

**SARDAR PATEL UNIVERSITY,  
Vallabh Vidyanagar, Anand Gujarat  
Structure of Core subject at B. Sc. Semester VI  
Subject: Botany  
Effective from June 2020**

<b>Paper code</b>	<b>Title of Paper</b>	<b>Credit</b>	<b>Lectures per week</b>	<b>Internal exam</b>	<b>External exam</b>	<b>External exam hrs</b>
US06CBOT21(T)	Pharmacognosy and Phytochemistry	4	4	30/12	70/28	3
US06CBOT22(T)	Anatomy of Angiosperms	4	4	30/12	70/28	3
US06CBOT23(T)	Plant Biochemistry	4	4	30/12	70/28	3
US06CBOT24(T)	Plant Biotechnology	4	4	30/12	70/28	3
US06CBOT25(P)	Botany Practical	6	12	45/18	105/42	6
US06DBOT26(T)	Microtechniques					
or	or	2	2	-----	50/20	2
US06DBOT27(T)	Floriculture					
		24	30 hrs/week			

**SARDAR PATEL UNIVERSITY**

**Programme: B. Sc. (BOTANY)**

**Semester: VI**

**Paper Code: US06CBOT21 (T)**

**Title of Paper: PHARMACOGNOSY AND PHYTOCHEMISTRY**

**Total Credit: 4 (Four Lectures per week)**

**(Total Marks 100, Internal-30 marks, External 70-marks)**

**Syllabus with effect from: June 2020**

**Learning Outcome:**

On completion of this course, students will be able to know about identification, chemical constituents, and uses of plant drugs with their nutraceutical values.

<b>US06CBOT21(T)</b>		<b>4 CREDIT</b>
<b>Pharmacognosy and Phytochemistry</b>		
<b>UNIT</b>	<b>CONTENT</b>	
1	<b>Introduction to Pharmacognosy:</b> Definition, history, scope, future and pharmacognostical scheme of Pharmacognosy. Organized and Unorganized drugs: Classification of drugs of natural origin: Alphabetical, Taxonomical, Morphological, Pharmacological, chemical, Chemotaxonomical and serotaxonomical classification.	
2	<b>Introduction to Primary and Secondary metabolites:</b> Definition, classification, properties and test for identification of carbohydrates, proteins, lipids, alkaloids, glycosides, flavonoids, tannins, volatile oils and resins.	
3	<b>Traditional drugs of India:</b> Study of biological source, chemical constituents and uses of following drugs: Adusa, Amla, Arjuna, Ashoka, Bhilama, Brahmi, Cassia, Chirata, Chitrak, Gokhru, Guggal, Kalejire, Lahsun, Methi, Palas, Punarnava, Shatavari, Shankhpushpi, Tulsi, Tylophora.	
4	<b>Nutraceuticals:</b> Definition, scope and future prospects. Classification-Inorganic mineral supplements, vitamin supplement, Digestive enzyme, Prebiotic, Probiotic, Dietary fibers, Cereals, Health drinks, Antioxidants, Polyunsaturated fatty acids. Herbs as functional foods: Flax seeds, Ginkgo biloba, Spirulina, Ginseng, Garlic organo-sulphur compounds, Tea catechins, Citrus Limonoids, Soya products, Tomato lycopenes, Momordica charantia, Turmeric curcuminoids, Fenugreek.	

**SARDAR PATEL UNIVERSITY**  
**Programme: B. Sc. (BOTANY)**  
**Semester: VI**  
**Paper Code: US06CBOT22 (T)**  
**Title of Paper: ANATOMY OF ANGIOSPERMS**  
**Total Credit: 4 (Four Lectures per week)**  
**(Total Marks 100, Internal-30 marks, External 70-marks)**  
**Syllabus with effect from: June 2020**

**Learning Outcome:**

Students will be able to explain structural organization of plants, tissues, its growth and adaptations.

<b>US06CBOT22</b>		<b>4 CREDIT</b>
<b>Anatomy of Angiosperms</b>		
<b>UNIT</b>	<b>CONTENT</b>	
1	<p><b>Introduction and scope of Plant Anatomy:</b>            Applications in systematics, forensics and pharmacognosy.            Structure and Development of Plant Body: Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development.</p>	
2	<p><b>The Tissue systems:</b>            Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers.            Apical meristems: Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory); Types of vascular bundles; Structure of dicot and monocot stem. Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root.</p>	
3	<p><b>Vascular Cambium and Wood:</b>            Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.</p>	
4	<p><b>Adaptive and Protective Systems:</b>            Epidermal tissue system, cuticle, epicuticular waxes, trichomes(uni-and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.</p>	

**SARDAR PATEL UNIVERSITY**  
**Programme: B. Sc. (BOTANY)**  
**Semester: VI**  
**Paper Code: US06CBOT23 (T)**  
**Title of Paper: PLANT BIOCHEMISTRY**  
**Total Credit: 4 (Four Lectures per week)**  
**(Total Marks 100, Internal-30 marks, External 70-marks)**  
**Syllabus with effect from: June 2020**

Learning outcome:

The students will be able to explain various plant processes and functions, metabolism, concepts of assimilation, biological oxidation and nitrogen fixation.

<b>US06CBOT23</b>		<b>4 CREDIT</b>
<b>Plant Biochemistry</b>		
<b>UNIT</b>	<b>CONTENT</b>	
1	<p><b>Carbon assimilation:</b>            Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes).            Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centers, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO<sub>2</sub> reduction, photorespiration, C<sub>4</sub> pathways; Crassulacean acid metabolism; Factors affecting CO<sub>2</sub> reduction.            Synthesis and catabolism of sucrose and starch.</p>	
2	<p><b>Carbohydrate Metabolism:</b>            Glycolysis, Fermentation, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, Gluconeogenesis cyanide-resistant respiration, factors affecting respiration.</p>	
3	<p><b>Lipid and Nitrogen metabolism:</b>            Lipid Metabolism: alpha, beta and omega oxidation of fatty acids.            Nitrogen metabolism: Ammonification, Nitrification, Nitrate assimilation, Denitrification, Nitrogen fixation: Biological and nonbiological Nitrogen fixation, Biochemistry of nitrogen fixation, Non symbiotic and symbiotic nitrogen fixation, Nitrogen fixation in cyanobacteria, Biosynthesis of aminoacids-Reductive amination, Transamination.</p>	
4	<p><b>Enzymes:</b>            Historical background, Classification, nomenclature and importance of enzymes, role of enzymes as bio catalysts, physiological and biochemical properties, concept of holo-enzymes, coenzymes, apoenzymes &amp; prosthetic groups, mechanism and kinetics of action, enzyme inhibition, isozymes, allosteric enzymes, industrial aspects of enzymology.</p>	

**SARDAR PATEL UNIVERSITY**  
**Programme: B. Sc. (BOTANY)**  
**Semester: VI**  
**Paper Code: US06CBOT24 (T)**  
**Title of Paper: PLANT BIOTECHNOLOGY**  
**Total Credit: 4 (Four Lectures per week)**  
**(Total Marks 100, Internal-30 marks, External 70-marks)**  
**Syllabus with effect from: June 2020**

**Learning Outcome:**

The goal of this course is to introduce biotechnology methods in plants. The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production. Understanding of biotechnological processes has also applicative value in pharmaceutical and food industry, in agriculture and in ecology.

<b>US06CBOT24</b>		<b>4 CREDIT</b>
<b>Plant Biotechnology</b>		
<b>UNIT</b>	<b>CONTENT</b>	
1	<b>Plant Tissue Culture:</b> Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).	
2	<b>Recombinant DNA technology:</b> Restriction endonucleases, prokaryotic and eukaryotic cloning vectors; genomic and cDNA libraries; Southern and Northern Analysis, various techniques of gene mapping and DNA fingerprinting (RFLP, RAPD, AFLP); chromosome walking, polymerase chain reaction; DNA sequencing.	
3	<b>Methods of gene transfer:</b> <i>Agrobacterium</i> -mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes.	
4	<b>Applications of Biotechnology:</b> Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Biosafety concerns.	

**SARDAR PATEL UNIVERSITY**  
**Programme: B. Sc. (BOTANY)**  
**Semester: VI**

Suggested Readings:

US06CBOT21

1. Pharmacognosy: C. S. Shah and J. S. Qadry
2. Pharmacognosy: C. K. Kokate, Purohit and Gokhle
3. Pharmacognosy: Mohmmad Ali
4. Textbook of Pharmacognosy and Phytochemistry: Shah and Seth
5. Experimental Pharmacognosy: Rajesh Nema and C S Bhan

US06CBOT22

1. Dickison, W. C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
3. Mauseth, J. D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4. Evert, R. F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

US06CBOT23

1. Hopkins, W. G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I. M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6<sup>th</sup> edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
4. Verma and Verma, Text book of Plant Physiology.
5. Mukherji and Ghosh, Plant Physiology.
6. Salisbury and Ross, Plant Physiology.

US06CBOT24

1. Bhojwani, S. S. and Razdan, M. K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B. R., Pasternak, J. J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics. John Wiley and Sons, U. K. 5<sup>th</sup> edition.
4. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
5. B. D. Singh, Biotechnology
6. U.Satyanarayan, Biotechnology
7. P. K. Gupta, Elements of Biotechnology

**SARDAR PATEL UNIVERSITY**  
**Programme: B. Sc. (BOTANY)**  
**Semester: VI**  
**Paper Code: US06CBOT25 (P)**  
**Title of Paper: BOTANY PRACTICAL**  
**Total Credit: 6 (Twelve Lectures per week)**  
**(Total Marks 150, Internal-45 marks, External 105-marks)**  
**Syllabus with effect from: June 2020**

<b>US06CBOT25 (P)</b>	<b>6 CREDIT</b>
<b>Botany Practical</b>	

	<b>PART-1 Plant Anatomy</b>
1.	Study of anatomical details through permanent slides/temporary stain mounts/macerations/ museum specimens with the help of suitable examples.
2.	Apical meristem of root, shoot and vascular cambium.
3.	Distribution and types of parenchyma, collenchyma and sclerenchyma.
4.	Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
5.	Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6.	Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7.	Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8.	Root: monocot, dicot, secondary growth.
9.	Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10.	Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
11.	Adaptive Anatomy: xerophytes, hydrophytes.
12.	Secretory tissues: cavities, lithocysts and laticifers.
	<b>PART-2 Plant Biochemistry</b>
1.	Chemical separation of photosynthetic pigments.
2.	To study the effect of light intensity on the rate of photosynthesis.
3.	Effect of carbon dioxide on the rate of photosynthesis.
4.	To compare the rate of respiration in different parts of a plant.
5.	To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.
6.	Detection of organic acids in plants.
7.	Estimation of reducing sugar/protein/DNA by suitable method.
8.	Demonstration of respiratory enzymes in plant tissues
9.	Assay of amylase/urease/catalase/peroxidase
10.	Qualitative tests for carbohydrates
11.	Qualitative tests for proteins.
12.	Qualitative tests for lipids

<b>US06CBOT25 (P)</b>	<b>6 CREDIT</b>
<b>Botany Practical</b>	<b>continued</b>

<b>PART-3 Plant Biotechnology and Pharmacognosy</b>	
1.	Preparation of MS medium. (Protocol)
2.	Demonstration of <i>in vitro</i> sterilization and inoculation methods using leaf and nodal explants of tobacco, <i>Datura</i> , <i>Brassica</i> etc.
3.	Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
4.	Isolation of protoplasts. (Protocol)
5.	Construction of restriction map of circular and linear DNA from the data provided.
6.	Study of methods of gene transfer through photographs: <i>Agrobacterium</i> -mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
7.	Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
8.	Identification and characterization of crude drugs as prescribed in theory course by performing suitable chemical tests.
9.	Chemical Tests for various classes of Phyto-constituents.
10.	Isolation of Caffeine/Quinine/Nicotine from suitable source.
11.	Field visit of Medicinal Plants.
12.	Visit to a biotechnology laboratory of repute.



**SARDAR PATEL UNIVERSITY**  
**Programme: B. Sc. (BOTANY)**  
**Semester: VI**  
**Paper Code: US06DBOT26 (T)**  
**Title of Paper: MICROTECHNIQUES**  
**Total Credit: 2 (Two Lectures per week)**  
**(Total Marks 50, External marks 50)**  
**Syllabus with effect from: June 2020**

**Learning outcome:**

Students will be able to know about microscopy, sample preparation and about microtome which enables them to utilize knowledge in practical applications.

<b>US06DBOT26</b>		<b>2 CREDIT</b>
<b>MICROTECHNIQUES</b>		
<b>UNIT</b>	<b>CONTENT</b>	
1	<b>Light microscopy:</b> Properties of lenses, Optical corrections, Properties and types of objectives, Oculars and Illumination. Light microscopes: Bright field, dark field, fluorescence, phase contrast.	
2	<b>Electron microscopy:</b> Basic components of electron microscopes. Thermionic and field emission guns. Types of electron microscopes: TEM, SEM, STEM, ESEM and HVEM.	
3	<b>Sample preparation and techniques for microscopy:</b> Maceration, squash and clearing techniques. Classification of fixatives, formulas', (Plant and animal samples). Sample preparation for light microscopy: Fixation, dehydration and infiltration procedures. Embedding media for light microscopy. Stains and staining procedures- negative and positivestaining procedures.	
4	<b>Microtomes:</b> Types of microtomes: Rotary, sliding, cryostat. Histochemical localization of metabolites for light microscopy: Starch, proteins, lipids, total carbohydrates, lignins, polyphenols, nucleic acid, histones, cutin, suberin and waxes. Localization of enzymes: Peroxidase, acid phosphatase and succinic dehydrogenase.	

**Suggested readings:**

1. Microscopy and Microtechnique: R Marimuthu, MJP Publisher, Chennai
2. The study of plant structure: Principles and selected methods- T. P. O' Brien and M E McCully.
3. Plant Microtechnique- Johansen, DA, McGraw Hill Book Co., New York.
4. Botanical Microtechnique and Cytochemistry; Graeme P. Berlyn and Jerome P Micksche.

**SARDAR PATEL UNIVERSITY**  
**Programme: B. Sc. (BOTANY)**  
**Semester: VI**  
**Paper Code: US06DBOT27 (T)**  
**Title of Paper: FLORICULTURE**  
**Total Credit: 2 (Two Lectures per week)**  
**(Total Marks 50, External marks 50)**  
**Syllabus with effect from: June 2020**

Learning outcome: Students will be able to

- Get applied knowledge of cut flowers, postharvest handlings.
- Develop skill in floriculture techniques.
- Develop garden area with landscaping knowledge.

<b>US06DBOT27</b>		<b>2 CREDIT</b>
<b>FLORICULTURE</b>		
<b>UNIT</b>	<b>CONTENT</b>	
1	Introduction to the basic concepts of floriculture Classification of floricultural and landscape plants Propagation of ornamental plants	
2	Cut flower production like Chrysanthemum, Carnation, Orchids, Rose, Gerbera, Marigold. Postharvest handling of cut flowers.	
3	Dry flower production Bonsai techniques and care Foliage plants: Indoor and outdoor foliage plants, care for better growth.	
4	Landscaping: Types of landscaping, elements for landscaping, designs for landscape area. Care for landscaping area. Plant selection for landscaping. Turf production and uses	

Suggested readings:

1. Amitabha Mukhopadhyay and G. S. Randhawa, Floriculture in India
2. L.L. Somani, Floriculture and Landscaping at a Glance.
3. Prasad S. and U. Kumar, Handbook of Floriculture.