Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Four B. Sc. Degree Program in Botany

Faculty of Science and Technology`

CBCS Syllabus

T. Y. B. Sc. Botany

Semester -VI

Program Outcomes (Pos) for B. Sc. Program

PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioural skills needed for successful social adaptation , work in groups, exhibit thoughts and ideas effectively in writing and orally
PO4	**Research-related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem
PO6	**Personal and professional competence:** Performing dependently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Anekant Education of Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

SYLLABUS (CBCS) FOR T. Y. B. Sc. BOTANY

(w.e. from June, 2024)

Semester	Paper	Title of Paper	Credits
V	USBT351	Cryptogamic Botany (Algae, Fungi, Bryophytes and Pteridophytes)	03
	USBT352	Spermatophyta and Palaeobotany	03
	USBT353	Cell and Molecular Biology	03
	USBT354	Industrial Botany	03
	USBT355	Biostatistics	03
	USBT356	Research Methodology	03
	USBT357	Practical based on USBT351 and USBT353	02
	USBT358	Practical based on USBT352	02
	USBT359	Practical based on USBT354 to USBT356	02
VI	USBT361	Plant Physiology and Biochemistry	03
	USBT362	Plant Biotechnology	03
	USBT363	Genetics and Plant Breeding	03
	USBT364	Plant Pathology	03
	USBT365	Pharmacognosy	03
	USBT366	Botanical Techniques	03
	USBT367	Practical based on USBT361 to USBT363	02
	USBT368	Practical based on USBT 364 to USBT366	02
	USBT369	Project	02

Class	**:**	**T. Y. B. Sc. (Semester - VI)**
Paper Code	**:**	**USBT361**
Paper	**:**	**I**
Title of Paper	**:**	**Plant Physiology and Biochemistry**
Credit	**:**	**3**
No. of lectures	**:**	**48**

A) Course Objectives:

1. To understand translocation of molecules.
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 **(16L)**

Unit – I

1. **Photosynthesis:** Ultrastructure of a chloroplast, photosynthetic pigments and their role, Photosystems, Light reaction, electron transport chain, Cyclic and Non- cyclic photophosphorylation, Path of carbon in photosynthesis – C_3 (Calvin cycle), C4 (HSK pathway), CAM pathway, Photo-respiration, Significance of photosynthesis. 10L
2. **Respiration:** Ultrastructure of a mitochondrion, Respiratory substrates, Types of respiration, Mechanism of aerobic respiration – Glycolysis, TCA cycle. Electron transport system, Chemi-osmotic hypothesis of ATP synthesis, Balance sheet of ATP generation in respiration. Cyanide resistant pathway, Significance of respiration. 6L

Credit – II **(16L)**

Unit II

1. **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
2. **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. 5L

3. **Secondary Metabolites:** Definition, Types, Metabolic pool, biosynthesis of terpens, phenols and nitrogen containing compounds, Role of secondary metabolites in plant. 6L

Credit – III **(16L)**

Unit – III

1. **Carbohydrates:** Definition, classification, Properties and functions of carbohydrates. Synthesis and breakdown of starch. 3L
2. **Amino acids:** Definition, classification, properties, functions of amino acids**. (2L)**
3. **Proteins:** Definition, Classification of proteins on the basis of structure, properties, functions of proteins. 2L
4. **Lipids:** Definition, classification, properties and functions of lipids. Synthesis and breakdown of lipid in plants. 3L
5. **Enzymology:** Definition and nature of enzymes, active site, Classification (IUB) and properties of enzymes, Co-enzymes, Isoenzyme, Allosteric enzyme, Ribozyme. Mechanism of enzyme action- Lock and key hypothesis, Induced fit theory. Factors affecting enzyme activity – pH, temperature, substrate concentration, enzyme concentration. Enzyme Activator and 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. William G. Hopkins (1995) Introduction to Plant Physiology, Published by – John Wiley and Sons, Inc.
5. Lincoln Taiz and Eduardo Zeiger (2003). Plant Physiology (3rd edition), Published by – Panima Publishing Corporation
6. R. G. S. Bidwell (revised edn.)-Plant Physiology
7. Verma S.K. and Verma Mohit (2007). A.T.B of Plant Physiology, Biochemistry
8. and Biotechnology, S.Chand Publications.
9. Leninger A.C (1987). Principles of Biochmistry, CBS Publishers and Distributers (Indian Reprint)
10. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant Metabolism (Second Edition) Longman, Essex, England.
11. Galstone A.W. 1989. Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA.
12. Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York, USA.
13. 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
14. Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.
15. Verma S.K. and Mohit Verma 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S. Chand Publications.

Mapping of Program Outcomes with Course Outcomes

Class: T.Y. B. Sc. (Sem. VI) **Subject**: Botany

Course: **Plant Physiology and Biochemistry** **Course Code**: USBT 361

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

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

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.

Class	**:**	**T. Y. B. Sc. (Semester- VI)**
Paper Code	**:**	**USBT 362**
Paper	**:**	**II**
Title of Paper	**:**	**Plant Biotechnology**
Credit	**:**	**3**
No. of lectures	**:**	**48**

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:

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.

UNIT- I **(16L)**

1. Introduction to Biotechnology **(2L)**

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

2. Plant Tissue Culture **(14L)**

Definition of cell and tissue, structure of cell, Importance of plant tissue culture, Types of culture, basic technique of plant tissue culture, Concept, techniques and applications of callus culture, cell suspension culture, protoplast culture, somatic hybridization and cybrids, Haploid production, embryo culture-and embryo rescue.

UNIT - II **(16 L)**

3. Germplasm and Cryopreservation **(4L)**

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

4. Methods of gene transfer in plants **(6L)**

Restriction Endonucleases, 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.

5. 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 solubilising.

UNIT – III (16L)

6. 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.

7. Bioinformatics (4L)

Introduction, Database and its classification**,** NCBI, EMBA, Data retrieval tools, INTREZ, OMIN, BLAST, FASTA, Applications of Bioinformatics.

8. Genomics and Proteomics (4L)

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

9. Molecular techniques (4L)

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 Biology, Biochemistryand
8. Genetics Agrobios, Jodhpur, India.
9. Glick B.R. and Tompson J.E.(1993). Methods in Plant Molecular Biology and
10. Biotechnology CRC Press Boca Raton, Florida.
11. Hall R.D. (Ed.) 1999. Plant cell culture Protocol human press Inc., New Jersey, USA
12. Kumar H.D. (2002) A Text Book of Biotechnology 2nd Edn. Affiliated Easyt-West Press Private Ltd New Delhi.
13. Ramawat K.G. (2003).Plant Biotechnology, S. Chand & Co. Ltd .Ramnagar New Delhi.
14. Trivedi P.C.(2000). Plant Biotechnology, Panima Publishing Carpation, NewDelhi.
15. Razdan M K (2019). Introduction to Plant tissue culture.

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Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: T.Y.B. Sc. (Sem. VI) **Subject**: Botany

Course: Plant Biotechnology **Course Code**: USBT362

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

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1						3			
CO 2									3
CO 3	3								
CO 4	3								
CO 5	3								
CO 6					2				
CO 7		3							

Justification for the mapping

PO1: Disciplinary Knowledge

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.

PO2: Critical Thinking and Problem Solving

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

PO5: Trans-disciplinary Knowledge

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

PO6: Personal and Professional Competence

CO1. Develop plant tissue culture industry.

PO 9: Self-directed and Life-long Learning

CO2. Get expertise to develop agro based industries.

Class : **T.Y. B. Sc.**
Semester **VI**
Course Code : **USBT 363**
Course Title : **Genetics and Plant Breeding**
No. of Credits **03**
No. of lectures **48**

A) Learning Objectives:

1. To study the principles of genetical heredity.
2. To study types of crosses in genetics.
3. To give knowledge of interaction of genes.
4. To give knowledge of cytoplasmic inheritance.
5. To give knowledge of sex linked inheritance.
6. To study different methods of plant breeding.
7. To study polyploidy in crop improvement

B) Course Outcome:

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

CO1. Learnt the principles of genetical heredity.
CO2. Learnt types of crosses in genetics.
CO3. Get knowledge of interaction of genes.
CO4. Get knowledge of cytoplasmic inheritance.
CO5. Get knowledge of sex linked inheritance.
CO6. Learnt different methods of plant breeding.
CO7. Get knowledge of polyploidy in crop improvement.

Credit: 1
Unit - 1 **(14L)**

1. **Genetics - Introduction** **(1 L)**
   Definition, Branches and Applications of Genetics
2. **Mendelism** **(3 L)**
   Mendel's contribution, Mendel's law / Law of independent assortment, Monohybrid cross, dihybrid cross, test cross, back cross.
3. **Neomendelism / Interaction of genes** **(4 L)**
   Complementary genes (9:7), Duplicate genes (15:1), Supplementary genes (9:3:4), masking genes (12:3:1)
4. **Multiple allelism** **(2 L)**
   Definition, Characters of multiple alleles, Examples – Inheritance of blood group in human, self-incompatibility in ***Nicotiana.***.
5. **Quantitative and Cytoplasmic Inheritance** **(4 L)**
   Concept of quantitative inheritance, Inheritance of quantitative trait in Maize (Cob length), Concept of cytoplasmic inheritance, Varigation in four O'clock plants.

Credit: 2
Unit - I1 **(16L)**

1. **Linkage and recombination** **(2L)**
   Linkage - Definition and types, Crossing over - Definition and types, Construction of a linkage map by two and three point test crosses.

2. **Sex linked inheritance (4 L)**
   Concept of sex chromosomes and autosomes, Inheritance of X - linked genes – Inheritance of colour blindness in humans, Inheritance of Y- linked genes - Holandric genes in humans, Sex influenced genes - baldness in humans, Sex-limited genes - feathering in domestic fowl.
3. **Euploidy and Aneuploidy (5L)**
   Euploidy- Monoploidy, morphology and uses, Polyploidy - Concept and Characteristics of polyploids, Autopolyploidy - Origin and production, effects of autopolyploidy, uses. Allopolyploidy - Concept, synthesized allopolyploidy (wheat and cotton).
   Aneuploidy - Monosomy and nullisomy, Trisomy in ***Datura*** and humans.
4. **Chromosomal Abberations (5L)**
   Types of structural changes in chromosomes, Deletion: types, Duplication: Types, Inversion: types, Translocation: types, Variation in chromosome morphology: Isochromosomes, ring chromosomes and Robertsonian translocation.

Credit: 3
Unit - I1I (18 L)
Plant Breeding

1. **Introduction, scope and importance (1 L)**
2. **Plant introduction and acclimatization (1 L)**
   Concept, objectives, Advantages and disadvantages.
3. **Selection (2 L)**
   Concept , types - mass, pure line and clonal selection, Advantages and disadvantages.
4. **Hybridization (2 L)**
   Concept, difficulties and precaution, Procedure.
5. **Heterosis and hybrid vigour (1 L)**
   Concept, Causes of heterosis- dominance hypothesis, Applications.
6. **Mutation breeding (3 L)**
   Introduction and concept, Types of Mutation, mutagens used - Chemical and physical mutagens, Gamma gardens, Applications.
7. **Importance of Polyploidy and aneuploidy in crop improvement (4 L)**
   Properties of polyploids, Methods of obtaining polyploids, Methods used in obtaining haploids, Production of triploids in plant breeding, Applications and achievements.
8. **Breeding for stress tolerance (4 L)**
   Breeding for resistance/tolerance, Characteristics evaluated for drought tolerance, Characteristics evaluated for insect/pest tolerance, Achievements.

References :

1. Principles of Genetics, J. Gardner and Simmons Snustad.
2. Genetics and Cytogenetics, Gupta P. K.
3. Principles and practices of Plant Breeding, Sharma J. R.
4. Plant Breeding - Principles and methods, Singh B. D.
5. Genetics Vol. I and II, Pawar C. B.
6. The Science of Genetics, Burus and Bottino
7. Genetics, Strikberger
8. Priniples of Plant Breeding, Allard R.W.

9. Genetics, Verma P. S. and Agarwal V. K.
10. Genetics, Singh B. D.
11. Gene VII, Lewin, B.
12. Genetics, Ahluwalia K. B.
13. Plant Breeding, Fundan singh

Mapping of Program Outcomes with Course Outcomes

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

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9
CO 1	3				3				
CO 2	3				3				
CO 3	2				2				
CO 4	2				2				
CO 5	3				3				
CO 6	2	3	3	3	2	3	3	3	3
CO 7	3	2	2	2	3	2	2	2	2

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding

CO1. Learnt the principles of genetical heredity.
CO2. Learnt types of crosses in genetics.
CO3. Get knowledge of interaction of genes.
CO4. Get knowledge of cytoplasmic inheritance.
CO5. Get knowledge of sex linked inheritance.
CO6. Learnt different methods of plant breeding.
CO7. Get knowledge of polyploidy in crop improvement.

PO2. Practical, Professional, and Procedural Knowledge

CO6. Learnt different methods of plant breeding.
CO7. Get knowledge of polyploidy in crop improvement.

PO3. Entrepreneurial Mindset and Knowledge

CO6. Learnt different methods of plant breeding.
CO7. Get knowledge of polyploidy in crop improvement.

PO4. Specialized Skills and Competencies

CO6. Learnt different methods of plant breeding.
CO7. Get knowledge of polyploidy in crop improvement.

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

CO1. Learnt the principles of genetical heredity.
CO2. Learnt types of crosses in genetics.
CO3. Get knowledge of interaction of genes.
CO4. Get knowledge of cytoplasmic inheritance.
CO5. Get knowledge of sex linked inheritance.
CO6. Learnt different methods of plant breeding.
CO7. Get knowledge of polyploidy in crop improvement.

PO6. Communication Skills and Collaboration

CO6. Learnt different methods of plant breeding.

CO7. Get knowledge of polyploidy in crop improvement.

PO7. Research-related Skills

CO6. Learnt different methods of plant breeding.

CO7. Get knowledge of polyploidy in crop improvement.

P08. Learning How to Learn Skills

CO6. Learnt different methods of plant breeding.

CO7. Get knowledge of polyploidy in crop improvement.

PO9. Digital and Technological Skills

CO6. Learnt different methods of plant breeding.

CO7. Get knowledge of polyploidy in crop improvement.

Class	**:**	**T. Y. B. Sc. (Semester - VI)**
Paper Code	**:**	**USBT 364**
Paper	**:**	**IV**
Title of Paper	**:**	**Plant Pathology**
Credit	**:**	**3**
No. of lectures	**:**	**48**

A) Learning Objectives:

1) To study the diversity among the plant diseases.
2) To understand the mechanism of diseases development.
3) To study the economic losses caused by plant diseases.
4) To study the fundamentals of plant pathology.
5) To study historical context.
6) To understand molecular diagnostics and transgenic in crop protection.
7) To study the principles of plant disease control.

B) Course Outcome:

CO1. Students can be understood the details of meteorological factors and pathogens involved in disease development. So, it will help as prerequisite for avoiding the disease spreading.

CO2. Knowledge of plant pathology will helpful to use diseases resistant varieties of crop plants and their disease management.

CO3. Students can be start their own business related to eco-friendly management of plant diseases and its consultancy.

CO4. Understanding of Key Terminology: Students will be able to define and differentiate between terms such as incitants, host, parasite, pathogen, inoculum, penetration, infection, incubation, disease, disease development, symptoms and signs.

CO5. Students will understand the history of plant pathology and the contributions of key figures, including Anton De Bary and Prof. B.B. Mundkur.

CO6. Students will be familiar with classical and modern approaches to plant Disease diagnostics, including the use of antibodies.

CO7. Students will understand general principles and various control measures

Credit - I **(19L)**

Unit – 1

1) **Fundamentals of plant pathology :** Introduction, Important terminology- Incitants, Host, Parasite, Pathogen, Inoculum, Penetration, Infection, Incubation, Disease, Disease development, Symptoms, Sign, Endophyte, Predisposition, Suscept, Resistance, Epidemic, Etiology. Economic importance of plant diseases, History of plant pathology, 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. 5L
2) **Mechanism of Disease Development:** Concept of disease cycle, Inoculation, Prepenetration, Penetration, Infection, Dissemination. Epidemics - Forms, Decline, Exponential model. Disease forecasting, Measurement of plant disease and yield loss. 6L

3) **Defence Mechanisms :** Concept and Definition, Types- Preexisting- Structural and chemical, Induced Structural and Biochemical. 3L
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 (5L)

Credit - II (16L)
Unit – 2

5) **Fungal Plant Diseases :** Introduction to fungi as plant pathogens. Study of Diseases- Club root of Cabbage, Downy Mildew of Grapes, Powdery Mildew of Teak, Stem Rust of Wheat, Red Rot of Sugar cane with reference to causal organism, symptoms and signs, disease cycle and control measures. 5L
6) **Bacterial Plant Diseases :** Introduction to bacteria as plant pathogens, Study of Diseases- Citrus Canker, Black arm of Cotton with reference to causal organism, symptoms and signs, control measures. 3L
7) **Viral Plant Diseases :** Introduction to Viruses as plant pathogens. Study of Diseases- Tobacco Mosaic Disease, Bunchy top of Banana with reference to causal organism, symptoms and signs, control measures. 3L
8) **Mycoplasma Plant Diseases** Introduction to Mycoplasma as plant pathogens, Study of Diseases- Grassy shoot disease of sugarcane, Little leaf of brinjal with reference to symptoms and signs, control measures. 3L
9) **Nematodal Plant Diseases :** Introduction to Nematodes as plant pathogens. Study of Diseases- Root knot disease of vegetables, Ear cockle of Wheat with reference to causal organism, symptoms and signs, control measures. 2L

Credit - III (13L)
Unit – 3

10) **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
11) **Principles of Plant Disease Control :** General account, Quarantine, Eradication, cultural control practices, Biological control, Curative measures, Chemical control, Use of Effective Microorganism Solution (EMS), Microbial Pesticides, IPM. 5L
12) **Molecular Diagnostics and Transgenic in Crop Protection:** Introduction, Classical approaches, Use of antibodies, Pathogen derived resistance against bacterial and fungal diseases, Expression of vaccines in plants. 4L

References:

1. Plant Pathology by R. S. Mehrotra, first edition, McGraw-Hill Education publication, 1982.
2. Plant Pathology by George N Agrios, fifth edition, Academic Press, London, 2005.
3. Plant Nematode: Morphology, Systematics, Biology and Ecology by M. R. Khan, firstedition, Science Publishers, 2008.
4. Plant Pathogenesis and Resistance by Jeng-Sheng Huang, first edition, Springer,Netherlands, 2001.

5. Plant Pathology by R. S. Mehrotra and Ashok Agarwal, second edition, Tata McGrawHill Education, 2003.
6. Bio control of Plant Diseases by P. C. Trivedi, first edition, Aavishkar Publishers and Distributors, 2007.
7. Concise Encyclopedia of Plant pathology by P. Vidhyasekaran, first edition, CRCPress, 2004.
8. Topics in Mycology and Pathology by L. N. Nair, first edition, New Central BookAgency Kolkata, 2007.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: T.Y. B. Sc. (Sem. VI) **Subject** : Botany

Course: Plant Pathology **Course Code** : USBT 364

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

	Programme Outcomes (POs)								
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3		3	3					
CO2	3		3					3	
CO3	3			2				2	
CO4	2			3				3	
CO5	2								3
CO6	3			3			3		
CO7	3			3				3	

Justification for the mapping

PO1 Disciplinary Knowledge

CO1. Students can understand the details of meteorological factors and pathogens involved in disease development, which will help as a prerequisite for avoiding disease spreading.

CO2. Knowledge of plant pathology will be helpful to use disease-resistant varieties of crop plants and manage their diseases.

CO4. Understanding of Key Terminology: Students will be able to define and differentiate between terms such as incitants, host, parasite, pathogen, inoculum, penetration, infection, incubation, disease, disease development, symptoms, and signs.

CO5. Students will understand the history of plant pathology and the contributions of key figures, including Anton De Bary and Prof. B.B. Mundkur.

CO6. Students will be familiar with classical and modern approaches to plant disease diagnostics, including the use of antibodies.
CO7. Students will understand general principles and various control measures.

PO3 Social competence
CO1. Students can understand the details of meteorological factors and pathogens involved in disease development, which will help as a prerequisite for avoiding disease spreading.
CO2. Knowledge of plant pathology will be helpful to use disease-resistant varieties of crop plants and manage their diseases.
CO3. Students can start their own business related to eco-friendly management of plant diseases and consultancy.
CO4. Understanding of Key Terminology: Students will be able to define and differentiate between terms such as incitants, host, parasite, pathogen, inoculum, penetration, infection, incubation, disease, disease development, symptoms, and signs.

PO4 Research-related skills and Scientific temper
CO1. Students can understand the details of meteorological factors and pathogens involved in disease development, which will help as a prerequisite for avoiding disease spreading.
CO3. Students can start their own business related to eco-friendly management of plant diseases and consultancy.
CO6. Students will be familiar with classical and modern approaches to plant disease diagnostics, including the use of antibodies.
CO7. Students will understand general principles and various control measures.

PO7 Effective Citizenship and Ethics
CO6. Students will be familiar with classical and modern approaches to plant disease diagnostics, including the use of antibodies.

PO8 Environment and Sustainability
CO2. Knowledge of plant pathology will be helpful to use disease-resistant varieties of crop plants and manage their diseases.
CO3. Students can start their own business related to eco-friendly management of plant diseases and consultancy.
CO7. Students will understand general principles and various control measures.
CO4. Understanding of Key Terminology: Students will be able to define and differentiate between terms such as incitants, host, parasite, pathogen, inoculum, penetration, infection, incubation, disease, disease development, symptoms, and signs.

PO9 Self-directed and Life-long learning

CO5. Students will understand the history of plant pathology and the contributions of key figures, including Anton De Bary and Prof. B.B. Mundkur.

Class	**:**	**T. Y. B. Sc. (Semester - VI)**
Paper Code	**:**	**USBT 365**
Paper	**:**	**V**
Title of Paper	**:**	**Pharmacognosy**
Credit	**:**	**3**
No. of lectures	**:**	**48**

A) Course 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 pharmacgnosy.
7. To understand Ethno botanical and Cultural Significance of Medicinal Plants

B) Course Outcomes:

By the end of course student will be able to:

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 pharmacgnosy.
CO7. Understand Ethno botanical and Cultural Significance of Medicinal Plants

Unit-I **(16L)**

1. Introduction to Pharmacognosy 06L

1.1 History, definition and Scope of Pharmacognosy.
1.2 Traditional and alternative systems of medicine.
1.3 Classification of crude drugs: Morphological Taxonomical, and Chemical.
1.4 Plant antioxidants: Properties of Antioxidants, Vitamins (C and E).

2. Ayurvedic Pharmacy 10L

2.1 Introduction to Ayurveda-History and Description.
2.2 Tridosha concept, Humoral, Indigenous systems of medicine. (Ayurveda, Siddha, Unani)
2.3 Ayurvedic principles- Ras, Guna, Vipaka, Virya, Prabhava.
2.4 Ayurvedic formulations: Asava, Arishta, Churna, Vatika, Taila, Bhasma.
2.5 Nutraceuticals &Cosmaceuticals: concept and description.

Unit-II **(16L)**

3. Analytical Pharmacognosy 8L

3.1 Drug adulteration: Definition and concept and its types.

3.2 Adulteration of drugs of natural origin: Evaluation by morphological, Microscopic, Chemical, Physical methods.

3.3 Health hazards of adulterants, Prevention of Food Adulteration Act, 1954.

4. Cultivation, collection and processing of Crude drugs 8L

4.1 Crude drugs Definition, Importance of herbal drug.

4.2 Cultivation and methods of propagation, factors affecting of cultivation.

4.3 Collection and Processing harvesting, collection, drying, packing, storage of crude drugs and marketing of Mentha and Eucalyptus.

Unit-III (16L)

5. Study of drugs w.r.t. occurrence, distribution cultivation, macroscopic and microscopic characters, constituents, uses and adulterants (any two) of the following.…… 12L

Root Rhizome drugs: *Liquorice*, Ginger

Stem drugs: *Ephedra*, *Tinospora*

Bark drugs: *Cinnamon*, *Cinchona*

Leaf drugs: *Aloe*, *Adhatoda*

Flower drugs: *Clove, Hibiscus*

Fruit drugs: - Amla, Coriander

Unorganized drugs: Shilajit and *Acacia* gum

6. Ethno botany 4L

Ethnobotany:

Introduction, Definition, concepts ,Branches of ethno botany.

Sacred grooves: Concept, Importance, Present status of sacred grooves in India.

Ethnic Societies of India and world & their contribution.

Ethno botany of *Aegle marmelos*, *Butea monosperma*, Neem (*Azadirachta indica*) w.r.t. Taxonomic description, distribution, phytochemistry and uses, Social &religious practices.

References:

1) A Pharmacognosy and Pharmacobiotechnology. New Age international (P) Limited,
2) AshalotaRazario*etal*. A Hand Book of Ethno biology KalyaniPublishesr 1999.
3) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –Chichester
4) Kokate C.K. Practical Pharmacognosy, Vallabhprakashan, New Delhi,
5) Kokate C.K. Purohit A.P. and Gokhale S.B. Pharmacognosy, Nirali Prakashan Pune Publishers (formerly wiley Easterm Limited).
6) Rajiv K. Sinha – Ethno botany The Renaissance of Traditional Herbal Medicine – INA
7) Rama Ro, N and A.N. Henry (1996). The Ethno botany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah.
8) S.K. Jain (ed.) 1989. Methods and approaches in ethno botany. Society of ethno botanists, Lucknow, India

9) S.K. Jain (ed.) Glimpses of Indian. Ethno botany, Oxford and I B H, New Delhi – 1981
10) S.K. Jain, 1990. Contributions of Indian ethno botany. Scientific publishers, Jodhpur
11) S.K. Jain, Manual of Ethno botany, Scientific Publishers, Jodhpur, 1995. SHREE Publishers, Jaipur-1996.
12) Trease G.E. and Evans. W.C. Pharmacognosy ELBS Twelfth Edition
13) Vaidya S.S. and Dole.V.A. Bhaishyajakalpana, Anmol Prakashan, Pune
14) Wallis,T.E. Test books of pharmacognosy CBS publishers and distributors New Delhi .

Mapping of Program Outcomes with Course Outcomes

Class: T.Y. B. Sc. (Sem. VI) **Subject** : Botany

Course: Pharmaconosy **Course Code** : USBT 364

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

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3	3	3	2				3		3
CO 4						3			
CO 5				3					
CO 6	2								
CO 7	2								

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Knowledge of traditional and alternative systems of medicines.
CO2. Understand Ayurveda and its importance
CO3. Knowledge of drug adulteration and its evaluation methods.
CO6. Get knowledge of analytical pharmacgnosy.
CO7. Understand Ethno botanical and Cultural Significance of Medicinal Plants.

PO2: Critical Thinking and Problem Solving

CO3. Knowledge of drug adulteration and its evaluation methods.

PO 3: Social competence

CO3. Knowledge of drug adulteration and its evaluation methods.

PO 4: Research-related skills and Scientific temper

CO5. Vision of scientific approach towards Ayurveda.

PO6: Personal and Professional Competence

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

PO 7: Effective Citizenship and Ethics

CO3. Knowledge of drug adulteration and its evaluation methods.

PO 9: Self-directed and Life-long Learning

CO3. Knowledge of drug adulteration and its evaluation methods

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **USBT 366**
Paper **VI**
Title of Paper : **Botanical Techniques**
Credit : **3**
No. of lectures **48**

Course 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.

Course Outcome:

CO1. Principal and types of microscopes, microtomes and various types of stains, solutions

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 (16 L)

Unit – 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 (6 L)
2. Micrometry: Principle and measurement of microscopic objects, Microscopic measurements of cell size, calibration of ocular and stage micrometer. (2 L)
3. Aerobiology: Principal, methods of data collection, types of sampler (2 L)
4. Stains and staining- Principles of staining, preparation of stains and fixatives, simple staining, negative staining, differential staining, A brief account of histochemical staining technique (4 L)
5. Preservation techniques in lower and higher plants, acetolysis (4L)

Credit - II (18 L)
Unit – II

1. Microtomy: Principle, Types- rotary, sledge, Techniques of microtomy, Applications (4L)
2. Chromatography: Principle; Types - Paper chromatography, Column chromatography, TLC, Applications (4L)
3. Spectroscopy: Principle, types, general outlines of working of UV- Vis spectroscopy, Applications (4L)
4. Centrifugation: Principle, types of rotors, types of centrifuges and types of centrifugations, Applications, Radiation, Leaf fluroscence, Flame photometer. (4L)

Credit - III **(14L)**
Unit – III

1. Buffers and Solutions: types of buffers, preparations of Buffers, functions of buffers in biological systems, Preparation of Percentage, Molar, Molal and Normal solutions. (06 L)
2. Soil Analysis: Soil sampling, importance, soil structure, soil profile, methods of analysis for Physical, Chemical and Biological properties, Water Analysis: Sampling, methods of analysis for Physico-chemical and Biological properties. (08 L)

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 BiologyPrinciples 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. Essinngton (2003) Soil and water Chemistry: An integrative Approach, CRC press

Mapping of Program out comes with Course Outcomes

Class: T.Y. B. Sc. (Sem. VI) **Subject**: Botany
Course: Plant Ecology **Course Code**: USBT 366

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

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9
CO1	3			3	2				2
CO2		3					3		2
CO3	3		2					3	
CO4					2	3			
CO5		3		3		2	3	2	
CO6	3		2	3					
CO7		3	2						

Justification for the mapping

PO.1 Comprehensive Knowledge and Understanding:

CO1. Principal and types of microscopes, microtomes and various types of stains, solutions

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, microtomes and various types of stains, solutions

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, microtomes and various types of stains, solutions

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.DigitalandTechnologicalSkills:

CO1. Principal and types of microscopes, microtomes and various types of stains, solutions

CO2. Various advanced methods for estimation of plant based molecules

Class	**:**	**T. Y. B. Sc. Practical-I (Sem. – VI)**
Paper Code	**:**	**USBT 367**
Paper	**:**	**Practical-I**
Title of Paper	**:**	**Practical based on USBT 361 to USBT 363**
Credit	**:**	**3**
No. of Practicals	**:**	**12**

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 USBT 361- Plant Physiology and Biochemistry (04 Prac.)

1. Estimation of chlorophyll-a and chlorophyll-b by spectrometric 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.* method.

Practical based on USBT 362- Plant Biotechnology (04 Prac.)

1. Preparation of MS Medium or BGA culture Medium
2. Callus Induction / Maize embryo culture / Isolation of Protoplast.
3. Estimation of Nitrate Reductase enzyme from Legume nodules.
4. Study of methods of gene transfer through photographs.

Visit: Visit to Biotechnology institute and Report preparation

Practical based on USBT 363- Genetics and Plant Breeding (04 Prac.)

1. Induction of tetraploidy in onion root cells and preparation of squash for observation of tetraploid cells.
2. Genetic problems on gene mapping using three point test cross data.
3. Demonstration of Hybridization Techniques.
4. Effect of chemical mutagens on seed germination and seedling growth.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: T.Y. B. Sc. (Sem. VI) **Subject** : Botany

Course: Practical-I Title of Paper: Practical based on USBT 361 to USBT 363 **Course Code:** USBT 367

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

	Programme Outcomes (POs)								
CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3		3	3	3			3
CO2	3	3	3			3			3
CO3	3	3		3				3	
CO4	3			3	2				2
CO5	3			3	3				
CO6	3	3		2		2			
CO7	2	2		3				3	3

Justification for the mapping

PO1 Disciplinary 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 the effect of chemical mutagens on seed germination and seedling growth.

PO2 Critical Thinking and Problem solving
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.
CO7: Understand the effect of chemical mutagens on seed germination and seedling growth.

PO3 Social competence
CO2: Get employment in agro-industries.

PO4 Research-related skills and Scientific temper
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 the effect of chemical mutagens on seed germination and seedling growth.

PO5 Trans-disciplinary knowledge
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.

PO6 Personal and professional competence
CO1: Expertise in tissue culture techniques.
CO2: Get employment in agro-industries.
CO6: Explore basic skills in hybridization techniques.

PO8 Environment and Sustainability
CO3: Expertise in plant pathogenicity will help to identify and eradicate pathogens, which will help to enhance plant production.
CO7: Understand the effect of chemical mutagens on seed germination and seedling growth.

PO9 Self-directed and Life-long learning
CO1: Expertise in tissue culture techniques.
CO2: Get employment in agro-industries.
CO4: Use the knowledge of separation of photosynthetic pigments by TLC/Paper chromatography.
CO7: Understand the effect of chemical mutagens on seed germination and seedling growth.

Class	**: T.Y. B. Sc.**
Semester	**VI**
Course Code	**: USBT 368**
Course Title	**: Practical - II**
No. of Credits	**02**
No. of Practicals	**12**

A) Learning Objectives:

1. To study the preparation of culture media for plant pathogens.
2. To study culture techniques for preparation of pure culture.
3. To study different plant diseases.
4. To learn technique of section cutting and staining.
5. To study macroscopic and microscopic characters of medicinal plants.
6. To learn technique of micrometry.
7. To learn preparation of stains, buffer, molar and normal solutions.

B) Course Outcome:

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

CO1. Get expertise in preparation of culture media for plant pathogens.
CO2. Get expertise in culture techniques for preparation of pure culture.
CO3. Get knowledge of different plant diseases.
CO4. Get expertise in technique of section cutting and staining.
CO5. Get knowledge of macroscopic and microscopic characters of medicinal plants.
CO6. Get expertise in technique of micrometry..
CO7. Learnt preparation of stains, buffer, molar and normal solutions.

Practicals

1. Preparation of any one culture media for isolation of plant pathogens.
2. Culture technique - Streak plate methods, Pour plate methods, Spread plate and Serial dilution method for preparation of pure culture.
3. Study of any two of each fungal, bacterial and mycoplasma diseases.
4. Study of any two viral and non-parasitic diseases of plants.
5. Study of any six drug plants from theory syllabus (Macroscopic and Microscopic).
6. Qualitative analysis of Alkaloid, Glycoside and Tannin.
7. Micrometry of suitable botanical material.
8. Microtomy - Preparation and processing of suitable material, Sectioning, - Fixing, staining and mounting
9. Demonstrations - Rot rod sampler.
10. Preparation of Stains, Buffer and molar, molar and normal solutions.
11. Visit to any Agricultural Research Institute and Plant Pathology Laboratory and submission of report.
12. Survey of local flora with respects their medicinal and economic importance and submission of 10 dry specimens.

Mapping of Program Outcomes with Course Outcomes

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		3	3	3				3
CO 2		3	3	3	3		3	3	3				3
CO 3	3						2						
CO 4		2	2	2	2		2	2	2				2
CO 5	3						3						
CO 6		2	2	2	2		3	2	2				2
CO 7	2	3	3	3	3		3	3	3				3

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding

CO3. Get knowledge of different plant diseases.

CO5. Get knowledge of macroscopic and microscopic characters of medicinal plants.

CO7. Learnt preparation of stains, buffer, molar and normal solutions.

PO2. Practical, Professional, and Procedural Knowledge

CO1. Get expertise in preparation of culture media for plant pathogens.

CO2. Get expertise in culture techniques for preparation of pure culture.

CO4. Get expertise in technique of section cutting and staining.

CO6. Get expertise in technique of micrometry..

CO7. Learnt preparation of stains, buffer, molar and normal solutions.

PO3. Entrepreneurial Mindset and Knowledge

CO1. Get expertise in preparation of culture media for plant pathogens.

CO2. Get expertise in culture techniques for preparation of pure culture.

CO4. Get expertise in technique of section cutting and staining.

CO6. Get expertise in technique of micrometry..

CO7. Learnt preparation of stains, buffer, molar and normal solutions.

PO4. Specialized Skills and Competencies

CO1. Get expertise in preparation of culture media for plant pathogens.

CO2. Get expertise in culture techniques for preparation of pure culture.

CO4. Get expertise in technique of section cutting and staining.

CO6. Get expertise in technique of micrometry..

CO7. Learnt preparation of stains, buffer, molar and normal solutions.

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

CO1. Get expertise in preparation of culture media for plant pathogens.

CO2. Get expertise in culture techniques for preparation of pure culture.

CO4. Get expertise in technique of section cutting and staining.

CO6. Get expertise in technique of micrometry..

CO7. Learnt preparation of stains, buffer, molar and normal solutions.

PO7. Research-related Skills

CO1. Get expertise in preparation of culture media for plant pathogens.
CO2. Get expertise in culture techniques for preparation of pure culture.
CO3. Get knowledge of different plant diseases.
CO4. Get expertise in technique of section cutting and staining.
CO5. Get knowledge of macroscopic and microscopic characters of medicinal plants.
CO6. Get expertise in technique of micrometry..
CO7. Learnt preparation of stains, buffer, molar and normal solutions.

P08. Learning How to Learn Skills

CO1. Get expertise in preparation of culture media for plant pathogens.
CO2. Get expertise in culture techniques for preparation of pure culture.
CO4. Get expertise in technique of section cutting and staining.
CO6. Get expertise in technique of micrometry..
CO7. Learnt preparation of stains, buffer, molar and normal solutions.

PO9. Digital and Technological Skills

CO1. Get expertise in preparation of culture media for plant pathogens.
CO2. Get expertise in culture techniques for preparation of pure culture.
CO4. Get expertise in technique of section cutting and staining.
CO6. Get expertise in technique of micrometry..
CO7. Learnt preparation of stains, buffer, molar and normal solutions.

PO13. Community Engagement and Service

CO1. Get expertise in preparation of culture media for plant pathogens.
CO2. Get expertise in culture techniques for preparation of pure culture.
CO4. Get expertise in technique of section cutting and staining.
CO6. Get expertise in technique of micrometry..
CO7. Learnt preparation of stains, buffer, molar and normal solutions.

Class	**:**	**T. Y. B. Sc. Practical-I (Sem. – VI)**
Paper Code	**:**	**USBT 369**
Paper	**:**	**Practical-III**
Title of Paper	:	**Research Project**
Credit	**:**	**4**
No. of Practicals	**:**	**12**

A) Course Objectives:

1. To give idea about identification of research problem.
2. To create temperament for use of different methodology for their research work.
3. To make them able to use obtained results for writing results of research problem
4. To think and interpret conclusions of results.
5. To search different references for comparison of their research work with previous data.
6. To make them train for use of computer techniques for dissertation writing.
7. To publish research work in different journals

B) Course Outcome:

At the end of this course students will able to

1. Gather different sources for research problem.
2. Write and apply different techniques for methodology for research problem.
3. Apply the knowledge of interpretation of results using different sources.
4. Conclude their results in dissertation.
5. Search different references for bibliography section and compile them as per scientific temperament.
6. Use of computer knowledge for compilation of different topics in their dissertation.
7. Publish their research work in the form of research paper in journals

Research Project **(60L)**

Projects will be allotted for fifth and sixth semester and students will submit project work at sixth semester practical examination.

Practicals - Research Project

1 Introduction and review of literature

2 Material and methods and results and discussion

3 Conclusions and references

4 Compilation of data, typing, binding and submission of dissertation

5 Writing of research paper

6 Power point presentation based on project work

Mapping of Program Outcomes with Course Outcomes

Class: T. Y. B. Sc. **Subject**: Botany

Course: Research Projects **Course Code**: **USBT 369**

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

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

Justification for the mapping

PO 1: Disciplinary Knowledge

CO1. Gather different sources for research problem.

CO2. Write and apply different techniques for methodology for research problem.

CO3. Apply the knowledge of interpretation of results using different sources.

CO4. Conclude their results in dissertation.

CO5. Search different references for bibliography section and compile them as per scientific temperament.

CO6. Use of computer knowledge for compilation of different topics in their dissertation.

CO7. Publish their research work in the form of research paper in journals

PO 2 : Critical Thinking and Problem solving

CO2. Write and apply different techniques for methodology for research problem.

CO3. Apply the knowledge of interpretation of results using different sources.

CO4. Conclude their results in dissertation.

PO 3 : Research-related skills and Scientific temper.

CO1. Gather different sources for research problem.

CO2. Write and apply different techniques for methodology for research problem.

CO3. Apply the knowledge of interpretation of results using different sources.

CO4. Conclude their results in dissertation.

CO5. Search different references for bibliography section and compile them as per scientific temperament.

CO6. Use of computer knowledge for compilation of different topics in their dissertation.

CO7. Publish their research work in the form of research paper in journals

PO 6 : Self-directed and Life-long learning

CO1. Gather different sources for research problem.

CO7. Publish their research work in the form of research paper in journals

PO 7 Critical Thinking and Problem solving:

CO4. Conclude their results in dissertation.

CO7. Publish their research work in the form of research paper in journal