




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 					


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<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>
<p align="center">REFERENCES</p>					
<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				
YEAR	2	BOT 1303 PL: Paper III- Botany Practical -III		CREDIT	4
Semester	3			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					
	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					
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. 3 rd Ed, Elsevier cop. 6. Karp J, Iwasa J, Marshall W, 2018. Karp's Cell biology. 8 th 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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	<p>Bachelor of Science (Hons.) Botany</p>			
YEAR	2	<p align="center">Paper III: BOT 1403 PL Botany Practical-IV</p>	CREDIT	4
Semester	4		HOURS	120
OBJECTIVES:		To develop basic understanding of classical and molecular genetics and plant breeding.		
<p>COURSE CONTENT / SYLLABUS</p>				
	<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. 			<p>8 Hrs a week</p>
<p>REFERENCES</p>				
<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 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. 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				15 hrs.	
	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					
UNIT-II	Methods in Systematics and Families of Angiosperms				15 hrs.	
	Polypetalae: Annonaceae, Malvaceae, Rutaceae, Meliaceae, Fabaceae, Caesalpiniaceae, Mimosaceae. Gamopetalae: Asteraceae, Apocynaceae, Solanaceae, Lamiaceae. Monoclamydae: Amaranthaceae, Euphorbiaceae (Inclu. Phyllanthaceae). Monocotyledonae: Liliaceae, Poaceae.					
UNIT-III	Developmental biology				15 hrs.	
	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.					
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:		The students will practically examine the characteristic features and classify Plants and learn to prepare herbarium. Students will practically observe the different parts of the reproductive structures in the plants and variations in them.				
COURSE CONTENT / SYLLABUS						
		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						
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:	CREDIT	3
Semester	3	Paper I: BOT 1303ET	HOURS	45
Physiology and Biochemistry of plants (Theory)				
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


	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				
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.				

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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	Foundation:		CREDIT	2
Semester	3	BOT 1001 FT: Applied techniques in Botany		HOURS	30
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					
1. Casida, L. E. J. R. (2016). Industrial Microbiology. New Age International Publisher. 2. Sivakumar, P.K. (2010). 2. 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						
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.						