D. S. P. M's K.V. Pendharkar College of Arts, Science and Commerce Department of Botany		
PROGRAMME AND COURSE F.Y.B.Sc BOTANY	**COURSE OUTCOME**	**PROGRAM SPECIFIC OUTCOME**
USBO101 Plant Diversity I	On completion of this course the student would be able to: CO1: Gain knowledge about the general characters of division Chlorophyta (i.e. and its economic importance) and to Understand the systematic position, life cycle of *Spirogyra and Nostoc.* CO2: Know economic importance of Algae. CO3: Understand the life cycle of *Rhizopus* and *Aspergillus* and to learn the mode of nutrition in Fungi especially Saprophytism and Parasitism. CO4: Understand the general characters of Class Hepaticae and the systematic position, structure, life cycle of *Riccia.*	PO1: The students in general will be able to understand the traditional botany and upcoming modern computational and applied approach in botany. In view of above, an adequate balance of topics is introduced for undergraduate students which enable them to understand the concepts of lower and higher plants, anatomy physiology, medicinal botany, functional aspects of various cellular processes of plants, ecology, cell biology and modern tools i.e. tissue culture, genetics and field study. PO2: The field study along with the laboratory practicals, enhances their higher cognitive skills. The students are provided with environment that ensures cognitive development in a holistic manner. A dialogue about plants and its significance is fostered rather than didactic monologues on mere theoretical aspects. Students will acquire core competency in the subject Botany, and in allied subject areas.
USBO201 Plant Diversity I	The student would be able to: CO1: Understand life cycle , the systematic position and alternation of generations in *Neprolepis* CO2: Learn the Stelar evolution in Pteridophyte. CO3: Know life cycle, the systematic position and alternation of generations of *Cycas* as well as to know economic importance of Gymnosperm. CO4: Develop critical understanding on morphology of leaf and Inflorescence. CO5: Identify, classify and describe the characteristics of Families Malvaceae and Amaryllidaceae.	
USBO102 Form and Function 1	On completion of this course the student would be able to: CO1: Understand general structure of plant cell. CO2: Gain knowledge about ultrastructure, composition	

	and functions of various plant cell organelles such as cell wall, plasma membrane, endoplasmic reticulum and chloroplast. CO3: Learn about energy pyramids and how energy flows in an ecosystem. CO4: Acquire knowledge about terrestrial and aquatic ecosystem. CO5: Have an understanding about phenotype and genotype and to understand mendelian genetics- monohybrid, dihybrid; test cross; back cross ratios	PO3: The students are equipped in solving the biostatistical problems. Students develops the ability of critical thinking application of various statistical methods like mean, median, mode, standard deviation, pie chart, histogram and frequency distribution. PO4: The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae, fungi, bryophytes and pteridophytes) and higher (angiosperms and gymnosperms) plants. PO5: Students will be able to use the evidence based comparative botany approach to explain ecosystem and understand the Mendelian genetics. PO6: The students will be able to explain various plant processes and functions, metabolism, concepts of gene, genome and how organism's function is influenced at the cell, tissue and organ level.
USBO202 Form and Function 1	The student would be able to: CO1: Learn about simple and complex plant tissues. CO2: Gain knowledge of primary structure of dicot and monocot root, stem and leaf and to identify types of epidermal hair, monocot and dicot stomata and learn about epidermal tissue system. CO3: Have an understanding of Light reactions, photolysis of water, cyclic and non cyclic photophosphorylation, C3, C4 and CAM pathways involved in the process of photosynthesis. CO4: Get familiar with the concept of primary and secondary metabolites, difference between primary and secondary metabolites. CO5: Know about botanical source, part of the plant used, active constituents present and medicinal uses of plants of grandma's pouch using examples of *Oscimum sanctum, Adathoda vasica, Zinziber officinale, Curcuma longa, Santalum album, Aloe vera.*	
USBOP1 (01) Plant Diversity Practical 1	On the completion of the course the student would be able to : CO1: Identify and describe the morphological and anatomical characteristics of *Nostoc and Spirogyr*a. CO2: Describe the economic importance of Algae.	

	CO3: Develop an understanding of economic importance of fungi along with the demonstration skills in laboratory, field and glasshouse work related to mycology and develop an understanding of fungi like *Rhizopus and Aspergillus.* CO5: Demonstrate an understanding of antheridia, archegonia, and sporophyte of Bryophytes using *Riccia* as a specimen.	PO7: Students will be able to understand ecological adaptation, development and behavior of plants. PO8: The understanding of networked life on earth and tracing the energy pyramids through nutrient flow is known by the students.
USBOP2 (01) Plant Diversity	On the completion of the course the student would be able to: CO1: Demonstrate an understanding of Pteridophytes through the study of life cycle , the systematic position and alternation of generations in *Nephrolepis.* CO2: Develop critical understanding on morphology, anatomy and reproduction of Gymnosperms like *Cycas*. CO3: Develop critical understanding on morphology of leaf and inflorescence through study of common plant of nearby locality. CO4: To identify, classify and describe the characteristics of Families Malvaceae and Amaryllidaceae	PO9: Students will be able to demonstrate the experimental techniques and methods during practicals. PO10: The students will be able to demonstrate the knowledge in understanding research and addressing practical problems which will be helpful in developing analytical ability.
USBOP1 (02) Form and Function I	On the completion of the course the student would be able to: CO1: Examine various stages of mitosis in root tip cells of *Allium*. CO2: Demonstrate and identify cell inclusions such as concentric and eccentric type of starch grains, aleurone layer, Cystolith, Raphides and Sphaeraphides. CO3: Identify various plant cell organelles such Plastids: Chloroplast, Amyloplast, Endoplasmic Reticulum and Nucleus with the help of photomicrograph. CO4: Observe and learn about different types of ecological adaptations through specimens of Pistia/*Eichornia, Nymphaea, Hydrilla, Typha/Cyperus,*	PO11: Students will become critical thinker and acquire problem solving capabilities through an increased understanding of fundamental concepts and their applications of scientific principles.

	Opuntia, *Nerium*, *Avicennia* pneumatophores. CO5: Develop the skills of statistics by calculating mean, median, mode and standard deviation. CO6: Understand about Frequency distribution, graphical representation of data- frequency polygon, histogram, and pie chart. CO7: Learn about Karyotype of normal male, female and *Allium cepa.*	
USBOP2 (02) Form and Function	On the completion of the course the student would be able to: CO1: Demonstrate and learn about primary structure of monocot and dicot root, stem and stomata. CO2: Understand about unicellular, multicellular, glandular, peltate, stellate and T- shaped epidermal outgrowths in plants. CO3: Develop the skills of chromatography by performing separation of chlorophyll pigments and amino acids in laboratory. CO4: Perform of the colour of anthocyanin changes with the change in pH. CO5: Test the amount of tannins from tea powder or *Areca catechu.* CO6: Identify various plants of grandma's pouch.	

PROGRAMME AND COURSE S.Y.B.Sc BOTANY	COURSE OUTCOME	PROGRAM SPECIFIC OUTCOME
USBO301 Plant Diversity	On completion of this course the student would be able to: CO1: To gain knowledge about the general characters of division Phaeophyta (brown algae) and the life cycle of Sargassum CO2: To understand the general characters of Class Anthocerotae (hornworts) and Class Musci (moss) and the systematic position, life cycle of *Anthocero*s and *Funaria.* CO3: To learn the relation between Plant Taxonomy and Anatomy, Palynology, Embryology, Ecology, Cytology and Phytochemical constituents and write down the objectives of plant systematics and nomenclature. CO4: To know the morphological and diagnostic characteristics and economic importance of Angiospermic plant families Leguminosae, Asteraceae, Amaranthaceae and Palmae. CO5: To acquire skills of modern techniques such as wet and dry preservation and study the principle and working of light and electron microscopy. CO6: To update the concepts of paper and Thin-Layer Chromatography (TLC) and Gel Electrophoresis	PSO1: The students in general will be able to understand Classical Botany, current scientific and industrial trends along with its applied approach. In view of above, an adequate balance of topics is introduced for undergraduate students, enabling them to build their basic concepts regarding, anatomy, physiology, pharmacognosy, functional aspects of various cellular processes of plants, ecology, cell biology and modern tools, like tissue culture, recombinant DNA technology and field study. PSO2: The field study along with the laboratory practicals enhances their thinking ability. The students are provided with environment that ensures cognitive development in a holistic manner. A dialogue about plants and its significance is fostered rather than didactic monologues on mere theoretical aspects. Students will acquire core competency in the subject, and in allied subject areas. PSO3: The students are equipped in using experimental, analytical as well as biostatistical tools. Students develop the ability of applying the essential statistical methods like determining the coefficient of Correlation and the Chi-square test in practical sense.
USBO401 Plant Diversity	On completion of this course the student would be able to: CO1: To understand general characters of class Ascomycetae (sac fungi) and to study the life cycle of *Xylaria and Erysiphe*, symptoms, disease cycle and control measures of the fungal diseases - Powdery Mildew and Late Blight of Potato. CO2: To learn the classification, structure, reproduction and ecological and economic importance of lichens.	

	CO3: To know general characters of division Psilophyta and Lepidophyta and understand the life cycle of *Selaginella.* CO4: To relate the concept of Palaeobotany with respect to geological time scale, types of fossils and structure of *Rhynia*. CO5: To learn the salient features, classification upto orders and economic importance of Coniferophyta; also write down the systematic position and life-cycle of *Pinus.* CO6: To understand the structure and systematic position of form genus *Cordaites*	PSO4: The students would be able to identify, classify and describe the major plant groups of lower (e.g. algae, fungi, bryophytes and pteridophytes) and higher (angiosperms and gymnosperms) plants. Special emphasis is also given regarding their economic importance and phylogeny. They will also understand the classical as well as modern (applied) taxonomic systems. PSO5: Along with phylogenetic studies of living plants, they are also enlightened about morphology as well as behavior of extinct plants, covered comprehensively in Paleobotany. PSO6: Students will be able to use the evidence based comparative botany approach to explain ecosystem and understand the fundamentals of cytogenetic as well as molecular biology. Not only does the student understand the underlying theoretical concepts behind cytogenetic and molecular biology, but also gains a practical approach regarding its direct applications, namely in commonly implemented techniques like plant tissue culture (PTC) and recombinant DNA (R-DNA) technology. Aforementioned techniques have direct applications in laboratories and industries.
USBO302 Form and Function-II	On the completion of the course student would be able to CO1: To study the ultra structure and functions of the cell organelles, namely Mitochondria, Micro bodies and Ribosomes. CO2: To understand cell division, its significance and the types and structure of nucleic acids. CO3: To study chromosomal aberrations and different methods of sex determination, sex linked, sex influences and sex limited traits. CO4: To understand the concept of extra-chromosomal inheritance. CO5: To study DNA replication in prokaryotes and eukaryotes. CO6: To study transcription of RNA and post transcriptional modifications	
USBO402 Form and Function-II	On the completion of the course the student would be able to: CO1: To study normal secondary growth in dicot root and stem. Also to study the mechanical tissue system. CO2: To understand the different types of vascular bundles. CO3: To study respiration and photorespiration.	

	CO4: To understand the concept of photoperiodic and vernalization. CO5: To study carbon, nitrogen and water cycles CO6: To study soil as an edaphic factor and qualitative and quantitative characters of community	PSO7: The students will be able to explain the physiological processes behind respiration in plants. PSO8: Students will be able to understand behavior of plants with respect to ecology PSO9: Students are also introduced to the fundamentals of horticulture and gardening. PSO10: Students will be able to utilize bioinformatical tools (namely Entrez and BLAST) for foraging and managing biological data. Also, they are introduced to the concepts and importance of Pharmacognosy. PSO11: The students will be able to demonstrate the knowledge in understanding research and addressing practical problems which will be helpful in developing analytical ability.
USBO303 Current Trends in Plant Sciences-I	The student would be able to: CO1: To study the Indian Pharmacopoeia, Indian Herbal Pharmacopoeia, Ayurvedic Pharmacopoeia of India and Monographs. CO2: To understand the different secondary metabolites, seasonal and regional variations and adulterants. CO3: To study the outline of forest types in India, agroforestry, organic farming, urban forestry and Silviculture. CO4: To understand the sources, types and uses of fibres and spices and condiments. CO5: To study aromatherapy and nutraceuticals. CO6: To study plant enzyme based industry and biofuel.
USBO403 Current Trends in Plant Sciences	The student would be able to: CO1: To study the different garden features. CO2: To understand the concept of different types of gardens, formal and informal. CO3: To study plant tissue culture with reference to organogenesis, totipotency, embryo, root, meristem and anther culture. CO4: To understand the concept of gene cloning with reference to enzymes and vectors used in gene cloning CO5: To study Chi square test and coefficient of correlation. CO6: To study the concept of Bioinformatics.

		PSO12: Students will become critical thinkers and acquire problem solving capabilities through an increased understanding of fundamental concepts and their applications of scientific principles.
USBOP3 (01) Plant Diversity	On the completion of the course the student would be able to: CO1: Identify and understand the morphological and anatomical characteristics of *Sargassum* and describe the range of thallus in brown algae CO2: Identify and demonstrate an understanding of morphology, gametophyte-sporophyte differences of bryophytes using *Anthoceros* and *Funari*a as specimens. CO3: Identify, classify and describe the characteristics of Families Leguminosae, Asteraceae, Amaranthaceae and Palmae. CO4: Describe plant anatomy in relation to taxonomy CO5: Demonstrate qualitative Tests for Phenols and Flavonoids. CO6: Acquaint themselves with the technique of preparing Herbarium, Wet Preservation of plant material and Chromatography. CO7: Demonstrate the technique of Horizontal as well as Vertical Gel Electrophoresis	
USBOP3 (01) Plant Diversity	On the completion of the course the student would be able to: CO1: Identify and understand the morphological and anatomical characteristics of *Sargassum* and describe the range of thallus in brown algae CO2: Identify and demonstrate an understanding of morphology, gametophyte-sporophyte differences of bryophytes using *Anthoceros* and *Funaria* as specimens.	

	CO3: Identify, classify and describe the characteristics of Families Leguminosae, Asteraceae, Amaranthaceae and Palmae. CO4: Describe plant anatomy in relation to taxonomy CO5: Demonstrate qualitative Tests for Phenols and Flavonoids. CO6: Acquaint themselves with the technique of preparing Herbarium, Wet Preservation of plant material and Chromatography. CO7: Demonstrate the technique of Horizontal as well as Vertical Gel Electrophoresis	
USBOP4 (01) Plant Diversity	On the completion of the course the student would be able to: CO1: Describe parasitic fungi, using *Erysiphe* and *Xylaria* as specimens and identify and describe Powdery Mildew and Late Blight disease. CO2: Describe the morphological and microscopic characteristics of Lichens CO3: Identify and describe the morphological and anatomical characteristics of *Selaginella* CO4: Describe the anatomical characteristics of *Rhynia* using permanent slides CO5: Identify and describe the morphological and anatomical characteristics of *Pinus* CO6: Describe the anatomical characteristics of *Cordaites* using permanent slides	
USBOP3 (02) Form and Function-II	On the completion of the course the student would be able to: CO1: Describe the structure and functioning of cell organelles using photomicrographs. CO2: Acquaint themselves with the technique of quantitatively estimating DNA and RNA from plant material. CO3: Describe inheritance patterns with	

	reference to plastid inheritance. CO4: Identify and describe laggards and ring chromosomes from photomicrographs. CO5: Learn the technique of squash and smear slide preparations, essential for understanding the stages seen in mitosis and meiosis. CO6: Understand the concepts Sanger sequencing and determination of amino acid sequence from m-RNA strand in prokaryotes and eukaryotes	
USBOP4 (02) Form and Function-II	On the completion of the course the student would be able to: CO1: Study normal secondary growth in dicotyledonous root and stem through sectioning and staining. CO2: Develop an understanding about the types of mechanical tissue systems in underground and aerial organs from different plants, using sectioning and staining. CO3: Understand the differences in the conducting tissues as seen in Gymnosperms and Angiosperms using maceration technique. CO4: Study the different types of vascular bundles and lenticels, tyloses, growth rings, heart wood and sap wood CO5: Learn the technique of performing experiments to study Q10, NR activity and estimate proteins. CO6: Understand the working and use of various ecological instruments and study soil composition CO7: Learn the technique of estimating organic matter in soil CO8: Learn the technique of studying vegetation by list quadrant method	
USBOP3 Current Trends in Plant	On the completion of the course the student would be able to:	

Sciences-I	CO1: Describe the macroscopic and microscopic characters of *Saraca asoca, Phyllanthus amarus* and *Bacopa monnieri* CO2: Understand the biodiversity by visiting a Botanical Garden. CO3: Learn about the sources of fibres, spices and condiments. CO4: Acquaint the knowledge regarding the preparation of herbal cosmetics. CO5: Describe the method of estimation of crude fibre from cereals and their products. CO6: Demonstrate the method of preparation and evaluation of probiotic food. CO7: Understand the methods of evaluating nutraceutical value of Mushrooms/Wheat germ	
USBOP4 Current Trends in Plant Sciences-I	On the completion of the course the student would be able to: CO1: Know and understand the different plants used in various garden locations. CO2: Demonstrate the method of preparing garden plans for formal and informal gardens, bottle and dish gardens. CO3: Acquaint themselves with the knowledge regarding different sterilization techniques. CO4: Demonstrate the technique of seed sterilization, callus induction and regeneration of plantlets from callus. CO5: Describe various cloning vectors. CO6: Understand the concepts of Chi-Square test and Coefficient of Correlation. CO7: Learn and practice using search engines of google, ENTREZ and BLAST	

PROGRAMME	**COURSE OUTCOME**	**PROGRAM SPECIFIC OUTCOME**

AND COURSE T.Y.B.Sc BOTANY		
USBO501 Plant Diversity III	The students would be able : • To gain knowledge about microbial diversity and techniques for culturing and visualization. • To understand the salient features of three major groups of algae, their life cycle patterns with a suitable example; to be able to identify them. • To learn the general characteristics and classification of two major groups of fungi along with life cycles of each group; to be able to identify them. • To understand the scope and importance of Plant Pathology and apply the concepts of various control measures of commonly widespread plant diseases.	PSO 1: To recognize and identify major groups of non-vascular and vascular plants and their phylogenetic relationships. To understand the phylogeny of plants and study various systems of classification. PSO 2: To explore the morphological, anatomical, embryological details as well as economic importance of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. PSO 3: To understand physiological processes and adaptations of plants. To provide knowledge about environmental factors and natural resources and their importance in sustainable development. PSO 4: To be able to carry out phytochemical analysis of plant extracts and application of the isolated compounds for treatment of diseases. PSO 5: To be able to deal with all microbes and the technologies for their effective uses in industry and mitigation of environmental concerns. PSO 6: To explain how current medicinal practices are often based on indigenous plant knowledge and to get introduced to different perspectives on treating ailments according to ethnomedicinal principles.
USBO502 Plant Diversity IV	The students would be able : • To acquire knowledge of different fossil forms and understand their role in evolution. • To provide plant description, describe the morphological and reproductive structures of seven families and also identify and classify according to Bentham and Hooker's system. • To gain proficiency in the use of keys and identification manuals for identifying any unknown plants to species level. • To relate anomalies in internal stem structure with function and appreciate the salient features of the root stem transition zone. • To get exposure to pollen study and learn to apply it in various fields.	
USBO503 Forms and Functions III	The students would be able : • To acquire knowledge about two important organelles and molecular mechanisms of translation • To understand water relations of plants, inorganic and	

	organic solute transport, and apply the knowledge to manage mineral nutrition and survival in challenging abiotic stresses. • To understand succession in plant communities and study remediation technologies in order to apply knowledge acquired for cleanup of polluted sites. • To get exposure to principles and techniques of plant tissue culture and apply these studies for improving agriculture and horticulture and to become an entrepreneur	PSO 7: To understand patterns of heredity and variation among individuals, species and populations and apply principles for improvement of quality and yield. PSO 8: To be able to apply statistical tools to gain insights into significantly different data from different sources. PSO 9: To acquire recently published knowledge in molecular biology, such as rDNA technology; PTC and bioinformatics and their applications.
USBO504 Current trends in plant sciences II	The students would be able : • To get exposure to the technique of mushroom cultivation and explore the possibility of entrepreneurship in the same. • To learn ethnobotanical principles, applications and utilize indigenous plant knowledge for the cure of common human diseases and improvement of agriculture. • To gain knowledge about the latest molecular biology techniques for isolation and characterization of genes. • To learn principles and application of commonly used techniques in instrumentation. • To gain proficiency in the monograph study and pharmacognostic analysis of six medicinal plants	
USBO601 Plant Diversity III	The students would be able : • To identify, describe and study in detail the life cycles of three Bryophytes. • To and study in detail classification and general characters of three classes of Pteridophytes and identify as well as describe the life cycles of one example from each class. • To study evolutionary aspects and economic utilization of Bryophytes and Pteridophytes.	

	• To identify, describe and study in detail the life cycles of three Gymnosperms.	
USBO602 Plant Diversity IV	The students would be able : • To study contribution of Botanical gardens, BSI to Angiosperm study and provide plant description, describe the morphological and reproductive structures of seven families. • To gain exposure to a phylognetic system of classification. • To gain insight into the anatomical adaptations of different ecological plant groups. • To understand development plant of male and female gametophytes, embryonic structure and development. • To understand the different aspects and importance of Biodiversity and utilize them for conservation of species so as to prevent further loss or extinction of Biodiversity and preserve the existing for future generations.	
USBO603 Forms and Functions III	The students would be able : • To study various plant bimolecular structures and appreciate the structures, role, functions and applications of enzymes. • To gain insight into the Nitrogen and plant hormone metabolism with applications of the same in agriculture and horticulture. • To understand principles of genetic mapping , mutations and solve problems based on them, gain knowledge of various metabolic disorders and their implications. • To generate and test hypotheses, make observations, collect data, analyze and interpret results, derive conclusions, and evaluate their significance within a broad scientific context, using suitable statistical techniques.	

USBO604 IV Current Trends in plant Sciences II	The students would be able : • To gain insight into recent molecular biology techniques for DNA analysis and amplification and Bar coding techniques and applications therein. • To understand and apply tools of Bioinformatics for data retrieval and phylogenetic analysis. • To learn about the sources of economically important plants in the field of fats and oils and apply it for extraction, dealing with entrepreneurship in the field. • To gain knowledge and proficiency in preservation of post harvest produce and explore the possibility of entrepreneurship in the field	