




PRINCIPAL AND CORE BOTANY SEMESTER I


	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2020-2021		
Bachelor of Science (Hons.) Botany				
YEAR	1	Paper 1: BOT 1101 CT/ PT	CREDIT	3
Semester	1	Diversity of plants	HOURS	45
OBJECTIVES:		To familiarize the students with diversity of plants.		
COURSE CONTENT / SYLLABUS				
UNIT-I	Diversity of plants and Microbes Introduction to plant diversity, concept of plant kingdom, different systems of classification Viruses: Physiochemical and biological characteristics, General structure. Bacteria: Archaeobacteria and Eubacteria General characteristics, structure and types. Fungi : General characteristics, general structure and reproduction. <i>Saccharomyces</i> , <i>Aspergillus</i> , <i>Agaricus</i> . Economic importance of Microbes in agriculture and industry			15 hrs.
UNIT-II	Cyanobacteria and Algae Cyanobacteria: Occurrence and range of thallus organization, Characteristic features, cell structure and heterocyst structure, Method of reproduction (general), <i>Nostoc</i> , <i>Oscillatoria</i> (life cycles). Algae: Occurrence and range of thallus organization, Characteristic features, cell structure and types of reproduction, Economic importance of algae i.e. role of algae in environment, agriculture and industry. <i>Ulothrix</i> and <i>Sargassum</i> (Life cycles).			15 hrs.
UNIT-III	Archegoniate plants Bryophytes: Occurrence and range of thallus organization, Characteristic features. <i>Riccia</i> , <i>Funaria</i> . (Life cycles) Ecological and economical importance of bryophytes. Pteridophytes: Occurrence, Characteristic features. <i>Psilotum</i> , <i>Selaginella</i> , <i>Equisetum</i> , <i>Nephrolepis</i> . (Life cycles) Ecological and economical importance of Pteridophytes. Gymnosperms: Characteristic features, <i>Cycas</i> (life cycle). Ecological and economical importance of Gymnosperms			15 hrs.
REFERENCES				
<ol style="list-style-type: none"> 1. Gangulee, S. C., Das, K.S, Dutta, C.D. and Kar, A.K. (1968) College Botany Vol. I and Vol. II 2. Smith, G. M. - (1972) Cryptogamic Botany Vol. I and Vol. II . McGraw-Hill 3. Verma, J.P. - (1968) The Bacteria, Vikas Publications 4. Clifton, A. (1950) Introduction to Bacteria, McGraw - Hill 5. Parihar, N.S. -(1956) Bryophyta 6. Parihar, N.S. -(1955) Pteridophyta 7. Vashishta, B.R. -(1962) Botany for Degree Students: Vol. II Fungi 8. Vashishta, B.R. - (2006) Botany for Degree Students: Vol. III Bryophyta 				


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Bachelor of Science (Hons.) Botany				
YEAR	1	Paper II : BOT 1102 CT/ PT	CREDIT	2
Semester	1	Plant Resources	HOURS	30
OBJECTIVES:	To familiarize the students with different resources from plants for human welfare			
COURSE CONTENT / SYLLABUS				
UNIT-I	Plants for human welfare			15 hrs.
	Fibers: Classification based on the origin of fibers. Cotton, jute and coconut (Morphology, extraction and uses) Natural Rubber: Para – rubber : tapping, processing, and uses. Tobacco: Morphology, processing, uses and health hazards Essential oils: General account, extraction methods, any two examples. Timber Plants: General account with special reference to teak and mango Drug yielding plants: Five common drug yielding plants: <i>Adhatoda</i> , <i>Ocimum</i> , <i>Tinospora cordifolia</i> , <i>Withania somnifera</i> , <i>Azadirachta indica</i>			
UNIT-II	Major crops			15 hrs.
	Cereals: Wheat, Rice, Maize and brief account of millets (Morphology, processing & uses) Legumes: Pigeon pea, green gram, green pea, soyabean, chick pea (Morphology, processing & uses) Oil and fats: General description, classification, extraction & their uses (ground nut, sunflower, cottonseed, soyabean) Spices: Fennel, coriander, cumin, mustard, turmeric (morphology and processing & uses) Beverages: Tea, coffee, cocoa, (morphology, processing & uses) Sugars & starches: Morphology, processing of sugarcane, products & by products of sugarcane industry. Potato: morphology, propagation and uses			
REFERENCES				
1. A. Hill - (1972) Economic Botany. 2. P.L. Kochar - (1981) Economic Botany. 3. S.D. Sabnis and M. Daniel – (1990) A Phytochemical Approach to economic Botany				


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Bachelor of Science (Hons.) Botany				
YEAR	1	Paper III : BOT 1103 CL/ PL	CREDIT	3
Semester	1	Plant Diversity and Resources	HOURS	90
OBJECTIVES: To familiarize the students with different resources from plants for human welfare				
COURSE CONTENT / SYLLABUS				
	<ol style="list-style-type: none"> 1. Study of Simple and Compound microscope 2. Type study of cyanobacteria <i>Nostoc</i> and <i>Oscillatoria</i> 3. Type study of algae <i>Ulothrix</i> and <i>Sargassum</i> 4. Type study of fungi <i>Saccharomyces</i> , <i>Aspergillus</i> and <i>Agaricus</i> 5. Type study of bryophytes <i>Riccica</i> and <i>Funaria</i> 6. Type study of pteridophytes <i>Psilotum</i>, <i>Selaginella</i>, <i>Equisetum</i> and <i>Nephrolepis</i> 7. Type study of gymnosperms <i>Cycas</i> 8. Study of Cereals (wheat, rice maize) and Legumes (pigeon pea, green gram, green pea, soyabean, chick pea) 9. Study of Fibers (Cotton, jute, coconut) , Natural rubber and Timber yielding plants 10. Study of Oil and fats (groundnut, sunflower, cotton seed, soyabean- oils) and Essential oils (lemongrass, vetiver, rose, orange) 11. Study of Drug yielding plants <i>Adhatoda</i>, <i>Ocimum</i>, <i>Tinospora</i>, <i>Withania</i> and <i>Azadirachta</i> 12. Study of Spices (fennel, Coriander, cumin, mustard, turmeric), Beverages (tea, coffee, cocoa) , Sugars and starches (sugarcane and potato) 			6 Hrs per week
REFERENCES				
<ol style="list-style-type: none"> 1. Gangulee, S. C., Das, K.S, Dutta, C.D. and Kar, A.K. (1968) College Botany Vol. I and Vol. II 2. Smith, G. M. - (1972) Cryptogamic Botany Vol. I and Vol. II . McGraw-Hill 3. Verma, J.P. - (1968) The Bacteria, Vikas Publications 4. Clifton, A. (1950) Introduction to Bacteria, McGraw - Hill 5. Parihar, N.S. -(1956) Bryophyta 6. Parihar, N.S. -(1955) Pteridophyta 7. Vashishta, B.R. -(1962) Botany for Degree Students: Vol. II Fungi 8. Vashishta, B.R. - (2006) Botany for Degree Students: Vol. III Bryophyta 9. A. Hill - (1972) Economic Botany. 10. P.L. Kochar -(1981) Economic Botany. 11. S.D. Sabnis and M. Daniel – (1990) A Phytochemical Approach to economic Botany 				

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SEMESTER II


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Bachelor of Science (Hons.) Botany				
YEAR	1	Paper 1: BOT 1201 CT/ BOT 1201 PT Plant Architecture	CREDIT	3
Semester	2		HOURS	45
OBJECTIVES: To study the morphological and anatomical features of plant parts.				
COURSE CONTENT / SYLLABUS				
UNIT-I	Diverse morphological features in Angiosperms Vegetative, floral & fruit morphology: Root, stem, leaf, bract, peduncle & inflorescences, flower, fruit and seed			15 hrs.
UNIT-II	Plant tissue system (meristem & simple tissues) Cell wall: Layers, functions, formation of cell wall. Inter-cellular communications: Plasmodesmata. Pits: Structure, types & functions. Meristematic tissues: Characteristic features, types of meristems. Procambium & vascular cambium: Structure & functions Cork cambium: Structure of periderm & formation. Permanent simple tissue: Structure, types and functions of parenchyma, collenchyma, Sclerenchyma			15 hrs.
UNIT-III	Complex and Reproductive tissues Complex Tissue: Conducting elements Xylem & Phloem, secretory tissue Organs: Structure of monocot & dicot root, stem and leaf Adaptive & protective system: Epidermis, cuticle – Structure, Variations and functions. Stomata and trichomes: Structure, types and functions. Structural organization of flower: Structure of anther, structure of ovules & the types, embryo sac.			15 hrs.
REFERENCES				
<ol style="list-style-type: none"> 1. Gangulee, H.C., Das, K.S, Dutta, C.D. and Kar, A.K. (1968) College Botany Vol. III 2. Dutta A.C. - (1964) Botany for degree students. 3. Hickey M, King .C.(2002) The Cambridge Illustrated Glossary of Botanical Terms, Cambridge University press. 4. Sporne K.R. - (1968) The morphology of vascular plants. 5. Sharma O.P - (1968) Plant Taxonomy 6. Pandey B.P. - (1968) Taxonomy of Angiosperms. 7. Vashishta P.C - (1968) Taxonomy of Angiosperms. 8. K. Esau - (1961) Plant Anatomy. 9. A Fahn - (1968) Plant Anatomy. 10. B.P. Pandey - (1978) Plant Anatomy. 				


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Bachelor of Science (Hons.) Botany					
YEAR	1	Paper 2: BOT1202 CT / BOT1202 PT		CREDIT	2
Semester	2	Plant interactions		HOURS	30
OBJECTIVES:		To familiarize the students with interaction of plants with microbes and other organisms.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Plant-microbe interactions Life of microbes in rhizosphere with emphasis on chemical diversity. Life of microbes on aerial plant parts. Life of microbes inside the plant. Associations: Negative (destructive) associations (diseases) Positive (beneficial) associations (symbiosis). Microbe-microbe interactions: Symbiosis between Algae & fungi (Lichens), Structure, types, Economic importance, reproduction. Antagonistic interactions: Amensalism, Competition, Parasitism & Predation.				15 hrs.
UNIT-II	Plant interactions with other organisms Plant-pollinator interactions: Reproductive traits, defence signals. Plant-parasite host response: Parasitic vascular plants. Plant-plant contact: Mutualism, Allelopathy (inhibition of competitions). Nitrogen fixation Plant-herbivore interactions				15 hrs.
REFERENCES					
<ol style="list-style-type: none"> 1. Odum, E. P. and Barrett, G. W. (2005). Fundamentals of Ecology, 5th Edition, Cengage Learning, New Delhi, India; 598 p 2. Sharma, P. D. (2009). Ecology and Environment, 10th Revised Edition, Rastogi Publications, Merrut, India: 600 p 3. Smith, T. M. & Smith, R. L. (2006). Element of Ecology, 6th Edition, Pearson Education, New Delhi, India; 658 p 4. Chapman, J. L. and Reiss, M. J. (1992). Ecology – Principles and Applications, Cambridge University Press, Cambridge, UK: 294 p 					


 <p>THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA सत्यं शिवं सुन्दरम्</p>	<p align="center">The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in</p>		<p align="center">ACADEMIC YEAR 2020-2021</p>		
<p align="center">Bachelor of Science (Hons.) Botany</p>					
YEAR	1	Paper 3 : BOT1203 CL / BOT1203 PL		CREDIT	3
Semester	2	Botany Practical II PLANT ARCHITECTURE AND INTERACTIONS		HOURS	90
<p>OBJECTIVES: To familiarize the students practically the morphological and anatomical features of plant parts.</p>					
<p align="center">COURSE CONTENT / SYLLABUS</p>					
	<ol style="list-style-type: none"> 1. Root Morphology and Morphology of Stem 2. Morphology Leaf – I & II 3. Morphology of Bracts, Peduncle and Inflorescence 4. Morphology of Flower – I,II,III 5. Angiosperms Classification & Morphological description of Plant 6. Study of tissue types in Dicot & Monocot stem and differences between them . 7. Study of Dicot & Monocot root including differences with stem. 8. Study the structure of leaf 9. Study of variations in the different plant tissues 10. Study examples of : <ul style="list-style-type: none"> Microbe-microbe interaction-Lichen Plant-plant interaction-Parasite <i>Cuscuta</i>, <i>Loranthus</i> Plant insect interaction- Galls Plants and microbes mutualistic relationship- <i>Rhizobium</i>, <i>Mycorrhiza</i> 				<p align="center">6 Hrs per week</p>
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<ol style="list-style-type: none"> 1. Gangulee, H.C., Das, K.S, Dutta, C.D. and Kar, A.K. (1968) College Botany Vol. III 2. Dutta A.C. - (1964) Botany for degree students. 3. Hickey M, King .C.(2002) The Cambridge Illustrated Glossary of Botanical Terms, Cambridge University press. 4. Sporne K.R. - (1968) The morphology of vascular plants. 5. Sharma O.P - (1968) Plant Taxonomy 6. Pandey B.P. - (1968) Taxonomy of Angiosperms. 7. Vashishta P.C - (1968) Taxonomy of Angiosperms. 8. K. Esau - (1961) Plant Anatomy. 9. A Fahn - (1968) Plant Anatomy. 					

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SEMESTER III


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Bachelor of Science (Hons.) Botany			
YEAR	2	CREDIT	4
Semester	3	HOURS	60
Paper I- BOT 1301PT Diversity of Non-Flowering Plants			
OBJECTIVES: To familiarize the students with diversity among non flowering plants.			
COURSE CONTENT / SYLLABUS			
UNIT-I	Diversity of Algae		15 hrs.
	General Characters and group characteristics with suitable examples. Occurrence, thallus structure and reproduction in: <i>Oedogonium</i> , <i>Chara</i> , <i>Ectocarpus</i> , <i>Dictyota</i> , <i>Batrachospermu</i> and <i>Polysiphonia</i>		
UNIT-II	Diversity of Bryophytes		15 hrs.
	General Characters and group characteristics with suitable examples Occurrence, thallus structure, Morphology, anatomy and reproduction in: <i>Marchantia</i> , <i>Pellia</i> , <i>Anthoceros</i> and <i>Polytrichum</i>		
UNIT-III	Diversity of Pteridophytes		15 hrs.
	General characters and group characteristics with suitable examples Morphology, anatomy and reproduction in: <i>Lycopodium</i> , <i>Isoetes</i> , <i>Marsilea</i> , <i>Osmunda</i> and <i>Adiantum</i>		
UNIT-IV	Diversity of Gymnosperms		15 hrs.
	General characteristics and group characteristics with suitable examples Morphology, anatomy and reproduction in: <i>Zamia</i> , <i>Pinus</i> , <i>Biota</i> and <i>Ephedra</i>		
REFERENCES			
1. Smith, G.M. 1972 Cryptogamic Botany Vol I and II 2. Vasishtha, B.R. 1974 Botany for Degree students Vol I Algae 3. Vasishtha, B.R. 1974 Botany for Degree students Vol III Bryophyta 4. Vasishtha, P.C. 1974 Botany for Degree students Vol IV Pteridophyta 5. Vasishtha, P.C. 1976 Botany for Degree students Vol V Gymnosperms 6. Bhatnagar, S.P. and Alok Moitra 1996. Gymnosperms New Age International Publishers 7. Inderdeep Kaur and Prem Lal Uniyal 2019. Text book of Gymnosperms Daya Publishing house			


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	Bachelor of Science (Hons.) Botany				
YEAR	2	Paper II- BOT 1302 PT Cell Biology		CREDIT	4
Semester	3			HOURS	60
OBJECTIVES:		To provide basic knowledge of structure and functions of cell and cell organelles.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Introduction to Cellular Organization			15 hrs.	
	General structure and constituents of cell; Origin and Evolution of Cells, structure and function of plant cell wall, structure and function of cell membrane, Cell receptors, Signal transduction mechanisms, cell Junction, cytoskeletal elements, organization of the cytoskeleton				
UNIT-II	Nucleus			15 hrs.	
	Structure and function of Nucleus, Chromatin ultrastructure and DNA packaging in eukaryotic chromosome, Centromere and telomere: types, structure and function.				
UNIT-III	Cellular Organelles			15 hrs.	
	Structure and function of major organelles: Chloroplasts, Mitochondria, Ribosomes, Lysosomes, Peroxisomes, Endoplasmic reticulum, Golgi apparatus, Vacuoles, transport vesicles.				
UNIT-IV	Cell Cycle and Cell Death			15 hrs.	
	Cell division (Mitosis, Meiosis); cell cycle and its regulation, Kinetochore and spindle apparatus-structural organization and functions, Mechanism of cell cycle control in Yeast (checkpoints and role of MPF); Plant cell death – types, factors involved and its mechanism				
REFERENCES					
1. Earnshaw WC, Johnson GT, 2017. Cell biology. 3 rd Ed, Elsevier cop. 2. Karp J, Iwasa J, Marshall W, 2018. Karp's Cell biology. 8 th Ed, John Wiley. 3. Lodish HF et al. 2016. Molecular Cell Biology. 8th Ed. W.H. Freeman-Macmillan learning. 4. Primrose SB. 2001. Molecular Biotechnology. Panima. 5. Krebs JE, Goldstein ES, Kilpatrick ST, 2018. Lewin's Genes XII. Jones and Bartlett learning. 6. Bruce Alberts, 2017. Molecular Biology of the Cell. 6 th Ed. Garland Science. 7. Gunning B, Steer MW, 1996. Plant cell biology: structure and function. Jones and Bartlett Publishers. 8. Older editions of the books, easily affordable to students may also be referred.					


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Bachelor of Science (Hons.) Botany										
<table border="1" style="width: 100%;"> <tr> <td style="width: 50%;">YEAR</td> <td style="width: 50%;">2</td> </tr> <tr> <td>Semester</td> <td>3</td> </tr> </table>	YEAR	2	Semester	3	BOT 1303 PL: Paper III- Botany Practical -III	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%;">CREDIT</td> <td style="width: 50%;">4</td> </tr> <tr> <td>HOURS</td> <td>120</td> </tr> </table>	CREDIT	4	HOURS	120
YEAR	2									
Semester	3									
CREDIT	4									
HOURS	120									
OBJECTIVES:	To practically make students understand the diversity among non flowering plants To understand basic cell structure and its components									
COURSE CONTENT / SYLLABUS										
	<ol style="list-style-type: none"> 1. Morphology and anatomy of vegetative and reproductive parts in: <ul style="list-style-type: none"> ▪ <i>Oedogonium, Chara, Dictyota, Batrachospermum</i> ▪ <i>Marchantia, Anthoceros, Polytrichum</i> ▪ <i>Lycopodium, Isoetes, Marsilea, Adiantum</i> ▪ <i>Zamia, Pinus, Biota</i> 2. Plant cell structure in epidermal peel of Onion/Rheo 3. Study of electron micrographs for internal organelles 4. Study of plasmolysis and deplasmolysis 5. Study of Mitosis 6. Staining techniques for plant cell and cell wall 7. Chromosome structure 8. Shapes of chloroplast in plant cells (Members of algae as an example) 9. To study Yeast growth curve 	8 Hrs a week								
REFERENCES										
<ol style="list-style-type: none"> 1. Vasishtha, B.R. 1974 Botany for Degree students Vol I Algae 2. Vasishtha, B.R. 1974 Botany for Degree students Vol III Bryophyta 3. Vasishtha, P.C. 1974 Botany for Degree students Vol IV Pteridophyta 4. Vasishtha, P.C. 1976 Botany for Degree students Vol V Gymnosperms 5. Earnshaw WC, Johnson GT, 2017. Cell biology. 3rd Ed, Elsevier cop. 6. Karp J, Iwasa J, Marshall W, 2018. Karp's Cell biology. 8th Ed, John Wiley. 7. Lodish HF et al. 2016. Molecular Cell Biology. 8th Ed. W.H. Freeman-Macmillan learning. 										

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SEMESTER IV


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Bachelor of Science (Hons.) Botany				
YEAR	2	Paper I: BOT 1401 PT	CREDIT	4
Semester	4	Plant Ecology	HOURS	60
OBJECTIVES: To familiarise the students with basic principles of ecology and ecosystems.				
COURSE CONTENT / SYLLABUS				
UNIT-I	Components of Ecosystem			15 hrs.
	Introduction, Abiotic components and biotic components, Organisms response to abiotic components, specific adaptations to biotic and abiotic components			
UNIT-II	Ecosystems			15 hrs.
	Ecosystem, structure and function; types of ecosystems; Trophic organisation; Energy flow; Nutrient cycling; Cycling of carbon, water and nitrogen; Production and Productivity			
UNIT-III	Synecology (Community Ecology)			15 hrs.
	Plant communities, Characteristics; Classification of communities; Succession, process, types; Climax community, Ecotone and edge effect; Habitat and niche			
UNIT-IV	Autecology (Population Ecology)			15 hrs.
	Plant population studies, r and k- selection; Ecological speciation (Ecads, ecotypes), Biodiversity and conservation; Global environmental changes (Human population growth, Pollution, Climate change)			
REFERENCES				
<ol style="list-style-type: none"> 1. Ecology by Robert E. Ricklefs and Gary L. Miller 4th edition by W. H. Freeman Publications, 1999. 2. Ecology by William D. Bowman, Sally D. Hacker and Michael L. Cain 4th edition by Oxford University Press, USA Publications, 2017. 3. Fundamentals of Ecology by Eugene. P. Odum and Gary W. Barrett 5th edition by BrookCole Publications, 2004. 4. Ecology: The experimental Analysis of Distribution and Abundance by Charles J. Krebs 6th edition by Pearson Education Publications, 2016. 5. Ecology by P. N. Michael 1st edition by CBS Publishers and Distributors, 2016. 6. Ecology by Stanley I. Dodson, Timothy F. H. Allen, Stephen R. Carpenter, Anthony R. Ives, Robert L. Jeanne, James F. Kitchell, Nancy E. Langston and Monica G. Turner by Oxford University Press, 1998. 7. Ecology: Principles and Applications by J. L. Chapman and M. J. Reiss 2nd edition by Cambridge University Press, 1999. 				


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Bachelor of Science (Hons.) Botany					
YEAR	2	Paper II: BOT 1402 PT		CREDIT	4
Semester	4	Genetics and Plant breeding		HOURS	60
OBJECTIVES:		To develop basic understanding of classical and molecular genetics and plant breeding.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Introduction to Genetics				15 hrs.
	Early concepts of inheritance; Mendelian and Non-Mendelian inheritance, multiple Allelism; Sex determination, Differentiation and sex-linkage, Sex-influenced and sex limited traits; linkage, recombination and genetic mapping.				
UNIT-II	Cytogenetics and Population Genetics				15 hrs.
	Numerical changes in chromosomes: Aneuploidy and Polyploidy: Types, examples, meiotic behaviour and importance of Aneuploidy, Polyploidy; Speciation and evolution through polyploidy. Structural changes in chromosomes: Types, meiotic behaviour of Deletion, Duplication, Translocation, and Inversion, male sterility and genetic incompatibility; Population Genetics: Populations and gene pool, Genetic variation and evolution; Genotypic and gene frequencies; Evolutionary change and the Hardy-Weinberg law; applications of the Hardy-Weinberg law; Migration; random genetic drift; Founder effect and bottlenecks.				
UNIT-III	Plant Breeding				15 hrs.
	Plant breeding: introduction and objectives, breeding systems- modes of reproduction in crop plants, important achievements and undesirable consequence of plant breeding. Methods of crop improvement: Introduction- centres of origin and domestication of crop plants, plant genetics resources; acclimatization, selection methods- for self-pollinated, cross pollinated and vegetatively propagated crops, hybridization- procedure, advantages and limitations. Mass selections and Pure line selection, Back cross method.				
UNIT-IV	Methods In Plant Breeding				15 hrs.
	Heterosis and hybrid seed production, Male sterility and its use in plant breeding; Inbreeding and inbreeding depression, effect of outcrossing- a very brief idea; Molecular Breeding (use of DNA markers in plant breeding).				
REFERENCES					
<ol style="list-style-type: none"> 1. Klug WS & Cummings MR. 2003 Concepts of Genetics. Peterson Education 2. Lewin B. 2008. Genes IX. Jones & Bartlett Publ. 3. Russell PJ. 1998. Genetics. The Benjamin/Cummings Publ. Co. 4. Strickberger MW. 1990. Genetics. Collier MacMillan. 5. Tamarin RH. 1999. Principles of Genetics. Wm. C. Brown Publs. 6. Uppal S, Yadav R, Subhadra & Saharan RP. 2005. Practical Manual on Basic and Applied Genetics. Dept. of Genetics, CCS HAU Hisar. 7. B.D. Singh, 1995. Plant breeding. 5th Ed, Kalyani Publishers. 8. JM Poehlman, 2005. Breeding field crops. Blackwell publishers. 					

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	Bachelor of Science (Hons.) Botany				
YEAR	2	Paper III: BOT 1403 PL		CREDIT	4
Semester	4	Botany Practical-IV		HOURS	120
OBJECTIVES: To develop basic understanding of classical and molecular genetics and plant breeding.					
COURSE CONTENT / SYLLABUS					
	<ol style="list-style-type: none"> 1. Plant ecological adaptations – Hydrophytes, Xerophytes and Halophytes 2. Quadrate study 3. Tree biomass estimation 4. Physical, chemical and biological characters of soil 5. Problems on monogenic and digenic inheritance 6. Problems pertaining to genetic interactions 7. Problems of sex-linkage 8. Problems of genetic recombination mapping 9. Squash of root tips for studying cell division 10. Squash of flower buds for meiotic studies 11. Emasculation of flowers 12. Any other practicals relevant to theory papers which aids in improving student understanding can be added. 				8 Hrs a week
REFERENCES					
<ol style="list-style-type: none"> 1. Klug WS & Cummings MR. 2003 Concepts of Genetics. Peterson Education 2. Lewin B. 2008. Genes IX. Jones & Bartlett Publ. 3. Russell PJ. 1998. Genetics. The Benzamin/Cummings Publ. Co. 4. Strickberger MW. 1990. Genetics. Collier MacMillan. 5. Tamarin RH. 1999. Principles of Genetics. Wm. C. Brown Pubs. 6. Uppal S, Yadav R, Subhadra & Saharan RP. 2005. Practical Manual on Basic and Applied Genetics. Dept. of Genetics, CCS HAU Hisar. 7. B.D. Singh, 1995. Plant breeding. 5th Ed, Kalyani Publishers. 8. JM Poehlman, 2005. Breeding field crops. Blackwell publishers. 9. Ecology by Robert E. Ricklefs and Gary L. Miller 4th edition by W. H. Freeman Publications, 1999. 10. Ecology by William D. Bowman, Sally D. Hacker and Michael L. Cain 4th edition by Oxford University Press, USA Publications, 2017. 11. Fundamentals of Ecology by Eugene. P. Odum and Gary W. Barrett 5th edition by BrookCole Publications, 2004. 12. Ecology: The experimental Analysis of Distribution and Abundance by Charles J. Krebs 6th edition by Pearson Education Publications, 2016. 					


GENERIC ELECTIVE BOTANY SEMESTER III


GENERIC ELECTIVE I

	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2020-2021		
Bachelor of Science (Hons.)				
YEAR	2	Generic Elective I	CREDIT	3
Semester	3	Paper I :BOT 1301ET	HOURS	45
Plant Systematics and development (Theory)				
OBJECTIVES:	The students will be able to classify Plants and enable them to prepare herbarium. The students will understand basic structure of flower and understand different developmental processes during micro and megasporogenesis.			
COURSE CONTENT / SYLLABUS				
UNIT-I	Basics of Plant Systematics Introduction: Aims and components of systematics; identification, nomenclature and classification, Taxonomic categories Nomenclature: Principles and rules of Nomenclature; ranks and names; type method. Storage and Preservation: Importance of herbarium specimens and their preparation, other methods of storing plant material. Herbaria and Botanical Garden. Systems of Classification: Types of classification, Bentham and Hooker's System			15 hrs.
UNIT-II	Methods in Systematics and Families of Angiosperms Polypetalae: Annonaceae, Malvaceae, Rutaceae, Meliaceae, Fabaceae, Caesalpiaceae, Mimosaceae. Gamopetalae: Asteraceae, Apocynaceae, Solanaceae, Lamiaceae. Monoclamydae: Amaranthaceae, Euphorbiaceae (Inclu. Phyllanthaceae). Monocotyledonae: Liliaceae, Poaceae.			15 hrs.
UNIT-III	Developmental biology Introduction of flowering; flower as a modified determinate shoot. Anther wall: Structure and functions, microsporogenesis, Microgametogenesis; Pollen wall structure, NPC system; Palynology and scope (a brief account) Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac. Pollination types and significance, path of pollen tube in pistil, double fertilization.			15 hrs.
REFERENCES				
<ol style="list-style-type: none"> 1. Plant Developmental biology-Biotechnological Perspective Vol I 2009 2. B.M. Johri and P.S. Srivastava 2001 Reproductive biology of plants 3. S.S. Bhojwani and S.P. Bhatnagar 2008 The Embryology of Angiosperms 4. Gurucharan Singh. Plant Systematics 5. O.P. Sharma. Plant Taxonomy. 6. Judd. Plant Systematics. 				

		<p align="center">The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj , Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in</p>		ACADEMIC YEAR 2020-2021		
Bachelor of Science (Hons.)						
YEAR	2	Generic Elective I		CREDIT	1	
Semester	3	Paper II :BOT 1302EL		HOURS	30	
Plant Systematics and development (Practical)						
OBJECTIVES:		<p>The students will practically examine the characteristic features and classify Plants and learn to prepare herbarium.</p> <p>Students will practically observe the different parts of the reproductive structures in the plants and variations in them.</p>				
COURSE CONTENT / SYLLABUS						
		<ol style="list-style-type: none"> 1. Study the structure of anther 2. Study of different types of pollen 3. Male and female gametogenesis 4. Structure of ovule 5. Placentation types 6. Study of monocot and dicot embryo 7. Preparation of herbarium 8. Study of vegetative and floral characters of the families prescribed in the theory. 9. Any other practicals relevant to theory paper which helps in students understanding will be added. 			2 Hrs per week	
REFERENCES						
<ol style="list-style-type: none"> 1. Plant Developmental biology-Biotechnological Perspective Vol I 2009 2. B.M. Johri and P.S. Srivastava 2001 Reproductive biology of plants 3. S.S. Bhojwani and S.P. Bhatnagar 2008 The Embryology of Angiosperms 4. Gurucharan Singh. Plant Systematics 5. O.P. Sharma. Plant Taxonomy. 6. Judd. Plant Systematics. 						


GENERIC ELECTIVE II


	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2020-2021		
Bachelor of Science (Hons.)				
YEAR	2	Generic Elective 2: Paper I: BOT 1303ET Physiology and Biochemistry of plants (Theory)	CREDIT	3
Semester	3		HOURS	45
OBJECTIVES:		To understand the principles and concepts of physiology and biochemistry of plants		
COURSE CONTENT / SYLLABUS				
UNIT-I	Transportation of Water and Nutrition Plant water relationships- Water potential, pathway of water movement, Water and plant cells, Ascent of sap- cohesion-tension theory; Transpiration and factors affecting transpiration, Nutrient uptake and translocation in phloem- Macro and micronutrients, Experiments and mutants to study nutritional deficiency in plants, essential elements and chelating agents, Role of ATP, carrier system, proton-ATPase pump and ion flux in nutrient uptake			15 hrs.
UNIT-II	Photosynthesis and Nitrogen Metabolism Photosynthesis- Photopigments and its role, Antenna complex and reaction centres, light reactions, carbon reactions, photorespiration, C3, C4, CAM photosynthesis, Respiration, control and regulation of photosynthetic reactions Nitrogen metabolism: Assimilation of nitrate by plants, Biochemistry of dinitrogen fixation in Rhizobium, GS and GOGAT enzyme system			15 hrs.
UNIT-III	Phytohormones, Movements, Photoresponses and Senescence. Role of plant hormones: auxin, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, strigolactones, Jasmonic acid, Salicylic acid; Phototropism and Gravitropism; phytochromes and light control of plant development, blue-light responses; Photoperiodism; plant circadian rhythm; vernalization, Senescence and cell death			15 hrs.
REFERENCES				
1. Salisbury FB, Ross CW, 2009. Plant physiology. 4 th Ed., Cengage learning. 2. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Plant physiology and development. 6 th Ed, Oxford University press. 3. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Fundamentals of plant physiology. 1 st Ed, Oxford University press. 4. Buchanan Bob et al., 2015. Biochemistry and molecular biology of plants. 2 nd Ed., Wiley-Blackwell. 5. Voet D, Voet JG, Pratt CW, 2016. Fundamentals of Biochemistry. 5 th Ed., Wiley.				

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Bachelor of Science (Hons.)					
YEAR	2	Generic Elective 2:		CREDIT	1
Semester	3	Paper II: BOT 1304 EL		HOURS	30
Physiology and Biochemistry of plants (Practical)					
OBJECTIVES:	To perform experiments and understand the principles and concepts of physiology and biochemistry of plants				
COURSE CONTENT / SYLLABUS					
	<ol style="list-style-type: none"> 1. Estimation of plant water potential using <i>Rheo</i> leaf method 2. Estimation of plant water potential using potato tuber method 3. Demonstration of water transpiration practicals 4. Measurement of rate of photosynthesis by <i>Hydrilla</i> method 5. Role of colour of light in rate of photosynthesis 6. Role of light intensity in rate of photosynthesis 7. Variation in leaf anatomy of C3, C4 and CAM plants 8. Structure of root nodule. 9. Any other practicals relevant to theory paper which helps in students understanding will be added. 				2 Hrs per week
REFERENCES					
<ol style="list-style-type: none"> 1. Salisbury FB, Ross CW, 2009. Plant physiology. 4th Ed., Cengage learning. 2. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Plant physiology and development. 6th Ed, Oxford University press. 3. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Fundamentals of plant physiology. 1st Ed, Oxford University press. 4. Buchanan Bob et al., 2015. Biochemistry and molecular biology of plants. 2nd Ed., Wiley-Blackwell. 5. Voet D, Voet JG, Pratt CW, 2016. Fundamentals of Biochemistry. 5th Ed., Wiley. 					


**GENERIC ELECTIVE BOTANY
SEMESTER IV**


GENERIC ELECTIVE I

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in			ACADEMIC YEAR 2020-2021	
		Bachelor of Science (Hons.)				
YEAR	2	Generic Elective 1:			CREDIT	3
Semester	4	Paper I: BOT 1401 ET			HOURS	45
Plant Ecology and Adaptive Biology (Theory)						
OBJECTIVES:		To familiarise the students with basic principles of ecology and ecosystems				
COURSE CONTENT / SYLLABUS						
UNIT-I	Ecosystem					15 hrs.
	Concept and structure of Ecosystem, Food chain, Food web, Ecological Pyramids, Energy flow, Production, Ecological efficiencies, Biogeochemical cycles: carbon, nitrogen and phosphorous, Ecological instruments					
UNIT-II	Adaptive Biology					15 hrs.
	Ecological classification of plants: Hydrophytes, Mesophytes, Xerophytes and epiphytes, Insectivorous plants, Environmental factors: climate, edaphic. Biotic factors influencing plant growth, Air, water and land pollution, causes and control measures.					
UNIT-III	Ecophysiology					15 hrs.
	Introduction to Ecophysiology, Definition, Light intensity, Temperature, Water, Co ₂ Concentration, Wind and Flooding. Factors affecting Ecophysiology of plants, Plant responses in relation to climate change.					
REFERENCES						
1. Smith 2014 Elements of Ecology 2. Misra, R. 2018 Indian manual of plant Ecology 3. Eugene Odum 2017 Fundamentals of Ecology 4. Anil Kumar De 2018 environmental chemistry 5. R.S. Ambasht 2017 15th ed. A textbook of plant ecology 6. Khitoliya R.K. 2006 Environmental pollution 7. P.D. Sharma 2011 Ecology and Environment						

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Bachelor of Science (Hons.)					
YEAR	2	Generic Elective 1:		CREDIT	1
Semester	4	Paper II: BOT 1401 EL		HOURS	30
Plant Ecology and Adaptive Biology (Practical)					
OBJECTIVES:		To familiarise the students with basic principles of ecology and ecosystems			
COURSE CONTENT / SYLLABUS					
1. Plant ecological adaptations – Hydrophytes, Xerophytes and Halophytes 2. Quadrant study 3. Tree biomass estimation 4. Physical, chemical and biological characters of soil 5. Physical, chemical and biological characters of soil 6. Insectivorous plants 7. Ecological instruments 8. Any other practicals relevant to theory paper which helps in students understanding will be added.					2 Hrs per Week
REFERENCES					
1. Smith 2014 Elements of Ecology 2. Misra, R. 2018 Indian manual of plant Ecology 3. Eugene Odum 2017 Fundamentals of Ecology 4. Anil Kumar De 2018 environmental chemistry 5. R.S. Ambasht 2017 15th ed. A textbook of plant ecology 6. Khitoliya R.K. 2006 Environmental pollution 7. P.D. Sharma 2011 Ecology and Environment					


GENERIC ELECTIVE II

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj , Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2020-2021		
Bachelor of Science (Hons.)				
YEAR	2	Generic Elective 2:	CREDIT	3
Semester	4	Paper I: BOT 1403 ET	HOURS	45
		Genetic engineering and Plant biotechnology (Theory)		
OBJECTIVES:	To familiarize the students with the fundamentals of Recombinant DNA technology, cell and tissue culture techniques and their applications in Plant Biotechnology.			
COURSE CONTENT / SYLLABUS				
UNIT-I	Recombinant DNA Technology Recombinant DNA technology, Restriction enzymes, Vectors, Gene cloning, Direct and indirect method of gene transfer, Transgenic and Cisgenic approaches for plant improvement; RNAi gene knockouts and overexpression, Gene editing tools: CRISPR-CAS9, Zinc finger nucleases, TALENs; screening; selection markers (nptII, hpt, bar, gox) and reporter genes- GUS, GFP, Luciferase, Agrobacterium			15 hrs.
UNIT-II	Genetic Modified Organisms Achievements in crop biotechnology, environment and industry (suitable example)- pest resistant plants (Bt cotton), herbicide resistance, disease and stress tolerance, transgenic crop with improved quality (flavrSavr tomato, golden rice, Amflora potatoes, Arctic apples), role of transgenic in pollution degradation (super-bug), leaching of minerals, production of industrial enzymes, edible vaccine, improved ornamental plants.			15 hrs.
UNIT-III	Plant Tissue Culture Concepts of Plant cell and tissue culture, Scope and importance, Totipotency and Morphogenesis, Plant tissue Culture media, regeneration of plants from differentiated tissues, organogenesis, and somatic embryogenesis, and synthetic seeds Micropropagation and its stages, factors affecting micropropagation, Protoplast culture, somatic hybrids and cybrids, Applications in crop improvement.			15 hrs.
REFERENCES				
<ol style="list-style-type: none"> 1. Primrose SB. 2001. Molecular Biotechnology. Panima. 2. Primrose SB, Twyman R, 2009. Principles of gene manipulation and genomics. 7th Ed, Wiley. 3. Sambrook et al., 2014. Molecular cloning: a laboratory manual part 1 to 3. 4th Ed., Cold spring harbor laboratory press. 4. Singh BD, 2011. Plant biotechnology. 2nd Ed, Kalyani publishers. 5. Bhojwani SS, Soh WY, 2003. Agrobiotechnology and plant tissue culture. Science publishers. 6. Thorpe Trevor et al., 2013. Plant tissue culture: Techniques and experiments. 3rd Ed, Academic press. 				

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Bachelor of Science (Hons.)					
YEAR	2	Generic Elective 2: Paper II: BOT 1404 EL Genetic engineering and Plant biotechnology (Practical)		CREDIT	1
Semester	4			HOURS	30
OBJECTIVES:		To familiarize the students with the fundamentals of Recombinant DNA technology, cell and tissue culture techniques and their applications in Plant Biotechnology.			
COURSE CONTENT / SYLLABUS					
		1. Molecular biology Lab visit (within University campus) 2. DNA isolation – genomic and plasmid 3. Gel pictures of Genomic and Plasmid DNA prep 4. Models of restriction enzymes and its calculations 5. Models and problems of restriction sites on plasmid DNA 6. Problems of Genetic engineering and rDNA technology 7. Plant tissue culture basics and media 8. Demonstration of varieties of culture techniques			2 Hrs per week
REFERENCES					
1. Primrose SB. 2001. Molecular Biotechnology. Panima. 2. Primrose SB, Twyman R, 2009. Principles of gene manipulation and genomics. 7 th Ed, Wiley. 3. Sambrook et al., 2014. Molecular cloning: a laboratory manual part 1 to 3. 4 th Ed., Cold spring harbor laboratory press. 4. Singh BD, 2011. Plant biotechnology. 2 nd Ed, Kalyani publishers. 5. Bhojwani SS, Soh WY, 2003. Agrobiotechnology and plant tissue culture. Science publishers. 6. Thorpe Trevor et al., 2013. Plant tissue culture: Techniques and experiments. 3 rd Ed, Academic press.					


FOUNDATIN IN BOTANY

SEMESTER III


	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2020-2021	
Bachelor of Science (Hons.)			
YEAR	2	CREDIT	2
Semester	3	HOURS	30
Foundation:			
BOT 1001 FT: Applied techniques in Botany			
OBJECTIVES:	To familiarize the students theoretically and practically the different applied techniques in Botany		
COURSE CONTENT / SYLLABUS			
UNIT-I	Cytogenetics and Staining Techniques		15 hrs.
	Staining procedures, classification and chemistry of stains, staining equipment, reactive dyes and fluorochromes (including genetically engineered protein labelling with GFP and other tags), Cytogenetic techniques with squashed plant materials		
UNIT-II	Industrial Botany		15 hrs.
	Microbes and plant cells involved in industrial production, Bioreactors/fermenters, fermentation process, media, fermentation conditions, downstream processing; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilisation, spray drying Role of fungi in Biotechnology. Application in food industry. Biological control: Biofertilisers, Bioherbicides, Bioinsecticides, Bionematicides		
REFERENCES			
<ol style="list-style-type: none"> 1. Casida, L. E. J. R. (2016). Industrial Microbiology. New Age International Publisher. 2. Sivakumaar, P.K. (2010). An Introduction to Industrial Microbiology. S Chand publishing. 3. Waites, M.J., Morgan, N.L., Rockey, Higon G. (2001). Industrial Microbiology: An Introduction. Blackwell Science. 4. Okafor, N., Benedict, C. and Okeke. (2017). Modern Industrial Microbiology and Biotechnology. Taylor & Francis. 5. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A. 			


FOUNDATIN IN BOTANY

SEMESTER IV


	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2020-2021		
Bachelor of Science (Hons.)				
YEAR	2	Foundation:	CREDIT	2
Semester	4	BOT 1002 FT: Plant Identification Techniques	HOURS	30
OBJECTIVES:		Students will learn theoretically and practically the different techniques of identifying all groups of plants.		
COURSE CONTENT / SYLLABUS				
UNIT-I	Collection and Preservation of Plants.			15 hrs.
	Specimen Collection: how to collect plant, what organs should be collected which helps in identification, precaution taken during collection.			
Specimen preservation: Herbarium preparation (Dry collection), wet collection, preservation of algae, fungi bryophyte, Pteridophyte, Gymnosperms and Angiosperms.				
UNIT-II	Description and Identification			15 hrs.
	Describing plants: Floral Morphology in detail. Inflorescence-Types of Cymose and Racemose in detail. Floral- Bracts, Bracteole, Calyx, Corolla, Androecium, Gynoecium.			
	Fruit- Types and Seed. Identification: Identification of higher taxa till family with help of local available plants and floras.			
REFERENCES				
<ol style="list-style-type: none"> 1. Singh G. (2010). Plant Systematics: An Integrated Approach. 2. Judd <i>et al.</i>, (2004) <i>Plant Systematics: a Phylogenetic Approach</i> 3. Cooke, T. (1903). Flora of Bombay Presidency Vols. I, II & III. Botanical Survey of India, Calcutta. 4. Lawrence G.H.M. Taxonomy of Vascular Plants. 				

PRINCIPAL BOTANY SEMESTER V


	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2021-2022	
Bachelor of Science (Hons.) Botany			
YEAR	3	CREDIT	4
Semester	5	HOURS	60
CORE BOT1501PT: Paper I-Plant Molecular Biology			
OBJECTIVES:	To understand the fundamental cellular processes at molecular level.		
COURSE CONTENT / SYLLABUS			
UNIT-I	Nucleic acid structure and types, types of DNA, Nucleosome organisation, Fine structure of genes, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Repetitive elements, Gene families, genome organization in plants; Genome organization in prokaryotes and eukaryotes and organelles.		15 hrs.
UNIT-II	DNA replication mechanism in prokaryotes and eukaryotes; DNA polymerases, topoisomerases, DNA ligase; Molecular basis of mutations and repair mechanisms in prokaryotes and eukaryotes.		15 hrs.
UNIT-III	Transcription and post-transcriptional regulation: Transcription in prokaryotes and eukaryotes; RNA types, Processing of RNA, Alternative splicing; RNA polymerases, Transcriptional factors, Reverse transcriptase.		15 hrs.
UNIT-IV	Translation and its regulation: Ribosomes; r-RNA; t-RNA; Aminoacyl tRNA synthetases; mediator complexes; Genetic code; Translation in prokaryotes and eukaryotes; Translational and post-translational modifications in prokaryotes and eukaryotes; post-translational modifications of plant proteins. Operon concept – lac operon; Attenuation of trp operon; important features of gene regulation in eukaryotes.		15 hrs.
REFERENCES			
<ol style="list-style-type: none"> 1. Alberts Bruce, 2017. Molecular Biology of the Cell. 6th Ed. Garland Science. 2. Watson JD, 2017. Molecular biology of the gene. 7th Ed, Peason Education. 3. Krebs JE, Goldstein ES, Kilpatrick ST, 2018. Lewin's Genes XII. Jones and Bartlett learning. 4. Clark David, Pazdernik NJ, McGehee MR, 2019. Molecular biology. 3rd Ed., Academic press. 5. Brown TA, 2018. Genomes. 4th Ed. Garland science. 			

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<p align="center">Bachelor of Science (Hons.) Botany</p>					
YEAR	3	CORE BOT1502PT: Paper II- Angiosperms Systematics		CREDIT	4
Semester	5			HOURS	60
OBJECTIVES:		To provide knowledge of systematic classification of plants and characteristic features of different families.			
COURSE CONTENT / SYLLABUS					
UNIT-I	<p>Basics of Plant Systematics Introduction: Aims and components of systematics; identification, nomenclature and classification, Taxonomic categories; species concept, Nomenclature: Principles and rules of Nomenclature; ranks and names; type method. Storage and Conservation: Importance of herbarium specimens and their preparation, other methods of storing plant material. Herbaria and Botanical Garden.</p>				15 hrs.
UNIT-II	<p>Phylogeny of Angiosperms Contemporary Taxonomy: Supporting evidences for taxonomy; taxonomy in relation to anatomy, embryology, palynology, ecology, cytology; chemotaxonomy. Different approaches and their utility for taxonomy a brief review. Evolution of Characters: Bessey's Dicta, evolution in vegetative characters (roots, stem and leaf), evolution in floral characters and fruit. Systems of Classification: Bentham and Hooker's System, Outline of Cronquist's classification System and Angiosperm Phylogeny Group (APG). Phylogenetic Methods: Basics of phenetics and cladistics, cladogram and its components, principle components, how cladograms are prepared. Software used for cladograms, recent molecular techniques.</p>				15 hrs.
UNIT-III	<p>Methods in Systematics Field Methods: Plant collection, preservation Herbarium techniques and documentation. Identification and Nomenclature: Types of taxonomic keys. Floras, Monographs and Revision. Procedure of describing and naming new plant species.</p>				15 hrs.
UNIT-IV	<p>Families of Angiosperms Polypetalae: Annonaceae, Malvaceae, Tiliaceae, Rutaceae, Meliaceae, Fabaceae, Caesalpinaceae, Mimosaceae, Myrtaceae, Apiaceae. Gamopetalae: Asteraceae, Asclepiadaceae, Apocynaceae, Solanaceae, Convolvulaceae, Acanthaceae, Lamiaceae. Monoclamydae: Amaranthaceae, Chenopodiaceae, Nyctaginaceae, Euphorbiaceae (Inclu. Phyllanthaceae). Monocotyledonae: Musaceae, Amaryllidaceae, Liliaceae, Poaceae.</p>				15 hrs.
REFERENCES					
<ol style="list-style-type: none"> 1. B.P. Pandey - (1980) Taxonomy of Angiosperms. S. Chand Limited, 600 p. 2. Cronquist, A. (1988). The evolution and classification of flowering plants. 3. Davis, P.H. and Heywood V.H. (1967). Principles of Angiosperm Taxonomy. 4. Gangulee, S.C., Das, K.S, Dutta, C.D. and Kar, A.K. (1972) College Botany Vol. II & III. New central book agency(P) Ltd. 5. Goldberg, A. (1986). Classification, evolution and phylogeny of the families of Dicotyledons. 6. Heywood, V.H. and Moore D.M. (1984). Current concepts in Plant Taxonomy. 7. Hutchinson, J. (1969). Evolution and phylogeny of flowering plants. Dicotyledons: Facts and Theory. 8. K.R. Sporne - (1973) The morphology of vascular plants. Hutchinson University library. 9. M. G. Simson (2010) Plant systematics. 2nd Edition Elsevier P 752 					


10. N.S. Subramanyam - (1984) Modern Plant Taxonomy. Vikas Publishing House, New Delhi
11. O.P. Sharma -(1984) Plant Taxonomy., Tata McGraw-Hill publishing company Ltd., 483p.
12. P.C. Vashishta - (1974) Taxonomy of Angiosperms. R. Chand, 884 p.
13. Radford, A.E. Dickison, W.C. Massey J.R., Bell C.R. (1974). Vascular Plant Systematics. Harper and Row, New York
14. Singh, G. 1999. Plant Systematics - Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi
15. Y.D. Tyagi& S. Kshetrapal - (1973) An Introduction to Taxonomy of Angiosperms

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<p align="center">Bachelor of Science (Hons.) Botany</p>					
YEAR	3	CORE BOT1503PL: Paper III-Botany Practical -V		CREDIT	4
Semester	5			HOURS	120
OBJECTIVES:		To familiarize the students to basic molecular biology and plant systematics techniques.			
<p align="center">COURSE CONTENT / SYLLABUS</p>					
		<ol style="list-style-type: none"> 1. Molecular biology Laboratory visit (within University campus) 2. Preparation of standard and buffer solutions 3. Handling techniques of solutions and buffers 4. Isolation of genomic DNA from plant samples 5. Isolation of plasmid DNA 6. Isolation of proteins from plant samples 7. Estimation of DNA, RNA and proteins 8. Gel electrophoresis of digested plasmid DNA 9. Problems and models based on DNA and RNA chemistry 10. Plant morphology revision 11. Plant collection methods 12. Herbarium preparation 13. Selected representative members of the all the Families included in the theory 14. Hands on experience in some modern plant systematic studies 			


DISCIPLINE SPECIFIC ELECTIVE SEMESTER V


	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2021-2022		
Bachelor of Science (Hons.) Botany				
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 1	CREDIT	4
Semester	5	BOT1501ET: Plant Evolution and Biodiversity	HOURS	60
OBJECTIVES:		To develop an understanding of basic concepts of evolution, phylogeny, biodiversity and conservation of plants.		
COURSE CONTENT / SYLLABUS				
UNIT-I	Basic concept of evolution: Account of origin of life, changes in atmosphere, theory of special creation. Chemical evolution; experimental evidences for chemical evolution: Miller's, Fox and Urey's experiments. Evidences for evolution, Theories of evolution: Lamarck, Darwin, Mutation and Neo-Lamarckism, Neo-Darwinism and its present understanding. Synthetic theory of evolution: Steps involved, chromosomal variation and Natural selection of organisms, Reproductive isolation Major trends: Origin of higher categories, rate of evolution and evolutionary constancy.			15 hrs.
UNIT-II	Phylogeny of angiosperms: A general account of the origin and evolution of angiosperms (special reference to Bennettitalean, Gnetalean, Caytonialean and herbaceous origin theories); primitive living angiosperms- basal angiosperms; co-evolution of angiosperms and animals. Speciation: origin of species: Species, racial differences in species, reproductive isolation, sibling sps. and isolating mechanisms.			15 hrs.
UNIT-III	Biodiversity - Introduction to Biodiversity, Why Preserve Biodiversity? Biogeographical classification of India, India as a mega-diversity nation, Hot-spots of biodiversity. Present Status Floral Biodiversity of Gujarat. India's share in global biodiversity. Endemic forms. Threatened forms. Threats to biodiversity. What Has Happened to the Species? Types of diversity- Species diversity, Genetic Diversity and Ecosystem Diversity; Ecosystem Function, resilience and ecosystem services .			15 hrs.
UNIT-IV	Conservation: Definition, Needs to conserve biodiversity; Methods of conservation of living resources; red and green data books, world conservation strategy; In-situ conservation and Ex-situ conservation. Efforts in India and Gujarat to conserve biodiversity and various Strategies suggested and adopted; Laws and Legal Actions CBD, NBA, GBB; Grassroots Action Programs			15 hrs.
REFERENCES				


1. G.S. Mani - (2000) Evolutionary dynamics of genetic diversity. Springer-Verlag, 312 p.
2. G.L. Stebbins - (1977) Process of Organic evolution. Ed. 3. Engle-wood clifts, NJ: Prentice hall.
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4. T.H. Dobzhanski - (1982) Genetics & Origin of species. Columbia university Press, New York
5. F. J. Ayala –Population and Evolutionary genetics: A primer., Benjamin/Cummings, Menlo Park, CA.
6. K. V. Krishnamurthy.2003. An Advanced Textbook on Biodiversity Principles and Practice. Oxford & IBH Publishing C. Pvt. Ltd. New Delhi

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Bachelor of Science (Hons.) Botany					
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 2		CREDIT	4
Semester	5	BOT1502ET : Phycology, Mycology and Plant Pathology		HOURS	60
OBJECTIVES:		To study the life cycle of different members of Algae, fungi and lichens and their adaptive strategies. To develop an understanding of various plant diseases, plant defense responses and disease management.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Phycology: Characters, Range of thallus, Reproductive Methods, algal ecology of Fresh waters and Marine waters, Chemical constituents of sea weeds, Techniques in algae: General preservation methods of algae, Culture methods for fresh water (<i>Chlorella</i>) and marine water alga (<i>Gracillaria</i>), symbiotic associations of algae. Life cycles of important forms: <i>Ulva</i> , <i>Laminaria</i> , <i>Porphyra</i> and <i>Gracillaria</i>				15 hrs.
UNIT-II	Introduction- General Characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction. General characteristics, ecology and significance, life cycle : <i>Rhizopus</i> (Zygomycota), <i>Phytophthora</i> , <i>Penicillium</i> , <i>Alternaria</i> , <i>Puccinia</i> Symbiotic associations of fungi: Lichen: Occurrence, characteristics, forms, range of thallus organization & reproduction. Mycorrhiza: characteristics, thallus (Glomeromycota) organisation. Importance				15 hrs.
UNIT-III	Infection strategies of fungal pathogens. Strategies to prevent plant diseases (Biocontrol, chemical, genetic engineering) Plant hormones in defense response (Jasmonite, ethylene etc.,) Plant systemic defense response (Systemic acquired resistance) Plant disease management (Quarantine, chemical, Biological integrated) Physiology of fungal growth, reproduction (asexual and sexual), and mating compatibility, Importance and ecological role of fungi.				15 hrs.
UNIT-IV	Disease concept, Classification of diseases, Disease triangle, Disease cycle Symptoms, Causal organism, Disease cycle and Control measures of the following: Diseases caused by fungi: White rust of crucifers, Red rot of sugarcane, Tikka disease of ground nut, Stripe rust of wheat. Diseases caused by bacteria: Citrus canker, angular leaf spot of cotton; Diseases caused by Viruses: Leaf curl of papaya, Yellow leaf vein mosaic of Bhindi, Tobacco mosaic.				15 hrs.
REFERENCES					


1. Alexopolous C J and Mims C W and Blackwell M. (1996). Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
2. Vasishtha, B.R. (1974) Botany for Degree students Vol I Algae
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6. Y.S. Paul 2nd edition Text book of Mycology and Plant pathology.
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8. Varma, Ajit, Prasad, Ram, Tuteja. (2017). Mycorrhiza: State of the Art, Genetics and Molecular Biology, Eco-Function, Biotechnology, Eco-Physiology, Structure and Systematics.
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	Bachelor of Science (Hons.) Botany				
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 3		CREDIT	4
Semester	5	BOT1503ET : Plant Biochemistry		HOURS	60
OBJECTIVES:		To develop a basic understanding of concepts of plant biochemistry and also provide basic knowledge of structure, functions and metabolism of biomolecules.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Biomolecules: Carbohydrates chemistry – monosaccharides, oligosaccharides and polysaccharides, Glycoproteins. Lipid chemistry – properties, classification, lipid aggregates and lipoproteins. Amino acid – types, structure and optical activities.				15 hrs.
UNIT-II	Protein structure – primary structure and its determination. Three-dimensional structures – secondary and quaternary structures, globular and fibrous proteins. Enzymes – introduction, classification, mechanism, reaction kinetics, coenzymes and allosteric enzymes.				15 hrs.
UNIT-III	Metabolic pathways, Cellular metabolic compartments, Interconnectivity amongst metabolic pathways, Fatty acid biosynthesis and oxidation				15 hrs.
UNIT-IV	Specialised metabolism – Importance and evolutionary aspects in brief; Isoprenoids, alkaloids, Phenolics, Phenylpropanoids, phenylpropanoid metabolic pathway, Primary and specific functioning of specialised metabolites.				15 hrs.
REFERENCES					
1. Plant Biochemistry by Hans-Walter Heldt 3 rd edition by Academic Press, 2004. 2. Plant Biochemistry by Hans-Walter Heldt and Birgit Piechulla 4 th edition by Academic Press, 2010. 3. Plant Biochemistry by P. M. Dey and J. B. Harborne 1 st edition by Academic Press, 1997. 4. Plant Biochemistry by James Bonner and Joseph E. Varner 3 rd edition by Academic Press, 1977. 5. Voet D, Voet JG, Pratt CW, 2016. Fundamentals of Biochemistry. 5 th Ed., Wiley 6. Buchanan Bob et al., 2015. Biochemistry and molecular biology of plants. 2 nd Ed., Wiley-Blackwell					

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<p align="center">Bachelor of Science (Hons.) Botany</p>					
YEAR	3	BOT1504ET : Biophysical Techniques and Instrumentation		CREDIT	4
Semester	5			HOURS	60
OBJECTIVES:		To understand the fundamentals of Biophysics and Instrumentation To develop a basic understanding of concepts and principles of different latest technologies in Microscopy, chromatography, spectroscopy, Electrophoresis			
<p align="center">COURSE CONTENT / SYLLABUS</p>					
UNIT-I	Structural aspects of biomolecules (Proteins, Polysaccharides, Nucleic acids) Macromolecular assembly in chromatin, ribosome - elementary ideas Autofluorescence aspects of Chlorophyll				15 hrs.
UNIT-II	Microscopy: Principles of light and electron microscopy; phase contrast and fluorescence microscopy; TEM, SEM and STEM (Review) Spectroscopy: Principle and applications of X-ray, UV, Visible and IR spectroscopy				15 hrs.
UNIT-III	Chromatography: Principle, Planar and column chromatography, Types: Adsorption and partition, size-exclusion, Affinity chromatography, TLC, HPLC and GC. Electrophoresis: Principle of electrophoresis; different kinds of electrophoretic techniques Centrifugation: Principle of centrifugation, types of centrifuges.				15 hrs.
UNIT-IV	Physiological Biophysics: Properties of lights and water. Absorption, transduction and storage of energy by molecules.				15 hrs.
<p align="center">REFERENCES</p>					
<ol style="list-style-type: none"> Voet D, Voet JG 2011. Biochemistry. 4th Ed., Wiley. ISBN-13: 978-0470570951 Joseph R. Lakowicz 2013 Principles of Fluorescence Spectroscopy, 3rd edition, 3rd edition. Springer Science & Business Media ISBN 1475730616, 9781475730616 Daniel, M. (1990) Basic Biophysics for Biologists. Agrobotanical Publishers, Bikaner Berlyn, G.P. and Miksche, J.P. (1976) Botanical Microtechnique and Cytochemistry. JSouthworth, H.M. (1982) Introduction to modern microscopy. Willard, H.H., Meritt, L.L., Dean, J.A. and Settle, F.A. (1986) Instrumental Methods of Analysis. Plumer, D.T. (1979) An Introduction to Practical Biochemistry. Winson, K. and Walker, J.M. (1996) Principles & Techniques of Practical Biochemistry Rodney C.W. (2002) Biophysics : An introduction Nelson P. (2003) Biological Physics: Energy, Information, Life Freeman 					


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Bachelor of Science (Hons.) Botany				
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 5 PRACTICAL	CREDIT	2
Semester	5	BOT1505EL: Botany Practical VI	HOURS	60
OBJECTIVES:	To acquaint the students with various plant diseases, biomolecules estimation, gel electrophoresis and chromatography techniques, and fungal isolation methods			
COURSE CONTENT / SYLLABUS				
<ol style="list-style-type: none"> 1. Preparation of standard and buffer solutions 2. Preparation of buffers of different strengths and pH values 3. Estimation of sugars and amino acids 4. Separation of biomolecules by TLC and paper chromatography 5. Estimation of Carbohydrates and Lipids in plant samples 6. Separation of amino acids by paper chromatography 7. Isolation of fungal strains from soil and other substratum 8. Study life cycle of <i>Rhizopus</i>, <i>Phytophthora</i>, <i>Penicillium</i>, <i>Alternaria</i>, <i>Puccinia</i> to identify them. 9. Analysis of Growth Characteristics of Filamentous Fungi in Different Nutrient Media. 10. Study examples of plant diseases caused by fungi, bacteria and virus Viruses. 11. Study examples of lichens. 12. To separate nitrogenous bases by paper chromatography. 13. To separate sugars by thin layer chromatography. 14. To separate chloroplast pigments by column chromatography 15. Demonstration of Gel Electrophoresis 				

Skill Enhancement Course Semester V

	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2021-2022		
Bachelor of Science (Hons.)				
YEAR	3	Skill Enhancement:	CREDIT	2
Semester	5	BOT1501ST: Horticulture and Gardening	HOURS	30
OBJECTIVES:	To familiarize the students with basic principles and applications of various horticultural, gardening and landscaping techniques			
COURSE CONTENT / SYLLABUS				
UNIT-I	Horticulture : General introduction: Definition and scope Plant propagation: seed propagation, seed dormancy, seed germination. Vegetative propagation methods, propagation by cutting (root, stem, leaf) types, rooting – conditions required, establishment – factors affecting, layering types including natural modes of plant modification for propagation. Plant improvement: Types (grafting, budding), process, advantages, techniques. Horticulture tools.			15 hrs.
UNIT-II	Landscaping and Gardening Landscaping-Principles and its elements Gardening-Principles and designs, essential tools, Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Selection of plants, maintenance and care of garden plants, Ingredients of potting mixes, soils and nutrients, fertilizers, deficiencies and toxicities			15 hrs.
REFERENCES				
<ol style="list-style-type: none"> 1. Chris Young 2009 Encyclopedia of Garden Design: Planning, Building and planting your perfect outdoor space DK Publisher 2. Jack Ingels 2009 Landscaping: Principles and Practices Delmar Cengage Learning. 3. Dorling Kindersley. 2010. Gardening step by step. 4. Sinha Amita. 2006. Landscapes in India; Forms and meanings. 5. Rosemary Alexander 2009 The essential Garden design workbook, Timber Press 				

PRINCIPAL BOTANY

SEMESTER VI

	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2021-2022	
Bachelor of Science (Hons.) Botany			
YEAR	3	CREDIT	4
Semester	6	HOURS	60
CORE BOT1601PT: Paper I- Plant Physiology			
OBJECTIVES:	To understand the major concepts and principles of plant physiology		
COURSE CONTENT / SYLLABUS			
UNIT-I	Water and plant cells, water balance of plants, xylem structure and water transport function, evolution of plant water transport system, phloem structure and translocation in the phloem, transpiration, stomatal movements, Role of carbon dioxide, potassium ion, abscisic acid (ABA) and blue light in stomatal movement, Anti-transpirants, mineral nutrition.		15 hrs.
UNIT-II	Photosynthesis: Photopigments and its role, Photosystem structure: Antenna complex and reaction centres, light reactions: Electron transport pathways in chloroplast membranes; Rubisco, carbon reactions - the Calvin-Benson cycle (C3); CO ₂ concentrating mechanisms: C ₄ and CAM photosynthesis. Photorespiration: The photorespiratory pathway, role of photorespiration in plants; photoinhibition and regulation of photosynthesis.		15 hrs.
UNIT-III	Respiration in plants: Glycolysis and Citric acid cycle in plants, Plant mitochondrial electron transport, Plant mitochondrial ATP synthesis; Nitrogen metabolism: Assimilation of nitrate by plants, Biochemistry of dinitrogen fixation in Rhizobium, GS and GOGAT enzyme system, Integration of Carbon and nitrogen metabolism in plants.		15 hrs.
UNIT-IV	Phytohormones and its physiological roles: Auxins, Cytokinins, Gibberellins, Ethylene, Abscisic acid, Brassinosteroids, Strigolactones, Jasmonic acid, Salicylic acid; Phototropism and gravitropism; photoreceptors; phytochromes and light control of plant development; photoperiodism; circadian rhythms; vernalisation; Senescence and cell death.		15 hrs.
REFERENCES			
<ol style="list-style-type: none"> 1. Salisbury FB, Ross CW, 2009. Plant physiology. 4th Ed., Cengage learning. 2. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Plant physiology and development. 6th Ed, Oxford University press. 3. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Fundamentals of plant physiology. 1st Ed, Oxford University press. 4. Buchanan Bob et al., 2015. Biochemistry and molecular biology of plants. 2nd Ed., Wiley-Blackwell. 5. Voet D, Voet JG, Pratt CW, 2016. Fundamentals of Biochemistry. 5th Ed., Wiley. 			



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ACADEMIC YEAR
2021-2022

Bachelor of Science (Hons.) Botany

YEAR	3	CORE BOT1602PT: Paper II- Developmental Biology	CREDIT	4
Semester	6		HOURS	60


OBJECTIVES: To develop an understanding of the plant development and study the genetic and molecular events involved in developmental processes.

COURSE CONTENT / SYLLABUS


UNIT-I	Plant model system. Organization and maintenance of shoot and root apical meristems, plant stem cell niches, pluripotent and totipotent stem cells. Primary and lateral root development, shoot branching, Leaf development, leaf identity, leaf polarity and leaf complexity.	15 hrs.
UNIT-II	Organization and maintenance of vascular cambium, xylem and phloem development. Cell wall biosynthesis. Trichome, root hair and stomata development.	15 hrs.
UNIT-III	The transition from vegetative to reproductive development, flower development, ABC-DE model of floral organ development. Male gametogenesis. Anther structure and function, Pollen morphology- Pollen wall structure, Female gametogenesis, Ovule – structure, types, mature embryo sac, Genetic control of male and female gametophyte development	15 hrs.
UNIT-IV	Pollination types and significance, Genetic self-incompatibility, methods to overcome self-incompatibility, Fertilization, Double fertilization, parasexual hybridization, Cybrids, embryo and seed development, molecular basis of embryogenesis, genetic imprinting and Seed Development, endosperm development. Seed maturation, polyembryony and Apomixis: introduction, types, causes, molecular bases and application.	15 hrs.


REFERENCES


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2. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Fundamentals of plant physiology. 1st Ed, Oxford University press.
3. Buchanan Bob et al., 2015. Biochemistry and molecular biology of plants. 2nd Ed., Wiley-Blackwell.


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<p align="center">Bachelor of Science (Hons.) Botany</p>					
YEAR	3	CORE BOT1603PL : Paper III-Botany Practical -VII		CREDIT	4
Semester	6			HOURS	120
OBJECTIVES:		Practically perform and understand the different physiological and developmental processes in plants			
<p align="center">COURSE CONTENT / SYLLABUS</p>					
		<ol style="list-style-type: none"> 1. Protoplasmic streaming in response to light in Hydrilla 2. Calculate water potential using potato 3. Effect of KCl on stomatal movement 4. Effect of antitranspirants on stomata 5. Separation of plant pigments by paper chromatography 6. Effect of plant hormones on rate of transpiration 7. Diurnal acid cycle in succulent plants 8. Comparative C3 and C4 anatomy 9. Calculate rate of photosynthesis 10. Effect of monochromatic light on rate of photosynthesis 11. Find effects of phototropism and gravitropism in plants 12. Effect of circadian rhythm on plant growth 13. Structure of plant meristems 14. Calculation of growth rate in plant leaf 15. Anther and pistil structure 16. Pollen morphology and pollen viability 17. Germination studies of pollen 18. Ovule and Embryo structure 19. Seed types and structure 20. Seed viability and dormancy 			


Discipline Specific Elective Semester VI

	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2021-2022		
Bachelor of Science (Hons.) Botany				
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 1	CREDIT	4
Semester	6	BOT1601ET : Plant Biotechnology	HOURS	60
OBJECTIVES:				
To familiarize the students with major principles and applications of Plant Biotechnology.				
COURSE CONTENT / SYLLABUS				
UNIT-I	Concepts of Plant tissue culture, Scope and importance in plant Improvement, Totipotency and Morphogenesis, Nutritional requirements of in vitro cultures, culture media, Role of plant hormones in morphogenesis, Direct and indirect organogenesis, Techniques of tissue culture, meristem culture, shoot tip culture, Factors affecting tissue culture.			15 hrs.
UNIT-II	Somatic embryogenesis and synthetic seed production, Embryo rescue and wide hybridization, Somaclonal variation, Protoplast isolation, Culture, Manipulation and Fusion of protoplast, somatic hybrids and cybrids, Applications in crop improvement.			15 hrs.
UNIT-III	Concept of genetic engineering: Scope and importance in Crop Improvement, DNA recombinant technology, Restriction enzymes, Vectors for gene transfer in plants, Gene cloning, Direct and indirect method of gene transfer, screening and selection of transformants, selection markers (nptII, hpt, bar, gox) and reporter genes (GUS, GFP, Luciferase), Agrobacterium, Ti and Ri Plasmids. Genetic and molecular analyses of transgenics; Biosafety issues, testing of transgenics.			15 hrs.
UNIT-IV	Transgenic and Cisgenic approaches for plant improvement; RNAi, gene knockouts and overexpression, Gene editing tools: CRISPR-Cas system, Zinc finger nucleases, TALENs; achievements in crop biotechnology, environment and industry (suitable example)- pest resistant plants (Bt cotton), herbicide resistance, disease and stress tolerance, transgenic crop with improved quality (flavrSavr tomato, golden rice, Amflora potatoes, Arctic apples), role of transgenic in pollution degradation (super-bug), leaching of minerals, production of industrial enzymes, edible vaccine.			15 hrs.
REFERENCES				
Primrose SB. 2001. Molecular Biotechnology. Panima. 1. Primrose SB, Twyman R, 2009. Principles of gene manipulation and genomics. 7 th Ed, Wiley. 2. Sambrook et al., 2014. Molecular cloning: a laboratory manual part 1 to 3. 4 th Ed., Cold spring harbor laboratory press. 3. Singh BD, 2011. Plant biotechnology. 2 nd Ed, Kalyani publishers. 4. Bhojwani SS, Soh WY, 2003. Agrobiotechnology and plant tissue culture. Science publishers. 5. Thorpe Trevor et al., 2013. Plant tissue culture: Techniques and experiments. 3 rd Ed, Academic press. 6. Razdan MK, 2019. Introduction to Plant Tissue culture. 3 rd Ed, Oxford and IBH Pub. 7. Kalyankumar De, 1997. Plant tissue culture. New central book agency.				


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<p align="center">Bachelor of Science (Hons.) Botany</p>					
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 2 BOT1602ET: Stress Physiology		CREDIT	4
Semester	6			HOURS	60
OBJECTIVES:		To gain a broad understanding of physiological and biochemical response of plants to various stresses			
<p align="center">COURSE CONTENT / SYLLABUS</p>					
UNIT-I	Plant stress- definition, Stress and Stress factors; Environmental stress; Water deficit and drought resistance – detailed mechanism and plant response of desiccation postponement, tolerance and escape, morphological changes. Role of Abscisic acid and osmotic adjustment during drought. Concept of WUE. Salinity stress – Mechanism of tolerance, ion exclusion and Na, K, Ca transport across membrane.			15 hrs.	
UNIT-II	Heat stress- introduction, causes, plant response, adaptation and tolerance mechanisms; Role of heat shock proteins, synthesis of HSP and thermotolerance, Role of calcium in heat stress. Chilling and Freezing stress – Membrane response, ice-crystal formation, Freezing tolerance, resistance and role of ABA.			15 hrs.	
UNIT-III	Oxygen deficiency – anaerobiosis mechanism, tolerance and metabolic changes. Heavy metal stress and role of phytochelatin; Radiation stress and tolerance mechanisms.			15 hrs.	
UNIT-IV	Biotic stress- local and systemic response. Oxidative stress – causes, site of ROS generation, cellular damage, antioxidant defense system, role of ozone. Cross-talk in stress responses- local and systemic, gene and hormone level.			15 hrs.	
<p align="center">REFERENCES</p>					
<ol style="list-style-type: none"> Salisbury FB, Ross CW, 2009. Plant physiology. 4th Ed., Cengage learning. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Plant physiology and development. 6th Ed, Oxford University press. Taiz L, Zeiger E, Moller Ian, Murphy Angus, 2018. Fundamentals of plant physiology. 1st Ed, Oxford University press. Buchanan Bob et al., 2015. Biochemistry and molecular biology of plants. 2nd Ed., Wiley-Blackwell. Jenks MA, Hasegawa PM, 2014. Plant abiotic stress. 2nd Ed., Wiley-Blackwell. 					

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Bachelor of Science (Hons.) Botany					
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 3		CREDIT	4
Semester	6	BOT1603ET: Biostatistics and Bioinformatics		HOURS	60
OBJECTIVES:		To understand the basic principles and applications of statistics and Bioinformatics.			
COURSE CONTENT / SYLLABUS					
UNIT-I	Introduction to Biostatistics, Importance in biological studies; Sampling methods; Types of variables; Levels of measurements; Accuracy and uncertainty, Measures of central tendency, Measures of dispersion.				15 hrs.
UNIT-II	Scatter plots, Correlation and regression, Hypothesis and testing, Parametric and non-parametric tests, Types of probability, confidence intervals, t-test, chi-square test, Analysis of variance				15 hrs.
UNIT-III	Introduction to bioinformatics, overview and exploring available bioinformatics resources like PUBMED, NCBI, EBI, EMBL, gene bank, gene expression database etc; Applications of bioinformatics in plant sciences.				15 hrs.
UNIT-IV	Pair-wise alignment of protein and DNA, Database search using BLAST, FASTA; interpretation of output and its biological significance for DNA/protein sequences, Primer designing, Applications of Image J				15 hrs.
REFERENCES					
<ol style="list-style-type: none"> 1. Biostatistics by Ronald Forthofer, Eun Lee, Mike Hernandez 2nd edition by Academic Press, 2006. 2. Biostatistics: Basic Concepts and Methodology for the Health Sciences by Wayne W. Daniel, Chad L. Cross 10th edition by Wiley Publications, 2014. 3. Biostatistics by Veer BalaRastogi 3rd edition by Medtech Publications, 2015. 4. Biostatistics: How It Works by Steve Selvin by Pearson Education Publications, 2005. 5. A Textbook of Biostatistics by B. Annadurai 1st edition by New Age International Publications, 2007. 6. Biostatistical Analysis by Jerrold H. Zar 4th edition by Pearson Education Publications, 2009. 7. Principles of Biostatistics by Marcello Pogano and Kimberlee Gauvreau 2nd edition by Brooks/Cole, 2007. 8. Arthur M. Lesk. (2003). Introduction to Bioinformatics, Oxford University Press, Indian edition. 9. Des Higgins and Willie Taylor. (2000). Bioinformatics, Sequence, structure and databanks. A practical approach. Oxford University Press, Indian edition, Second impression, New Delhi. 10. Rastogi, S.C., Mediratta, N. and Rastogi. P. (2004). Bioinformatics, methods and applications, genomics, proteomics and drug discovery, Prentice hall of India, Pvt. Ltd., New Delhi. 11. Baxevanis, A. D. and Ouellette, B. F. F. (2002). Bioinformatics: A Practical Guide to the analysis of Genes and Proteins. (2nd Ed.), New York, John Wiley & Sons, Inc. Publications. 12. Attwood, T. K. and Parry-Smith, D. J. (2001). Introduction to Bioinformatics Delhi. Pearson Education (Singapore) Ptd. Ltd. 					

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<p align="center">Bachelor of Science (Hons.) Botany</p>					
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 4 BOT1604ET: Biosafety and IPR		CREDIT	4
Semester	6			HOURS	60
OBJECTIVES:		To understand biosafety laws, its regulations, and Intellectual Property.			
<p align="center">COURSE CONTENT / SYLLABUS</p>					
UNIT-I	Biosafety and risk assessment issues, Regulatory framework; National biosafety policies and law, Role of biosafety committees: IBSC, DLC, SBCC, RDAC, RCGM, GEAC; The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, cross border movement of germplasms.				15 hrs.
UNIT-II	Risk management issues – biocontainment; General principles of Laboratory and environmental biosafety, Biosafety level facilities; Plant biosafety level facilities; Health aspects, toxicology, allergenicity, antibiotic resistance and superweeds, superviruses, monitoring and method of detection.				15 hrs.
UNIT-III	WTO and other international agreement, Intellectual property rights, copyrights, trademarks, trade secrets, patents, geographical indications, etc; protection of plant variety and farmers right act; Indian patent act and amendments; patent filing; convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products, Examples of IPR conflicts				15 hrs.
UNIT-IV	Protection of traditional knowledge, industrial designs and plant varieties, Concept of traditional knowledge, Holders, Issues concerning, Bioprospecting and Bio-piracy, Alternative ways, Protectability, Sui-generis regime and its need, Traditional knowledge on the international area, at WTO, at national level; Plant varieties protection in India, Rights of farmers, National gene bank, Benefit sharing, Protection of Plant varieties and Farmer's rights Act, 2001.				15 hrs.
<p align="center">REFERENCES</p>					
<ol style="list-style-type: none"> Singh BD. 2015. Biotechnology: Expanding Horizon. Kalyani. http://dbtindia.gov.in/ https://www.wipo.int/ https://ibkp.dbtindia.gov.in/ http://dbtindia.gov.in/regulations-guidelines/regulations/biosafety-programme 					

	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2021-2022		
Bachelor of Science (Hons.) Botany				
YEAR	3	DISCIPLINE SPECIFIC ELECTIVE 5 PRACTICAL BOT1605EL: Botany Practical VIII	CREDIT	2
Semester	6		HOURS	60
OBJECTIVES:	To acquaint the students with basic concepts, techniques and analysis methods used in Plant Biotechnology, Stress Physiology, Biostatistics and Bioinformatics			
COURSE CONTENT / SYLLABUS				
<ol style="list-style-type: none"> 1. Laboratory set-up 2. Preparation of culture media 3. Handling and sterilization of media and plant materials 4. Inoculation and subculturing 5. Cell, protoplast and tissue culture 6. Gene transfer methods in plants 7. Selection of transformed plants 8. Abiotic stress treatments 9. ROS analysis 10. Analysis of antioxidant enzymes 11. Analysis of plant growth rate, growth direction and orientation of stressed plants 12. Analysis of chlorophyll 13. Analysis of photosynthesis, Transpiration and metabolites of stressed plants 14. Computational exercises and data interpretation 15. Measures of central tendency 16. t-test 17. chi-square test 18. Analysis of variance 19. Probability distribution 20. Biological database 21. NCBI Genomic Resources and Usage 22. Retrieval of sequence from databases 23. BLAST analysis 24. Multiple sequence analysis 25. Phylogenetic analysis 26. Laboratory biosafety guidelines 27. Laboratory setup and biosafety 28. Biocontainment in laboratory setup 29. Biosafety level facilities 30. Plant biosafety level facilities 31. GMOs and impact assessment on biodiversity (Bt-cotton) 32. Methods for detecting transgenics (T-DNA, Bt-cotton) 				

Skill Enhancement Course Semester VI

	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Botany Sayajigunj, Vadodara 390002, 0265-2791891, nsr.krishnayya-botany@msubaroda.ac.in	ACADEMIC YEAR 2021-2022		
Bachelor of Science (Hons.)				
YEAR	3	Skill Enhancement:	CREDIT	2
Semester	6	BOT1601ST: Herbal Technology and Natural Resources	HOURS	30
OBJECTIVES:	To develop understanding on different herbal resources and their value added products. To learn the different methods of evaluating crude drugs and its adulteration.			
COURSE CONTENT / SYLLABUS				
UNIT-I	Herbal resources Herbal medicines – Cultivation, Harvesting, Processing, Storage and marketing of herbal medicines. Nutraceuticals and its importance. Herbal cosmetics and volatile oils: Importance, Major resources, extraction, common preparation. Mushroom cultivation: Commercially cultivated edible mushrooms – biology and cultivation aspects.			15 hrs.
UNIT-II	Ethnopharmacology and Analytical pharmacognosy Pharmacognosy: Introduction to ethnopharmacology and ethnobotany; account of mono and polyherbal formulations, Pharmacological studies of a few ethnobotanical formulations. Analytical pharmacognosy Drug adulteration- Types, methods of evaluation, biological testing of herbal drugs. Phytochemical screening tests for secondary metabolites			15 hrs.
REFERENCES				
<ol style="list-style-type: none"> 1. Chattopadhyay, P K 2008. Herbal cosmetics and Ayurvedic medicines. 2. Panda, H 2004. Herbal cosmetic: Handbook. Asia Pacific Business Press, Delhi. 3. Trease G E and Evans, W C. 2002. Pharmacognosy. 4. Harborne, J B . 1984. Phytochemical methods. 				