GOKUL GLOBAL UNIVERSITY
Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Master of Science

Botany

Faculty of Science
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Semester I

Subject Code	Subject Name	Teaching Scheme (Hours)			Credits	Theory Marks		Tutorial/ Practical Marks		Total Marks
		Theory	Tutorial	Practical		ESE	IA	CSE	Viva	
MBOT111DSC	STUDY OF LIFE FORMS - I AND PLANT PATHOLOGY	4	0	0	4	70	20	10	0	100
MBOT112DSC	PRINCIPLES OF BIOCHEMISTRY	4	0	0	4	70	20	10	0	100
MBOT113DSC	PRINCIPLES OF CELL BIOLOGY	4	0	0	4	70	20	10	0	100
MBOT114DSC	GENETICS AND EVOLUTION	4	0	0	4	70	20	10	0	100
MBOT115SE	BIODIVERSITY	2	0	0	2	35	10	5	0	50
MBOT116PRA	PRACTICAL PAPER -I	0	0	6	3	0	0	0	75	75
MBOT117PRA	PRACTICAL PAPER -II	0	0	6	3	0	0	0	75	75

Semester II

Subject Code	Subject Name	Teaching Scheme (Hours)			Credits	Theory Marks		Tutorial/ Practical Marks		Total Marks
		Theory	Tutorial	Practical		ESE	IA	CSE	Viva	
MBOT121DSC	Study of life forms II	4	0	0	4	70	20	10	0	100
MBOT122DSC	Plant Reproductive & Development Biology	4	0	0	4	70	20	10	0	100
MBOT123DSC	Instrumental method for Biological science & Biostatistics	4	0	0	4	70	20	10	0	100
MBOT124DSC	Plant Resources Utilization & Conservation	4	0	0	4	70	20	10	0	100
MBOT125SE MBOT126SE MBOT127SE	Herbal Medicine/ Pomology/ Bioinformatics	2	0	0	2	35	10	5	0	50
MBOT126PRA	PRACTICAL-I	0	0	6	3	0	0	0	75	75
MBOT127PRA	PRACTICAL-II	0	0	6	3	0	0	0	75	75

Semester III

Subject Code	Subject Name	Teaching Scheme (Hours)			Credits	Theory Marks		Tutorial/ Practical Marks		Total Marks
		Theory	Tutorial	Practical		ESE	IA	CSE	Viva	
MBOT211DSC	PLANT MOLECULAR BIOLOGY	4	0	0	4	70	20	10	0	100
MBOT212DSC	PLANT PHYSIOLOGY	4	0	0	4	70	20	10	0	100
MBOT213DSC	PLANT ECOLOGY	4	0	0	4	70	20	10	0	100
MBOT214DSC	ANGIOSPERM TAXONOMY	4	0	0	4	70	20	10	0	100
MBOT215SE	BIOFERTILIZER	2	0	0	2	35	10	5	0	50
MBOT216PRA	PRACTICAL PAPER -I	0	0	6	3	0	0	0	75	75
MBOT217PRA	PRACTICAL PAPER -II	0	0	6	3	0	0	0	75	75

Semester IV

Subject Code	Subject Name	Teaching Scheme (Hours)			Credits	Theory Marks		Tutorial/ Practical Marks		Total Marks
		Theory	Tutorial	Practical		ESE	IA	CSE	Viva	
MBOT221DSC	Plant Biotechnology	4	0	0	4	70	20	10	0	100
MBOT222DSC	Ethnobotany	4	0	0	4	70	20	10	0	100
MBOT223DSC	Plant Bio-informatics & Research Methodology	4	0	0	4	70	20	10	0	100
MBOT224DSC	Horticulture and Plant Breeding	4	0	0	4	70	20	10	0	100
MBOT225SE	The Environment Pollution & Climate Change	2	0	0	2	35	10	5	0	50
MBOT226PRA	PRACTICAL-I	0	0	6	3	0	0	0	75	75
MBOT227PRA	PRACTICAL-II	0	0	6	3	0	0	0	75	75

MBOT111DSC - Study of Life forms - I and Plant Pathology

Objective:

To discuss important results on Thallus organization, Nutrition, lifecycle and classification of fungi.To discuss important results on Host-Pathogen relationships and Disease cycle and control measures of plant diseases.Increase the awareness and appreciation of human friendly viruses, bacteria, algae and their economic importance.

Credits: 04

Unit	Description in detail	Credit	Weightage
I	**Virus and Bacteria**	1	25 %
	Virus: General Characters and Types of Virus (On the basis of Genome), Ultra structure of Virons (Symmetry: Helical and Complex). Economic Importance of Virus.		
	Bacteria: General Characters and classification of Bacteria (Based on Flagella), Nutrition and Reproduction in Bacteria, Ultra structure of Bacteria.		
	Cyanobacteria: Salient features		
	Economic Importance of Bacteria.		
II	**Phycology (Algae)**	1	25 %
	Algae: General Characters and Classification of Algae by Smith		
	Thallus organization in Algae. Reproduction in Algae		
	Salient features of Chlorophyta, Charophyta, Phaeophyta and Rhodophyta		
	Economic Importance of Algae: Algal blooms, Algal biofertilizer, Algae in Industry.		
III	**Mycology (Fungi)**	1	25 %
	General Characters and Classification of Fungi by Ainsworth.		
	Cellular Organization (Unicellular and Multicellular), Nutrition in fungi. Reproduction in Fungi, Heterothallism.		
	General account of Zygomycotina, Ascomycotina, Basidomycotina and Deutromycotina.		
	Economic Importance of Fungi: In Industry, Medicine and bio-control agent		
IV	**Plant Pathology**	1	25 %
	Plant Pathology: Classification of plant diseases (on the basis of host and origin)		
	General Symptoms of plant diseases		
	Dissemination of plant diseases (Direct and Indirect). Defense mechanism (Morphological and Bio-Chemical).		
	Plant pathogens: Symptoms, Diseases cycle, Control measures: Bacterial (Bacterial blight of paddy) and Fungal (Late blight of Potato, Tikka disease in Groundnut & Powdery mildew of Cucurbits).		

Reference Books:

1. Sharma, P. D. (2011) Microbiology. Rastogi Publication. Meerut.

2. Pelczar M. J, Chan E. C. Sand Krieg N. R. (2004) Microbiology, Tata McGraw – Hall Publishing Company Ltd. New Delhi.
3. Hait G; Bhattacharya K and Ghosh A. K. (2008) A Text Book of Botany,Vol-I, New Central Book Agency (P) Ltd. Kolkata. SinghV; Pande P. Cand Jain D. K. (2008-09) A Taxt Book of Botany, rastogi Publication, Meerut.
4. Barsanti L, Gualtieri P (2006) Algae: Anatomy, Biochemistry and Biotechnology, CRC Press, Taylor and Francis, Boca Raton.
5. Bold H C, Wynne M J (1985) Introduction to the Algae, 2nd edition, Prentice-HallInc, New Jersey.
6. Kumar H D (1999) Introductory Phycology, 2nd edition, Affiliated East-West Press Pvt. Ltd., New Delhi. Fritsch F E (1935) The Structure and Reproduction of the Algae, Vol I, Cambridge University Press, Cambridge.
7. Fritsch F E (1945) The Structure and Reproduction of the Algae, Vol II, Cambridge University Press, Cambridge.
8. Lee R E (2008) Phycology, 4th edition, Cambridge University Press, Cambridge.
9. South G R, Whittick A (1998) Introduction to Phycology, Blackwell Scientific Publication, London.
10. Webster John (1980) Introduction to fungi, Cambridge University Press, Cambridge.Alexopoulos C J, Minus C W , Blackwell M (1996) Introductory Mycology, John Wiley and Sons, Inc, NewYork.

Outcome:

After successfully completion of the course, the student will be able to…….

1. Develop understanding on the concept of microbial nutrition.
2. Classify viruses based on their characteristics and structures
3. Examine the general characteristics of bacteria and their cell reproduction.
4. Increase the awareness and appreciation of human friendly viruses, bacteria, algae, fungi and their economic importance.
5. Demonstrate skills in laboratory, field and glasshouse work related to mycology and plant pathology.

Course Outcomes: At the end of the course, students shall be able to

CO1	Develop understanding on the concept of microbial nutrition
CO2	Classify viruses based on their characteristics and structures
CO3	Examine the general characteristics of bacteria and their cell reproduction
CO4	Increase the awareness and appreciation of human friendly viruses, bacteria, algae, fungi and their economic importance
CO5	Demonstrate skills in laboratory, field and glasshouse work related to mycology and plant pathology

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**1**	**-**	**-**	**2**	**2**	**2**	**1**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**2**	**3**				
CO5	**3**	**3**	**-**	**-**	**3**	**2**	**3**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1													**2**	**2**
CO2													**2**	**1**
CO3													**3**	**2**
CO4													**3**	**1**
CO5													**3**	**1**

MBOT112DSC - Principles of Biochemistry

Objective:

To discuss important results on Behavior of Biological Compounds, Classification of carbohydrates, Structure and Function of Complex lipids, Function and Conformation of Proteins and Properties of enzymes.

Credits: 04

Unit	Description in detail	Credit	Weightage
I	**Biochemistry-I**	1	25 %
	Behavior of Biological Compounds: Solubility, Isomerism, Adsorption, Chemical bonds, Ionization of Water.		
	Carbohydrates: Classification of carbohydrates.		
	Occurrence, Structure and Function of Monosaccharides (Triose, Pentose and Hexose), Disaccharides and Polysaccharides (Starch and Cellulose).		
	Carbohydrates as informational Molecules: The Sugar Code.		
II	**Biochemistry-II**	1	25 %
	Lipids: Classification of Lipids, Occurrence.		
	Structure and Function of Simple lipids (Triglycerides and Waxes).		
	Structure and Function of Complex lipids (Phospholipids and Sphingolipids).		
	Oxidation of fatty acids, Biosynthesis of Phospholipids.		
III	**Biochemistry-III**	1	25 %
	Amino Acids: Structure, Properties, and Classification of Amino Acids.		
	Amino Acids metabolism (Biosynthesis and Degradation of Amino Acids).		
	Proteins: classification and structure of Proteins, Function and Conformation of Proteins (Ramachandran Plot).		
	Protein denaturation and stability, Importance of Proteins.		
IV	**Biochemistry-IV**	1	25 %
	Enzymes: An introduction to Enzymes, Nomenclature, Classification of Enzymes.		
	Properties of enzymes, Mechanism of enzyme action Enzyme and Enzyme kinetics.		
	Types of inhibition, Enzyme Regulation, Factors affecting the enzyme action.		
	Vitamins: Occurrence, Classification, Structure and function of various Vitamins and their deficiency diseases.		

Reference Books:

1. Lehninger A C, Biochemistry.
2. Deb A C (2008), Fundamentals of Biochemistry, New Central Book (P0 Ltd, Kolkata (9th Edition Revised).

Outcome:

After successfully completion of the course, the student will be able to…….

1. Classify the enzymes and explain mechanism of action and structure .
2. Describe the relationship between the structure and function of biomolecules.

Course Outcomes: At the end of the course, students shall be able to

CO1	Knowledge about biomolecules like protein, nucleic acids, lipids.
CO2	Describe the relationship between the structure and function of biomolecules.
CO3	Concept building about enzyme mediated catalysis, structure, function etc.
CO4	Classify the enzymes and explain mechanism of action and structure .
CO5	Carry out a range of laboratory exercises, demonstrating the development of practical scientific skills.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**1**	**-**	**-**	**2**	**2**	**2**	**2**				
CO3	**3**	**1**	**-**	**-**	**3**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**3**	**-**	**-**	**3**	**3**	**2**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1													**2**	**-**
CO2													**2**	**-**
CO3													**3**	**-**
CO4													**3**	**-**
CO5													**3**	**-**

MBOT113 - DSC Principles of Cell Biology

Objective:

To discuss important results on Cell wall, Plasma membrane, cellular organelles, cell cycle and cell division, Cell Fixation and Cell staining.

Credits: 04

Unit	Description in detail	Credit	Weightage
I	**Cell Biology-I**	1	25 %
	Cell wall: Structure and functions; Plasmodesmata: Structure; role in movement of molecules and macromolecules.		
	Plasma membrane: Structure, models, and functions; sites for ATPases, ion carriers, channels and pumps; receptors.		
	Chloroplast and Mitochondria: Ultra Structure and Functions.		
	Other cellular organelles: Structure and functions of microbodies, Golgi apparatus, Lysosomes, endoplasmic reticulum, Ribosomes.		
II	**Cell Biology-II**	1	25 %
	Cytoskeleton; organization and role of microtubules and flagella.		
	Cell cycle: Phases and regulation		
	Cell Division: Amitosis, Mitosis and Meiosis.		
	Apoptosis/ Programmed Cell Death with reference to plant cells.		
III	**Cell Biology-III**	1	25 %
	Nucleus: Structure; nuclear pores; nucleosome organization, Nucleolus.		
	Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere.		
	Euchromatin and Hetero chromatin, Karyotype analysis.		
	Specialized type of chromosomes: Structure and functions of polytene, lamp brush and Sex chromosomes.		
IV	**Cell Biology-IV**	1	25 %
	Experimental approaches for studying Cells: Cell Fixation.		
	Experimental approaches for studying Cells, Cell Staining.		
	Cytochemical methods (Flow Cytometry) and cell fractionation (Centrifugation).		
	Techniques in cell biology: Immuno techniques; in situ hybridization to locate transcripts in cell types; FISH, GISH.		

Reference Books:

1. Lewin, B. (2000). Genes VII. Oxford University Press, New York.
2. Rost, T. et al. (1998). Plant Biology. Wadsworth Publishing Co., California, USA.
3. Krishnamurthy, K. V. (2000). Methods in Cell Wall Cyto chemistry. CRC Press, Boca Raton, Florida.
4. De, D. N. (2000). Plant Cell Vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.

5. Fukui, K. and Nakayama, S. (1996). Plant Chromosomes: Laboratory Methods. CRC Press, BocaRaton, Florida.
6. Sharma, A. K. and Sharma, A. (1999). Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia.
7. Buchanan B B, Gruisemm W, Jones R L (2015). Biochemistry and Molecular Biology of Plants, 2ndedition, Wiley Blackwell, New Jersey.
8. Hopkins W G, Huner NPA (2009) Introduction to Plant Physiology, 4th edition Wiley International edition, John Wiley & Sons, New York.
9. Taiz L, Zeiger E, Moller I M, Murph A (2015) Plant Physiology and Development, 6 thedition, Sinurer Associates Inc Publishers, Sunderland, Massachusetts

Outcome:

After successfully completion of the course, the student will be able to…….

1. The student understands the concept of Compare the structure and function of cells & explain the development of cells.
2. Identify the concept that explains chemical composition and structure of cell wall and membrane.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Compare the structure and function of cells & explain the development of cells.
CO2	Identify the concept that explains chemical composition and structure of cell wall and membrane.
CO3	Visualize the structure and function of cellular components through illustration or labeling of visual graphics
CO4	Illustrate the structure and function of cellular components.
CO5	Describe how cells transport materials and communicate

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**2**	**1**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				

CO-PO & CO-PSO Mapping

Course Outcome	Program Outcomes													
	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO

s	1	2	3	4	5	6	7	8	9	0	1	2	1	2
CO1													**3**	**-**
CO2													**3**	**-**
CO3													**2**	**-**
CO4													**2**	**-**
CO5													**3**	**-**

MBOT114DSC - Genetics and Evolution

Objective:

To discuss important results on Gene structure, chromosomal inheritance, Mutation, Origin of cells and unicellular evolution.

Credits: 04

Unit	Description in detail	Credit	Weightage
I	**Genetics – I**	1	25 %
	Gene structure: Gene vs allele, fine structure of gene as cistron, recon and muton.		
	Gene structure: Gene vs allele, fine structure of gene as cistron, recon and muton.		
	Extra chromosomal inheritance(maternal inheritance): Chloroplast genome (cp-DNA); Plastid inheritance in Mirabilis jalapa. Mitrochondrial genome (mt-DNA); Mitochondrial inheritance in Zea mays (Male sterility-Types, origin, induction and application).		
	Petite in yeast and Porky in Neurospora. Comparison between Cp-DNA and Mt-DNA		
II	**Genetics – II**	1	25 %
	Mutation: Spontaneous and induced mutation, Physical and chemical mutagens; Molecular basis of gene mutations.		
	Transposable elements: IS elements, Transposons in Prokaryotes and Eukaryotes, Ac-Ds system, Retroelements(Viral and Non-viral).		
	DNA damage and repair mechanisms; inherited human diseases and defects in DNA repair.		
	Initiation of cancer at cellular level; Oncogenesis, Oncogene, proto-oncogenes and onco viruse.		
III	**Genetics - III**	1	25 %
	Mendalian (mono & Di-hybridization) and Non-mendelian genetics (9:6:1), Epistatis (9:3:4 & 12:3:1), Polygenic inheritance (characteristics and Kernel colour in Wheat) and multiple allele.		
	Chromosome theory and sex determination, chromosomal aberration.		
	Linkage and crossing over: Complete and incomplete linkage, Types of Crossing over, a three point test cross and Chi square(X2) test for segregation.		
	Linkage maps in Drosophila and chromosomal mapping.		
IV	**Evolution**	1	25 %
	Emergence of evolutionary thoughts: Lamarckism; Darwinism – concepts of variation, adaptation, struggle for existence, survival of fittest and natural selection.		
	Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The First cell.		
	Origin of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic		

	metabolism.		
	Evolutionary divergence : Plant diversity as a result of evolution		

Outcome:

After successfully completion of the course, the student will be able to…….

1. The student understands the concept of Have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
2. Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
3. Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.
4. Analyze the effect of mutations on gene functions and dosage.
5. Examine the structure, function and replication of DNA

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
CO2	Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders
CO3	Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels
CO4	Analyze the effect of mutations on gene functions and dosage.
CO5	Examine the structure, function and replication of DNA

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**1**	**-**	**-**	**2**	**2**	**2**	**1**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**2**	**2**				
CO5	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1													**2**	**-**
CO2													**2**	**-**
CO3													**3**	**-**
CO4													**3**	**-**

CO5													**3**	**-**

MBOT115SE - BIODIVERSITY

Objective:

To discuss important results on Significance of Biodiversity, Conservation of Biodiversity, Role of Educational Institute in Biodiversity Conservation.

Credit: 2

Unit	Description in detail	Credit	Weightage
I	**Biodiversity– Types, Uses and its depletion**	1	25 %
	Biodiversity Science: Definition, Significance of Biodiversity, types of Biodiversity (Genetic diversity, Species diversity and Ecosystem diversity).		
	Ethics and Uses of Biodiversity: Biodiversity values, Ethical and Aesthetic values, Uses of plants (Food, Fodder and forage, Rattans and Canes, Medicinal and Ornamental Plants).		
	Depletion of Biodiversity: Law of Genetic diversity, Species diversity and Ecosystem diversity.		
	Factors affecting in loss of Biodiversity and process of species extinction, Loss in diversity of Major Ecosystem of the world.		
II	**Biodiversity- Conservation and Management**	1	25 %
	Conservation of Biodiversity: Why Conservation; Conservation of Genetic diversity, Species diversity and Ecosystem diversity; In-situ and Ex-situ conservation; Role of Biotechnology in Biodiversity conservation; Current Practice in conservation of it in India; Social approaches in conservation of Biodiversity (examples like Chipko movement etc.)		
	Role of Educational Institute in Biodiversity Conservation (BSI, NBPGR, ICAR).		
	Biodiversity Management and Prospecting: Organizations associated with Biodiversity Management (IUCN, UNEP, UNESCO, WWF, ICSU, FAO, WCMC, GEF, ETC).		
	Biodiversity legislation and conservation; Biodiversity Laws; Biodiversity-Information and Communication; Role of Indigenous Knowledge System in Biodiversity Prospecting and conservation; Intellectual Property Rights (IPRs); and Biopiracy.		

Reference Books:

1. Heywood V H, Watson R T (1996) Global Biodiversity Assessment, Cambridge University Press, London.
2. Singh J S, Singh S P, Gupta S R (2014) Ecology, Environmental Science and Conservation, S Chand & Co, New Delhi.

Course Outcome:

After successfully completion of the course, the student will be able to…….

1. The student understands the concept of Biodiversity Management and Prospecting.
2. Gain knowledge about basic Factors affecting in loss of Biodiversity and process of species extinction.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Biodiversity Management and Prospecting.
CO2	Gain knowledge about basic Factors affecting in loss of Biodiversity and process of species extinction.
CO3	Demonstrating the fundamental processes underlying adaptive evolution, speciation and extinction, population growth and regulation, species coexistence, and maintenance of biodiversity
CO4	Demonstrating the ability to design and execute collection, evaluation and interpretation of scientific data.
CO5	Identifying human-caused species loss as one of the major current threats to biodiversity.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**2**	**2**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**2**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**2**	**3**				
CO5	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1													**2**	**3**
CO2													**2**	**3**
CO3													**3**	**3**
CO4													**3**	**2**
CO5													**3**	**2**

MBOT121DSC - Study of life forms II

Objective:

To discuss important results on Morphology, anatomical structure, reproduction and life history; distribution; classification; general account Origin of bryophytes, Economic and ecological importance, Vegetative propagation in Bryophyte, Pteridophytes and Gymnosperms and Fossils.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**Bryophytes-I**	1	25 %
	Morphology, anatomical structure, reproduction and life history; distribution; classification; general account and comparative study of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales and Bryales.		
	Origin of bryophytes, Economic and ecological importance, Vegetative propagation in Bryophytes.		
	Morphological and anatomical study of thallus and reproductive structures of Riccia, Plagiochasma. Morphological and anatomical study of thallus and reproductive structures of Anthoceros		
	Morphological and anatomical study of thallus and reproductive structures of Sphagnum and Polytrichum, Evolution of Sporophytes in Bryophyta.		
II	**Pteridophytes**	1	25 %
	Morphology, anatomical structure, reproduction and life history; distribution; classification; general account of Psilopsida, Lycopsida, Sphenopsida and Pteropsida, Economic and ecological importance. Heterospory and origin of Seed habit, Telome theory, Apospory and Apogamy.		
	Morphological and anatomical study of thallus and reproductive structures of Psilotum.		
	Morphological and anatomical study of thallus and reproductive structures of Lycopodium and Isoetes.		
	Morphological and anatomical study of thallus and reproductive structures of Osmunda and Marsilea, Types and evolution of Stele in Pteridophyta.		
III	**Gymnosperms**	1	25 %
	Introduction, Distribution, General characters, Origin, Evolution and Classification of Gymnosperms (Bierhost), Comparison of Angiosperms and Gymnosperms, Geological rise and fall of Gymnosperms. Economic importance of gymnosperms.		
	Comparative account of habit, anatomy and reproduction of Cycadales: Cycas and Zamia. Comparative account of habit, anatomy and reproduction of Ginkgoales : Ginkgo.		
	Comparative account of habit, anatomy and reproduction of Coniferales: Pinus, Thuja.		
	Comparative account of habit, anatomy and reproduction of Gnetales: Gnetum, Ephedra.		
IV	**Fossils**	1	25 %
	Paleobotany – Objectives and Nomenclature, Geological timescale,		

	Methods of Fossil study, Processes of plant fossilization: Impressions, Petrification. Technique of fossil study, factors affecting fossilization, work in fossils in India.		
	Study of morphology, anatomy and evolutionary trends of following groups of fossil plants: Psilophytales, Lepidodendrales. Study of morphology, anatomy and evolutionary trends of following groups of fossil plants: Calamitales, Filicales.		
	Study of morphology, anatomy and evolutionary trends of following groups of fossil plants: Pteridospermales. Study of morphology, anatomy and evolutionary trends of following groups of fossil plants: Cycadales, Coniferales, Bennettitales, Pentoxylales, Cordiatales.		

Reference Books:

1. Parihar NS (1973) An Introduction to Embryophyta, Vol I (Bryophyta) and Vol II (Pteridophyta), Central Book Department, Allahabad.
2. Sambamurty AVSS (2005) A Textbook of Bryophytes, Pteridophytes, Gymnosperm and Palaeobotany, IK International Pvt Ltd, New Delhi
3. Rashid A (2011) An Introduction to Pteridopyta, 2nd edition, Pub Vikas Publishing House Pvt Ltd, Noida.
4. Singh V. Pande P.C. and Jain D.K (2008-09) A Taxt book of Botany, Rastogi Publications, and Meerut.
5. Vashishta B.R. and Sinha A.K. (2007) Botany for Degree students-Bryophytes & Pteridophytes, S.Chand & Company Ltd. New Delhi
6. Sporne K R (1967) Morphology of Gymnosperms, B I Publication, New Delhi.

Course Outcome:

After successfully completion of the course, the student will be able to…….

1. The student understands the concept of Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
2. Understanding of plant evolution and their transition to land habitat.
3. Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes, Pteridophytes, Gymnosperms.
4. **Course Outcomes:** At the end of the course, students shall be able to

CO1	The student understands the concept of Develop critical understanding on morphologyof Bryophytes, Pteridophytes and Gymnosperms.
CO2	The student understands the concept of Develop critical understanding on, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
CO3	Understanding of plant evolution and their transition to land habitat.
CO4	Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes, Pteridophytes, Gymnosperms.

CO5	Explain the processes of growth and development in individuals and populations.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**1**	**-**	**-**	**2**	**2**	**1**	**1**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1													**2**	**2**
CO2													**2**	**2**
CO3													**3**	**2**
CO4													**3**	**2**
CO5													**3**	**3**

MBOT122DSC - PLANT Reproductive & Development Biology

Objective:
To discuss important results on concept and Classification of Meristems, Theories of Root apex organization, Anomalous Secondary Growth, Microsporangium, Pollen Structure, Fertilization and Embryogenesis.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**Plant Development**	1	25 %
	Meristems: concept and Classification of Meristems. Theories of Shoot Apical meristems, Apical Cell Theory, Histogen theory, Anneuainitial & meristem d'attente theory		
	Vascular Elements: Xylem, Phloem, Transfusion tissue. Secretory ducts and laticifers tissues.		
	Root Apex: Theories of Root apex organization, Apical Cell Theory, Korper-Kappe theory, Concept of quiescent centre, development of lateral roots and root hairs.		
	Wood Anatomy: Ontogeny of secondary vascular tissues, Growth rings, Heart wood & Sap wood, Porous & non-porous wood, wood parenchyma.		
II	**Plant Anatomy**	1	25 %
	Vascular Cambium: origin, structure, seasonal changes in cambium activity, cambium in monocotyledons.		
	Anomalous Secondary Growth in Aristolochia stem, Mirabilis stem, Bougainvillea stem and Chenopodium stem.		
	Anatomy of Structural variability in Leaves of Helianthus, Aloe, Typha, Nymphaea and Maize.		
	Systematic Plant Anatomy: with special references to Trichomes, Stomata, leaf anatomy, nodal anatomy, cellular contents.		
III	**Plant Reproduction-I**	1	25 %
	Microsporangium: Introduction, structure of Anther, anther wall, Sporogenous tissue, Microsporogenesis, role of tapetum.		
	Male gametophyte: Introduction, morphology, pollen development, Formation of vegetative cell and generative cells.		
	Pollen Structure: Pollen wall features, Scope of Palynology, preparation of pollen grains.		
	Megasporangium: Introduction, Structure of ovules, its integuments, ovule development, process of mega sporogenesis.		
IV	**Plant Reproduction-II**	1	25 %
	Female gametophyte: Organization of embryosacs, structure of embryosac cells, developments of mature embryo sac, types of embryosac development.		
	Fertilization: pollen germination, pollen tube growth, in-vitro pollen germination, fertilization and double fertilization.		
	Endosperm: Structure and development during early, maturation and desiccation stages, protein of endosperm and embryo.		

	Embryogenesis: Ultrastructure and nuclear cytology and processes of Embryogenesis, polyembryony in plant, Definition, types and applications.		

Reference Books:

1. Singh V, Pande P C and Jain D K (1998) Anatomy of Seed Plants, Rastogi Publications, Meerut (1st Edition's Reprint).
2. Pandey B P (1997) Plant Anatomy, S Chand & Co. Ltd, New Delhi. (1st Edition's Reprint).
3. E John Jothi Prakash (2000) A Text Book of Plant Anatomy, Emkay Publications, Delhi. (2nd Revised Edition).
4. Tayal M S (2001) Plant Anatomy, Rastogi Publications, Meerut (5th Edition's New Delhi (1st Edition's Reprint)
5. Reddy S M, Madhusudana Rao M, Reddy S A, Reddy M M and Chary J S (2004) University Botany-3, New Age International (P) Ltd, Publishers, New Delhi (1st Edition).
6. Pandey B P (2003) Simplified Course in Botany –B Sc-II, S Chand & Company Ltd.,

Outcome:

After successfully completion of the course, the student will be able to…….

1. The student understands the concept of understand structure and functions of anther wall and pollen wall.
2. Evaluate the special structures of Ovule. Solve Self-incompatibility in Pollination and fertilization & relate between Embryo, Endosperm and Seed. Comprehend the causes of Polyembryony and apomixes with its classification

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of structure and functions of anther wall and pollen wall.
CO2	The student understands the concept of structure and function of female reproductive organ of plant.
CO3	The student understands the concept of Evaluate the special structures of Ovule
CO4	The student Solve Self-incompatibility in Pollination and fertilization & relate between Embryo, Endosperm and Seed.
CO5	The student Comprehend the causes of Polyembryony and apomixes with its classification

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**2**	**2**				
CO3	**3**	**3**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1													**2**	**2**
CO2													**2**	**1**
CO3													**3**	**1**
CO4													**3**	**1**
CO5													**3**	**1**

MBOT123DSC Instrumental method for biological Science & Biostatistics

Objective:

To discuss important results on Instrument UV/Visible, fluorescence, NMR and ESR spectroscopy, application of HPLC & HPTLC, Statistical Methods and Mathematical Definition and theory of Probability.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**Instrumentation-I**	1	25 %
	Molecular analysis using UV/Visible, fluorescence, NMR and ESR spectroscopy.		
	Application of Photometry.		
	Colorimetry application.		
	Application of spectrophotometry		
II	**Instrumentation-II**	1	25 %
	Principles and application of gel-filtration, ion exchange and affinity, chromatography: Paper chromatography, thin layer and gas chromatography.		
	HPTLC		
	Electrophoresis: PAGE, Agarose gel electro-phoresis and electro-focusing.		
	Ultra- centrifugation: Principles and types.		
III	**Biostatistics-I**	1	25 %
	Statistical Methods: Data analysis- variables, numerical, categorical Central measures (mean, medium, mode);		
	Dispersion measures (range, mean & standard deviation)		
	Variance, standard error.		
	Co- relation and regression, Binomial, poisson and normal distribution		
IV	**Biostatistics-II**	1	25 %
	Parametric (t-test, f-test, chi-square test, ANOVA)		
	Non-Parametric tests (Rank test, F-max test, Mann –Whitney (U) test, and Sign test).		
	Mathematical Definition and theory of Probability, Marginal Probability and Conditional Probability.		
	Mutual exclusive & Independent Events. Some simple laws of probabilities (Statements only).		

Reference Books:

1. Verma S K and Verma Mohit, Plant Physiology, Biochemistry and Biotechnology. Biophysics by Vasantha Pattabhi and N. Gautam, Narosa Pub.
2. G. B. N. Chainy, G. Mishra and P. K. Mohanty (2004) Basic Biostatistics. Kalyani Publisher.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Comprehend the fundamental concepts related to descriptive and inferential biostatistics. Develop skills in data tabulation, its treatment, analysis, interpretation and

graphical representation of data. Analyze the implications of inferential statistics in biology. Develop their competence in hypothesis testing and interpretation.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Comprehend the fundamental concepts related to descriptive and inferential biostatistics.
CO2	The student Develop skills in data tabulation, its treatment, analysis, interpretation and graphical representation of data
CO3	The student Analyze the implications of inferential statistics in biology.
CO4	The student Develop their competence in hypothesis testing and interpretation.
CO5	The student understand uses of Instrumentation and Biostatic application.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**2**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**1**	**2**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**2**				
CO5	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**2**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1													**2**	**3**
CO2													**2**	**1**
CO3													**3**	**1**
CO4													**3**	**1**
CO5													**3**	**1**

MBOT124 - DSC Plant Resources Utilization and Conservation

Objective:

To discuss important results on Adulteration in plant products, Origin, evolution, cultivation and uses of plant parts, Principles of conservations and Conservation of wild biodiversity.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**Plant Resources-I**	1	25 %
	Adulteration in plant products: Introduction, detection of adulteration in the following: Oils- groundnut and sunflower, Spices and condiments: pepper, fennel, cardamom, saffron and clove, Cereals and pulses: Bajara, Rice, Tur and Gram.		
	Origin, evolution, cultivation and uses of: (i) Food – Wheat, chicken pea, potato, Mustard (ii) Forage/fodder crops- bajara, guarbean.		
	Plant fibers: Textile fibers- cotton, jute, linen, sun hemp, cannabis, Cordage (coir), Fibers for stuffing (silk cotton).		
	Plant Resources-II		
II	Dyes- Turmeric, Indigo, Butea monosperma, Lawsonia alba.	1	25 %
	Important fire wood and timber yielding plants: Acacia nilotica, Tectona grandis, Dalbergia sissoo, Terminalia arjuna, Mangifera indica.		
	Rubber- Introduction, chemical composition, hevea rubber, Plantation and production of rubber in the world and India, Processing. Uses of rubber and synthetic rubber.		
	Medicinal plants- Atropa belladonna, Catheranthus roseus, Adhatoda vasica, Allium sativum, Phyllanthus emblica, Papaver somniferum, Aloe barbadense.		
	Conservations-I		
III	Principles of conservations, Strategies for conservations - In situ conservation.	1	25 %
	International efforts and Indian initiatives, protected areas in India,		
	Conservation of wild biodiversity: sanctuaries, national parks, biosphere reserves, Wetlands.		
	Conservation of wild biodiversity: Mangroves and coral reefs.		
IV	**Conservations-II**	1	25 %
	Ex situ conservation: Principles and practices, botanical gardens, field gene bank, seed banks, in vitro repositories.		
	General account of the activities of Botanical survey of India (BSI), National Bureau of plant genetic resources (NBPGR),		
	Indian council of Agriculture research(ICAR), Council of scientific and Industrial research (CSIR)		
	The department of Biotechnology(DBT) for conservation and non formal conservation efforts		

Reference Books:

1. Paroda, R.S. and Arora R.K(1991) Plant resources conservation and management, IPGRIP USACampus, New Delhi.
2. Chandel, K.P.S., Shukla, G. and Sharma, N (1996) Biodiversity in medicinal and aromatic plants in India, conservation and utilization. National bureau of plant genetic resources, New Delhi.
3. Heywood, V.H. and Wyse Jakon, P.S (1991) Tropical botanical gardens, their role in conservation and development, Academic press San. Diego.
4. Council of Scientific and Industrial Research (1986) The Useful Plants of India. Publications and directorate, CSIR, New Delhi.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Understand core concepts of Economic Botany and relate with environment, populations, communities, and ecosystems . Develop critical understanding on the evolution of concept of organization of apex new crops/varieties, importance of germplasm diversity, issues related to access and ownership. Develop a basic knowledge of taxonomic diversity and important families of useful plants.Appreciate the diversity of plants and the plant products in human use.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Economic Botany and relate with environment, populations, communities, and ecosystems.
CO2	The student Develop critical understanding on the evolution of concept of organization of apex new crops/varieties, importance of germplasm diversity, issues related to access and ownership
CO3	The student Develop a basic knowledge of taxonomic diversity and important families of useful plants.
CO4	The student Appreciate the diversity of plants and the plant products in human use
CO5	The student understands the concept of conservation

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**3**	**-**	**-**	**2**	**2**	**2**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1													**3**	**3**
CO2													**2**	**3**
CO3													**2**	**2**
CO4													**2**	**3**
CO5													**3**	**2**

MBOT125SE - HERBAL MEDICINE

Objective:

To discuss important results on

Credit: 2

Unit	Description in detail	Credit	Weightage
I	**Unit -1**	1	25 %
	Secondary metabolites: Introduction, its type and functions.		
	Synthesis: Common pathway of biosynthesis of major secondary metabolites.		
	Diagnostic features, bioactive molecules and therapeutic values of some common medicinal plants viz., Giloy, Brahmi, Safed musli, Amla, Kalmegh, Satavari, Bel, Sarpgandha, Ashwagandha, Aloe, Tulsi, Ashok		
II	**Unit -2**	1	25 %
	Multiplication and conservation of medicinal plants using in vivo & in vitro techniques.		
	Nutraceuticals and medicinal foods.		
	Bioprospecting, biopiracy and protection of traditional medicinal knowledge.		
	Commercial cultivation of medicinal plants and Standardization of herbal drugs.		

Reference Books:

1. Cultivation of Selected Medicinal Plants, National Medicinal Plant Board, 36, Janpath, NewDelhi.
2. Mandal S C, Mandal V, Das A K (2015) Essentials of Botanical Extraction: Principles and Applications, Academic Press, Elsevier, Amsterdam.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of recognize the basic medicinal plants. Apply techniques of conservation and propagation of medicinal plants. Setup process of harvesting, drying and storage of medicinal herbs.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of recognize the basic medicinal plants.
CO2	The student Apply techniques of conservation and propagation of medicinal plants
CO3	The student Setup process of harvesting, drying and storage of medicinal herbs.

CO4	The student understands new strategies to enhance growth of medicinal herbs considering the practical issues.
CO5	The student Identify the major active constituents and their therapeutic actions of the herbs studied.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**2**	**2**	**-**	**-**	**2**	**2**	**1**	**1**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**2**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1													**2**	**2**
CO2													**2**	**2**
CO3													**2**	**2**
CO4													**2**	**2**
CO5													**3**	**2**

MBOT211DSC - Plant Molecular Biology

Objective:

To discuss important results on Nucleic Acids, Transcription, Translation, Application of proteomics, Gene Cloning, Human Genome Project, DNA synthesis and sequencing and DNA Fingerprinting.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**MOLECULAR BIOLOGY OF PLANTS**	1	25 %
	Nucleic Acids: Introduction, Components, Chemical Structure of DNA, Forms of DNA and types of RNA and their functions.		
	DNA Replication in Prokaryotes and Eukaryotes; Enzymes involved in Replication.		
	Transcription in Prokaryotes and Eukaryotes; RNA Polymerases.		
	Translation: Process of Protein synthesis.		
II	**MOLECULAR BIOLOGY OF PLANTS**	1	25 %
	Regulation of gene expression in Prokaryotes and Eukaryotes.		
	Proteomics and Proteome: Overview of analytical proteomics, protein digestion techniques, mass spectrometers for protein.		
	Application of proteomics: Protein expression profiling, identifying protein-protein interactions.		
	Human Genome Project.		
III	**MOLECULAR BIOLOGY OF PLANTS**	1	25 %
	Recombinant DNA technology and Restriction Endonuclease (Types, Source and classification)		
	Gene Cloning principles and technique; Choice of Vectors (Plasmid, Cosmid, Bacteriophage, Phasmid, Shuttle, Yeast and Expression vectors).		
	Construction of Genomic and c DNA libraries.		
	Southern and Northern Analysis.		
IV	**MOLECULAR BIOLOGY OF PLANTS**	1	25 %
	DNA synthesis and sequencing.		
	PCR (Polymerase Chain Reaction).		
	DNA Fingerprinting (RFLP, RAPD, AFLP).		
	DNA Microarray.		

Reference Books:

1. Alberts, B., Bray ,D., Lewis ,J., Raff, M., Roberts, K., and Watson, J.D. (1999). Molecular Biology of the Cell. Garland Publishing, Inc., New York.
2. Wolfe, S.L. (1993). Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA
3. Krishnamurthy, K.V. (2000). Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
4. Buchanan, B.B., Gruissem,W. and Jones,R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.

5. Kleinsmith, L.J. and Kish,V.M. (1995). Principles of Cell and Molecular Biology. Harper Collins College Publishers, NewYork, USA.
6. Lodish,H., Berk,A., Zipursky,S.L., Matsudaira,P., Baltimore,D. and Darnell,J. (2000). Molecular Cell Biology (41Edition). W.H.Freem anand Co., NewYork, USA.
7. Glick, B.R. and Thompson, J.E. (1993). Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Analyse the structures and chemical properties of DNA and RNA through various historic experiments. Differentiate the main types of prokaryotes through their grouping abilities and their characteristic. Evaluate the experiments establishing central dogma and genetic code.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Analyse the structures and chemical properties of DNA and RNA through various historic experiments.
CO2	The student Differentiate the main types of prokaryotes through their grouping abilities and their characteristic.
CO3	The student Evaluate the experiments establishing central dogma and genetic code
CO4	The student Describe and analyze how plant proteins are synthesized, transported, fold, form complexes and finally break down
CO5	Apply knowledge of the uptake and metabolism of nitrogen and other nutrients in plants

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**1**	**-**	**-**	**2**	**2**	**1**	**1**				
CO3	**2**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**2**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**2**	**-**	**-**	**3**	**2**	**2**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1													**2**	**3**
CO2													**2**	**1**
CO3													**3**	**1**
CO4													**3**	**1**

CO5													**3**	**1**

MBOT212DSC - PLANT PHYSIOLOGY

Objective:

To discuss important results on Seed germination and seedling growth, dormancy, transport and translocation of water and solutes, Stress physiology, Photosynthesis**,** Respiration, Plant Growth Regulators and Elicitors and Flowering Process.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**Growth and Development**	1	25 %
	Seed germination and seedling growth: Introduction, Physiological aspects of germination, mobilization of food reserve during germination, hormonal control, Seedling growth, Factors affecting seed germination.		
	Latent Life Dormancy: Introduction to Seed dormancy, Types, Causes and overcoming of seed dormancy, factors affecting seed dormancy.		
	Bud Dormancy: Introduction, causes and factors affecting bud dormancy.		
	Senescence: Introduction, metabolic Changes associated with senescence and its regulation, Influence of Hormones and Environmental Factors on Senescence.		
II	**Mineral Transport and Stress**	1	25 %
	Membrane transport and translocation of water and solutes: Mechanism of water transport through xylem, root microbe interactions in facilitating nutrient uptake, Phloem loading and Unloading, Passive and active solute transport.		
	Mechanism of absorption, regulation and transport of Macronutrients (K, P) and Micronutrients (Zn, Fe) in Plant.		
	Stress physiology: Plant responses to biotic and abiotic stress, Physiological effects and mechanisms of abiotic stress tolerance.		
	Water deficit and drought resistance, salinity stress, freezing and heat stress, oxidative stress.		
III	**Photo-physiology**	1	25 %
	Photosynthesis: General concepts and historical background, Photosynthetic Pigments systems and Light harvesting Complexes, Photo oxidation of water, Photophosphorylation and Mechanism of electron and proton transport and energy changes during light reaction.		
	Carbon assimilation mechanism - The Calvin cycle / C3 Cycle, C4 Cycle, CAM Pathway, Photorespiration and its significance.		
	Respiration: Overview of plant respiration, Glycolysis, the TCA cycle, electron-transport and ATP synthesis, Pentosephosphate pathway, Glycoxylate cycle.		
	Sensory Photobiology: History and discovery of Phytochromes and Cryptochromes and their Photochemical and Biochemical Properties.		
	Nitrogen fixation, nitrogen and sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and non-factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate uptake, transport	1	25 %

	and assimilation. Plant growth regulators and elicitors: Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, hormone receptors, single transduction and gene expression.		
IV	**Plant hormones and flowering**		
	Plant Growth Regulators and Elicitors: Introduction, Types of hormones, natural and synthetic hormones, application of hormones.		
	Structure, Physiological Effects and Mechanisms of Action of Auxins, Gibberellins, Cytokinins, Ethylene, Abscissic Acid. Physiological Effects and metabolism of Brassinosteroides, Polyamines.		
	Structure, Physiological Effects and Mechanisms of Action of Auxins, Gibberellins, Cytokinins, Ethylene, Abscissic Acid. Physiological Effects and metabolism of Brassinosteroides, Polyamines.		
	The Flowering Process: Photoperiodism, types and its significance, Floral Induction and Development, Vernalization.		

Reference Books:

1. Buchanan B B, Gruisemm W, Jones R L (2015) Biochemistry and Molecular Biology of Plants, 2ndedition, Wiley Blackwell, NewJersey.
2. Hopkins W G, Huner N P A (2009) Introduction to Plant Physiology, 4th edition Wiley International edition, JohnWiley & Sons, NewYork.
3. Taiz L, Zeiger E, Moller I M, Murph A (2015) Plant Physiology and Development, 6 thedition, Sinurer Associates Inc Publishers, Sunderland, Massachusetts.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of understand Water relation of plants with respect to various physiological processes. Explain chemical properties and deficiency symptoms in plants. Classify aerobic and anaerobic respiration. Explain the significance of Photosynthesis and respiration. **Assess** dormancy and germination in plants.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of understand Water relation of plants with respect to various physiological processes.
CO2	Explain chemical properties and deficiency symptoms in plants.
CO3	The student Classify aerobic and anaerobic respiration.
CO4	The student Assess dormancy and germination in plants
CO5	The student Explain the significance of Photosynthesis and respiration.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**2**	**2**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**2**	**3**	**3**				
CO5	**3**	**3**	**-**	**-**	**2**	**3**	**2**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1													**2**	**2**
CO2													**2**	**2**
CO3													**3**	**2**
CO4													**3**	**2**
CO5													**3**	**2**

MBOT213DSC - PLANT ECOLOGY

Objective:

To discuss important results on Phytogeography and major biomes of the world, Vegetation development, Ecosystem organization, Biological diversity, Air, water and soil pollution, Climate change, Ecosystem stability and Ecological management.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**Plant Ecology**	1	25 %
	Climate, soil and vegetation patterns of India.		
	Phytogeography and major biomes of the world.		
	Vegetation organization: Concepts of community; analysis of communities (analytical and synthetic characters); interspecific associations, concept of ecological niche.		
	Vegetation development: Temporal changes (cyclic and non-cyclic); mechanism of ecological succession, changes in ecosystem properties during succession		
II	**Plant Ecology**	1	25 %
	Ecosystem organization: Structure and functions; Production (primary & secondary). Measurement of primary productivity (harvest & leaf area index).		
	Types of ecosystem: Natural and artificial ecosystems.		
	Energy dynamics (trophic organization, energy flow pathways (Single & Y - shaped), ecological efficiencies; litter fall and decomposition, climatic factors (light, temperature, wind, precipitation).		
	Global biogeochemical cycles of C, N, P and S, mineral cycles (pathways & processes).		
III	**Plant Ecology**	1	25 %
	Biological diversity: Concept and levels; role of biodiversity in ecosystem functions and stability; speciation and extinction.		
	IUCN categories of threat; distribution and global patterns.		
	Terrestrial biodiversity hot spots.		
	Air, water and soil pollution: Kinds; sources; quality parameters; effects on plants and ecosystems.		
IV	**Plant Ecology**	1	25 %
	Climate change: Greenhouse gases (CO_2, CH_4, N_2O, CFCs: sources, trends and role); ozone layer and ozone hole; consequences of climate change (CO_2 fertilization, global warming, sea level rise, UV radiation).		
	Ecosystem stability: Concept, ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration.		
	Ecological management: Concepts; sustainable development.		
	Sustainability indicators.		

Reference Books:

1. Smith, R.L. (1996). Ecology and Field Biology. Harper Collins, New York.
2. Muller-Dombois, D. and Ellenberg, H. (1974). Aims and Methods of Vegetation Ecology, Wiley, New York.
3. Begon, M., Harper, J.L. and Townsend, C.R. (1996). Ecology. Blackwell Science, Cambridge, U.S.A.
4. Ludwig, J. and Reynolds, J.F. (1988). Statistical Ecology. John Wiley & Sons. Odum, E.P. (1971). Fundamentals of Ecology. Saunders, Philadelphia.
5. Odum, E.P. (1983). Basic Ecology. Saunders, Philadelphia.
6. Barbour, M.G., Burk, J.H. and Pitts, W.D. (1987). Terrestrial Plant Ecology. Benjamin / Cummings Publication Company, California.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Understand core concepts of biotic and abiotic. Classify the soils on the basis of physical, chemical and biological components. Analysis the phytogeography or phytogeographical division of India. Assess the adaptation of plants in relation to light, temperature, water, wind and fire. Conduct experiments using skills appropriate to subdivisions.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Understand core concepts of biotic and abiotic.
CO2	The student Classify the soils on the basis of physical, chemical and biological components.
CO3	The student Assess the adaptation of plants in relation to light, temperature, water, wind and fire.
CO4	The student Conduct experiments using skills appropriate to subdivisions.
CO5	The student Analysis the phytogeography or phyto-geographical division of India.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**1**	**-**	**-**	**2**	**2**	**2**	**2**				
CO3	**3**	**1**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1													**2**	**3**
CO2													**2**	**3**
CO3													**3**	**3**
CO4													**3**	**3**
CO5													**3**	**2**

MBOT214DSC - Angiosperm Taxonomy

Objective:
To discuss important results on Principles of taxonomy, Aims of taxonomy, Taxonomic hierarchy, History of plant nomenclature and study families with reference to their geographical distribution, systematic position, floral variation and economic importance.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**Taxonomy-I**	1	25 %
	Principles of taxonomy, Aims of taxonomy, Taxonomic hierarchy.		
	Major categories: Families and other categories; Minor categories: Genus and Species.		
	Origin and evolution of Angiosperms.		
	Herbarium methodology, Important world Herbaria and Botanical gardens, Importance of Herbaria and Botanical gardens.		
II	**Taxonomy-II**	1	25 %
	History of plant nomenclature.		
	ICBN–Principles, Ranks, Typification, The principle of priority, Retention, Choice of rejection of names & epithet.		
	Classification and relative merits and demerits of major systems of classification Bentham & Hooker, Takhtajan.		
	Classification and relative merits and demerits of major systems of classification, Bassey, APG (IV).		
III	**Taxonomy-III**	1	25 %
	The Taxonomic importance characters derived form the following disciplines: Morphology, anatomy, embryology, cytology.		
	Taxonomic tools: Flora and Monographs, Serology, computers and GIS.		
	Flora of Gujarat state: General account and Endemic plants of Gujarat.		
	Concepts of phytogeography: Endemism, Hot spots of India.		
IV	**Taxonomy-IV**	1	25 %
	Taxonomical study of the following families with reference to their geographical distribution, systematic position, floral variation and economic importance:		
	Study of DICOTYLEDONS families: Polypetalae: Menispermaceae, Capparaceae, Rutaceae, Meliaceae, and Apiaceae. Gamopetalae: Oleaceae,Salvadoraceae,Asclepiadaceae, Boraginaceae, Lamiaceae.		
	Apetalae: Amaranthaceae, Euphorbiaceae, Casuarinaceae.		
	Study of MONOCOTYLEDONS families: Liliaceae, Poaceae.		

Reference Books:

1. Cole, A. J. (1969) Numerical Taxonomy, Academic Press, London

2. Davis, P. H. and Heywood, V. H. (1973) Principles of Angiosperms Taxonomy. Robert Kreiger Pub. Co., New York.
3. Grant, V. 1971. Plant Speciation. Columbia University Press, New York.
4. Grant, W. F. (1984).Plant Biosystematics. Academic Press, London.
5. Harrison, H. J. (1971). New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
6. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd., UK.
7. Heywood, V. H. and Moore, D. M. (1984). Current Concepts in Plant Taxonomyz Academic Press, London.
8. Jones, A. D. and Wilbins, A. D. (1971). Variations and Adaptations in Plant Species. Hieman & Co. Educational Books Ltd., London.
9. Jones, S. B., Jr. and Luchsinger, A. E. (1986). Plant Systematics . McGraw-Hill Book Co., New York.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Classify Plant systematics and recognize the importance of herbarium and Virtual herbarium. Evaluate the Important herbaria and botanical gardens .Interpret the rules of ICN in botanical nomenclature .Generalize the characters of the families according to Bentham & Hooker's system of classification. Analyze the implications of biometrics, numerical taxonomy and cladistics.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Classify Plant systematics and recognize the Importance of herbarium and Virtual herbarium.
CO2	The student Evaluate the Important herbaria and botanical gardens ..
CO3	The student understands Interpret the rules of ICN in botanical nomenclature
CO4	The student understands Generalize the characters of the families according to Bentham & Hooker's system of classification.
CO5	Analyze the implications of biometrics, numerical taxonomy and cladistics.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**2**	**2**				
CO3	**3**	**1**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				

CO5	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes**													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1													**2**	**2**
CO2													**2**	**2**
CO3													**3**	**2**
CO4													**2**	**-**
CO5													**2**	**-**

MBOT215SE - BIOFERTILIZER

Objective:

To discuss important results on Characteristics of biofertilizers, Biological nitrogen fixation, Application technology.

Credit: 2

Unit	Description in detail	Credit	Weightage
I	**BIOFERTILIZER TECHNOLOGY-I**	1	25 %
	Biofertilizers: Definition, types and applications in agriculture.		
	Characteristics of biofertilizers: Rhizobium, Azotobactor, Azospirillum, phosphate-solubilizing microorganisms (PSMs), cyanobacteria, Azolla, mycorrhizae.		
	Biological nitrogen fixation: Nitrogenase, substrates for nitrogenase, mechanism of action of nitrogenase, strategies to exclude oxygen and need to control hydrogen evolution.		
	Regulation of nitrogen fixation.		
II	**BIOFERTILIZER TECHNOLOGY-II**	1	25 %
	Rhizobium- legume symbiosis.		
	Production technology: Strain selection, sterilization, growth and fermentation, mass production of various biofertilizers.		
	Application technology: Standards and quality control, application for field and tree crops.		
	Nursery plants and seedlings, agronomical significance.		

Reference Books:

1. Gallon J R, Chaplin A E (1987) An Introduction to Nitrogen Fixation, Cassel Educational Limited, London.
2. Smith R J, Lea P J, Chaplin J R (1999) Nitrogen Fixation. In: Plant Biochemistry &Molecular Biology, 2 ndedition, eds : Lea P J, Lee good R C, John Wiley & Sons, New York, pp. 137-162.
3. Rai A N (1990) A Handbook of Symbiotic Cyanobacteria, CRC Press, BocaRaton, USA.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Develop their understanding on the concept of bio-fertilizer. Compose the Green manuring and organic fertilizers. Develop the integrated management for better crop production by using both nitrogenous and phosphate bio fertilizers and vesicular arbuscular mycorrhizal (VAM). Interpret and explain the components, patterns, and processes of bacteria for growth in crop production

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Develop their understanding on the concept of bio-fertilizer.
CO2	The student Compose the Green manuring and organic fertilizers.
CO3	The student Develop the integrated management for better crop production by using both nitrogenous and phosphate bio fertilizers and vesicular arbuscular mycorrhizal (VAM).
CO4	The student Interpret and explain the components, patterns, and processes of bacteria for growth in crop production
CO5	Ability to distinguish the types of biofertilizers and methods of application in farmers field

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**1**	**-**	**-**	**2**	**2**	**1**	**1**				
CO3	**3**	**1**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**1**	**1**				
CO5	**3**	**3**	**-**	**-**	**3**	**2**	**2**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1													**2**	**2**
CO2													**2**	**1**
CO3													**2**	**2**
CO4													**1**	**2**
CO5													**2**	**2**

MBOT221DSC - PLANT BIOTECHNOLOGY

Objective:

To discuss important results on Genetic Engineering of Plants, Microbial Genetic

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**PLANT BIOTECHNOLOGY**	1	25 %
	Biotechnology - Basic concepts, principles and scope		
	Genetic Engineering of Plants: Aims, strategies for development of transgenics, Gene transfer methods, Vector mediated/indirect gene transfer (Agrobeacterium- the natural genetic engineer, T-DNA mediated gene tagging, Virus mediated gene transfer).		
	Vector less\direct DNA transfer.		
	Introduction to bioethics: Principles, Social, Ethical issues and Ethical conflicts in biotechnology.		
II	**PLANT BIOTECHNOLOGY**	1	25 %
	Microbial Genetic Manipulation: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.		
	Genetic Engineering of Plants: Aims, strategies for development of transgenes (with suitable examples).		
	Molecular farming: Production of Antibodies, Vaccines, Polymers and Bioplastic.		
	Genomes and comparative genomics- Molecular markers for introgression of useful traits. Brief account of Arabidopsis genomes and genome annotation.		
III	**PLANT BIOTECHNOLOGY**	1	25 %
	Transgenic plants for crop improvement in W heat, Rice and resistance to herbicides, insecticides, virus and other diseases.		
	Transformation of chloroplast (Cp) genome in higher plants (using micro injection & partical gun).		
	Embryo culture, Bud culture, Pollen culture, Clonal propagation, Artificial seeds, Germ plasm storage, Cryopreservation.		
	Production of hybrids and somatoclones, Production of secondary metabolites and natural products and application, Hybridoma technology.		
IV	**PLANT BIOTECHNOLOGY**	1	25 %
	Application of Biotechnology: In Horticulture, Floriculture & Agriculture, GMO crops and Traditional knowledge.		
	Roll of Biotechnology: In Herbal medicine, Food nutrition and Health.		
	Controlling environmental pollution and hazards, waste management by using biotechnology, social responsibility		
	Biotechnological Products: Industrial products and other related product for human welfare, biotechnology & sustainability.		

Reference Books:

1. Brown, T.A. (1999) Genomes, John Wiley and Sons (Asia) Pvt.Ltd., Singapore.
2. Callow, J.A., Fort-Lloyd, B.V. and Newbury, H.J. (1997) Biotechnology and Plant Genetic Resources: Conservation and Use, CAB International, Oxon, UK.
3. Chrispeels, M.J. and Sadava,(1994) Plants, Genes and Agriculture, Jones & Barlloy Publishers, Boston, USA.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Develop their competency on different types of plant tissue culture.Analyze the enzymes and vectors for genetic manipulations. Examine gene cloning and evaluate different methods of gene transfer. Critically analyze the major concerns and applications of transgenic technology.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Develop their competency on different types of plant tissue culture..
CO2	Analyze the enzymes and vectors for genetic manipulations
CO3	Examine gene cloning and evaluate different methods of gene transfer.
CO4	Critically analyze the major concerns and applications of transgenic technology.
CO5	Describe what GM plant and products are in the market and pipeline, and their contributions to food security, sustainable environment and medicine

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**2**	**2**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1													**3**	**3**
CO2													**3**	**2**

CO3													**3**	**2**
CO4													**2**	**1**
CO5													**2**	**2**

MBOT222DSC - ETHNOBOTANY

Objective:

To discuss important results on Ethnobotany, Role of ethnobotany in modern Medicine, Mushrooms: Basic Introduction, Types of Mushrooms, Mycorrhizae and Role in crop productivity and forestry.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**ETHNOBOTANY-I**	1	25 %
	Ethnobotany: Introduction, concept, scope and objectives, Ethnobotany as an interdisciplinary science.		
	Ethnic groups: Major and minor, Tribals of India and their life styles. Forest vs. ethnic groups, sacred grooves.		
	Medico-ethnobotanical survey and their role in Ayurveda.		
	Significance of the following plants in ethnomedicinal practices (along with their habitat and morphology) a) Azadiractha indica b) Ocimum sanctum c) Vitex negundo d) Gloriosa superba e) Tribulus terrestris f) Pongamia pinnata g) Cassia auriculata h) Indigofera tinctoria.		
II	**ETHNOBOTANY-II**	1	25 %
	Methodology of Ethnobotanical studies: Field work, Herbarium, Ancient Literature, Archaeological findings, Protocols.		
	Ethnobotany as a source (recent) of already known drugs: (a) Withania as an antioxidant and relaxant (b) Rauvolfia in brain ailments (c) Becopa and Centella in epilepsy and memory development in children (d) Phyllanthus fraternus in diabetic and viral jaundice (e) Artemisia as a powerful cerebral antimalarial agent and its possible use in tuberculosis.		
	Role of ethnobotany in modern Medicine: Medico-ethnobotanical sources in India with special reference to Gujarat.		
	The relevance of ethnobotany in the present context.		
III	**MUSHROOMS**	1	25 %
	Mushrooms: Basic Introduction, Types of Mushrooms: Oyster, white button, paddy straw, Morels, Truffles and poisonous mushrooms.		
	Method of cultivation of Agaricus bisporus, scope and biological significance.		
	Medicinal and nutritional value of Edible and Poisonous mushrooms.		
	Effect of environmental, nutrient and chemical factors on mushroom formation.		
IV	**MYCORRHIZAE**	1	25 %
	Mycorrhizae: Basic introduction, types of Mycorrhiza: Endomycorrhizae and Ectomycorrhizae.		
	Isolation and multiplication of mycorrhizae, VAM Fungi and orchid mycorrhizae.		
	Role in crop productivity and forestry.		
	Phosphate solubilizing fungi (PSF).		

Reference Books:

1. S.K. Jain (1995) Manual of Ethnobotany, Scientific Publishers, Jodhpur.
2. S.K. Jain (ed.) (1981) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi.
3. S.K. Jain (ed.) (1989) Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. S.K. Jain (1990) Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
5. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
6. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.
7. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Conceptualize ethnobotany as an interdisciplinary science. Restate the established methodology of ethnobotany studies.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Conceptualize ethnobotany as an interdisciplinary science..
CO2	Identify and define the most commonly used medicinal plants across the continents and their bioactive compounds
CO3	Acquire an understanding of the general principals of ethnobotany
CO4	Learn how ethnobotany is related to and a part of ethno ecology
CO5	Restate the established methodology of ethnobotany studies

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**1**	**2**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**1**	**3**	**1**				
CO5	**3**	**2**	**-**	**-**	**2**	**3**	**2**	**3**				

CO-PO & CO-PSO Mapping

Course	Program Outcomes

Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1													**2**	**3**
CO2													**2**	**2**
CO3													**3**	**2**
CO4													**3**	**2**
CO5													**3**	**2**

MBOT223DSC - Plant Bioinformatics & Research Methedology

Objective:
To discuss important results on Database, Sequence analysis, Gene prediction, Characteristics and types of scientific research, Citations and Publication processes.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**Plant Bioinformatics**	1	25 %
	Introduction to Bioinformatics, Overview, Internet and Bioinformatics Application		
	Database: Database in Bioinformatics, Various biological database, Protein and Nucleotide sequence Database. Protein sequence, structure and classification database, pathway database.		
	Sequence analysis: Pairwise alignment, local and global alignment, Scoring matrices, multiple sequence alignment.		
	Tools for sequence alignment, programming algorithms.		
II	**Plant Bioinformatics**	1	25 %
	Gene prediction: Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods: Neural Networks, Pattern Discrimination methods, Signal sites predictions, Evaluation of Gene prediction methods		
	Transcriptomics: Complete transcript cataloguing and gene discovery-sequencing based approach, Microarray based technologies and data analysis.		
	RNA secondary structure prediction.		
	Introduction to Chemi-informatics.		
III	**RESEARCH METHODOLOGY-I**	1	25 %
	Characteristics and types of scientific research		
	Basics of research methodology		
	Research and Experimental design		
	Method of Data collection		
IV	**RESEARCH METHODOLOGY-II**	1	25 %
	Scientific Deliveries and Communications: Writing Research proposal, Paper, Thesis, Report and Citations.		
	Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications.		
	Presenting scientific research: Power point presentations, Posters, Flyers, etc.		
	Publication processes, Review Processes and Significance of scientific communications.		

Reference Books:

1. Patilv C. S., Ajit Gangawane and Srinath Rao, Bioinformatics and Bioinformation (2011) APH Publishing Corporation. NewDelhi.

2. Arumugam N., Gopi A., Sundaralingam R., Meena A., and Kumarasen V (2010).
3. Biostatistics Computer Application Bioinformatics instrumentation Saras publication Nagar coil (TN).
4. Irfan A Khan and Atiya Khanum, Emerging trends in Bioinformatics (2002) Ukaaz Publications Hyderabad.
5. Padmini E. Biochemical calculations and Biostatistics (2007) Books and Allied (P.) Ltd. Kolkata.
6. Sudara Rajan S. and Balaji R. Introduction to Bioinformatics (2003) Himalaya Publishing House.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of understand the concept of. Reflect upon the role of various models in molecular evolution. Analyze the role of (QSAR) techniques in Drug Design.

Gain knowledge about basic. Develop laboratory experiment related skills. Develop competence on data collection and process of scientific documentation. Analyze the ethical aspects of research. Evaluate the different methods of scientific writing and reporting

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of understand the concept of. Reflect upon the role of various models in molecular evolution.
CO2	Analyze the role of (QSAR) techniques in Drug Design.
CO3	Gain knowledge about basic. Develop laboratory experiment related skills.
CO4	Develop competence on data collection and process of scientific documentation
CO5	Analyze the ethical aspects of research. Evaluate the different methods of scientific writing and reporting

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**1**	**1**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**2**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**2**	**-**	**-**	**3**	**2**	**2**	**2**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1													**2**	**3**
CO2													**2**	**2**

CO3													**3**	**1**
CO4													**2**	**1**
CO5													**2**	**2**

MBOT224DSC- HORTICULTURE AND PLANT BREEDING

Objective:

To discuss important results on Fundamentals of horticulture, Ornamental horticulture, Role of plant growth regulators in seed and bud dormancy, Modes of reproduction, Hybridization, Polyploidy in plant breeding and Plant Breeder's Right.

Credit: 4

Unit	Description in detail	Credit	Weightage
I	**HORTICULTURE-I**	1	25 %
	Fundamentals of horticulture (History, nature and scope of horticulture)		
	Origin of Horticulture: Domestication of plants, importance of horticulture in terms of economy, horticultural crops, pomology, olericulture, spices and planting,		
	Ornamental horticulture: horticultural climatic zones of India and Gujarat, development of horticulture in India		
	Divisions of horticulture, nutritive value and nutra-ceutical properties of horticultural crops.		
II	**HORTICULTURE-II**	1	25 %
	Factors influencing horticultural crop production		
	Growth and development: seed physiology; dormancy and germination, physiology of flowering, pollination, fruit set, fruit ripening and senescence.		
	Factors influencing growth and development: soil, light, temperature, rainfall, humidity, wind.		
	Role of plant growth regulators in seed and bud dormancy, juvenility, maturity and senescence, flowering, pollination, fruit set including parthenocarpy, fruit growth, fruit drop and fruit ripening (climacteric and non- climacteric) and fruit colour development, tuber and bulb formation and sex expression and extension of shelf life in fruits, vegetables and flowers.		
III	**PLANT BREEDING-I**	1	25 %
	History, methods, goals, objectives and applications of plant breeding, Origin, domestication and introduction of crop plants.		
	Modes of reproduction: asexual and sexual reproduction.		
	Methods of plant breeding in Self and Cross Pollinated crops (pedigree method, bulk method, backcross method), merits and demerits of methods.		
	Selection: pure line selection, mass selection, recurrent selection, population improvement, hybrid variety, synthetic variety.		
IV	**PLANT BREEDING-II**	1	25 %
	Hybridization: History , techniques and consequences, objectives, types of hybridization – choice of parents, evaluation of parents, emasculation – different methods, bagging, tagging, pollination , harvesting and storing of the F1 seeds and selfing, consequences of hybridization, Hybrid vigour.		
	Polyploidy in plant breeding: Application of polyploidy in crop improvement and its limitations.		

	Basics of Genetically modified plants, Seed certification, Plant Breeder's Right, Biosafety and Bioethics.		
	Intellectual Property Rights (IPR), Patents: Concept and Benefits.		

Reference Books:

1. Adams, C.R. and M. P. Early(2004) Principles of horticulture. Butterworth – Heinemam, Oxford University Press.
2. Chadha, K.L (2001) Handbook of Horticulture, ICAR, New Delhi.
3. Chandra, R. and M. Mishra. (2003) Micropropagation of horticultural crops. International Book Distributing Co., Lucknow.
4. Chattopadhyaya, P.K (2001) A text book on Pomology (Fundamentals of fruit growing) Kalyani Publication, New Delhi
5. Christopher, E.P (2001) Introductory Horticulture, Biotech Books, New Delhi
6. Edmond, J.B. T.L.Senn, F.S. Andrews and P.G.Halfacre (1975) Fundamentals of Horticulture, Tata MC. Graw Hill Publishing Co.New Delhi
7. Hartman, H.T. and Kester, D.E (1986) Plant propagation – Principles and Practices – Prentice Hall of India Ltd., New Delhi.
8. Jitendra Singh (2006) Basic Horticulture. Kalyani Publishers, New Delhi.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of develop their competency on pre and post-harvest technology in horticultural crops .Analyze the different methods of weed control and harvest treatments of horticultural crops.Examine the economic implications of cultivation of tropical and sub-tropical vegetable crops .Evaluate the importance of floriculture and contribution spices and condiments on economy.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of develop their competency on pre and post-harvest technology in horticultural crops.
CO2	Analyze the different methods of weed control and harvest treatments of horticultural crops.Examine the economic implications of cultivation of tropical and sub-tropical vegetable crops
CO3	Evaluate the importance of floriculture and contribution spices and condiments on economy.
CO4	Gain knowledge about basic familiarize with genetic basis of heterosis. Classify Sexual and Asexual modes of reproduction.
CO5	Explain monogenic and polygenic inheritance. Reflect upon the role of various non- conventional methods used in crop improvement.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**1**	**-**	**-**	**2**	**2**	**1**	**1**				

CO3	**2**	**1**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**2**	**-**	**-**	**2**	**2**	**2**	**3**				
CO5	**1**	**2**	**-**	**-**	**2**	**3**	**3**	**2**				

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes**													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1													**2**	**2**
CO2													**2**	**2**
CO3													**3**	**2**
CO4													**2**	**2**
CO5													**2**	**2**

MBOT225SE - The environment Pollution & Climate change

Objective:

To discuss important results on Atmospheric composition and climate, pollution effect on human health, Stratospheric ozone depletion, Climate change and Biomonitoring of air pollution.

Credit: 2

Unit	Description in detail	Credit	Weightage
I	**Unit-1**	1	25 %
	Atmospheric composition and climate; gaseous and particulate pollutants, indoor air pollution.		
	Sulphur derivatives: Sources, effects on plants and human health, mechanism of toxicity, resistance and buffering, sulphur metabolism.		
	Nitrogen derivatives: Formation and sources; uptake, metabolism, critical load; effects on plants, eco systems and human health.		
	Fluoride derivatives: Sources, bioaccumulation, effects on plants and human health. Tropospheric ozone: Formation, photochemical smog; effects on plants and human health, mechanism of toxicity, induction of defense system.		
II	**Unit-2**	1	25 %
	Stratospheric ozone depletion: Phenomenon, causes, effects of enhanced UV-Bon terrestrial plants, microbes, marine life and human health; mechanisms of action, evolution of land plants in relation to UV radiation.		
	Climate change: Green house effects: process; drivers of climate change; consequences, global warming, sea level rise, agriculture, natural vegetation; human implications, effects of increased CO2 on plants, carbon sequestration in terrestrial ecosystem.		
	Acid rain: Formation, deposition, trends; consequences on soil fertility, aquatic and terrestrial ecosystems; forest decline.		
	Biomonitoring of air pollution: Concept, active and passive monitoring; bioindicator parameter.		

Reference Books:

1. Bell J N B, Treshow M (2002) Air Pollution and Plant Life, John Wiley and Sons Ltd, NewYork.
2. Omasa K, Nouchi I, DeKok L J (2005) Plant responses to air pollution and global change, Springer Japan, Tokyo.
3. Agrawal S B, Agrawal M (1999) Environmental Pollution and Plant Responses, CRC Press, BocaRaton, USA.

Outcome:

After successfully completion of the course, the student will be able to…….

The student understands the concept of Analyse the causes and effects of depletion of stratospheric ozone layer. Examine the climate change and its effect on living beings. Understand the physical basis of natural green gashouse effect on man and materials.Evaluate human influenced

Course Outcomes: At the end of the course, students shall be able to

CO1	The student understands the concept of Analyse the causes and effects of depletion of Stratospheric ozone layer.
CO2	The student Examine the climate change and its effect on living beings.
CO3	The student Understand the physical basis of natural green gashouse effect on man and materials.
CO4	The student understands Evaluate human influenced
CO5	Identify some climate change policies and adaptation measures

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**3**				
CO2	**3**	**2**	**-**	**-**	**2**	**2**	**2**	**2**				
CO3	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**2**				
CO4	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**3**				
CO5	**3**	**2**	**-**	**-**	**3**	**2**	**2**	**2**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1													**2**	**3**
CO2													**2**	**2**
CO3													**3**	**3**
CO4													**2**	**2**
CO5													**3**	**3**