Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: VI

Course Code	US06CBOT51(T)	Title of the Course	PHARMACOGNOSY AND PHYTOCHEMISTRY
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To study about identification, classification, chemical constituents, and uses of plant as drugs. 2. To understand the scopes in nutraceuticals.

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction to Pharmacognosy**: 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.	25%
2.	**Introduction to Primary and Secondary metabolites:** Definition, classification, properties and test for identification of carbohydrates, proteins, lipids, alkaloids, glycosides, flavonoids, tannins, volatile oils and resins.	25%
3.	**Traditional drugs of India:** 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.	25%
4.	**Nutraceuticals**: 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.	25%

Teaching-Learning Methodology	Classroom interaction, Power point presentation, Charts, quiz, Preserved specimens, assignments, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Know about identification, chemical constituents, and uses of plant drugs with their nutraceuticals values.
2.	Understand the importance and potential of medicinal plants

Suggested References:	
Sr. No.	References
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

On-line resources to be used if available as reference material
On-line Resources : Articles from Google scholar

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Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: VI

Course Code	US06CBOT52(T)	Title of the Course	ANATOMY OF ANGIOSPERMS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To understand the basic structural organization of plants, tissues and its growth 2. To learn adaptations and protective system in plant.

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction and scope of Plant Anatomy:** 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.	25%
2.	**The Tissue systems**: 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	25%
3.	**Vascular Cambium and Wood**: 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.	25%
4.	**Adaptive and Protective Systems**: 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.	25%

Teaching-Learning Methodology	Classroom interaction, Power point presentation, Charts, quiz, assignments, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	explain structural organization of plants, tissues, its growth and adaptations.

Suggested References:	
Sr. No.	References
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.

On-line resources to be used if available as reference material
On-line Resources : Articles from Google scholar

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Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: VI

Course Code	US06CBOT53(T)	Title of the Course	PLANT BIOCHEMISTRY
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn about fundamental concepts of respiration, carbon assimilation, biological oxidation, nitrogen metabolism and enzymes.

Course Content		
Unit	Description	Weightage* (%)
1.	**Carbon assimilation:** 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, CO2 reduction, photorespiration, C4pathways; Crassulacean acid metabolism; Factors affecting CO2 reduction. Synthesis and catabolism of sucrose and starch.	25%
2.	**Carbohydrate Metabolism:** 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.	25%
3.	**Lipid and Nitrogen metabolism:** 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.	25%
4.	**Enzymes**: Historical background, Classification, nomenclature and importance of enzymes, role of enzymes as bio catalysts, physiological and biochemical properties, concept of holoenzyme, coenzymes, apoenzymes & prosthetic groups, mechanism and kinetics of action,	25%

	enzyme inhibition, Isozymes, allosteric enzymes, industrial aspects of enzymology.	

Teaching-Learning Methodology	Classroom interaction, Power point presentation, Charts, quiz, assignments, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Explain various plant processes and functions, metabolism, concepts of assimilation, biological oxidation and nitrogen fixation.

Suggested References:	
Sr. No.	References
1	Nelson D L, Cox M M; Lehninger principles of biochemistry (forth edition)
2	Verma and Verma, Text book of Plant Physiology
3	Rodwell, Bender, Botham, Kennelly, Weil; Harper's illustrated biochemistry (31st edition)
4	U. Satyanarayan, U. Chakrapani ; Biochemistry (fifth edition)

On-line resources to be used if available as reference material
On-line Resources : Articles from Google scholar

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Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester: VI

Course Code	US06CBOT54(T)	Title of the Course	PLANT BIOTECHNOLOGY
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn classical and modern plant biotechnology processes for improvement in quality and quantity of the trait. 2. To pharmaceutical and food industry, in agriculture and in ecology

Course Content		
Unit	Description	Weightage* (%)
1.	**Plant Tissue Culture:** 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 (micropopagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).	25%
2.	**Recombinant DNA technology:** 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.	25%
3.	**Methods of gene transfer:** *Agrobacterium*-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes.	25%
4.	**Applications of Biotechnology:** Pest resistant (Bt-cotton); herbicide resistant plants (Roundup Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moon dust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Biosafety concerns	25%

Teaching-Learning Methodology	Classroom interaction, Power point presentation, Charts, quiz, laboratory visits, assignments, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.
2.	Understanding of applicative value of biotechnological processes in pharmaceutical and food industry, in agriculture and in ecology

Suggested References:	
Sr. No.	References
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. 5th 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

On-line resources to be used if available as reference material
On-line Resources : Articles from Google scholar

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Bachelor of Science (BOTANY)
B. Sc. (BOTANY) Semester :VI

Course Code	US06CBOT55(P)	Title of the Course	BOTANY PRACTICAL
Total Credits of the Course	6	Hours per Week	12

Course Objectives:	1. To study the structural arrangements in plants. 2. To learn the histochemistry of tissues. 3. To develop a plant *in-vitro* using plant biotechnological methods.

Course Content		
Unit	Description	Weightage* (%)
1.	**Plant Anatomy** Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples. 1. Apical meristem of root, shoot and vascular cambium. 2. Distribution and types of Parenchyma, Collenchyma and Sclerenchyma. 3. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres. 4. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood. 5. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres. 6. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular. 7. Root: monocot, dicot, secondary growth. 8. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels. 9. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy). 10. Adaptive Anatomy: xerophytes, hydrophytes. 11. Secretory tissues: cavities, lithocysts and laticifers.	33.33%
2.	**Plant Biochemistry** 1. Separation of photosynthetic pigments. 2. To find out stomatal index. 3. Effect of carbon dioxide on the rate of photosynthesis. 4. To compare the rate of respiration in different parts of a plant. 5. Detection of organic acids in plants. 6. Estimation of reducing sugar/protein/DNA by suitable method. 7. Demonstration of respiratory enzymes in plant tissues 8. Assay of amylase/urease/catalase/peroxidase 9. Qualitative tests for carbohydrates 10. Qualitative tests for proteins. 11. Qualitative tests for lipids	33.33%

3.	**Plant Biotechnology and Pharmacognosy** 1. Preparation of MS medium. (Protocol) 2. Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc. 3. Study of anther, embryo and endosperm culture, micropopagation, somatic embryogenesis & artificial seeds through photographs. 4. Isolation of protoplasts. (Protocol) 5. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by Electroporation, microinjection, Microprojectile bombardment. 6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs. 7. Identification and characterization of crude drugs as prescribed in theory course by performing suitable chemical tests. 8. Morphological studies of various drugs prescribed in unit-3. 9. Chemical Tests for various classes of Phyto-constituents. 10. Isolation of Caffeine/Quinine/Nicotine from suitable source. 11. Study of various types of starch grains. 12. Field visit of Medicinal Plants/Submission. 13. Visit to a biotechnology laboratory of repute.	33.33%

Teaching-Learning Methodology	Charts, Power point presentation, quiz, Preserved specimens, laboratory visits, assignments, seminars, online content from internet.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Know about various tissues and structures found in plants.
2.	Understand the skill requirements and applications of plant tissue culture.
3.	Know about Identification and characterization of crude drugs, chemical tests and isolation.

Suggested References:	
Sr. No.	References
1	Experimental Pharmacognosy: Rajesh Nema and C S Bhan
2	Bhojwani, S. S. and Razdan, M. K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3	Pharmacognosy: C. K. Kokate, Purohit and Gokhle
4	Glick, B. R., Pasternak, J. J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
5	Verma and Verma, Text book of Plant Physiology.

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