Three Years B.Sc. Programme

Scheme of Teaching and Examination
B.Sc. Third Semester Biotechnology
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the Academic Year 2021-2022)

Shri Rawatpura Sarkar University, Raipur

S. No.	Course Code	Th / Pr	Subject	Type of Course	Teaching Hours / Week			TC	Examination Scheme				Total Marks
									Theory		Practical		
					L	T	P		EX	IN	EX	IN	
1.	SBS02301	Th	Biotech-III: Biochemistry	Core	4	-	-	4	70	30	-	-	100
2.	SBS02302	Th	Biotech-IV: Animal Biotechnology and Genetic Engineering	Core	4	-	-	4	70	30	-	-	100
3.	SBS02303	Th	Bioscience: Plant Physiology and anatomy	Core	4	-	-	4	70	30	-	-	100
4.	SBS02304	Th	Chemistry III:	Core	4	-	-	4	70	30	-	-	100
5.	SBS02311	Th	Research Methodology	AEC C	4	-	-	4	70	30	-	-	100
6.	SBS02391	Pr	Lab Course VII: Biotech-III	Core Practical	-	-	4	2	-	-	35	15	50
7.	SBS02392	Pr	Lab Course VIII: Chemistry	Core Practical	-	-	4	2	-	-	35	15	50
8.	SBS02393	Pr	Lab Course IX : Bioscience	Core Practical	-	-	4	2	-	-	35	15	50
	Total				**20**		**12**	**26**					**650**

<table>
<tr><td>Course Title</td><td colspan="5">BIOTECH III: Biochemistry</td></tr>
<tr><td>Course Code</td><td colspan="5">SBS02301</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>4</td><td>-</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Basic Chemistry</td></tr>
<tr><td>Course Objectives</td><td colspan="5">• To understand the chemistry by biological frontiers.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT I
Carbohydrates: General Properties, Types (Monosaccharide, Oligosaccharide and Polysaccharide) and Biological Importance, Monosaccharide: Structure, Occurrence, Reactions and Biological importance of Monosaccharide, Isomerism: Stereoisomerism and Optical isomerism, Ring Structure and Anomeric forms, Mutarotation, Derivatives: Derivatives of Monosaccharide, Di and Tri-saccharide. Important Polysaccharide: Glycogen, Starch and Cellulose.
UNIT II
Lipids: General Properties and Classification, Fatty acids: Nomenclature, Classification, Structure and Properties of Saturated and Unsaturated fatty acids. Essential Fatty Acids, Triacylglycerols: Properties and Characterization of Fats, Hydrolysis, Saponification value, Acid value, Rancidity of fats and Functions, Biological Significance of Glycerophospholipids, Sphingomyelins and Glycolipids.
UNIT III
Amino acids: Definition, Classification and Properties of Amino acids, Peptide bond: Definition, Structure, Solid phase Protein Synthesis in brief, C – terminal and N – terminal Amino acid determination, Protein: Structure, Types (Primary, Secondary, Tertiary and Quaternary) and Functions.
UNIT IV
Nucleic Acids: Definition, Structure, Phosphodiester bond and Properties, Purine and Pyrimidine Bases: Structure and Types, Composition of DNA and RNA, Nucleosides and Nucleotides, DNA double helix: Watson - Crick Model, Complementary base- pairings, Base staking, Chargaff’s rule. Different forms of DNA structure (A, B & Z DNA), Major and Minor groove, Denaturation and Annealing of DNA, RNA: Types of RNA, Secondary and Tertiary structure of t-RNA.
UNIT V</td></tr>
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	Porphyrin: General Properties, Structure of Nucleus and Classification, Metalloporphyrins: Structure of Haemoglobin, Myoglobin, Chlorophyll, Cyanocobalamin and their biological importance.
Course Outcomes	CO1. The basics of biomolecules (source, properties, classification, structure etc) CO2. Through this course the students are exposed to importance of biological macromolecules CO3.They acquire knowledge in the quantitative and qualitative estimation of biomolecules CO4.They study the influence and role of structure in reactivity of biomolecules CO5.At the end of the course, the students have a thorough understanding on the role of biomolecules and their functions
Text and References	1. Biochemistry: J M Berg, J L Tymoczko and L Stryer. 2. Lehninger Principles of Biochemistry: David L Nelson and Michael M Cox. 3. Biochemistry: D Voet, J Voet and C W Pratt. 4. Biochemistry: U Satyanarayana and U Chakrapani. 5. Textbook of Biochemistry: Edward S West. 6. Fundamentals of Biochemistry: J L Jain, Sunjay Jain and Nitin Jain 7. Harpers Illustrated Biochemistry: Robert K Murray, Daryl K Garner and Peter A MayesBiophysical and biochemical technique : Nath and Upadhyaya

Course Title	**BIOTECH IV: Animal Biotechnology and Genetic Engineering**				
Course Code	SBS02302				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Basic Biotechnology**				
Course Objectives	Understanding the concept of Animal Biotechnology and its application. To understand the fundamentals of Genetic engineering and its tools.				
Course Contents	**UNIT I** Animal Biotechnology: Animal Biotechnology- Introduction, History, Scope,				

	Advantages & Disadvantages, Tissue Culture Media, Applications of Animal Biotechnology **UNIT II** Cell Culture & Cell Lines, Culture Procedure, Large Scale Cell Culture in Biotechnology, Cell Banking & Scaling up of Cell Culture, Organ Culture- Types & Techniques, Applications in the field of Biotechnology **UNIT III** Genetic Engineering- Concepts, Tools, Enzymes responsible for Genetic Engineering, Cloning Vectors and their Applications **UNIT IV** Gene Libraries- Creating & Screening Methods & Its different Techniques, Methods of DNA Technology, Molecular Research Procedures of DNA. **UNIT V** DNA & its Sequencing, Applications of Genetic Engineering in the Field of Agriculture, Industry, Medicine & Diagnostics.
Course Outcomes	CO1. Understanding the basic knowledge of Animal biotechnology, cloning its scope, advantages and disadvantages, knowledge about animal cell tissue culture media. CO2. Demonstrate knowledge of basic cell culture techniques, establishment of cell lines and their maintenance, knowledge on design and use the cell culture facilities, discuss the advantages and limitations of primary cell culture compared to immortalized or transformed cell lines, cell banking and basic knowledge of organ culture and application of cell culture in biotechnology and research. CO3. Understanding the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering. CO4: Describes the genome mapping and sequencing and methods for gene therapy. CO5: Able to describe applications of genetic engineering in the field of agriculture, Industry, medicine and diagnostics.

Text and References	• Elements of Biotechnology (2nd Edition): P K Gupta • Animal Cell Culture: A Practical Approach: R. I. Freshney • Methods in Cell Biology(Vol-57): Animal Cell Culture Methods Mather & David Barnes • Principles of Genetic Manipulation: Old & Primrose • Animal Cell Culture Techniques- Martin Clynes • Recombination DNA Technology: Glick • Gene Cloning: T.A. Brown • Applied Molecular Genetics: Roger L Meisfeld • DNA Cloning:- A Practical Approach; A.M. Glover and B.D. Hames, IRL Press, Oxford • Genetic Engineering:- An Introduction to Gene Analysis and Exploitation in Eukaryotes: S.M. Kingsam; A.J. Kingsman • Recombination DNA: Watson et.al • Principles of Gene Manipulation: Old and Primrose • Molecular Biotechnology: Glick and Pasternak

Course Title	**BIOSCIENCE III: PLANT PHYSIOLOGY AND ANATOMY**				
Course Code	**SBS02303**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**General Botany**				
Course objectives	To help students acquire a comprehension of plant biology from the subcellular to the organismal level. The course explores various topics in plant cell biology, physiology, and biochemistry including primary and secondary metabolism, photosynthesis, respiration, water relations, mineral nutrition, response to environmental stress, roles of plant hormones, and plant biotechnology				
Course Contents	**UNIT 1: -** **Meristematic and permanent tissues:** Root and shoot apical meristems; Simple and complex tissues. **Organ:** Structure of dicot and monocot root stem and leaf.				

	UNIT 2: **Secondary Growth** Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). **U NIT 3:** **Adaptive and protective systems:** Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes. **UNIT 4:** **Structural organization of flower:** Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac **UNIT 5:** **Pollination and fertilization:** Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.Endosperm types, structure and functions;
Course Outcomes	Students will be able to: CO1: To gain knowledge of plant cells, tissues and their functions. CO2: Understand the normal and anomalous secondary growth in plants and their causes. CO3: Describe the adaptive and protective systems CO4: Discuss the Structural organization of flower. CO5: Identify the process of pollination and fertilization.
Text and References	1. Bhojwani, S.S. &Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition. 2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

Course Title	**ChemistryIII: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II**				
Course Code	SSH05304				
Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	
Prerequisites	Students should pass bsc I year				
Course	• Understand the basic knowledge of atomic solution, electro chemistry and functional group				

Objectives	organic chemistry
Course Contents	**UNIT-I** **Solutions and Phase Equilibrium** **Solutions**:Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature- composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes, **Non-Aqueous solvents:**Dipole moments, reactions in aqueous and non-aqueous medium, reactions in ammonia, sulfur dioxide, nitric oxide, hydrogen fluoride, nitric acid, HCletc, **Phase Equilibrium**: Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation ofClausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only). **UNIT-II** **Conductance and Electrochemistry** **Conductance**: Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions, Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base),**Electrochemistry**: Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data,Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.pH determination using hydrogen electrode and quinhydroneelectrode.Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only). **UNIT-III** **Carboxylic acids, Amines and Diazonium Salts** **Carboxylic acids and their derivatives:** Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell –Vohlard - ZelinskyReaction.Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.,**Amines and DiazoniumSalts**Amines (Aliphatic and Aromatic): (Upto 5 carbons)Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamidereaction.Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.Diazonium salts: Preparation: from aromatic amines.Reactions: conversion to benzene, phenol,

	dyes.**Hetrocyliccompounds:**Introduction,resonance and aromaticity of heterocyclic compounds, structure and reactions of furan, pyridine, bipyridine, furane, thiophene, quinone, isoquinone, pyrrol crown ether etc. **UNIT-IV** **Amino Acids, Peptides and Proteins:-**Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.Reactions of Amino acids: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrintest.Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins,Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis,Functions of proteins in foods- physical and chemical properties of proteins important protein sources- milk- meat- fish- egg and cereal proteins. **UNIT-V** **Carbohydrates**: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation,Dietary sources -functional properties of dietary carbohydrates- biological role of dietary fibrenutrition- flavor and colour development sweetness - texturing characteristics of carbohydrates - plasticizing action and humectancy of carbohydrates.
Course Outcomes	CO1: On the completion of this course successfully students will be able to know the behaviour of non-ideal gas on the basis ofRaoult's law, and will understand the application of non-aqueous solvents for chemical reaction. Also, will be able to determine phase, component and degree of freedom of different component system. CO2: Students will be capable to understand the electrochemistry, free energy and EMF on the basis of Nerst Equation and will be able to determine the work of different type cell. CO3: Students will be able to understand the mechanism of many types name reaction and physical and chemical properties of carboxylic acid and amines. CO4: They will be able to explain the different structure and function of amino acid protiens. CO5: Students will understand the determination and configuration of monosaccharides, absolute configuration of Glucose and Fructose. Also, will capable to classify and property of carbohydrate.
Text Book	1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007). 2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004). 3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009). 4. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998). 5. I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 6. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education

Reference Book	1. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985). 2. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 3. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., 4. Berg, J.M., Tymoczko, J.L. &Stryer, L. Biochemistry, W.H. Freeman, 2002.

Course Title	Research Methodology				
Course Code	SBS05311				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites					
Course Objectives					
Course Contents	**UNIT I** Introduction, Biological data, Collection of data, Processing of data, Primary and Secondary data, Frequency distribution – Discrete and Continuous. Cumulative frequency distributions. **UNIT II** Diagrammatic and graphic representation of data: Advantages, Disadvantages; Types: Line diagram, Bar diagram, Pie Chart, Histogram, Frequency polygon, Frequency Curve. **UNIT III** Central tendency: Mean, Median, and Mode. Measures of dispersion – Standard Error, Standard deviation and Coefficient of Variations. Random Variable: Expectation and variance. **UNIT IV** Research Methodology: Introduction, Meaning, Objectives of Research, Motivation in Research, Types of Research, Significance of Research, Research Methods versus Research Methodology. **UNIT V** Research and Scientific Method, Process of Research, Criteria of Good Research, Limitations of Research, Research Problem: Definition, Selection and Techniques;				

	Interpretation, Technique of Interpretation, Report writing.
Course Outcomes	At the end of the course students will be able to... CO1: Develop the ability to apply the methods while working on a research project work. CO2: Describe the appropriate statistical methods required for a particular research design. CO3: Choose the appropriate research design and develop appropriate research hypothesis for a research project. CO4: Develop a appropriate framework for research studies.
Text Books	1. Research Methodology: Dr. V Upagade and Dr.ArvindShende
Reference Books	1. Research Methodology: Methods and Techniques: C R Kothari

Course Title	**LAB COURSE VII: BIOTECH III**				
Course Code	SBS02391				
Course Credits	**L**	**T**	**P**	**TC**	
	-	**-**	**2**	**2**	
Prerequisites	8. Theoretical knowledge of basic biotechnological techniques.				
Course Contents	1. To study activity of any enzyme under optimum conditions. 2. To study the effect of pH, temperature on the activity of salivary amylase enzyme. 3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity. 4. Estimation of blood glucose by glucose oxidase method. 5. Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein. (ii) To study relation between absorbance and % transmission. 6. Preparation of buffers. 7. Separation of Amino acids by paper chromatography. 8. Qualitative tests for Carbohydrates, lipids and proteins Purification of an enzyme from any natural resource				

	9. Quantitative estimation of proteins by Bradford/Lowry's method. 10. Perform assay for the purified enzyme. 11. Calculation of kinetic parameters such as Km, Vmax, Kcat**.** 12. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization 13. Sources of contamination and decontamination measures. 14. Preparation of Hanks Balanced salt solution 15. Preparation of Minimal Essential Growth medium 16. Isolation of lymphocytes for culturing 17. DNA isolation from animal tissue 18. Quantification of isolated DNA. **19.** Resolving DNA on Agarose Gel.
Course Outcomes	Students will able to perform: CO1: Colorimetry, pH meter, paper chromatography and TLC. CO2: Qualitative tests for Carbohydrates, lipids and proteins. CO3: Extraction of protein/enzyme and its quantitative test. CO4:Caculate enzyme activity. CO5: Learn Sterilization techniques. CO6: Isolation, quantization and detection of DNA.
Text And References	1. Elements of Biotechnology (2nd Edition): P K Gupta 2. Animal Cell Culture: A Practical Approach: R. I. Freshney 3. Methods in Cell Biology(Vol-57): Animal Cell Culture Methods Mather & David Barnes 4. Principles of Genetic Manipulation: Old & Primrose 5. Animal Cell Culture Techniques- Martin Clynes

Course Title	**Lab Course VIII: Chemistry III**				
Course Code	SBS02392				
Course Credits	**L**	**T**	**P**	**TC**	
	-	**-**	**2**	**2**	
Prerequisites	Theoretical knowledge of physical, organic and inorganic chemistry.				
Course	• To enable the students to develop skills on inorganic qualitative analysis,				

Objectives	potentiometric and conductometric titration and qualitative organic chemistry.
Course Contents	**Section A: Inorganic Chemistry** Semi-microqualitativeanalysis(usingH_2Sorothermethods)ofmixtures-notmore than four ionic species (two anions and two cations, excluding insoluble salts) out of the following: Cations : NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+ Anions : CO_3^{2-} , S^{2-}, SO^{2-}, $S_2O_3^{2-}$, NO_3^- CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^- (Spot tests should be carried out wherever feasible) 1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel(II) or aluminium as oximate in a given solutiongravimetrically. 2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations usingEDTA. 3. Estimation of total hardness of a given sample of water by complexometric titration. **Section B: Physical Chemistry** 1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves. 2. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it. 3. Study of the equilibrium of one of the following reactions by the distribution method: $I_2(aq) + I\text{-}(aq) : I_3\text{-}(aq)$ $Cu_2+(aq) + xNH_2(aq) : [Cu(NH_3)x]_2+$ 4. Perform the following conductometric titrations: 5. Strong acid vs. strong base 6. Weak acid vs. strong base 7. Perform the following potentiometric titrations: i. Strongacidvs.strongbase ii. Weakacidvs.strongbase iii. Potassium dichromate vs. Mohr'ssalt 8. Surface tension measurement (use of organic solventsexcluded). a) Determination of the surface tension of a liquid or a dilute solution usinga stalagmometer. b) Study of the variation of surface tension of a detergent solution with concentration.

	9. Viscosity measurement (use of organic solventsexcluded). c) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald'sviscometer. d) Study of the variation of viscosity of an aqueous solution with concentration ofsolute. 10. Study the kinetics of the following reactions. 1. Initial rate method: Iodide-per sulphatereaction 2. Integrated ratemethod: a. Acid hydrolysis of methyl acetate with hydrochloricacid. b. Saponification of ethylacetate. c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methylacetate **Section C: Organic Chemistry** 1. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative. 2. Separation of amino acids by paper chromatography 3. Determination of the concentration of glycine solution by formylation method. 4. Titration curve of glycine 5. Action of salivary amylase on starch 6. Effect of temperature on the action of salivary amylase on starch. 7. Differentiation between a reducing and a nonreducing sugar.
Course Outcomes	• On the completion of this course successfully, student will be able to semi-microqualitative analysis, principles of kinetic reaction and Qualitative Organic Analysis of Organic Compounds
Text Books	1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996. 2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
Reference Books	1. Khosla, B. D.; Garg, V. C. &Gulati, A. Senior Practical Physical Chemistry,R. Chand & Co.: New Delhi (2011). 2. Ahluwalia, V.K. &Aggarwal, R. Comprehensive Practical Organic Chemistry, UniversitiesPress.

Course Title	**Lab Course IX : Bioscience**				
Course Code	SBS02393				
Course Credits	**L**	**T**	**P**	**TC**	
	-	**-**	**2**	**2**	
Prerequisites	9. Theoretical knowledge of animal and plant physiology				
Course Contents	1. Study of meristems through permanent slides and photographs. 2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs) 3. Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides). 4. Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides). 5. Leaf: Dicot and Monocot leaf (only Permanent slides). 6. Adaptive anatomy: Xerophyte (Neriumleaf); Hydrophyte (Hydrillastem). 7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides). 8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous. 9. Female gametophyte: Polygonum(monosporic) type of Embryo sac Development (Permanent slides/photographs). 10. Ultrastructure of mature egg apparatus cells through electron micrographs. 11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens). 12. Dissection of embryo/endosperm from developing seeds. 13. Calculation of percentage of germinated pollen in a given medium.				
Course Outcomes	Students will be able to: CO1: Hands on experience of study through microscope, dissections and identification: plant tissue, permanent slide and photograph. CO2: Study of anatomy study in stem and root of dicots. CO3: Study of morphological and anatomical adaptation in locally available hydrophyte and Xerophyte. CO4: Describe technical description of various plants CO5: Observe various Embryology slides.				
Text and References	1. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI				

	2. Edition John Wiley & sons 3. correlations. XII Edition. Lippincott W. & Wilkins.