

Shri Rawatpura Sarkar University,

Raipur



**Examination Scheme & Syllabus as per
Outcome Based Education (OBE) and
Choice Based Credit System (CBCS)**

for

Bachelor of Science

In

MICROBIOLOGY



Shri Rawatpura Sarkar University, Raipur

Faculty of Science

Three Years B. Sc. Programme

Scheme of Teaching and Examination

B. Sc. First Semester Microbiology

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2022-2023)

SN	Course Code	Course Title	Hours/Week			Credits	Maximum Marks			Sem End Exam Duration (Hrs.)
			L	T	P		Continuous Evaluation	Sem. End Exam	Total	
1.	SBS05101T	Micro I: Cell Biology	4	-	-	4	30	70	100	3
2.	SBS05102T	Bioscience I: Animal Diversity	4	-	-	4	30	70	100	3
3.	SBS05103T	Chemistry I: Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4	-	-	4	30	70	100	3
4.	SBS05111T	English Language	4	-	-	4	30	70	100	3
5.	SBS05191P	Lab Course I: Micro I	-	-	4	2	15	35	50	5
6.	SBS05192P	Lab Course II: Bioscience I	-	-	4	2	15	35	50	5
7.	SBS05193P	Lab Course III: Chemistry I	-	-	4	2	15	35	50	5
TOTAL						22			550	

Course Title	MICROBIO I: CELL BIOLOGY				
Course Code	SBS05101T				
Course Credits	L	T	P	TC	
	4	-	-	4	
Prerequisites	Basic knowledge of cell and cell organelle.				
Course Objectives	<ul style="list-style-type: none"> • Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles • Students will understand the cellular components underlying mitotic cell division. • Students will learn different cell membrane composition in different types of cells, various cell –cell interactions. • Students will have knowledge of various tools and techniques in cell biology. 				
Course Contents	<p>UNIT I History, Cell theory, Overview of Prokaryotic and Eukaryotic Cells, Plant and Animal cells, exceptions to cell theory, Phages, Virioids, Mycoplasmas, Prions. Cell cycle (Mitosis and Meiosis cell division) and regulation of cell cycle in eukaryotic cell.</p> <p>UNIT II Cell wall, extra cellular matrix and cell interactions - Cell wall, distribution, chemical composition, functions and variations in prokaryotic and eukaryotic cells (primary and secondary wall), Glycocalyx, Cell-cell interactions/ Junctions, pit connections in plants and animals</p> <p>UNIT III Cell membrane- Structure and functions, active and passive transport, proton pumps associated (Na-K, Ca calmodulin etc. and their distribution), phagocytosis, pinocytosis, exocytosis.</p> <p>UNIT IV Cell Organelles (Structure and functions) - Mitochondria, Chloroplast, Nucleus, Ribosomes, Endoplasmic Reticulum, Golgi body, Lysosomes, Peroxisomes and Glyoxisomes.</p> <p>UNIT V Tools and techniques in cell biology -Microscopy: Light microscopy, Phase contrast microscopy, Electron microscopy (SEM, TEM, STEM), fluorescence microscopy, principles and applications. Basics and uses of flow cytometry.</p>				
Course Outcomes	<p>CO1. Organization of cell its history and type of cells: prokaryotic and eukaryotic cell cytoplasmic constituents, cell cycle and its control.</p> <p>CO2. Learners will have knowledge of cell wall composition, extracellular matrix and various cell-cell interactions.</p> <p>CO3. Learners will have basic knowledge cell membrane structure and functions.</p> <p>CO4.The students will have basic knowledge of various cell organelles.</p>				

	CO5. The learner of this course will have an understanding of various tools and techniques in cell biology.
Text and References	<ol style="list-style-type: none"> 1. Nelson, D. L. and Cox, M.M. (2008).Lehninger, Principles of Biochemistry, 5th Edition, W.H.Freeman and Company, N.Y., USA. 2. Voet, D. and Voet, J.G. (2004). Biochemistry, 3rd Edition, John Wiley & Sons, Inc. USA. 3. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. 4. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. 5. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA

Course Title	BIOSCIENCE I: ANIMAL DIVERSITY			
Course Code	SBS05102T			
Course Credits	L	T	P	TC
	4	-	-	4
Prerequisites	Preliminary Knowledge of Zoology			
Course Objectives	<ul style="list-style-type: none"> • To make students familiar with the classification of animals and study about the major classes of animal kingdom 			
Course Contents	<p>UNIT – I</p> <p>Introduction to Animal kingdom, Major and Minor phyla, Protozoa: General characters, type study: Plasmodium; Protozoa and diseases, Porifera: General characters, type study: Sycon-Morphology, Different types of cells in Sycon, canal system in Porifera, Coelenterate: General characters, type study: Obelia -Morphology of Obelia colony, life history, Helminthes, type study: Liver fluke - Structure, Life cycle</p> <p>UNIT – II</p> <p>Annelida: General characters, type study: Nereis - Morphology; Digestive, Excretory and Reproductive systems, Arthropoda: General characters, type study: Cockroach - Morphology; Digestive, Respiratory and Reproductive systems. Economic importance of insects, Mollusca: General characters; type study: Pila - Morphology; Respiratory system, Echinodermata: General characters, Type study: Star fish - Morphology; Respiratory and Canal system</p> <p>UNIT – III</p> <p>General characters of Hemichordate, Chordate and Protochordates, Origin and classification of chordate. Agnatha: General features of Agnatha and classification of cyclostomes up to classes.</p> <p>UNIT – IV</p>			

	<p>Fishes: General characters, Skin and scales, Migration, Parental care, Amphibia: General characters parental care, Neoteny, Reptiles: General characters, Extinct reptiles, Poisonous and non poisonous snakes; Poison apparatus and snake venom</p> <p>UNIT – V</p> <p>Birds: General characters, migration, Flight adaptation, Mammals: General characters, aquatic, prototheria, metatheria, eutheria and affinities.</p>
Course Outcomes	<p>On the completion of this course successfully student will be able to:</p> <ol style="list-style-type: none"> 1. To classify Phylum Porifera with taxonomic Keys, Coelenterata and its Polymorphism and the unique characteristics of phylum helminthes and their parasitic Adaptation. 2. Classify Phylum Annelida, Arthropoda, Molluscs and Echinodermata using examples and adaptation with taxonomic keys 3. Classify Phylum Hemichordata, Chordate and Protochordates with taxonomic keys 4. Classify the unique characteristics of migration in fishes, parental care in amphibia and reptiles of phylum Chordata with taxonomic keys 5. Gain knowledge in the areas of systematic position, general organization and affinities of vertebrates w.r.t birds and mammals
Text Books	<ol style="list-style-type: none"> 1. Unified Zoology by Shivalal publication. 2. Zoology for degree students by S Chand publication
References Book	<ol style="list-style-type: none"> 1. Biological Sciences: Taylor, Green & Stout. 2. Concepts in Biology; Enger & Ross. 3. Chordate Zoology: Dhama & Dhama. 4. Invertebrates: R. L. Kotpal. 5. Modern Text Book of Zoology – Vertebrates: R. L. Kotpal.

Course Title	Chemistry I: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS				
Course Code	SBS05103T				
Course Credits	L	T	P	TC	
	4	-	-	4	
Prerequisites	Preliminary knowledge of chemistry.				
Course	<ul style="list-style-type: none"> • Understand the basic knowledge of atomic structure, bonding, general chemistry and 				

Objectives	aliphatic hydrocarbon
Course Contents	<p>UNIT I</p> <p>Atomic Structure-Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure, What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).</p> <p>UNIT II</p> <p>Chemical Bonding and Molecular Structure-Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character, Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds, MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approaches.</p> <p>UNIT III</p> <p>Fundamentals of Organic Chemistry-Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.</p> <p>UNIT IV</p> <p>Stereochemistry-Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Mesocompounds). Threo and erythro; D and L; cis- trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).</p> <p>UNIT V</p> <p>Aliphatic Hydrocarbons-Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation. Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis- addition (alk. KMnO₄) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation. Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC₂ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alk.</p>

	KMnO ₄ .
Course Outcomes	<ul style="list-style-type: none"> On the completion of this course successfully, student will be able to understand the basics of bonding mainly Ionic and covalent bonding Understanding of quantum mechanics and stereochemistry organic compounds.
Text Books	<ol style="list-style-type: none"> Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014). McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
References Book	<ol style="list-style-type: none"> Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988). Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.

Course Title	English Language				
Course Code	SBS05111T				
Course Credits	L	T	P	TC	
	2	-	-	2	
Prerequisite	Basic English knowledge of 10+2				
Course Objectives	<ol style="list-style-type: none"> To refresh the previous knowledge of students in the area of grammar. Revise what they already know so that all students come on the same level; and to enhance their skills further. To increase their expertise in the language, which in turn would help them in being better communicators, understand and express themselves better and clearer. To enable students to apply basic principles of grammar both in oral and written communication. To cultivate reading habit through off line study of English literature 				
Course Contents	<p>UNIT – I</p> <p>Literature:-The Open Window (Lesson) - H.H. Munro, All the World's a Stage (Poem) - W. Shakespeare Kabuliwala (lesson) - Rabindranath Tagore, The Portrait of Lady (Lesson) Khushwant Singh.</p> <p>UNIT – II</p> <p>Grammar:-Introductory Grammar, Articles, Determiners, Introduction to communication skills Prepositions; Active and passive voice and Modals; Listening skills: Introduction, Homophones. Tenses; Pronoun, Adjective, Adverb.</p>				

	<p>UNIT – III</p> <p>Writing and Vocabulary:-Writing Skills- Basic Rules, Letter writing-Applications, Paragraph writing; Précis writing; Idioms and phrases; Antonyms, Synonyms, Vocabulary.</p> <p>UNIT – IV</p> <p>Business Communication:-Writing Skill: Official Correspondence, Circular, Agenda, Notice, Press Release, Report writing about the proceedings of any seminar, Preparation of official reports, Letter to Vendor quotation, Query for details of any item, Reminder letter, Newspaper Reports and Advertisement.</p> <p>UNIT – V</p> <p>Communication Skills and Personality Grooming:- Conversation Practice, Debates, Mock Interview, Group Discussions and Seminar Presentations.</p>
Course Outcomes	<ul style="list-style-type: none"> This course student will be able to understand the language for presenting the real extract of the subject to the society.
Text Books And Reference Books	<p>Text Books:</p> <ul style="list-style-type: none"> Advanced English Grammar – Martin Hewings. English Grammar & Composition by- Wren & Martin. <p>Reference Books:</p> <ul style="list-style-type: none"> A Practical English Grammar by- A.J. Thompson & A. V. Martinet. Intermediate grammar usage & Composition by- M. L. Tickoo, A. E. Subramaniam, & P. R. Subramaniam.

Course Title	LAB COURSE: MICROBIO I				
Course Code	SBS05191P				
Course Credits	L	T	P	TC	
	-	-	2	2	
Prerequisites	Theoretical knowledge of cell biology				
Course Objectives	<ul style="list-style-type: none"> To enable students the concepts of Cell Biology Practically and understand the fundamentals of Cell functioning and its application 				

<p>Course Contents</p>	<p>Any 10</p> <ol style="list-style-type: none"> 1. To study various parts of Microscope 2. Study of the following microscopic techniques by photographs: Fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching, shadow casting. 3. Study of different stages of meiosis by temporary preparation/ permanent slides of onion flower buds. 4. Study of different stages of mitosis by temporary preparation/ permanent slides of onion root tips. 5. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs. 6. Study of the photomicrographs of cell organelles 7. To study the structure of plant cell through temporary mounts. 8. To observe and classify the prokaryotic cells (bacteria) using differential staining. 9. To Prepare the blood smear slides and visualization the components of blood using light microscope. 10. To perform RBC count using haemocytometer. 11. Study of structure of any Prokaryotic and Eukaryotic cell. 12. To observe and differential identification of lymphocytes using giemsa staining.
<p>Course Outcome</p>	<p>CO1: The students get familiarized with basic principles of working of Microscopy. The students acquire practical skills in preparation and observation of slides of all prokaryotes and eukaryotes</p> <p>CO2: After the practical course, students will be able to differentiate the cells of various living organisms and get awareness of physiological processes of cell e.g. cell divisions.</p> <p>CO3: Students will be able to observe and correctly identify different cell cycle stages of mitosis and meiosis cell division using microscopic techniques.</p> <p>CO4: The student will demonstrate proficiency in understanding the basic structure of gene and interpret the inheritance of characters by using linkage and crossing over. Students will acquire the knowledge of and familiarize about pedigree and Karoyotyping.</p>
<p>Text Books and References Book</p>	<ul style="list-style-type: none"> • Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. • De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. • Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. • Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Course Title	LAB COURSE: BIOSCIENCE I				
Course Code	SBS05192P				
Course Credits	L	T	P	TC	
	-	-	2	2	
Prerequisites	Theoretical knowledge of Animal kingdom.				
Course Objectives	<ul style="list-style-type: none"> To be familiar with the different non chordate and chordate phyla, their general and distinguishing characters. 				
Course Contents	<ol style="list-style-type: none"> Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium. Examination of pond water collected from different places for diversity in protista. Study of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla. Study of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora. One specimen/slide of any ctenophore. Study of adult Fasciola hepatica, Taenia solium and their life cycles (Slides/microphotographs). Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO₂. 				
Course Outcomes	1. Students will be able to identify the invertebrates and vertebrates and classify them up to the class level.				
Text Books	<ol style="list-style-type: none"> Invertebrates: R. L. Kotpal. Modern Text Book of Zoology – Vertebrates: R. L. Kotpal. Chordate Zoology: Dhama & Dhama. 				
References Book	<ol style="list-style-type: none"> Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc. 				

Course Title	LAB COURSE CHEMISTRY I				
Course Code	SBS05193P				
Course Credits	P	T	P	TC	
	-	-	2	2	
Prerequisites	Theoretical knowledge of organic, inorganic and physical chemistry				

Course Objectives	<ul style="list-style-type: none"> To enable the students to develop skills inorganic, physical and organic chemistry.
Course Contents	<p>Perform Any Ten Experiments</p> <p>Section A: Inorganic Chemistry</p> <ol style="list-style-type: none"> 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of oxalic acid by titrating it with KMnO_4. 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4. 4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator. 5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$. 6. To identify two acid radicals (including interfering) and two basic radicals in a given inorganic mixture. <p>Section B: Physical Chemistry</p> <ol style="list-style-type: none"> 1. Determination of heat capacity of calorimeter for different volumes. 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 3. Determination of enthalpy of ionization of acetic acid. 4. Determination of integral enthalpy of solution of salts ($\text{KNO}_3, \text{NH}_4\text{Cl}$). 5. Determination of enthalpy of hydration of copper sulphate. 6. Study of the solubility of benzoic acid in water and determination of ΔH. 7. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter. 8. Preparation of buffer solutions: <ol style="list-style-type: none"> (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide 9. To determine the percentage composition of a binary liquid mixture by viscosity method. 10. To find out the percentage composition of a binary mixture by surface tension method. <p>Section C :Organic Chemistry</p> <ul style="list-style-type: none"> Detection of extra elements (N,S,Cl,Br,I) inorganic compounds(containing upto two extra elements) Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given) <ol style="list-style-type: none"> (a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography (b) Identify and separate the sugars present in the given mixture by paper chromatography. Purification of organic compounds by crystallization (from water and alcohol)

	<p>and distillation.</p> <ul style="list-style-type: none"> • Criteria of Purity: Determination of melting and boiling points. • Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done. <ul style="list-style-type: none"> (a) Bromination of Phenol/Aniline (b) Benzoylation of amines/phenols (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone • To identify the functional group in a given organic compound.
Course Outcomes	<ul style="list-style-type: none"> • On the completion of this course successfully, student will be able to volumetric analysis, physical parameters of drink, soap and preparation of organic molecules and determination of purity.
Text Books	<ol style="list-style-type: none"> 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. 3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
References Book	Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.