent responsibilities relevant to the biodiversity conservation practice.

PSO11. Environment and sustainability: Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable agricultural and environmental development.

PSO12. Ethics: Apply ethical principles and commit to environmental ethics and responsibilities and norms of the biodiversity conservation.

PSO13. Individual and team work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary task settings.

PSO14. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and intertie effective reports and design documentation, make effective presentations and give and receive clear instructions.

PSO15. Project management and finance: Apply knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team to manage projects and in eco-friendly environments.

PSO16. Life-long learning: Identify the necessities and have the preparation and ability to engage in independent and life-long learning in the broadest context of upcoming advanced technology.

Department of Botany T. Y. B.Sc. Semester- VI

Credit Distribution Structure for Three/Four Year Honours/Honours with Research Degree Programme

Level/ Difficulty	Sem.	Subject DSC-1	Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)	2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	22
	II	2(T)+2(P)	2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T)	22

Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor

Continue option: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.

Level/ Difficulty	Sem	Credits Related to Major				Minor	--	GE/OE	SEC	IKS	AEC	VEC	CC	Total
		Major Core	Major Elective	VSC	FP/OJT/CEP/RP									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	22
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	22

Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor

5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	22
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 3Years		44	8	8	10	18	8	8	6	4	8	4	6	132

Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor

6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	22
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	22
Total 4Years		64	16	8	22	22	8	8	6	4	8	4	6	176

Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits

6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	22
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 4Years		72	16	8	14	22	8	8	6	4	8	4	6	176

Four Year **UG Honours Degree** in Major and Minor with 176 credits

T = Theory P = Practical DSC = Discipline Specific Course OE = Open Elective SEC = Skill Enhancement Course

IKS = Indian Knowledge System AEC = Ability Enhancement Course VEC = Value Education Course CC = Co-curricular Course

VSC= Vocational Skill Course OJT= On Job Training CEP= Community Engagement Project FP= Field Project RP= Research Project

With Multiple Entry and Exit options as per National Education Policy (2024 Pattern as per NEP 2020)

Course Structure for F. Y. B. Sc. Botany Semester I and II (2023 Pattern)

Sem.	Course Type	Course Code	Title of Course	Theory/ Practical	No. of Credits	
I	Major Mandatory	BOT-101- MJM	Diversity of Cryptogams	Theory	02	
	Major Mandatory	BOT-102- MJM	Industrial Botany - I	Theory	02	
	Major Mandatory	BOT-103- MJM	Botany Practical - I	Practical	02	
	Open Elective (OE)	BOT-116-OE	Horticulture	Theory	02	
	Open Elective (OE)	BOT-117-OE	Floriculture	Practical	02	
	Vocational Skill Course (VSC)	BOT-121-VSC	Organic Farming	Theory	02	
	Skill Enhancement Course (SEC)	BOT-126-SEC	Fruit Processing	Practical	02	
	Ability Enhancement Course (AEC)	ENG-131-AEC	Functional English - 1	Theory	02	
	Value Education Course (VEC)	BOT-135-VEC	Environmental Science	Theory	02	
	Indian Knowledge System (IKS)	BOT-137-IKS	Botany in Ayurveda	Theory	02	
	Co- curricular Course (CC)	--	To be selected from the Basket	Theory	02	
	Total Credit Semester - I					22
II	Major Mandatory	BOT-151- MJM	Diversity of Phanerogams	Theory	02	
	Major Mandatory	BOT-152- MJM	Industrial Botany - II	Theory	02	
	Major Mandatory	BOT-153- MJM	Botany Practical - II	Practical	02	
	Minor	BOT-161-MN	Gardening and Nursery Management	Theory	02	
	Open Elective (OE)	BOT-166-OE	Economic Botany	Theory	02	
	Open Elective (OE)	BOT-167-OE	Seed Technology	Practical	02	
	Vocational Skill Course (VSC)	BOT-171-VSC	Plant Tissue Culture	Practical	02	
	Skill Enhancement Course (SEC)	BOT-176-SEC	Mushroom Cultivation	Practical	02	
	Ability Enhancement Course (AEC)	ENG-181-AEC	Functional English - 1	Theory	02	
	Value Education Course (VEC)	BOT-185-VEC	Digital and Technological Solutions	Theory	02	
	Co- curricular Course (CC)	--	To be selected from the Basket	Theory	02	
	Total Credit Semester - II					22
	Cumulative Credits Semester I + Semester II					44

**Course Structure for S. Y. B. Sc. Botany Semester III and IV
(2023Pattern)**

Sem.	Course Type	Course Code	Course Title	Theory/ Practical	Credits
III	Major Mandatory	BOT-201-MJM	Taxonomy of Angiosperms	Theory	02
	Major Mandatory	BOT-202-MJM	Plant Physiology - I	Theory	02
	Major Mandatory	BOT-203-MJM	Plant Biotechnology - I	Theory	02
	Major Mandatory	BOT-204-MJM	Practical - I	Practical	02
	Minor	BOT-241-MN	Floriculture - I	Theory	02
	Minor	BOT-242-MN	Floriculture - I	Practical	02
	Open Elective (OE)	BOT-216-OE	Bio-fertilizers	Theory	02
	Vocational Skill Course (VSC)	BOT-221-VSC	Herbal Cosmetics	Theory	02
	Ability Enhancement Course (AEC)	MAR-231-AEC HIN-231-AEC SAN-231-AEC	-	Theory	02
	Co-curricular Course (CC)	YOG/PES/CUL/N SS/NCC-239-CC	To be selected from the Basket	Theory	02
	Field Project (FP)	BOT-235-FP	-	Practical	02
	Generic IKS Course (IKS)	GEN-245-IKS	-	Theory	02
	Total Credits Semester - III				24
IV	Major Mandatory	BOT-251-MJM	Plant Anatomy	Theory	02
	Major Mandatory	BOT-252-MJM	Plant Embryology	Theory	02
	Major Mandatory	BOT-253-MJM	Plant Ecology	Theory	02
	Major Mandatory	BOT-254-MJM	Practical - II	Practical	02
	Minor	BOT-261-MN	Horticulture	Theory	02
	Minor	BOT-262-MN	Horticulture	Practical	02
	Open Elective (OE)	BOT-266-OE	Bio fertilizer	Practical	02
	Skill Enhancement Course (VSC)	BOT-276-SEC	Herbal Cosmetics	Practical	02
	Ability Enhancement Course (AEC)	MAR-281-AEC HIN-281-AEC SAN-281-AEC	-	Theory	02
	Co-curricular Course (CC)	YOG/PES/CUL/N SS/NCC-289-CC	To be selected from the Basket	Theory	02
	Community Engagement Project (CEP)	BOT-285-CEP	-	Practical	02
	Total Credits Semester - IV				22
	Cumulative Credits Semester III + Semester IV				46

Course Structure for T. Y. B. Sc. Botany Semester V and VI (2023 Pattern)

Sem.	Course Type	Course Code	Course Title	Theory/ Practical	Credits
V	Major Mandatory	BOT-301-MJM	Cryptogamic Botany	Theory	02
	Major Mandatory	BOT-302-MJM	Spermatophyta and Palaeobotany	Theory	02
	Major Mandatory	BOT-303-MJM	Cell Biology	Theory	02
	Major Mandatory	BOT-304-MJM	Molecular Biology	Theory	02
	Major Mandatory	BOT-305-MJM	Botany Practical - I	Practical	02
	Major Elective (MJE)	BOT-306-MJE(A)	Research Methodology	Theory (Any Two)	04
	Major Elective (MJE)	BOT-306-MJE(B)	Biostatistics		
	Major Elective (MJE)	BOT-306-MJE(C)	Plant Embryology		
	Minor	BOT-311-MN	Industrial Botany	Theory	02
	Minor	BOT-312-MN	Practical based on Industrial Botany	Practical	02
	Vocational Skill Course (VSC)	BOT-321-VSC	Practical based on Organic Farming	Practical	02
	Field Project (FP)	BOT-335-FP	Field Project	Practical	02
	Total Credits Semester - V				22
VI	Major Mandatory	BOT-351-MJM	Plant Physiology	Theory	02
	Major Mandatory	BOT-352-MJM	Plant Biotechnology	Theory	02
	Major Mandatory	BOT-353-MJM	Plant Genetics	Theory	02
	Major Mandatory	BOT-354-MJM	Plant Pathology	Theory	02
	Major Mandatory	BOT-355-MJM	Botany Practical - II	Practical	02
	Major Elective (MJE)	BOT-356-MJE(A)	Botanical Techniques	Theory (Any Two)	04
	Major Elective (MJE)	BOT-356-MJE(B)	Plant Breeding		
	Major Elective (MJE)	BOT-356-MJE(C)	Medicinal Botany		
	Minor	BOT-361-MN	Pharmacognosy	Theory	02
	Minor	BOT-362-MN	Practical based on Pharmacognosy	Practical	02
	On Job Training (OJT)	BOT-385-OJT	On Job Training	Practical	04
	Total Credits Semester - VI				22
	Total Credits Semester V + VI				44

Department of Botany T. Y. B.Sc. Semester- VI

Name of the Programme	:	B. Sc. Botany
Program Code	:	USBT
Class	:	T.Y. B. Sc.
Semester	:	VI
Course Code	:	BOT-351-MJM
Course Title	:	Plant Physiology (Theory)
No. of Credits	:	02
No. of lectures	:	30

A) Course Objectives:

1. To understand physiology of biomolecules.
2. To study the physiological processes occurring in plants.
3. To get idea about functioning of instruments.
4. To make student expert in plant physiology.
5. To understand the plant metabolism.
6. To get idea about metabolic cycles occurs in plants.
7. To get knowledge about role of biomolecules in plant physiology.

B) Course Outcomes:

At the end of this course students will able to:

- CO1. Understand basic physiological concepts.
CO2. Aware about the plant to response environmental conditions.
CO3. Get knowledge of internal activities in plant.
CO4. Develop the expertise in plant physiology.
CO5. Get knowledge of plant metabolism.
CO6. Get knowledge of plant cycle.
CO7. Get knowledge of structure and function of biomolecules.

Credit- I

Unit-1 (15L)

- 1.1 Growth:** Definition, Phases of Growth, Growth Rate calculations by Relative Growth Rate(RGR), Net Assimilation Rate (NAR), Absolute Growth Rate (AGR) 2L
- 1.2 Translocation of organic solutes:** Definition, Path of translocation, Mechanism of translocation – Pressure flow theory, Diffusion, Uniport, Symport, Antiport, Source-sink relationship, Phloem-loading and unloading. 5L
- 1.3 Stress Physiology:** Definition, Concept of abiotic, biotic and xenobiotic stresses. Types of abiotic stress – Salinity, drought. Response of plant to biotic stress (pathogen), Effect of stresses on the plant growth. 4L
- 1.4 Secondary Metabolites:** Definition, Types, Metabolic pool, Role of secondary metabolites in plant. 4L

Credit- II

Unit -2 (15L)

- 2.1 Carbohydrates:** Definition, classification, functions of carbohydrates. 3L
- 2.2 Proteins:** Definition, Classification of proteins on the basis of structure, functions of proteins. 2L
- 2.3 Amino acids:** Definition, types of Amino Acids, Importance of Amino acids. 2L
- 2.4 Lipids:** Definition, classification, properties and functions of lipids. 2L

2.5 Enzymology: Definition and nature of enzymes, active site, Classification (IUB) and properties of enzymes, Co-enzymes, Mechanism of enzyme action- Lock and key hypothesis, induced fit theory. Factors affecting enzyme activity – pH, temperature, substrate concentration, enzyme concentration. Enzyme Inhibitors – Competitive, uncompetitive, non-competitive.

6L

References:

1. S. N. Pandey and B. K. Sinha (2014). Plant Physiology, Vikas Publishing House Pvt. Ltd., India.
2. Buchanan B.B, Gruissem W. and Jones R.L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists Maryland, USA.
3. Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.
4. Lincoln Taiz and Eduardo Zeiger (2003). Plant Physiology (3rd edition), Published by – Panima Publishing Corporation
5. Verma S.K. and Verma Mohit (2007). A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.
6. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (Eds) 1997. Plant Metabolism (Second Edition) Longman, Essex, England.
7. Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi
8. Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.
9. Verma S.K. and Mohit Verma 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S. Chand Publications.

Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B. Sc. (Sem. VI)

Subject : Botany

Course: Plant Physiology

Course Code : BOT-351-MJM

Weightage: 1= Weak or low relation, 2= Moderate or Partial relation, 3= Strong or direct relation

Mapping of Program Outcomes with Course Outcomes

Programme Outcomes (POs)													
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3		1										
CO 2		3		3				2					
CO 3													
CO 4	2			2									
CO 5	3			3								2	
CO 6	3			3									
CO 7													

Justification for the mapping

PO1: Disciplinary Knowledge.

CO1. Students will get knowledge of physiological activities in plant.

CO3. Use of plant physiology knowledge for improvement of agricultural yield.

CO5. Students will be able to get knowledge of plant metabolism.

CO6. Students will get knowledge of plant cycle.

CO7. Students will get knowledge of structure and function of Biomolecules.

PO2: Critical Thinking and Problem Solving.

CO2. Students will get aware about the plant response towards environmental conditions.

PO 3: Social competence.

CO1. Students will be able to use knowledge of plant physiology for improvement of agricultural yield.

PO 4: Research-related skills and Scientific temper.

CO3. Students get knowledge of different physiological activities in plant.

CO5. Get knowledge of plant metabolism.

CO6. Students will understand physiology of Biomolecules.

CO7. Students will be able to apply use of secondary metabolites in agricultural practices.

Department of Botany T. Y. B.Sc. Semester- VI

Name of the Programme	:	B. Sc. Botany
Program Code	:	USBT
Class	:	T.Y. B. Sc.
Semester	:	VI
Course Code	:	BOT-352-MJM
Course Title	:	Plant Biotechnology (Theory)
No. of Credits	:	02
No. of lectures	:	30

A) Learning Objectives:

1. To give advance knowledge Bt theory and practical and modern techniques in tissue culture for production of high yielding varieties of plants.
2. This paper explores the use of biotechnology to how factors affects at cellular level the expression of genotypes and hence to phenotypic variations.
3. During Practical students will conduct recent techniques applied to generate information and observe genetic variation.
4. To Understand basics of plant resource based industries
5. To learn the basic concepts, principles and techniques in plant biotechnology.
6. To give knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.
7. To study use of bio techniques to explore plant to its molecular level.

B) Course Outcome:

By the end of the course, students will be able to:

- CO1. Develop plant tissue culture industry.
CO2. Get expertise to develop agro based industries.
CO3. Get expertise in field of Industrial Botany.
CO4. Understand basics of plant resource based industries.
CO5. Learn the basic concepts, principles and techniques in plant biotechnology.
CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.
CO7. Use of bio techniques to explore plant to its molecular level.

Credit- I

Unit- 1 **(15L)**

1.1 Introduction to Biotechnology: **1L**

Introduction and History of plant Biotechnology, Concept and importance of Plant Biotechnology, Types of Biotechnology.

1.2 Plant Tissue Culture: **4L**

Definition of cell and tissue, structure of cell, Importance of plant tissue culture, Types of culture, basic technique of plant tissue culture, Concept, callus culture, cell suspension culture, protoplast culture, somatic hybridization and cybrids.

1.3 Germplasm and Cryopreservation: **4L**

In-situ and *Ex-situ* conservation of germplasm, techniques of cryopreservation, cold storage, low pressure and low oxygen storage, applications of cryopreservation.

1.4 Methods of gene transfer in plants: **6L**

Restriction enzymes, its types, direct gene transfer methods- Electroporation, Biolistic

gene transfer, Liposome mediated transfer. Vector mediated gene transfer- *Agrobacterium* mediated gene transfer in plants, Ti-plasmid: structure and functions, Ti-plasmid based vectors, advantages.

Credit- II

Unit - 2

(15 L)

2.1 Biotechnology of Biological Nitrogen Fixation:

6L

Non-symbiotic Nitrogen Fixation-Diazotrophs and their ecology, special features, Mechanism of N₂-Fixation, Nitrogenase and Hydrogenase Symbiotic N₂ Fixation establishment of symbiosis, *Nif*- gene, Biofertilizers- algal, fungal, phosphate solubilizing.

2.2 Biotechnology and Society:

4L

Biotechnology- Benefits, GM foods and its safety, patenting of biotechnological inventions, Biotechnology and developing countries, Recombinant foods and religious beliefs, recombinant therapeutic product for human health care, Intellectual Property Rights (IPR).

2.3 Bioinformatics:

2L

Introduction, Databases and its classification, NCBI, EMBA, Data retrieval tools- INTREZ, OMIN, BLAST, FASTA, applications of Bioinformatics.

2.4 Genomics and Proteomics:

2L

Genomics- methods, types and applications, Proteomics- Concept, types and importance.

2.5 Molecular techniques:

1L

Blotting Techniques- Southern, Northern, Western and PCR.

Reference Books:

1. R. C. Dube (2008). A Text Book of Biotechnology, S. Chand.
2. P.K. Gupta (2019). Elements of Biotechnology.
3. U. Satyanarayana (2017). Biotechnology.
4. KalyanKumar De (2020). An introduction to Plant tissue culture.
5. Pal J.K. and Ghaskadabi S.S. (2008). Fundamentals of Molecular Biology.
6. Verma and Agrawal (2010). Molecular Biology.
7. Devi P., (2008). Principle and Methods of plant Molecular.
8. Glick B.R. and Tompson J.E. (1993). Methods in Plant Molecular Biology and
9. Biotechnology CRC Press Boca Raton, Florida.
10. Hall R.D. (Ed.) 1999. Plant cell culture Protocol human press Inc., New Jersey, USA.
11. Kumar H.D. (2002) A Text Book of Biotechnology 2nd Edn. Affiliated Easyt- West Press Private Ltd New Delhi.
12. Ramawat K.G. (2003). Plant Biotechnology, S. Chand & Co. Ltd .Ramnagar New Delhi.
13. Trivedi P.C. (2000). Plant Biotechnology, Panima Publishing Carpaton, NewDelhi.
14. Razdan M K (2019). Introduction to Plant tissue culture.

Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: Plant Biotechnology

Course Code : BOT-352-MJM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	2		2		3	2	2					3
CO 2	3	2	3	2		3	2	2					3
CO 3	3	2	2	2		3	2	2	3				3
CO 4	2	3	2	3		2	3	3	2			2	2
CO 5	2	3		3	2	2	3	3	3	2	3	2	2
CO 6	2	2		2	3	2	2	2	2	3		3	2
CO 7	2	2		2	3	2	2	2				3	2

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding

CO1. Develop plant tissue culture industry.

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

CO4. Understand basics of plant resource based industries.

CO5. Learn the basic concepts, principles and techniques in plant biotechnology.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

CO7. Use of bio techniques to explore plant to its molecular level.

PO2. Practical, Professional, and Procedural Knowledge

CO1. Develop plant tissue culture industry.

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

CO4. Understand basics of plant resource based industries.

CO5. Learn the basic concepts, principles and techniques in plant biotechnology.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

CO7. Use of bio techniques to explore plant to its molecular level.

PO3. Entrepreneurial Mindset and Knowledge

CO1. Develop plant tissue culture industry.

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

PO4. Specialized Skills and Competencies

CO1. Develop plant tissue culture industry.

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

CO5. Learn the basic concepts, principles and techniques in plant biotechnology.

CO7. Use of bio techniques to explore plant to its molecular level.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1. Develop plant tissue culture industry.

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

CO5. Learn the basic concepts, principles and techniques in plant biotechnology.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

CO7. Use of bio techniques to explore plant to its molecular level.

PO6. Communication Skills and Collaboration

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

PO7. Research-related Skill

CO1. Develop plant tissue culture industry.

CO3. Get expertise in field of Industrial Botany.

CO5. Learn the basic concepts, principles and techniques in plant biotechnology.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

CO7. Use of bio techniques to explore plant to its molecular level.

PO8. Learning How to Learn Skills

CO1. Develop plant tissue culture industry.

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

CO5. Learn the basic concepts, principles and techniques in plant biotechnology.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

CO7. Use of bio techniques to explore plant to its molecular level.

PO9. Digital and Technological Skills

CO5. Learn the basic concepts, principles and techniques in plant biotechnology.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

CO7. Use of bio techniques to explore plant to its molecular level.

PO10. Multicultural Competence, Inclusive Spirit, and Empathy

CO2. Get expertise to develop agro-based industries.

PO11. Value Inculcation and Environmental Awareness

CO1. Develop plant tissue culture industry.

CO4. Understand basics of plant resource based industries.

CO5. Learn the basic concepts, principles and techniques in plant biotechnology.

PO12. Autonomy, Responsibility, and Accountability

CO1. Develop plant tissue culture industry.

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

PO13. Community Engagement and Service

CO2. Get expertise to develop agro-based industries.

CO3. Get expertise in field of Industrial Botany.

CO6. Knowledge acquired students will be able to apply techniques in other branches such as biological, medical, agricultural etc.

CO7. Use of bio techniques to explore plant to its molecular level.

Department of Botany T. Y. B.Sc. Semester- VI

Name of the Programme	:	B. Sc. Botany
Program Code	:	USBT
Class	:	T.Y. B. Sc.
Semester	:	VI
Course Code	:	BOT-353-MJM
Course Title	:	Plant Genetics (Theory)
No. of Credits	:	02
No. of lectures	:	30

A) Learning Objectives:

1. To study Mendel's laws of independent assortment.
2. To study the principles of genetical heredity.
3. To study types of crosses in genetics.
4. To give knowledge of interaction of genes.
5. To study multiple allelism.
6. To give knowledge of quantitative and cytoplasmic inheritance.
7. To give knowledge of sex linked inheritance.

B) Course Outcome:

By the end of the course, students will be able to:

CO1. Learnt Mendel's laws of independent assortment.

CO2. Learnt the principles of genetical heredity.

CO3. Learnt types of crosses in genetics

CO4. Get knowledge of interaction of genes.

CO5. Learnt multiple allelism.

CO6. Get knowledge of quantitative and cytoplasmic inheritance.

CO7. Get knowledge of sex linked inheritance.

Credit: I

Unit - 1 (15L)

1.1 Genetics Introduction, Definition, Branches and Applications of Genetics. 2L

1.2 Mendelism Mendel's law / Law of independent assortment, Monohybrid cross, dihybrid cross, test cross, back cross. 4L

1.3 Neomendelism / Interaction of genes 3L

Complementary genes (9:7), Duplicate genes (15:1), Supplementary genes (9:3:4)

1.4 Multiple allelism 3L

Definition, Characters of multiple alleles, Examples – Inheritance of blood group in human.

1.5 Linkage and recombination 3L

Linkage - Definition and types, Crossing over - Definition and types, Two point test cross. three point test cross

Credit: II

Unit - 2 (15L)

2.1 Quantitative and Cytoplasmic Inheritance 4L

Concept of quantitative inheritance, Inheritance of quantitative trait in Maize (Cob length), Concept of cytoplasmic inheritance, Variegation in four O'clock plants.

2.2 Sex linked inheritance 5L

Concept of sex chromosomes and autosomes, Inheritance of X - linked genes: Inheritance of colour blindness in humans, Inheritance of Y- linked genes: Holandric

Department of Botany T. Y. B.Sc. Semester- VI

genes in humans, Sex influenced genes: Baldness in humans, Sex-limited genes: Feathering in domestic fowl.

2.3 Euploidy and Aneuploidy

6L

Euploidy: Monoploidy, morphology and uses, Polyploidy: Concept and Characteristics of polyploids, Autopolyploidy: Origin, production, effects and uses of autopolyploidy.

Allopolyploidy: Concept, synthesized allopolyploidy Ex. wheat.

Aneuploidy: Monosomy, Nullisomy, Trisomy in *Datura* and Humans.

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Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: Plant Genetics

Course Code : BOT-353-MJM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	2		2		3	2	2					3
CO 2	3	2	3	2		3	2	2					3
CO 3	3	2	2	2		3	2	2	3				3
CO 4	2	3	2	3		2	3	3	2			2	2
CO 5	2	3		3	2	2	3	3	3	2	3	2	2
CO 6	2	2		2	3	2	2	2	2	3		3	2
CO 7	2	2		2	3	2	2	2				3	2

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding

CO1. Learnt Mendel's laws of independent assortment.

- CO2. Learnt the principles of genetical heredity
- CO3. Learnt types of crosses in genetics.
- CO4. Get knowledge of interaction of genes.
- CO5. Learnt multiple allelism.
- CO6. Get knowledge of quantitative and cytoplasmic inheritance.
- CO7. Get knowledge of sex linked inheritance.

PO2. Practical, Professional, and Procedural Knowledge

- CO1. Learnt Mendel's laws of independent assortment.
- CO2. Learnt the principles of genetical heredity.
- CO3. Learnt types of crosses in genetics
- CO4. Get knowledge of interaction of genes.
- CO5. Learnt multiple allelism.
- CO6. Get knowledge of quantitative and cytoplasmic inheritance.
- CO7. Get knowledge of sex linked inheritance.

PO3. Entrepreneurial Mindset and Knowledge

- CO2. Learnt the principles of genetical heredity
- CO3. Learnt types of crosses in genetics.
- CO7. Get knowledge of sex linked inheritance.

PO4. Specialized Skills and Competencies

- CO3. Learnt types of crosses in genetics
- CO4. Get knowledge of interaction of genes.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning

- CO5. Learnt multiple allelism.
- CO6. Get knowledge of quantitative and cytoplasmic inheritance.

PO6. Communication Skills and Collaboration

- CO6. Get knowledge of quantitative and cytoplasmic inheritance.
- CO7. Get knowledge of sex linked inheritance.

PO7. Research-related Skill

- CO1. Learnt Mendel's laws of independent assortment.
- CO2. Learnt the principles of genetical heredity.
- CO3. Learnt types of crosses in genetics.
- CO4. Get knowledge of interaction of genes.
- CO5. Learnt multiple allelism.
- CO6. Get knowledge of quantitative and cytoplasmic inheritance.
- CO7. Get knowledge of sex linked inheritance.

PO8. Learning How to Learn Skills

- CO1. Learnt Mendel's laws of independent assortment.
- CO2. Learnt the principles of genetical heredity.
- CO3. Learnt types of crosses in genetics.
- CO4. Get knowledge of interaction of genes.
- CO5. Learnt multiple allelism.
- CO6. Get knowledge of quantitative and cytoplasmic inheritance.
- CO7. Get knowledge of sex linked inheritance.

PO9. Digital and Technological Skills

- CO3. Learnt types of crosses in genetics.
- CO4. Get knowledge of interaction of genes.
- CO6. Get knowledge of quantitative and cytoplasmic inheritance.
- CO7. Get knowledge of sex linked inheritance.

PO10 Multicultural Competence, Inclusive Spirit, and Empathy

- CO1. Learnt Mendel's laws of independent assortment.

PO11. Value Inculcation and Environmental Awareness

CO5. Learnt multiple allelism.

PO12 Autonomy, Responsibility, and Accountability

CO1. Learnt Mendel's laws of independent assortment.

CO2. Learnt the principles of genetical heredity.

PO13. Community Engagement and Service

CO6. Get knowledge of quantitative and cytoplasmic inheritance.

CO7. Get knowledge of sex linked inheritance.

Department of Botany T. Y. B.Sc. Semester- VI

Name of the Programme	:	B.Sc. Botany
Class	:	T. Y. B. Sc.
Semester	:	VI
Course Type	:	Major Mandatory (Theory)
Course Code	:	BOT-354-MJM
Course Title	:	Plant Pathology
No. of Credits	:	02
No. of Teaching Hours	:	30

A) Learning Objectives:

1. To understand the fundamental terminology and basic concepts related to plant pathology.
2. To study the stages of disease development and the dynamics of epidemics in plants.
3. To learn about the natural and induced defense mechanisms in plants against pathogens.
4. To develop skills in studying plant diseases using macroscopic and microscopic techniques, including culture methods and Koch's postulates.
5. To identify and describe major fungal, bacterial, viral, mycoplasma, and nematodal diseases of economically important crops.
6. To understand the impact of abiotic factors causing non-parasitic plant diseases and their management.
7. To make students aware of the work of important scientists and research institutes in plant disease management.

B) Course Outcome:

After successful completion of the course, students will be able to:

- CO1.** Explain key terminologies and fundamental concepts used in plant pathology.
- CO2.** Describe the process of disease development and interpret various stages of the disease cycle and epidemics.
- CO3.** Distinguish between different types of plant defense mechanisms and explain their significance.
- CO4.** Demonstrate practical understanding of studying plant diseases through culture techniques, microscopy, and Koch's postulates.
- CO5.** Identify causal organisms, symptoms, and disease cycles of major fungal, bacterial, viral, mycoplasma, and nematodal diseases.
- CO6.** Analyse the effects of abiotic factors causing non-parasitic diseases and suggest appropriate control measures.
- CO7.** Understand the contributions of Anton De Bary, Prof. B.B. Mundkur, and research institutes like IARI and ICRISAT in the development of plant pathology and crop disease management.

Credit - I

(15L)

Unit – 1

1.1 Fundamentals of plant pathology : Important terminology- Incitants, Host, Parasite, Pathogen, Inoculum, Penetration, Infection, Incubation, Disease, Disease development, Symptoms, Sign, Endophyte, Predisposition, Suscept, Resistance, Epidemic, Etiology. Introduction to Indian Agricultural Research Institute (IARI), International Crop Research Institute for Semi-Arid Tropics (ICRISAT), Contribution of Anton De Bary and Prof. B.B. Mundkur.

4L

- 1.2 Disease Development:** Concept of disease cycle, Inoculation, Pre-penetration, Penetration, Infection, Dissemination. Epidemics - Forms, Decline, Exponential model. 4L
- 1.3 Defense Mechanisms:** Concept and Definition, Types- Pre-existing: Structural and Chemical, Induced: Structural & Biochemical mechanisms. 3L
- 1.4 Methods of Studying Plant Diseases:** Macroscopic study, Microscopic study, Koch's postulates, Culture techniques, Media Types and Preparation, Pure culture methods- streak plate, pour plate, spread plate, serial dilution. 4L

Credit - II (15L)

Unit – 2

- 2.1 Fungal Plant Diseases:** Introduction to fungi as plant pathogen. Study of Club root of Cabbage and Stem Rust of Wheat with reference to causal organism, symptoms and signs, disease cycle and control measures. 3L
- 2.2 Bacterial Plant Diseases:** Introduction to bacteria as plant pathogen, Study of Citrus Canker with reference to causal organism, symptoms and signs, control measures. 2L
- 2.3 Mycoplasma Plant Diseases:** Introduction to Mycoplasma as plant pathogen, Study of Grassy shoot disease of sugarcane with reference to causal organism, symptoms and signs, control measures. 2L
- 2.4 Nematodal Plant Diseases:** Introduction to Nematodes as plant pathogen. Study of Root knot disease of vegetables with reference to causal organism, symptoms and signs, control measures. 2L
- 2.5 Viral Plant Diseases:** Introduction to Viruses as plant pathogen. Study of Tobacco Mosaic Disease with reference to causal organism, symptoms and signs, control measures. 2L
- 2.6 Non-Parasitic Diseases :** The impact and abiotic causes - Temperature, Soil moisture and relative humidity, Poor oxygen, Poor light, Air pollutants, mineral deficiencies. Herbicide injury, Study of Tip burn of Paddy, Mango necrosis, Black Heart of Potato, Khaira disease of rice. 4L

References:

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Choice Based Credit System Syllabus (2023 Pattern)
Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: Plant Pathology

Course Code : BOT-354-MJM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	2		2		3	2	2					3
CO 2	3	2	3	2		3	2	2					3
CO 3	3	2	2	2		3	2	2	3				3
CO 4	2	3	2	3		2	3	3	2			2	2
CO 5	2	3		3	2	2	3	3	3	2	3	2	2
CO 6	2	2		2	3	2	2	2	2	3		3	2
CO 7	2	2		2	3	2	2	2				3	2

Justification for the Mapping

PO2. Practical, Professional, and Procedural Knowledge

CO1. Learnt the key terminologies and fundamental concepts used in plant pathology.

CO2. Understood the process of disease development and stages of disease cycle and epidemics.

CO3. Distinguished different plant defense mechanisms and their significance.

CO4. Gained practical experience in culture techniques, microscopy, and Koch's postulates.

CO5. Identified causal organisms, symptoms, and disease cycles of major fungal, bacterial, viral, mycoplasma and nematodal diseases.

CO6. Analysed abiotic factors causing non-parasitic diseases and suggested suitable control measures.

PO4. Specialized Skills and Competencies

CO1. Learnt to apply terminologies and principles in understanding plant diseases.

CO2. Developed the skill to interpret disease cycles and epidemics.

CO3. Acquired knowledge of plant defense mechanisms and their applications.

CO4. Practiced diagnostic skills using microscopy and isolation methods.

CO5. Identified disease-causing agents using standard pathological techniques.

CO6. Evaluated environmental and physiological effects on plant health.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning

CO2. Analysed stages of disease development and interpreted epidemiological data.

CO3. Understood mechanisms of plant defense to develop control strategies.

CO6. Applied analytical reasoning to diagnose abiotic and biotic diseases and suggest management measures.

PO6. Communication Skills and Collaboration

CO1. Developed ability to explain plant pathological terms and concepts clearly.

CO2. Shared and discussed disease cycles effectively in team or lab settings.

CO4. Communicated experimental observations through reports and presentations.

CO7. Recognized contributions of scientists and institutes, enhancing scientific communication.

PO7. Research-related Skills

CO4. Practiced isolation, culture, and microscopic study of pathogens.

CO5. Applied research methods in identifying causal organisms of diseases.

CO6. Conducted analytical observations on abiotic and biotic disease factors.

PO8. Learning How to Learn Skills

CO1. Developed independent learning through understanding key pathological concepts.

CO2. Gained ability to relate theoretical knowledge with practical examples.

CO7. Learnt from contributions of leading scientists and institutions for lifelong learning.

PO9. Digital and Technological Skills

CO4. Used digital microscopes and imaging tools for pathogen identification.

CO5. Applied digital databases and diagnostic tools for pathogen recognition and analysis.

PO10. Multicultural Competence, Inclusive Spirit, and Empathy

CO5. Understood global importance of plant disease management for food security.

CO7. Appreciated contributions of scientists worldwide in developing sustainable crop protection methods.

PO11. Value Inculcation and Environmental Awareness

CO6. Recognized the impact of abiotic stress and pollution on plant health.

CO7. Promoted eco-friendly approaches in disease management inspired by institutional research.

PO12. Autonomy, Responsibility, and Accountability

CO4. Conducted practical experiments responsibly using standard lab procedures.

CO5. Took responsibility for accurate disease diagnosis and documentation.

CO6. Suggested responsible management practices for plant disease control.

PO13. Community Engagement and Service

CO5. Applied knowledge to help farmers and communities identify and manage crop diseases.

CO6. Promoted sustainable and environment-friendly disease control practices.

CO7. Recognized the societal role of plant pathologists and agricultural institutes in crop protection.

Name of the Programme	:	B.Sc. Botany
Class	:	T. Y. B. Sc.
Semester	:	VI
Course Type	:	Practical-II
Course Code	:	BOT-355-MJM (Practical)
Course Title	:	Practicals based on BOT-351-MJM to BOT-354-MJM
No. of Credits	:	02
No. of Teaching Hours	:	60

A) Learning Objectives:

- 1 To make aware about tools and techniques required for plant analysis.
- 2 To give detailed idea about multiplication and production of new varieties.
- 3 To give hands-on training required for setting of experiments.
- 4 To give knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.
- 5 To give knowledge about callus induction / maize embryo culture / isolation of protoplast.
- 6 To impart the basic skills hybridization techniques.
- 7 To give knowledge about effect of chemical mutagens on seed germination and seedling growth.

B) Course Outcome:

By the end of the course, students will be able to:

CO1. Expertise in tissue culture techniques.

CO2. Get employment in agro-industries.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO4. Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

CO6. Explore basic skills in hybridization techniques

CO7. Understand effect of chemical mutagens on seed germination and seedling growth.

Practical based on BOT-351-MJM Plant Physiology

1. Estimation of chlorophyll-a and chlorophyll-b by spectrophotometric method.
2. Separation of photosynthetic pigments by TLC/Paper chromatography.
3. To determine diurnal fluctuation in TAN values of CAM plants.
4. Estimation of soluble proteins by Lowery *et al.* (1951) method.

Practical based on BOT-352-MJM - Plant Biotechnology

5. Preparation of MS Medium.
6. Maize embryo culture.
7. Estimation of Nitrate Reductase enzyme from Legume nodules.
8. Study of methods of gene transfer through photographs.
9. Visit to Biotechnology institute and report preparation.

Practical based on BOT-353-MJM – Plant Genetics

10. Induction of tetraploidy in onion root cells and preparation of squash for observation of tetraploid cells.
11. Genetic problems on gene mapping using two and three point test cross.

Practical based on BOT-354-MJM – Plant Pathology

12. Preparation of any one culture medium for isolation of plant pathogens.
13. Culture techniques - Streak plate method, Pour plate method, Spread plate and Serial dilution method for preparation of pure culture.
14. Study of any two of each fungal, bacterial and mycoplasma diseases.
15. Study of any two viral and non-parasitic diseases of plants.

Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: Botany Practical-II

Course Code : BOT-355-MJM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	2		2		3	2	2					3
CO 2	3	2	3	2		3	2	2					3
CO 3	3	2	2	2		3	2	2	3				3
CO 4	2	3	2	3		2	3	3	2			2	2
CO 5	2	3		3	2	2	3	3	3	2	3	2	2
CO 6	2	2		2	3	2	2	2	2	3		3	2
CO 7	2	2		2	3	2	2	2				3	2

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding

CO1. Expertise in tissue culture techniques.

CO2. Get employment in agro-industries.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO4. Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

CO6. Explore basic skills in hybridization techniques.

CO7. Understand effect of chemical mutagens on seed germination and seedling growth.

PO2. Practical, Professional, and Procedural Knowledge

CO1. Expertise in tissue culture techniques.

CO2. Get employment in agro-industries.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO4. Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

CO6. Explore basic skills in hybridization techniques.

CO7. Understand effect of chemical mutagens on seed germination and seedling growth.

PO3. Entrepreneurial Mindset and Knowledge

CO2. Get employment in agro-industries.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which

will help to enhance plant production.

CO6. Explore basic skills in hybridization techniques.

PO4. Specialized Skills and Competencies

CO1. Expertise in tissue culture techniques.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO4. Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

CO6. Explore basic skills in hybridization techniques.

CO7. Understand effect of chemical mutagens on seed germination and seedling growth.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO4. Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

CO6. Explore basic skills in hybridization techniques.

CO7. Understand effect of chemical mutagens on seed germination and seedling growth.

PO6. Communication Skills and Collaboration

CO2. Get employment in agro-industries.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO6. Explore basic skills in hybridization techniques.

PO7. Research-related Skill

CO1. Expertise in tissue culture techniques.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO4. Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

CO6. Explore basic skills in hybridization techniques.

CO7. Understand effect of chemical mutagens on seed germination and seedling growth.

PO8. Learning How to Learn Skills

CO1. Expertise in tissue culture techniques.

CO4. Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

CO6. Explore basic skills in hybridization techniques.

CO7. Understand effect of chemical mutagens on seed germination and seedling growth.

PO9. Digital and Technological Skills

CO4. Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

CO6. Explore basic skills in hybridization techniques.

PO10. Multicultural Competence, Inclusive Spirit, and Empathy

CO2. Get employment in agro-industries.

PO11. Value Inculcation and Environmental Awareness

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which

will help to enhance plant production.

CO5. Understand callus induction / maize embryo culture / isolation of protoplast.

PO12. Autonomy, Responsibility, and Accountability

CO1. Expertise in tissue culture techniques.

CO2. Get employment in agro-industries.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO6. Explore basic skills in hybridization techniques.

PO13. Community Engagement and Service

CO2. Get employment in agro-industries.

CO3. Expertise in plant pathogenicity will help to identify and eradicate pathogens which will help to enhance plant production.

CO6. Explore basic skills in hybridization techniques.

Name of the Programme	:	B. Sc. Botany
Program Code	:	USBT
Class	:	T.Y. B. Sc.
Semester	:	VI
Course Code	:	BOT-356-MJE (A) (Theory)
Course Title	:	Botanical Techniques
No. of Credits	:	02
No. of lectures	:	30

A) Learning Objectives:

To enable the students:

1. To have comprehensive knowledge on various analytical techniques
2. To understand the significance of techniques in plants science research.
3. To aware the students about the instrumentation.
4. To develop a deep understanding of various types of microscopy.
5. To understand and apply preservation techniques for both lower and higher plants.
6. To develop the ability to analyze the physical, chemical, and biological properties of soil and water samples.
7. To recognize the importance of botanical techniques in promoting conservation and sustainability.

B) Course Outcome:

By the end of the course, students will be able to:

- CO1. Principal and types of microscopes.
- CO2. Various advanced methods for estimation of plant based molecules
- CO3. Techniques of analysis of soil and water samples.
- CO4. Effectively communicate complex botanical concepts.
- CO5. Employ advanced botanical methodologies, such as molecular biology, genetic analysis, and ecological monitoring.
- CO6. Critically assess existing botanical techniques for their effectiveness and propose potential improvements.
- CO7. Apply a range of botanical techniques to design and execute independent research projects.

Credit-I

Unit – 1

(20 L)

- 1.1 Microscopy: Introduction, Principle, Types - Simple, Compound, Light, Bright and dark field, Fluorescence, Phase contrast, Electron Microscope- Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM), image processing- photomicrography. 6L
- 1.2 Micrometry: Principle and measurement of microscopic objects, Microscopic measurements of cell size, calibration of ocular and stage micrometer. 2L
- 1.3 Chromatography: Principle; Types - Paper chromatography, Column chromatography, TLC, Applications. 4L
- 1.4. Spectroscopy: Principle, types, general outlines of working of UV- Vis spectroscopy, Applications 4L
- 1.5 Centrifugation: Principle, types of rotors, types of centrifuges and types of centrifugations, Applications. 4L

Credit-II

Unit – 2

(10L)

2.1 Soil Analysis: Soil sampling, importance, soil structure, soil profile, methods of analysis for Physico-chemical and Biological properties. 5L

2.2 Water Analysis: Sampling, methods of analysis for Physico-chemical and Biological properties. 5L

References:

1. Douglas B. Murphy and Michael W. Davidson (2012) Fundamentals of Light Microscopy and Electronic Imaging, Wiley- Blackwell Publications
2. Kieth Wilson and John walker (2010) Principles and Techniques in Biochemistry and Molecular Biology, Cambridge University Press
3. Harry Salem and Sidney A. Katz (2016) Aerobiology: The toxicology of airborne Pathogen and Toxins, Royal society of Chemistry
4. Aakanchha Jain, Richa Jain and Sourabh Jain (2021) Basic Techniques in Biochemistry, Microbiology and Molecular Biology Principles and Techniques
5. PranabDey, (2018) Basic and Advanced Laboratory technique in Histopathology, Springer
6. Rob Beynon and J Easterby (2004) Buffer solutions, Oxford University Press
7. Michael E. Essington (2003) Soil and water Chemistry: An integrative Approach, CRC press

Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: Botanical Techniques

Course Code : BOT-356-MJE (A)

Weightage: 1= weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO 1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO 10	PO11	PO 12	PO13
CO1	3			3	2				2				
CO2		3					3		2				
CO3	3		2					3			3		
CO4					2	3				2			
CO5		3		3		2	3	2		2			2
CO6	3		2	3								2	2
CO7		3	2								2	3	

Justification for the mapping

PO.1 Comprehensive Knowledge and Understanding:

CO1. Principal and types of microscopes.

CO3. Techniques of analysis of soil and water samples.

CO6. Critically assess existing botanical techniques for their effectiveness and propose potential improvements.

PO2.Practical, Professional and Procedural Knowledge:

CO2. Various advanced methods for estimation of plant based molecules

CO5. Employ advanced botanical methodologies, such as molecular biology, genetic analysis, and ecological monitoring.

CO7. Apply a range of botanical techniques to design and execute independent research projects.

PO3. Entrepreneurial Mindset and Knowledge:

CO3. Techniques of analysis of soil and water samples.

CO6. Critically assess existing botanical techniques for their effectiveness and propose potential improvements.

CO7. Apply a range of botanical techniques to design and execute independent research projects.

PO4. Specialized Skills and Competencies:

CO1. Principal and types of microscopes.

CO5. Employ advanced botanical methodologies, such as molecular biology, genetic analysis, and ecological monitoring.

CO6. Critically assess existing botanical techniques for their effectiveness and propose potential improvements.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning:

CO1. Principal and types of microscopes.

CO4. Effectively communicate complex botanical concepts.

PO6. Communication Skills and Collaboration:

CO4. Effectively communicate complex botanical concepts.

CO5. Employ advanced botanical methodologies, such as molecular biology, genetic analysis, and ecological monitoring.

PO7. Research related Skills:

CO2. Various advanced methods for estimation of plant based molecules

CO5. Employ advanced botanical methodologies, such as molecular biology, genetic analysis, and ecological monitoring.

PO8. Learning How to Learn Skills:

CO3. Techniques of analysis of soil and water samples.

CO5. Employ advanced botanical methodologies, such as molecular biology, genetic analysis, and ecological monitoring.

PO9. Digital and Technological Skills:

CO1. Principal and types of microscopes.

CO2. Various advanced methods for estimation of plant based molecules

PO10. Multicultural Competence, Inclusive Spirit, and Empathy:

CO4. Effectively communicate complex botanical concepts.

CO5. Employ advanced botanical methodologies, such as molecular biology, genetic analysis, and ecological monitoring.

PO11. Value Inculcation and Environmental Awareness:

CO3. Techniques of analysis of soil and water samples.

CO7. Apply a range of botanical techniques to design and execute independent research projects.

PO12. Autonomy, Responsibility, and Accountability:

CO6. Critically assess existing botanical techniques for their effectiveness and propose potential improvements.

CO7. Apply a range of botanical techniques to design and execute independent research projects.

PO13. Community Engagement and Service:

CO5. Employ advanced botanical methodologies, such as molecular biology, genetic analysis, and ecological monitoring.

Name of the Programme	:	B. Sc. Botany
Program Code	:	USBT
Class	:	T.Y. B. Sc.
Semester	:	VI
Course Code	:	BOT-356-MJE (B) (Theory)
Course Title	:	Plant Breeding
No. of Credits	:	02
No. of lectures	:	30

A) Learning Objectives:

1. To study the objectives and methods of plant breeding.
2. To study types of selection and its applications.
3. To give knowledge and applications of hybridization technique.
4. To study mutation breeding and its applications in crop improvement.
5. To give knowledge of breeding for resistance and stress tolerance.
6. To study applications of different methods of plant breeding.
7. To study polyploidy and its role in crop improvement.

B) Course Outcome:

By the end of the course, students will be able to:

- CO1.** Learnt the objectives and methods of plant breeding.
CO2. Learnt types of selection and its applications.
CO3. Get knowledge of hybridization technique.
CO4. Learnt about mutation breeding.
CO5. Get knowledge of breeding for resistance and stress tolerance.
CO6. Learnt different methods of plant breeding.
CO7. Get knowledge of polyploidy and its role in crop improvement.

Credit: I

Unit - 1 (15L)

- 1.1** Introduction, scope and importance of plant breeding. 2L
1.2 Methods of breeding
 Plant introduction and acclimatization 2L
 Concept, objectives, Advantages and disadvantages.
1.3 Selection 3L
 Concept, types - mass, pure line and clonal selection,
 Advantages and disadvantages.
1.4 Hybridization 6L
 Concept, difficulties and precaution in hybridization, Procedure of hybridization,
 Achievements.
1.5 Heterosis and hybrid vigour 2L
 Concept, Causes of heterosis, dominance hypothesis, Applications.

Credit: II

Unit - 2 (15L)

- 2.1 Mutation breeding** 5L
 Introduction and concept, Types of Mutation, Mutagens used –
 Chemical and Physical mutagens, Procedure, Gamma gardens, Applications.
2.2 Importance of Polyploidy and Aneuploidy in crop improvement 5L
 Properties of polyploids, Methods of obtaining polyploids,

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Methods used in obtaining haploids, Production of triploids in plant breeding, Applications and achievements.

2.3 Breeding for stress tolerance

5L

Breeding for resistance/tolerance, Characteristics evaluated for drought tolerance, Characteristics evaluated for insect/pest tolerance, Breeding for abiotic and biotic stress, Achievements.

References:

1. Principles and practices of Plant Breeding, Sharma J. R. (2007) McGraw-Hill Publishing Company.
2. Plant Breeding - Principles and methods, Singh B. D. (2022) MedTech Publishers.
3. Principles of Plant Breeding, Allard R.W. (2019) John Wiley & Sons.
4. Plant Breeding, Phundan singh (2020) Kalyani Publishers.
5. Plant Breeding Kumaresan V. (2017) Saras Publication

Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: Plant Breeding

Course Code : BOT-356-MJE (B)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	2		2		3	2	2					3
CO 2	3	2	3	2		3	2	2					3
CO 3	3	2	2	2		3	2	2	3				3
CO 4	2	3	2	3		2	3	3	2			2	2
CO 5	2	3		3	2	2	3	3	3	2	3	2	2
CO 6	2	2		2	3	2	2	2	2	3		3	2
CO 7	2	2		2	3	2	2	2				3	2

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding

CO1. Learnt the objectives and methods of plant breeding.

CO2. Learnt types of selection and its applications.

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding.

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding.

CO7. Get knowledge of polyploidy and its role in crop improvement.

PO2. Practical, Professional, and Procedural Knowledge

CO1. Learnt the objectives and methods of plant breeding.

CO2. Learnt types of selection and its applications.

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding.

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding

CO7. Get knowledge of polyploidy and its role in crop improvement.

PO3. Entrepreneurial Mindset and Knowledge

CO2. Learnt types of selection and its applications.

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding.

PO4. Specialized Skills and Competencies

CO1. Learnt the objectives and methods of plant breeding.

CO2. Learnt types of selection and its applications.

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding.

CO5. Get knowledge of breeding for resistance and stress tolerance.

CO6. Learnt different methods of plant breeding.

CO7. Get knowledge of polyploidy and its role in crop improvement.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning

CO5. Get knowledge of breeding for resistance and stress tolerance.

CO6. Learnt different methods of plant breeding.

CO7. Get knowledge of polyploidy and its role in crop improvement.

PO6. Communication Skills and Collaboration

CO1. Learnt the objectives and methods of plant breeding.

CO2. Learnt types of selection and its applications.

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding.

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding

CO7. Get knowledge of polyploidy and its role in crop improvement.

PO7. Research-related Skill

CO1. Learnt the objectives and methods of plant breeding

CO2. Learnt types of selection and its applications

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding.

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding

CO7. Get knowledge of polyploidy and its role in crop improvement.

PO8. Learning How to Learn Skill

CO1. Learnt the objectives and methods of plant breeding

CO2. Learnt types of selection and its applications

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding.

CO7. Get knowledge of polyploidy and its role in crop improvement.

PO9. Digital and Technological Skills

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding.

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding.

PO10 Multicultural Competence, Inclusive Spirit, and Empathy

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding.

PO11. Value Inculcation and Environmental Awareness

CO5. Get knowledge of breeding for resistance and stress tolerance.

PO12 Autonomy, Responsibility, and Accountability

CO4. Learnt about mutation breeding.

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding

CO7. Get knowledge of polyploidy and its role in crop improvement.

PO13. Community Engagement and Service

CO1. Learnt the objectives and methods of plant breeding

CO2. Learnt types of selection and its applications

CO3. Get knowledge of hybridization technique.

CO4. Learnt about mutation breeding.

CO5. Get knowledge of breeding for resistance and stress tolerance

CO6. Learnt different methods of plant breeding

CO7. Get knowledge of polyploidy and its role in crop improvement.

Name of the Programme	:	B.Sc. Botany
Program Code	:	USBT
Class	:	T.Y.B.Sc.
Semester	:	VI
Course Type	:	Major Elective (MJE)
Course Code	:	BOT-356-MJE (C)
Course Title	:	Medicinal Botany (Theory)
No. of Credits	:	02
No. of Teaching Hours	:	30

A) Learning Objectives:

1. To understand the fundamental principles of Ayurveda and its relation to plant science.
2. To learn identification and classification of medicinal plants based on Ayurvedic and botanical criteria.
3. To study Ayurvedic concepts of Rasa, Guna, Virya, Vipaka and Prabhava and their biological significance.
4. To gain knowledge of important Ayurvedic plant groups, their botanical features, and uses in formulations.
5. To learn modern tools and techniques for authentication, conservation and quality control of medicinal plants.
6. To understand the phytochemical constituents of medicinal plants and their relevance in Ayurveda.
7. To develop skills for research, entrepreneurship and practical applications in the herbal and Ayurvedic industry.

B) Course Outcomes:

By the end of the course, students will be able to:

- CO1.** Understand the fundamental principles of Ayurveda and its relation to plant science.
- CO2.** Identify and classify medicinal plants based on Ayurvedic and botanical criteria.
- CO3.** Explain Ayurvedic concepts of Rasa, Guna, Virya, Vipaka and Prabhava and their biological relevance.
- CO4.** Recognize important Ayurvedic plant groups, their botanical features, and their uses in formulations.
- CO5.** Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6.** Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.
- CO7.** Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

Credit-I

Unit-1 – Fundamentals of Botany in Ayurveda (15 L)

- 1.1 Introduction to Ayurveda** – Meaning, origin and scope; the concept of *Panchamahabhuta* and *Tridosha* (Vata, Pitta, Kapha), Concept of *Dravya* – Definition and classification according to *Charaka* and *Sushruta Samhita*. Concept of *Rasa, Guna, Virya, Vipaka* and *Prabhava*. 4L
- 1.2 Botanical classification in ancient Ayurveda** – Basis of classification (*Gana, Varga, Gana Sangraha*). Plant morphology and identification – Ayurvedic descriptions of leaf, flower, fruit, and seed forms. 4L
- 1.3 Ayurvedic plant nomenclature (Sanskrit names, Common names and its medicinal uses)** examples: *Ashwagandha, Tulsi, Neem, Amla, Haritaki*. Conservation of medicinal plants – Importance of herbal gardens and biodiversity preservation. 3L

- 1.4 Role of Botany in Ayurvedic Pharmacognosy** – Identification, authentication, and adulteration of plant materials. Plant parts used in Ayurveda – Root, bark, leaf, flower, seed, fruit, and whole plant, Concept of *Ahara Dravya* (dietary plants) – Botanical understanding of food plants used in Ayurvedic nutrition. 4L

Credit-II

Unit-2 Medicinal Plants and Formulations in Ayurveda (15L)

- 2.1 Major Ayurvedic plant groups** and examples: *Dashamoola*, *Triphala*, *Trikatu*, *Panchavalka*, *Ashtavarga*. 2L

- 2.2 Identification, morphological characters, chemical constituents of important plants:** *Withania somnifera*, *Ocimum sanctum*, *Azadirachta indica*, *Embllica officinalis*, *Curcuma longa*, *Aloe vera*, *Tinospora cordifolia*, *Rauvolfia serpentina*, *Terminalia arjuna*, *Bacopa monnieri*. 5L

- 2.3 Ayurvedic formulations:** *Churna*, *Asava*, *Arishta*, *Kwatha*, *Taila*, *Ghruta*, Plant collection and preservation methods – Ethical harvesting and sustainable use. 3L

- 2.4 Modern tools in Ayurvedic Botany** – Microscopy, Chromatography and DNA barcoding for plant identification. 2L

- 2.5 Phytochemical constituents:** Alkaloids, glycosides, flavonoids, tannins, essential oils. Integration of Ayurveda and Modern Botany – Scope for interdisciplinary research and entrepreneurship. 3L

References

- Sharma, P.V. (1998). *Dravyaguna Vigyan*, Chaukhambha Bharati Academy.
- Dash, V.B. & Junius, F. (1991). *Materia Medica of Ayurveda*.
- Kirtikar, K.R. & Basu, B.D. (1935). *Indian Medicinal Plants*.
- Warrier, P.K., Nambiar, V.P.K. & Ramankutty, C. (1994). *Indian Medicinal Plants: A Compendium of 500 Species*.
- Pandey, B.P. (2009). *Taxonomy and Pharmacognosy of Medicinal Plants*.
- Ayurvedic Pharmacopoeia of India (Govt. of India, Ministry of AYUSH).

Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: Medicinal Botany

Course Code : BOT-356-MJE(C)

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	2	1	1	2	1	2	3	1	3	1	3	1
CO 2	3	3	2	2	2	2	3	2	2	2	1	2	1
CO 3	3	2	2	2	2	2	2	2	2	1	1	2	1
CO 4	3	2	2	3	2	3	2	2	2	1	1	2	2
CO 5	2	3	3	3	3	2	3	2	3	1	3	2	2
CO 6	3	2	3	2	2	2	3	2	3	1	2	2	2
CO 7	2	2	3	2	2	3	3	2	3	1	2	2	3

Justification for the Mapping

PO1. Comprehensive Knowledge and Understanding

- CO1. Understand the fundamental principles of Ayurveda and its relation to plant science.
- CO2. Identify and classify medicinal plants based on Ayurvedic and botanical criteria.
- CO3. Explain Ayurvedic concepts of Rasa, Guna, Virya, Vipaka and Prabhava and their biological relevance.
- CO4. Recognize important Ayurvedic plant groups, their botanical features, and their uses in formulations.
- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6. Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

PO2. Practical, Professional, and Procedural Knowledge

- CO2. Identify and classify medicinal plants based on Ayurvedic and botanical criteria.
- CO4. Recognize important Ayurvedic plant groups, their botanical features, and their uses in formulations.
- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

PO3. Entrepreneurial Mind set and Knowledge

- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6. Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

PO4. Specialized Skills and Competencies

- CO2. Identify and classify medicinal plants based on Ayurvedic and botanical criteria.
- CO3. Explain Ayurvedic concepts of Rasa, Guna, Virya, Vipaka and Prabhava and their biological relevance.
- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6. Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning

- CO3. Explain Ayurvedic concepts of Rasa, Guna, Virya, Vipaka and Prabhava and their biological relevance.
- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6. Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

PO6. Communication Skills and Collaboration

- CO2. Identify and classify medicinal plants based on Ayurvedic and botanical criteria.
- CO4. Recognize important Ayurvedic plant groups, their botanical features, and their uses in formulations.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

PO7. Research-related Skill

- CO1. Understand the fundamental principles of Ayurveda and its relation to plant science.
- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6. Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

PO8. Learning How to Learn Skills

- CO1. Understand the fundamental principles of Ayurveda and its relation to plant science.
- CO3. Explain Ayurvedic concepts of Rasa, Guna, Virya, Vipaka and Prabhava and their biological relevance.
- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6. Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.

PO9. Digital and Technological Skills

- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6. Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

PO10. Multicultural Competence, Inclusive Spirit, and Empathy

- CO1. Understand the fundamental principles of Ayurveda and its relation to plant science.
- CO3. Explain Ayurvedic concepts of Rasa, Guna, Virya, Vipaka and Prabhava and their biological relevance.

PO11. Value Inculcation and Environmental Awareness

- CO2. Identify and classify medicinal plants based on Ayurvedic and botanical criteria.
- CO4. Recognize important Ayurvedic plant groups, their botanical features, and their uses in formulations.
- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.

PO12. Autonomy, Responsibility, and Accountability

- CO1. Understand the fundamental principles of Ayurveda and its relation to plant science.
- CO5. Apply modern botanical and pharmacognostic techniques for authentication, conservation, and quality control of medicinal plants.
- CO6. Relate traditional Ayurvedic knowledge with modern phytochemical and pharmacological approaches.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

PO13. Community Engagement and Service

- CO2. Identify and classify medicinal plants based on Ayurvedic and botanical criteria.
- CO4. Recognize important Ayurvedic plant groups, their botanical features, and their uses in formulations.
- CO7. Develop skills for research, entrepreneurship, and practical applications in the herbal and Ayurvedic industry.

Department of Botany T. Y. B.Sc. Semester- VI

Name of the Programme	:	B. Sc. Botany
Program Code	:	USBT
Class	:	T. Y. B. Sc.
Semester	:	VI
Course Type	:	Minor Theory
Course Code	:	BOT-361-MN
Course Title	:	Pharmacognosy (Theory)
Credit	:	02
No. of Teaching Hours	:	30

A) Learning Objectives:

1. To Study traditional and alternative systems of medicines.
2. To Understand Ayurveda and its importance.
3. To study drug adulteration and its evaluation methods.
4. To understand herbal drugs cultivation methods, collection, processing and marketing.
5. To create scientific approaches towards Ayurveda.
6. To get knowledge of analytical pharmacognosy.
7. To understand Ethno botanical and Cultural Significance of Medicinal Plants

B) Course Outcome:

- CO1. Get knowledge of traditional and alternative systems of medicines.
CO2. Understand Ayurveda and its importance.
CO3. Knowledge of drug adulteration and its evaluation methods.
CO4. Awareness of herbal drugs cultivation methods, collection, processing and marketing.
CO5. Vision of scientific approach towards Ayurveda.
CO6. Get knowledge of analytical pharmacognosy.
CO7. Understand Ethno botanical and Cultural Significance of Medicinal Plants

Credit-I

Unit-1 (15L)

1. Introduction to Pharmacognosy: 05L

- 1.1 History, definition and Scope of Pharmacognosy.
1.2 Traditional and alternative systems of medicine.
1.3 Plant antioxidants: Definition, Properties of Antioxidants.

2. Ayurvedic Pharmacy: 05L

- 2.1 Introduction to Ayurveda-History and Description, Tridosha concept.
2.2 Ayurvedic principles- Ras, Guna, Vipaka, Virya, Prabhava.
2.3 Ayurvedic formulations- Asava, Arishta, Churna, Vatika, Taila, Bhasma.

3. Analytical Pharmacognosy: 05L

- 3.1 Drug adulteration: Definition, concept and its types.
3.2 Adulteration of drugs of natural origin: Evaluation by Morphological, Microscopic, Chemical and Physical methods.

Credit-II

Unit-2 (15L)

1. Study of drugs w.r.t. occurrence, distribution, cultivation, macroscopic and microscopic characters, constituents and uses: 10L

Root/ Rhizome drugs: *Liquorice*, *Ginger*

Stem drugs: *Ephedra*, *Tinospora*

Department of Botany T. Y. B.Sc. Semester- VI

Bark drugs: *Cinnamon*, *Cinchona*

Leaf drugs: *Aloe*, *Adhatoda*

Flower drugs: *Clove*, *Hibiscus*

Fruit drugs: - *Amla*, *Coriander*

2. Ethnobotany

5L

Ethnobotany: Introduction, Definition, concepts, Branches of Ethnobotany.

Ethnobotany of *Aegle marmelos*, *Neem (Azadirachta indica)* w.r.t. taxonomic description, distribution, phytochemistry and uses.

References:

- 1) Ashalota Razario *et al.*, A Hand Book of Ethno biology Kalyani Publishesr 1999.
- 2) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
- 3) Kokate C.K. Purohit A.P. and Gokhale S.B. Pharmacognosy, Nirali Prakashan Pune Publishers (formerly wiley Eastern Limited).
- 4) Rajiv K. Sinha – Ethno botany The Renaissance of Traditional Herbal Medicine – INA
- 5) Rama Ro, N and A.N. Henry (1996). The Ethno botany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
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Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: Pharmacognosy

Course Code : BOT-361-MN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	3											
CO 2	3		3										
CO 3		3			3								
CO 4		3		3							3		
CO 5				3	3								
CO 6							3			3			
CO 7			3							3	3		

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding:

Department of Botany T. Y. B.Sc. Semester- VI

CO1. Get knowledge of traditional and alternative systems of medicines.

CO2. Understand Ayurveda and its importance

PO2: Practical, Professional, and Procedural Knowledge

CO1. Get knowledge of traditional and alternative systems of medicines.

CO3. Knowledge of drug adulteration and its evaluation methods.

CO4. Awareness of herbal drugs cultivation methods, collection, processing and marketing

PO3: Entrepreneurial Mindset and Knowledge:

CO2. Understand Ayurveda and its importance.

PO4: Specialized Skills and Competencies:

CO4. Awareness of herbal drugs cultivation methods, collection, processing and marketing.

CO5. Vision of scientific approach towards Ayurveda.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning:

CO3. Knowledge of drug adulteration and its evaluation methods

CO5. Vision of scientific approach towards Ayurveda

PO7: Research-related Skills:

CO6. Get knowledge of analytical pharmacognosy.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:

CO6. Get knowledge of analytical pharmacognosy.

CO7. Understand Ethno botanical and Cultural Significance of Medicinal Plants

PO11: Value Inculcation and Environmental Awareness:

CO4. Awareness of herbal drugs cultivation methods, collection, processing and marketing

CO7. Understand Ethno botanical and Cultural Significance of Medicinal Plants

Department of Botany T. Y. B.Sc. Semester- VI

Name of the Programme	:	B. Sc. Botany
Programme Code	:	USBT
Class	:	T. Y. B. Sc.
Semester	:	VI
Course Type	:	Minor (Practical)
Course Code	:	BOT-362-MN
Course Title	:	Practical Based on Pharmacognosy
No. of Credits	:	02
No. of Teaching Hours	:	60

A) Learning Objectives

1. To perform qualitative phytochemical tests for the identification of major secondary metabolites such as alkaloids, glycosides, and tannins in medicinal plants.
2. To study and differentiate various crude drugs (leaf, root, stem, flower, fruit) using macroscopic and microscopic evaluation techniques.
3. To understand the anatomical structures of different plant parts through microscopic examination for accurate identification and authentication of crude drugs.
4. To gain hands-on experience in the preparation and evaluation of traditional Ayurvedic formulations such as Asava, Arishta, and Churna.
5. To explore and document antioxidant-rich medicinal plants and their traditional uses in local or regional health systems.
6. To learn the basic technique of essential oil extraction and understand the significance of volatile oils.
7. To identify and classify natural plant products like fibers, gums, and resins and understand their pharmaceutical and industrial applications.

B) Course Outcome:

By the end of course, student will be able to:

- CO1.** Perform qualitative phytochemical tests to detect and analyze secondary metabolites such as alkaloids, glycosides, and tannins in medicinal plants.
- CO2.** Identify and differentiate various crude drugs (leaf, root, stem, flower, and fruit) based on their macroscopic and microscopic characteristics.
- CO3.** Demonstrate understanding of internal plant structures through microscopic examination for the authentication of herbal drugs.
- CO4.** Prepare and evaluate traditional Ayurvedic formulations such as Asava, Arishta, and Churna, following classical preparation methods..
- CO5.** Investigate and document medicinal plants rich in antioxidants and correlate their traditional uses with current pharmacological relevance.
- CO6.** Extract essential oils from plant materials and interpret their therapeutic significance and uses.
- CO7.** Classify and describe the pharmaceutical applications of natural products like fibers, gums, and resins used in traditional and modern formulations.

Practical based on Pharmacognosy

1. Demonstration of Plant extraction methods-cold and Soxhlet extraction. (1P)
2. Study of stomatal index and vein islet number using suitable plant material with the help of micrometer and Camera Lucida. (1P)
3. Preparation of Triphala churna. (1P)
4. Study of Thin Layer Chromatography (TLC). (1P)

Department of Botany T. Y. B.Sc. Semester- VI

5. Qualitative analysis of alkaloids, glycosides and tannins. (1P)
6. Macroscopic and microscopic characters of leaf drug. (1P)
7. Macroscopic and microscopic characters of root/ rhizome drug. (1P)
8. Macroscopic and microscopic characters of flower drug. (1P)
9. Macroscopic and microscopic characters of stem drug. (1P)
10. Macroscopic and microscopic characters of Fruit drug. (1P)
11. Ayurvedic formulations: Asava and arishta. (1P)
12. Study on some antioxidant-rich plants and their traditional uses. (1P)
13. Essential oil extraction from Clove bud. (1P)
14. Study of fibers, resins and gums. (1P)
15. Visit to medicinal plant garden. (1P)

Choice Based Credit System Syllabus (2023 Pattern) Mapping of Program Outcomes with Course Outcomes

Class : T.Y. B.Sc. (Sem. VI)

Subject : Botany

Course: MN Practical

Course Code : BOT-362-MN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation.

	Programme Outcomes (POs)												
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	3		3	3								
CO 2	3	3		3	3								
CO 3	3	3		3	3								
CO 4		3		3								3	
CO 5	2						1	3			3		
CO 6	3	3		3					3				
CO 7	3	3		3									3

Justification of Mapping:

PO1: Comprehensive Knowledge and Understanding:

CO1. Perform qualitative phytochemical tests to detect and analyze secondary metabolites such as alkaloids, glycosides, and tannins in medicinal plants.

CO2. Identify and differentiate various crude drugs (leaf, root, stem, flower, and fruit) based on their macroscopic and microscopic characteristics.

CO3. Demonstrate understanding of internal plant structures through microscopic examination for the authentication of herbal drugs.

CO5. Investigate and document medicinal plants rich in antioxidants and correlate their traditional uses with current pharmacological relevance.

CO6. Extract essential oils from plant materials and interpret their therapeutic significance and uses.

CO7. Classify and describe the pharmaceutical applications of natural products like fibers, gums, and resins used in traditional and modern formulations.

PO2: Practical, Professional, and Procedural Knowledge

- CO1. Perform qualitative phytochemical tests to detect and analyse secondary metabolites such as alkaloids, glycosides, and tannins in medicinal plants.
- CO2. Identify and differentiate various crude drugs (leaf, root, stem, flower, and fruit) based on their macroscopic and microscopic characteristics.
- CO3. Demonstrate understanding of internal plant structures through microscopic examination for the authentication of herbal drugs.
- CO6. Extract essential oils from plant materials and interpret their therapeutic significance and uses.
- CO7. Classify and describe the pharmaceutical applications of natural products like fibers, gums, and resins used in traditional and modern formulations

PO4: Specialized Skills and Competencies

- CO1. Perform qualitative phytochemical tests to detect and analyze secondary metabolites such as alkaloids, glycosides, and tannins in medicinal plants.
- CO2. Identify and differentiate various crude drugs (leaf, root, stem, flower, and fruit) based on their macroscopic and microscopic characteristics.
- CO3. Demonstrate understanding of internal plant structures through microscopic examination for the authentication of herbal drugs.
- CO6. Extract essential oils from plant materials and interpret their therapeutic significance and uses.
- CO7. Classify and describe the pharmaceutical applications of natural products like fibers, gums, and resins used in traditional and modern formulations

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

- CO1. Perform qualitative phytochemical tests to detect and analyse secondary metabolites such as alkaloids, glycosides, and tannins in medicinal plants.
- CO2. Identify and differentiate various crude drugs (leaf, root, stem, flower, and fruit) based on their macroscopic and microscopic characteristics.
- CO3. Demonstrate understanding of internal plant structures through microscopic examination for the authentication of herbal drugs.

PO11: Value Inculcation and Environmental Awareness

- CO5. Investigate and document medicinal plants rich in antioxidants and correlate their traditional uses with current pharmacological relevance.

PO 12: Autonomy and Responsibility

- CO3. Demonstrate understanding of internal plant structures through microscopic examination for the authentication of herbal drugs.

Department of Botany T. Y. B.Sc. Semester- VI

Name of the Programme	:	B.Sc. Botany
Program Code	:	USBT
Class	:	T.Y.B.Sc.
Semester	:	VI
Course Type	:	On Job Training - Practical
Course Code	:	BOT-385-OJT
Course Title	:	On Job Training
No. of Credits	:	04
No. of Teaching Hours	:	60

A) Learning Objectives:

1. To bridge theory and practice in Botany.
2. To expose students to real world applications of Botanical science
3. To develop technical competencies in lab / field / industry relevant work.
4. To build soft skills: professional conduct, teamwork, communication
5. To help students understand operations in an industry / research institution / botanical garden / agricultural / forestry / biotech industry etc.
6. To enable students to undertake a meaningful project.
7. To develop entrepreneur skill in students.

B) Learning Outcomes:

By the end of the course, students will be able to:

- CO1. Apply theoretical botanical knowledge to practical, real-life lab and field situations.
- CO2. Demonstrate awareness of how botanical science is used in various sectors such as agriculture, environment, and industry.
- CO3. Operate laboratory and field instruments, follow standard protocols, and collect & analyse botanical data.
- CO4. Display professional behaviour, work effectively in teams, and communicate scientific information clearly.
- CO5. Describe and evaluate the organizational setup and workflows of botanical institutions and industries.
- CO6. Plan, execute, and report a small-scale project with scientific temperament.
- CO7. Identify and evaluate entrepreneurial opportunities in plant-based products, services, or processes.

Credit: 1 (30L)

Unit-1

Industry selection, Topic selection, Study design, Survey preparation, Field work, Analysis.

Credit: 2 (30L)

Unit-2

Report writing and Oral presentation based on Job Training (OJT) Project work.

Choice Based Credit system Syllabus (NEP 2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: T. Y. B. Sc. (Sem. VI)

Subject: Botany

Course: Community Engagement Project-Practical **Course Code: BOT-385-OJT**

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

Department of Botany T. Y. B.Sc. Semester- VI

	Programme Outcomes (POs)												
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	03	02			02			02					
CO2	02			03							02		02
CO3		03		02	02				02				
CO4						03						02	03
CO5		02										03	02
CO6					02		02	03					
CO7			02	02	03							02	

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding

CO1: Apply theoretical botanical knowledge to practical, real-life lab and field situations.

CO2: Demonstrate awareness of how botanical science is used in various sectors such as agriculture, environment, and industry.

PO2. Practical, Professional, and Procedural Knowledge

CO1: Apply theoretical botanical knowledge to practical, real-life lab and field situations.

CO3: Operate laboratory and field instruments, follow standard protocols, and collect & analyse botanical data.

CO5: Describe and evaluate the organizational setup and workflows of botanical institutions and industries.

PO3. Entrepreneurial Mind set and Knowledge

CO7: Identify and evaluate entrepreneurial opportunities in plant-based products, services, or processes.

PO4. Specialized Skills and Competencies

CO2: Demonstrate awareness of how botanical science is used in various sectors.

CO3: Operate laboratory and field instruments effectively.

CO7: Identify and evaluate entrepreneurial opportunities in the botanical domain.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1: Apply theoretical botanical knowledge to real-world situations.

CO3: Analyse field and lab data critically.

CO6: Plan and execute a small-scale scientific project.

CO7: Evaluate plant-based entrepreneurial ideas using scientific reasoning.

PO6. Communication Skills and Collaboration

CO4: Display professional behavior, work in teams, and communicate effectively.

PO7. Research-related Skills

CO6: Plan, execute, and report a small-scale project or case study with scientific rigor.

PO8. Learning How to Learn Skills

CO1: Apply theoretical knowledge independently in practical contexts.

CO6: Plan and manage independent learning through project execution.

PO9. Digital and Technological Skills

CO3: Operate lab/field instruments and use digital tools for botanical analysis.

PO11. Value Inculcation and Environmental Awareness

CO2: Demonstrate awareness of botany's applications in agriculture, ecology, and conservation.

PO12. Autonomy, Responsibility, and Accountability

CO4: Demonstrate professionalism and ethical behavior in teams.

CO5: Understand institutional responsibilities and work systems.

PO13. Community Engagement and Service

CO2: Demonstrate real-world relevance of botanical science.

CO4: Collaborate and communicate effectively in societal or field settings.

CO5: Understand how botanical institutions serve communities.

**Anekant Education Society's
Tuljaram Chaturchand College, Baramati
Standard Operating Protocols for On Job Training
UG (Year-III Semester-VI)**

1. Objective of On-Job Training (OJT)

To provide hands-on exposure to real-world working environments, improve employability, and bridge the gap between academic learning and industry expectations.

2. Industry/Organization Engagement

- Students must be placed in an industry, NGO, government organization, private enterprise, MSME, or other approved workplaces relevant to their field of study.
- The organization should be identified by the department/placement cell/student (with departmental approval).
- A formal letter (from department to organization) and consent letter (from organization to department) should be exchanged before OJT begins.

3. Faculty Guide and Departmental OJT Coordinator

- One faculty member will be assigned as a Guide for 2-3 students or per student (based on department policy).
- A departmental OJT Coordinator will oversee the implementation and record maintenance of all students.

4. Learning Hours Requirement

- A minimum of 30 hours per credit (i.e., 60 hours total) must be completed for the award of 2 credits.

5. Project Topic/Area Selection

Students should identify a training domain/topic aligned with their academic course and job aspirations.

The **Training Plan** must include:

- Objective of training
- Expected outcomes
- Activities to be undertaken
- Organization details

6. Training Diary / Logbook Maintenance

- Students must maintain a Daily Training Diary **or** Logbook detailing:
 - Date-wise tasks performed
 - Skills learned
 - Observations
 - Reflections on practical exposure
- The diary should be signed weekly by the industry supervisor and submitted to the guide for review.

7. Evaluation Parameters & Hours Allocation

Step of Project	Individual students work in hours	Marks
Topic Selection/ Study Design	05	05
Hands-on Training	30	20
Weekly Logbook/Daily Diary	05	05
Final Report Writing	10	10
Oral Presentation		10
Total	60	50

8. OJT Report Format

- Typed and spiral-bound report with the following structure (minimum 25 pages):
- Title Page
- Certificate (by Organization & College)
- Acknowledgment
- Index
- Chapter 1: Introduction of Organization
- Chapter 2: Nature of Work Assigned
- Chapter 3: Skills and Knowledge Acquired
- Chapter 4: Observations and Learning
- Chapter 5: Challenges and Solutions
- Chapter 6: Conclusion and Recommendations
- References
- Appendices (if any – photos, documents, certificates)

9. Submission Guidelines

- Submit the final OJT Report (2 copies) with signatures of the Guide and Industry Mentor to the Departmental OJT Coordinator.

10. Oral Presentation / Viva Voce

- All students must make a presentation of their training experience.
- Evaluation to be conducted by two examiners (internal/external) appointed by the HoD.

11. Passing Criteria

- This is a compulsory subject under the NEP curriculum.
- Students must successfully complete the OJT and pass all components to be eligible for their degree.

12. Important Notes

- Students are responsible for their own safety, conduct, and punctuality during the training.
- Attendance and behavior at the workplace will be monitored by both the industry and academic supervisors.
- Insurance coverage (if required) to be clarified in advance.