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, 2020)

Semester	Paper	Title of Paper	Credits
V	BOT3501	Cryptogamic Botany (Algae, Fungi, Bryophytes and Pteridophytes)	03
	BOT3502	Spermatophyta and Palaeobotany	03
	BOT3503	Cell and Molecular Biology	03
	BOT3504	Industrial Botany	03
	BOT3505	Biostatistics	03
	BOT3506	Research Methodology	03
	BOT3507	Practical based on BOT3501 and BOT3503	02
	BOT3508	Practical based on BOT3502	02
	BOT3509	Practical based on BOT3504 to BOT3506	02
VI	BOT3601	Plant Physiology and Biochemistry	03
	BOT3602	Plant Biotechnology	03
	BOT3603	Genetics and Plant Breeding	03
	BOT3604	Plant Pathology	03
	BOT3605	Pharmacognosy	03
	BOT3606	Botanical Techniques	03
	BOT3607	Practical based on BOT3601 to BOT3603	02
	BOT3608	Practical based on BOT3604 to BOT3606	02
	BOT3609	Project	02

Class : **T. Y. B. Sc (Semester –VI)**
Paper Code : **BOT 3601**
Paper: **I** Title of paper: **Plant Physiology and Biochemistry**
Credit : 3 No. of Lectures: 48

A) Learning Objectives

1. To give knowledge of physiological processes in plants.
2. To know structure and role of biomolecules.
3. To know role of different biochemical's in plant growth and development.

B) Course Outcome:

CO1. Use knowledge for improvement of agricultural yield
CO2. Students aware about the plant to response environmental conditions.
CO3. Students get knowledge of internal activities in plant.
CO4. Development of expertise in plant physiology.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge 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, photoinhibition, 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.

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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Plant Physiology and Biochemistry **Course Code**: BOT 3601

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Use knowledge for improvement of agricultural yield.
CO3. Students get knowledge of internal activities in plant.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge of biomolecules.

PO2: Critical Thinking and Problem Solving

CO2. Students aware about the plant to response environmental conditions.

PO 3: Social competence

CO1. Use knowledge for improvement of agricultural yield.

PO 4: Research-related skills and Scientific temper

CO3. Students get knowledge of internal activities in plant.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge of biomolecules.

Class	:	**T. Y. B. Sc. (Semester- VI)**		
Paper Code	:	**BOT 3602**		
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.

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.

Credit - I (16L)

1. Introduction to Biotechnology **2L**

Introduction and History of plant Biotechnology, pioneering work and significant achievements in Indian plant 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, Micro-propagation,embryo culture-and embryo rescue

Credit - 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, Types, Direct gene transfer methods- Electroporation, Biolystic 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, Factors affecting and mechanism of symbiotic N2 Fixation Genetics of Diazotrophs- Nod genes, Nif gene Biofertilizers- algal, fungal, phosphate solubilising.

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

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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Plant Biotechnology **Course Code**: BOT 3602

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)**
Paper Code : **BOT 3603**
Paper : **III** Title of Paper : **Genetics and Plant Breeding**
Credit : 3 No. of lectures: 48

A) Learning Objectives:

1. To study the principles of genetical heredity.
2. To give knowledge of different breeding methods.
3. To acquaint the students with hybridization technique.

B) Course Outcome:

CO1. Students get knowledge of genetical heredity.
CO2. Students become expertise in Plant Breeding Techniques.
CO3. Get knowledge for improving the new crop variety.
CO4. Get knowledge about gene expression and regulation of gene.
CO5. Demonstrate emasculation and pollination methods.
CO6. Explain floral biology for breeding techniques.
CO7. Demonstrate mutation in plant cells.

Credit - I (14 L)
Unit – 1

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), Lethal genes (2:1)
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, petite mutants in yeast.

Credit - II (16 L)
Unit – I1

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 - eye colour in ***Drosophila,*** 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 and bar eye phenotype in ***Drosophila***, Inversion: types, Translocation: types, Variation in chromosome morphology: Isochromosomes, ring chromosomes and Robertsonian translocation.

Credit - III (18 L)

Unit – I1I

PLANT BREEDING

1. Introduction, scope and importance (1 L)

2. Plant introduction and acclimatization (1 L)

Concept, objectives, Advantage, disadvantage and achievement.

3. Selection (2 L)

Concept , types - mass, pure line and clonal selection, Advantage and disadvantages.

4. Hybridization (2 L)

Concept, difficulties and precaution, Procedure, Achievements

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, methods of working, 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)

Mechanisms and genetic bases of resistance/tolerance to biotic and abiotic stresses in plants, 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

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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Genetics and Plant Breeding **Course Code**: BOT 3603

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		2	3						

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Students get knowledge of genetical heredity.
CO3. Get knowledge for improving the new crop variety.
CO4. Get knowledge about gene expression and regulation of gene.

PO2: Critical Thinking and Problem Solving

CO7. Demonstrate mutation in plant cells.

PO 3: Social competence

CO7. Demonstrate mutation in plant cells.

PO 4: Research-related skills and Scientific temper

CO2. Students become expertise in Plant Breeding Techniques.

PO6: Personal and Professional Competence

CO5. Demonstrate emasculation and pollination methods.

PO 9: Self-directed and Life-long Learning

CO6. Explain floral biology for breeding techniques.

Class	:	**T. Y. B. Sc. (Semester - VI)**
Paper Code	:	**BOT 3604**
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 recent techniques in plant disease management.

B) Course Outcome:

CO1. Students can be confident about basic idea and comparative study of cryptogams.

CO2. Students can be experts in identification of lower plants.

CO3. Students can be start their own business based on applications of cryptogams.

CO4. Get knowledge about life history of algae, fungi bryophytes.

CO5. 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.

CO6. Knowledge of plant pathology will helpful to use diseases resistant varieties of crop plants and their disease management.

CO7. Students can be start their own business related to eco-friendly management of plant diseases and its consultancy.

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) **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 (6 L).
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) **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).
8) **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).
9) **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).

Credit - III (13 L)
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. Fungi and Plant Diseases by B. B. Mundkur
2. Plant Pathology, R. S. Mehrotra
3. Principles of Plant Pathology, R. S. Singh
4. Plant Pathology, P. D. Sharma
5. Plant Disease, R. S. Singh
6. Plant Pathology, Mandal and Dasgupta
7. Plant Pathology, G. N. Agrios
8. Agricultural Microbiology, Rangaswamy and Bhagyaraj
9. Fundamentals of Plant Pathology by Ravi Chandra
10. 10.Methods of Microbial and Plant Biotechnology, L. N. Nair
11. Molecular Plant Pathology, 2003. Dickinson, Bios Scientific Publication, London, New York.

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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: T.Y.B. Sc. (Sem. VI) **Subject**: Botany
Course: Plant Pathology **Course Code**: BOT 3604

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1.Students can be confident about basic idea and comparative study of cryptogams.

CO4. Get knowledge about life history of algae, fungi bryophytes.

CO6. Knowledge of plant pathology will helpful to use diseases resistant varieties of crop plants and their disease management.

PO2: Critical Thinking and Problem Solving

CO2. Students can be experts in identification of lower plants.

CO5. 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.

PO 3: Social competence

CO6. Knowledge of plant pathology will helpful to use diseases resistant varieties of crop plants and their disease management.

PO 4: Research-related skills and Scientific temper

CO2. Students can be experts in identification of lower plants.

PO5: Trans-disciplinary Knowledge

CO1.Students can be confident about basic idea and comparative study of cryptogams.

PO6: Personal and Professional Competence

CO3. Students can be start their own business based on applications of cryptogams.

PO 7: Effective Citizenship and Ethics

CO6. Knowledge of plant pathology will helpful to use diseases resistant varieties of crop plants and their disease management.

PO 8: Environment and Sustainability

CO7. Students can be start their own business related to eco-friendly management of plant diseases and its consultancy.

PO 9: Self-directed and Life-long Learning

CO7. Students can be start their own business related to eco-friendly management of plant diseases and its consultancy.

Class: **T. Y. B. Sc. (Semester - VI)**
Paper Code: **BOT3605**
Paper: **V** Title of Paper: **Pharmacognosy**
Credit: 3 No. of lectures: 48

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.

B) Course Outcomes:

CO1. Knowledge of traditional and alternative systems of medicines.
CO2. To increase desire Ayurveda.
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 plant metabolism.
CO7. Students get knowledge of plant cycle.

Credit-I (16 L)

Unit-I

1. Introduction to Pharmacognosy (06 L)

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 (10 L)

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

Credit-II (16 L)

Unit-II

3. Analytical Pharmacognosy (8 L)

3.1 Drug adulteration:Definition and concept and its types.
3.2 Adulteration of drugs of natural origin: Evaluation by morphological, Microscopic, Chemical, Physical, Chromatographical, Spectrophotometric.
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 methodspropagations, factors affecting of cultivation.
4.3 Collection and Processing harvesting, collection, drying, garbling, packing, storage of crudedrugs and marketing of Mentha and Eucalyptus.

Credit-III (16 L)

Unit-III

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

Root Rhizome drugs: *Liquorice*, Ginger
Stem drugs: *Ephedra*, *Tinospora*
Bark drugs: *Cinnamon*, *Cinchona*
Leaf drugs: *Aloe*, *Adhatoda*
Flower drugs: *Clove*
Fruit drugs: - Amla, Coriander
Seed drugs: Fennel
Unorganized drugs: Shilajit and Acacia gum

6. Ethno botany (4L)

Ethnobotany:

Introduction, Definition, concepts and relevances.
Branches of Ethnobotany.
Sacred grooves: Concept, Importance, Present status of sacred grooves in India.
Ethnic Societies of India and world & their contribution.
Ethnobotany 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.
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4) Kokate C.K. Practical Pharmacognosy, Vallabhprakashan, New Delhi,
5) Kokate C.K. Purohit A.P. and Gokhale S.B. Pharmacognosy, NiraliPrakashan Pune Publishers (formerly wileyEasterm Limited).
6) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA
7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah.
8) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India
9) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981

10) S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur
11) S.K. Jain, Manual of Ethnobotany, 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
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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Pharmaconosy **Course Code**: BOT 3605

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. To increase desire Ayurveda.
CO3. Knowledge of drug adulteration and its evaluation methods.
CO6. Get knowledge of plant metabolism.
CO7. Students get knowledge of plant cycle.

PO2: Critical Thinking and Problem Solvin

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: **BOT 3606**
Paper: **VI** Title of Paper: **Botanical Techniques**
Credit: 3 No. of lectures: 48

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.

B) Course Outcome:

By the end of course students will be able to

CO1.Get acquainted in advance botanical techniques.
CO2. Understand different types and working of microscopes.
CO3. Students' expertise in microscopic techniques.
CO4. Expertise in different centrifugation techniques.
CO5. Train to use different electrochemical techniques.
CO6.Understand DNA sequencing techniques.
CO7. Analyze antigen –antibody interaction.

Credit - I (18 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 cryptogams : (4L)

Credit - II (16 L)
Unit – II

6. Microtomy: Principal, Types- rotary, sledge, Techniques of microtomy, Applications (4L)
7. Chromatography: Principle; Types - Paper chromatography, Column chromatography, TLC, Applications (4 L)
8. Spectroscopy: Principle, types, general outlines of working of UV- Vis spectroscopy, Applications (4 L)
9. Centrifugation: Principle, types of rotors, types of centrifuges and types of centrifugations, Applications (4 L)

Credit - III (14L)
Unit – III

10. 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)
11. 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

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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Botanical Techniques **Course Code**: BOT 3606

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1.Get acquainted in advance botanical techniques.

CO2. Understand different types and working of microscopes.
CO6.Understand DNA sequencing techniques.
CO7. Analyze antigen –antibody interaction.

PO 4: Research-related skills and Scientific temper

CO1.Get acquainted in advance botanical techniques.

PO5: Trans-disciplinary Knowledge

CO6.Understand DNA sequencing techniques.
CO7. Analyze antigen-antibody interaction.

PO6: Personal and Professional Competence

CO3. Students' expertise in microscopic techniques.
CO4. Expertise in different centrifugation techniques.

PO 9: Self-directed and Life-long Learning

CO5. Train to use different electrochemical techniques.

Class: **T. Y. B. Sc. Practical-I (Sem. – VI)**
Paper Code: **BOT 3607**
Paper: **Practical-I** Title of Paper: **Practical based on BOT3601 to BOT3603**
Credit: 2 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.

B) Course Outcome:

CO1. Students will be expert in tissue culture techniques.
CO2. Students can get employment in agro-industries.
CO3. Expertise of students in plant pathogenecity will help to identify and eradicate pathogens which will help to enhance plant production.
CO4. Students will be expert in tissue culture techniques.
CO5. Students can get employment in agro-industries.
CO6. Expertise of students in plant pathogenecity will help to identify and eradicate pathogens which will help to enhance plant production.
CO7. Train in different isolation techniques in cell organelle.

Practical based on BOT3601- 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 BOT3602- Plant Biotechnology (04 Prac.)

1. Preparation of MS Medium or BGA culture Medium
2. Callus Induction using maize embryo or 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 BOT3603- 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.

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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Practical I **Course Code**: BOT 3607

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO4. Students will be expert in tissue culture techniques.
CO5. Students can get employment in agro-industries.

PO 3: Social competence

CO2. Students can get employment in agro-industries.

PO 4: Research-related skills and Scientific temper

CO1. Students will be expert in tissue culture techniques.

PO5: Trans-disciplinary Knowledge

CO7. Train in different isolation techniques in cell organelle.

PO6: Personal and Professional Competence

CO1. Students will be expert in tissue culture techniques.

PO 9: Self-directed and Life-long Learning

CO3. Expertise of students in plant pathogenecity will help to identify and eradicate pathogens which will help to enhance plant production.

Class: **T. Y. B. Sc. Practical-II (Sem. – VI)**
Paper Code: **BOT 3608**
Paper: **Practical-II** Title of Paper: **Practical based on BOT3604 to BOT3606**
Credit: 2 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.

B) Course Outcome:

CO1. Students will be expert in tissue culture techniques.
CO2. Students can get employment in agro-industries.
CO3. Expertise of students in plant pathogenecity will help to identify and eradicate pathogens which will help to enhance plant production.
CO4. To aware the students about lower plants diversity.
CO5. To enhance the knowledge of students up to the molecular level.
CO6. To make students expert in molecular biology techniques.
CO7. Information acquired about research work.

Practical based on BOT3604- Plant Pathology (04 Prac.)

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.

Visit : Visit to any Agricultural Research Institute and Plant Pathology Laboratory and submission of report.

Practical based on BOT3605- Pharmacognosy (04 Prac.)

1. Study of any six drug plants from theory syllabus (Macroscopic and Microscopic).
2. Demonstration of Plant extraction methods- Cold and Soxhlet extraction and TLC of any one drug studied in theory.
3. Qualitative analysis of Alkaloid, Glycoside and Tannin
4. Study of stomatal index and vein islet number using suitable plant material using micrometer and camera Lucida.

Visit : Survey of local flora with respect their medicinal and economic importance and submission of 10 dry specimens.

Practical based on BOT3606- Botanical Techniques (04 Prac.)

1. Micrometry of suitable botanical material.
2. Microtomy- Preparation and processing of suitable material, Sectioning, - Fixing, staining and mounting
3. Demonstrations-Rotorod sampler
4. Preparation of Stains, Buffer and molar, molal and normal solutions

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

Course: Practical II **Course Code**: BOT 3608

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	2								
CO 6				3					
CO 7	3								

Justification for the mapping

PO1: Disciplinary Knowledge

CO4. To aware the students about lower plants diversity.
CO5. To enhance the knowledge of students up to the molecular level.
CO7. Information acquired about research work.

PO2: Critical Thinking and Problem Solving

CO3. Expertise of students in plant pathogenecity will help to identify and eradicate pathogens which will help to enhance plant production.

PO 4: Research-related skills and Scientific temper

CO6. To make students expert in molecular biology techniques.

PO6: Personal and Professional Competence

CO1. Students will be expert in tissue culture techniques.

PO 9: Self-directed and Life-long Learning

CO2. Students can get employment in agro-industries.

Class: **T. Y. B. Sc. Practical-III (Sem. – VI)**
Paper Code: **3609**
Paper: **Practical-III** Title of Paper: **Project Work**
Credit: 2 No. of Practicals: --

A) Learning Objectives:
1. To give information of research work
2. To create awareness about innovative methods.
3. To find out new conclusions through research

B) Course Outcome:
CO1. Information acquired about research work.
CO2. Getting of awareness of innovative methodology.
CO3. Significant conclusions and outputs.
CO4. Information acquired about research work.
CO5. Getting of awareness of innovative methodology.
CO6. Significant conclusions and outputs.
CO7. Information acquired about research work.

Project Work
1 Compilation of data, typing, binding and submission of dissertation
2 Writing of research paper
3 Power point presentation based on project work

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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Practical III **Course Code**: BOT 3609

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Information acquired about research work.
CO5. Getting of awareness of innovative methodology.
CO6. Significant conclusions and outputs.

PO2: Critical Thinking and Problem Solving

CO2. Getting of awareness of innovative methodology.

PO 4: Research-related skills and Scientific temper

CO3. Significant conclusions and outputs.