Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Science
Department of Life Science
B.Sc. (Major - Biotechnology)

SEMESTER I

COURSE CODE	Category	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BSCBT101	**Major**	**Biomolecules and Metabolism**	60	20	20	30	20	4	-	4	6

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment shall be based following components: Quiz / Assignment / Project / Participation in Class, given that no component shall exceed more than 10 marks.**

Course Objectives:-

1. Conferring basic knowledge about structure and functions of biomolecules
2. Understanding of how enzymes and metabolites in the living system work to synthesize different biomolecules and produce energy.
3. Comprehensive knowledge about biochemical pathways involved in intermediary metabolism and regulation of carbohydrate, protein, lipid, and nucleic acid.

Course Outcomes:-

1. An understanding of structural and functional fundamentals of carbohydrate, protein, lipid, and nucleic acid.
2. Understanding of the major metabolic processes in the living system.
3. Understanding the mechanism and the importance of enzymes.

Unit - I: **Chemical composition of living matter. Properties of water and aqueous environment**

Carbohydrates: Stereoisomerisms and classification of monosaccharaides. Di, tri and polysaccharides, their functions in energy storage and cell structure; Glyco-conjugates; glycoproteins, proteoglycans and glycolipids.

Lipids: Structure of fatty acids and complex lipids. Functions of complex lipids as components of membrane and storage molecules; Structure and functions of Terpenes and steroids

Unit – II: Amino acids: Structure, properties and classification

Proteins: primary, secondary, tertiary and quaternary structure; Ramchandran plot and Protein folding.

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BSCBT101 Biomolecules and Metabolism

Nucleic acids: Structure and properties of DNA and RNA; A, B and Z form of DNA.

Unit – III: Enzymes – nomenclature and classification. Enzyme kinetics and enzyme inhibition; Regulatory enzymes

Vitamins and co-enzymes: Structure, regulation of biochemical reactions and function of water soluble vitamins; Fat soluble Vitamins A, D, E and K.

Unit – IV: Glycolysis, citric acid cycle and energy generation; Pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma aminobutyrate shunt pathways, Cori cycle, Entner-Doudoroff pathway, glucuronate pathway.

Lipid Metabolism: biosynthetic pathway for triacylglycerols, phosphoglycerides, sphingomyelin and prostaglandins. Hydrolysis of triacylglycerols and oxidation of fatty acids.Metabolism of cholesterol and its regulation. Ketone bodies biosynthesis.

Unit - V: Protein metabolism**:** Synthesis and degradation of amino acids – transamination and deamination reactions. Urea cycle and metabolic disorders; metabolism and regulation of cholesterol; biosynthesis of ketone bodies

Books:

1. Donald Voet, Judith G. Voet, Charlotte W. Pratt (2018). Voet's Principles of Biochemistry (5th Edi), Wiley
2. David L. Nelson, Michael M. Cox (2021). Lehninger Principles of Biochemistry (8thEd.), W H Freeman & Co
3. Lubert Stryer, Jeremy M. Berg, John L. Tymoczko , Gregory J. Gatto Jr. (2019) Biochemistry(9th Ed.)– W. H. Freeman & Co.
4. Zubey G. L. Parson. W. W. (1995) Principles of Biochemistry - Brown (William C.) Co, U.S.

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BSCCH101	**Minor**	**Inorganic Chemistry I**	60	20	20	30	20	4	0	4	6

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Educational Objectives (CEOs):

The subject aims to provide the student with:

1. To understand the periodic law and significance of atomic no and electronic configuration as the basic for periodic classification.
2. To include the importance of different types and theories of chemical bonding.
3. To understand different properties and reactions of the compounds of s- and p- block elements.
4. To acquire required knowledge about coordination compounds and different theories of complexes.
5. To acquaint the students with practical knowledge of the concepts of inorganic chemistry.

Course Outcomes (COs):

1. Students will gain the basic knowledge of periodic law and significance of atomic no and electronic configuration as the basic for periodic classification and able to classify elements into s, p, d and f blocks.
2. They learn the importance of different types of chemical bonding in terms of the attainment of a stable electronic structure.
3. They will be able to understand the properties of s- and p- block elements and their compounds.
4. Students will be able to explain the fundamental concepts in coordination chemistry.
5. They can predict potential applications of inorganic chemistry and practical utility to become good chemist.

Syllabus

Unit – 1

Atomic structure:

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's uncertainty principle, and its significance. Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and

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orthogonal wave functions. Radial and angular distribution curves. Shapes of s, p, and d orbitals. Pauli's Exclusion Principle, Hund's rule of maximum spin multiplicity, Aufbau principle and its limitations.

Unit - 2

Periodic properties of elements:

Brief discussion of the following properties of the elements and the trends shown:

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
(b) Atomic and ionic radii.
(c) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization enthalpy and trends in groups and periods.
(d) Electron gain enthalpy and trends in groups and periods.
(e) Electronegativity, Pauling's/ Allred Rochow's scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

Unit - 3

Chemical bonding:

Ionic bond: General characteristics, radius ratio rule and its limitations. Born-Landé equation and Kapustinskii equation for lattice energy. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Covalent bond: Valence Bond theory and its limitations. Types of hybridization with examples. Valence shall electron pair repulsion (VSEPR) theory, shapes of some inorganic molecules based on VSEPR (H_2O, NH_3, PCl_5, SF_4, SF_6, ClF_3, ICl_4^-). Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, F_2, CO and NO.

Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, Hydrogen bonding.

Unit-4

Chemistry of *s* and *p* block elements:

Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen, and water. Common features such as ease of formation, thermal stability and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates.

Catenation, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group. Hydrides and their classification ionic, covalent, and interstitial. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses:

Boric acid and borates, borohydrides (diborane), carboranes, silanes, oxides and oxoacids of nitrogen, phosphorus, and chlorine. Interhalogen compounds. Pseudohalogens.

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BSCCH101 Inorganic Chemistry I

Unit-5

Coordination compounds

Werner's coordination theory and its experimental verification, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. A brief idea about chelate effect and labile and inert complexes. Valence bond theory and its application to complexes of coordination numbers 4 and 6.

Examples of inner and outer orbital complexes. Crystal field theory,Crystal field splitting in octahedral, tetrahedral, and square planner complexes. Factors affecting the crystal-field parameters.

References:

1. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K., Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education.
2. Lee, J.D. Concise Inorganic Chemistry, ELBS.
3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A., Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.
4. Cotton, F.A.; Wilkinson, G., Advanced Inorganic Chemistry Wiley-VCH.
5. Sodhi, G.S., Principles of Inorganic Chemistry, Viva books.
6. Garg, R., Singh, R., Inorganic Chemistry, McGraw Hill Education.

List of Experiments:

1. Calibration and uses of different apparatus and glasswares.
2. Preparation and standardization of solutions of different Molarity/Normality.
3. Preparation of stock solutions of different Molarity/Normality.
4. Inorganic Preparations. (Compound 1)
5. Inorganic Preparations. (Compound 2)
6. Inorganic Preparations. (Compound 2)
7. Determination of the strength of given unknown oxalic acid solution by titrating it against Potassium permanganate.
8. Estimation of free alkali present in different soaps/detergents.
9. An analysis of a mixture of Na_2CO_3 and NaOH using two indicators and a standard HCl solution.
10. Preparation of colloidal solution of starch.

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SEMESTER II

COURSE CODE	Category	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BSCBT201	**Major**	**Cell Biology and Cell Signaling**	60	20	20	30	20	4	-	4	6

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Objectives:
The objectives of this course are to sensitize the students to the fact that as we go down the scale of magnitude from cells to organelles to molecules, the understanding of various biological processes becomes deeper and inclusive.

Course Outcomes: Students will
(1) Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
(2) Apply their knowledge of cell biology to selected examples of changes or losses in cell function.

UNIT-I:
Cell theory, Structure of prokaryotic and eukaryotic cells. Structure and function of – Mitochondria and Chloroplast, Nucleus and Nucleolus, Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes. Structure and function of Cell membrane and Cell wall.

UNIT–II:
Transport across membranes – active transport, ABC transporters, Ion channels. Intra-cellular transport (vesicular and membrane transport). Vesicular Traffic in the Secretary and Endocytic Pathway, Transport from ER through the Golgi apparatus, Transport from the Trans Golgi network.

UNIT–III:
Cellular Processes – Cell cycle and its regulation, Role of Cyclins, CDKs in cell cycle. Apoptosis – Programmed cell death. Cancer Biology Mutations, proto-oncogenes, oncogenes and tumor suppressor genes. Carcinogens and their types: physical, chemical and biological. Mutagens and their types.

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BSCBT201 Cell Biology and Cell Signaling

UNIT–IV:

Cell Communication – Overview of extracellular signaling, Cell surface receptors in signal transduction: G-protein coupled receptor, Tyrosine kinase linked receptors, Receptors with intrinsic enzyme activity (RTK). Interaction and regulation of cell signaling pathways.

UNIT–V:

Tools and techniques of Cell Biology – Principles of Light microscopy; Phase contrast microscopy; Confocal microscopy, Spectrophotometry, Separation-Sub-cellular fractionation-differential and density gradient centrifugation; Chromatography- paper, thin-layer, gel-filtration.

PRACTICAL

1. Microscopy- Theoretical knowledge of Light and Electron microscope.
2. Observation of various stages of mitosis and meiosis.
3. Identification of the cell membrane, nucleus and cytoplasm in an animal cell and the cell wall, cell membrane, nucleus and chloroplasts in a plant cell.
4. Methods of cell lysis: osmotic/enzymatic/chemical.
5. Permanent slides of: Prokaryote, Eukaryote, Muscle, Nerve, Stomata

BOOKS

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th Ed.). New York: Garland Science.
2. Lodish, H. F. (2021). Molecular Cell Biology (9th Ed.). New York: W.H. Freeman.
3. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.
4. Cell Biology, 7th edition, (2014) Gerald Karp. John Wiley & Sons., USA

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BSCCH201	**Minor**	**Physical Chemistry I**	60	20	20	30	20	4	-	4	6

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Course Educational Objectives (CEOs):
The subject aims to provide the student with:
1. To develop basic concepts regarding three states of matters.
2. To acquire required knowledge about concept of electromotive force and its applications.
3. To study the concept of ionization in aqueous solution, pH, Buffer, and application of ionization.
4. To understand phase, co-existence of Phases, Phase diagram.
5. To acquaint the students with practical knowledge of the concepts of Physical chemistry.

Course Outcomes: -
After completion of this course the students are expected to be able to demonstrate following knowledge, skills, and attitudes. The student will demonstrate capability of

CO1. Derive mathematical expressions for different properties of gas, liquid, solids and understand their physical significance.
CO2. Became aware of the importance of Electrochemistry and its applications.
CO3. Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt. Understand and explain the types of Phases, components, Gibb's phase Rule, Phase diagrams and applications.
CO4. Demonstrate a fundamental/systematic understanding of the practical field of Chemistry

SYLLABUS:

UNIT I

Gaseous state:

Gas Laws, Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation. Ideal and real gas, Deviations from ideal gas behavior, Causes of deviation from ideal behavior. Vander Waal's equation of state. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy. Collision frequency; Collision diameter; Mean free path.

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BSCCH201 Physical Chemistry I

UNIT II
Liquid state:
Introduction, Qualitative treatment of the structure of the liquid state; Physical properties of liquids; vapor pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity.

Solid state:
Nature of the solid state, law of constancy of inter facial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravaislattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method.

UNIT III
Electrochemistry
Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

UNIT IV
Ionic equilibria:
Strong, moderate, and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di- and tri-protic acids (exact treatment). Salthydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

UNIT V
Phase equilibria:
Definitions of phase, component, and degrees of freedom. Phase rule and its derivations. Definition of phase diagram. Phase equilibria for one component system – water, CO2. First order phase transition and Clapeyron equation; Clausius-Clapeyron equation - derivation and use. Solid-liquid phase diagram. Eutecticmixture.

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BSCCH201 Physical Chemistry I

List of Practical:
Practical: (Credits: 2, Laboratory periods: 04)

Surface tension measurements using Stalagmometer.
1. Determine the surface tension of aqueous solutions by (i) drop number (ii) drop weight method.
2. Study the variation of surface tension with different concentration of detergent solutions. Determine CMC.

Viscosity measurement using Ostwald's viscometer.
3 Determination of co-efficient of viscosity of an unknown aqueous solution.
4 Estimation of iron by potentiometry.
5 To purify a given sample of phthalic acid by sublimation.
6. Conductometric titration -determination of strength of an acid.
7. To verify Lambert-Beer's law for K2Cr2 O7 by Colorimetrically.

pH-metry:
8. Determination of the strength of a given hydrochloric acid solution against a standard sodium hydroxide solution. (pH metric titration)
9. Preparation of buffer solutions of different pH values (a) Sodium acetate-acetic acid (b) Ammonium chloride-ammonium hydroxide
10. Study of Phase diagram of Phenol-Water system

Reference Books:

1. Atkins, P.W.& Paula,J.de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan,G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Mortimer, R.G. Physical Chemistry 3rd Ed. Elsevier: NOIDA,UP(2009).

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SEMESTER III

COURSE CODE	Category	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BSCBT301	**Major**	**Basic Microbiology**	60	20	20	30	20	4	-	4	6

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Objectives: The objectives of this course are

- To introduce the field of microbiology and understand the significance and importance of microorganisms.
- To familiarize with general characters of prokaryotic and Eukaryotic microorganisms for conventional and molecular characterization using modern methods.
- To introduce students to the basics of microbial growth, nutrition, methods for control of microbes, gene transfer and host microbe interactions.

Student Learning Outcomes: Students should be able to:

- Identify major categories of microorganisms and analyze their classification, diversity, and ubiquity
- Demonstrate to culture and control the growth of microorganisms
- Understand the nutritional requirements of microorganisms, and the pattern of their growth and methods of controlling microbial growth
- Acquaintance with the diversity of viruses and techniques for their cultivation and identification
- Analyze the gene transfer mechanism in bacteria and evaluate interactions between microbes, hosts and environment.

Unit – I: History, Microbial Diversity and classification

History of Microbiology and major contributions; Microbial diversity-Structure and general characters of Bacteria, Archaea, Fungi and Algae, Protozoa. Bacterial Classification Systems; Advances in Bacterial Taxonomy using Ribotyping, r-RNA sequencing and fatty acid profiling.

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BSCBT301 Basic Microbiology

Unit – II: Characteristics of Bacteria

Nutritonal uptake mechanism in bacteria; Nutritional classes of Bacteria; Culture Media, Microbial Growth; Bacterial Growth Curve; Methods of Measurement; Factors affecting bacterial growth: Temperature, Oxygen, pH, Osmotic concentration, and water activity, Batch and Continuous Culture.

Bacterial genetics: mutation and recombination in bacteria, plasmids, transformation, transduction and conjugation; Operon concept.

Unit – III: Virology

Morphology and General Properties of Viruses, Viroids and Prions; Classification of Viruses; Plants and Animals Viruses; Bacteriophages – Morphology, Genome Organization and Life Cycle of T4, T7, M13, Lambda Phage; Cultivation of Viruses.

Unit – IV: Control of Microorganisms

Sterilization; Physical and Chemical Methods for Control of Microorganisms; Biological Control of Microorganisms; Antimicrobial agents and their Mechanism of action; Drug Resistance Mechanism; Antibiotic sensitivity testing.

Unit – V: Host-Microbe Interactions

Host-microbe interaction and their types; Rhizoshpere and Phyllosphere Microorganisms; Symbiosis in Legumes and Ruminants, Plant Pathogens - Disease Symptoms, Transmission, Mechanism of Pathogenicity; Microbial Control of Insects and Pests.

Infectious Diseases in Humans – Mechanism of Pathogenesis; Host-pathogen interaction, Evasion of Host Defenses, Beneficial effects: Human microbiome, prebiotics and probiotics.

PRACTICAL

1. Isolation and characterization of microorganisms from extreme environments
2. Determination of bacterial growth rate and factors influencing it
3. Sterilization, disinfection and safety in microbiological laboratory
4. Preparation of media for cultivation of bacteria
5. Study of colony and growth characteristics of some common bacteria: *Bacillus, E. coli, Staphylococcus, Streptococcus*, etc.
6. Preparation of bacterial smear and Gram's staining.
7. Enumeration of bacteria: standard plate count.

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8. Antimicrobial sensitivity test and demonstration of drug resistance
9. Maintenance of stock cultures: slants, stabs and glycerol stock cultures
10. Determination of phenol co-efficient of antimicrobial agents
11. Determination of Minimum Inhibitory Concentration (MIC)
12. Isolation of Bacteriophages
13. Study of colony and growth characteristics of some common fungi: *Penicillium, Rhizopus, Mucor, Aspergillus sp.*

BOOKS

1. Pelczar, M. J., Reid, R. D., & Chan, E. C. (2001). Microbiology (5th Ed.). New York: McGraw-Hill.
2. Willey, J. M., Sherwood, L., Woolverton, C. J., Prescott, L. M., & Willey, J. M. (2011). Prescott's Microbiology (8th Ed, New York: McGraw-Hill.
3. Matthai, W., Berg, C. Y., & Black, J. G. (2005). Microbiology, Principles and Explorations. Boston, MA: John Wiley & Sons.
4. Cappuccino, J. G., & Welsh, C. (2016). Microbiology: a Laboratory Manual. Benjamin-Cummings Publishing Company.
5. Collins, C. H., Lyne, P. M., Grange, J. M., &Falkinham III, J. (2004). Collins and Lyne's Microbiological Methods (8th Ed.). Arnolds.
6. Tille, P. M., & Forbes, B. A., Bailey & Scott's Diagnostic Microbiology. (2018) 14th Edition

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SEMESTER III

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BSCCH301	**Minor**	**Organic Chemistry**	60	20	20	30	20	4	-	4	6

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Course Educational Objectives (CEOs):

The course Organic chemistry aims to provide the student with:

1. To understand the chemistry of saturated, unsaturated, and aromatic hydrocarbons.
2. To acquire the knowledge about Bayer's strain theory, Regioselectivity, and Thermodynamic aspects of organic reactions, and applications of Saytzeff rule.
3. To discuss the properties of Cycloalkanes, Cycloalkenes and Dienes.
4. To acquaint the students with practical knowledge and industrial applications of Organic chemistry.

Course Outcomes (COs):

1. Students will gain the basic knowledge of IUPAC nomenclature of alkanes, alkenes, dienes, and physical, chemical properties of the commercially important molecules.
2. Students can be able to understand Aromaticity, Kekule structure, Huckel's rule, and Aromatic electrophilic substitution reactions with mechanism.
3. They can understand the chemistry of Biomolecules with structures, properties, and biological importance of Carbohydrates and Aminoacids.
4. They can learn the industrial utility of Organic chemistry and practical knowledge to become good chemist.

Syllabus

Unit I: Alkanes and Cycloalkanes

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atom in alkanes, isomerism in alkanes, methods of preparation – Wurtz reaction, Kolbe reaction, Corey-House reaction, and decarboxylation of carboxylic acids. Physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes: orientation, reactivity, and selectivity. Cycloalkanes - nomenclature, preparation methods, chemical reactions. Bayer's strain theory and its limitations. Ring strain in small rings (Cyclopropane and cyclobutane). The case of cyclopropane ring, banana bonds.

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BSCCH301 Organic Chemistry

Unit II: Alkenes and Cycloalkenes
IUPAC nomenclature of alkenes, methods of formation, mechanism and regioselectivity of dehydration of alcohols and dehydrohalogenation of alkyl halides. Saytzeff rule, Hofmann elimination, physical properties, and relative stabilities of alkenes. Chemical reactions of alkenes – hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation, and oxidation with $KMnO_4$, Polymerization of alkenes, Industrial applications of ethylene and propene. Methods of formation, physical properties, and chemical reactions of cycloalkenes.

UNIT III: Dienes and Alkynes
Nomenclature and classification of dienes: isolated, conjugated, and cumulated dienes, Structure of allenes and butadiene, methods of formation, chemical reaction – 1, 2 and 1, 4 additions, Diels-Alder reaction, and polymerization. Nomenclature, structure and bonding in alkynes, methods of formation, chemical reactions of alkynes, acidity of alkynes, hydroboration-oxidation, metal-ammonia reductions, oxidation, and polymerization.

UNIT IV: Arenes and Aromaticity
Nomenclature of benzene derivatives, Structure of benzene - Kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: The Huckle rule, aromatic ions. Aromatic electrophilic substitution – general pattern of the mechanism, role of σ and π complexes, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio, Birch reduction.

UNIT V: Biomolecules
[A] Carbohydrates: Introduction, classification, Osazone formation, epimerization, step-up and step-down reactions of monosaccharides, simple structures of glucose and fructose, Fischer's proof of configuration of D-glucose.
[B] Amino acids: Introduction of amino acid, Classification, and properties of amino acids, Zwitter ion, Isoelectric point, Strecker's and Gabriel phthalimide synthesis of amino acids.

Guidelines for Practical:
A two-credit lab is to be conducted by covering the most relevant and useful topics from above mentioned syllabus.

List of Textbooks:

1. Robert Thorn Morrison and Robert Neilson Boyd, Textbook of Organic Chemistry, Prentice Hall of India Pvt Ltd, New Delhi, 6th Edition, 1992.
2. Bhupinder M4. Arun Bahl, B. S. Bahl, Advanced Organic Chemistry, S. Chand & Company Ltd., New Delhi, 1st Edition, 2003.

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BSCCH301 Organic Chemistry

3. James B Hedrickson Donald J. Cram and George S. Hammond, Organic Chemistry, McGraw-Hill Kogakusha,Ltd., 3rd Edition.
4. Arun Bahl, B. S. Bahl, Advanced Organic Chemistry, S. Chand & Company Ltd., New Delhi, 1st Edition, 2003.
5. I.L.Finar, Organic Chemistry Vol-I & Vol-II, Pearson Education Ltd, New Delhi, 5th Edition, 2016.
6. G.Marc Loudon, Organic Chemistry, Oxford University Press, 4th Indian edition, 2010.
7. P.S.Kalsi, Text book of Organic Chemistry, MacMillan, India Pvt. Ltd., 1999.

Reference Books:

1. Pine, S., Hendrickson, J. B., Cram, D.J., Hammond, S. Organic Chemistry, 8th Edition, Mc Graw-Hill, New York. 2012
2. John Mcmurry, Brooks Cole, Organic Chemistry, 6th Edition, John-Wiley International Edition.
3. Graham, T.W., Solomons, S., and Craig B. Fryhle, Organic Chemistry, 8th Edition, John-Wiley International Edition.
4. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry Part-A & B, 7th Edition, Mc Graw-Hill, 2015.

Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Science
Department of Life Science
B.Sc. (Major - Biotechnology)

SEMESTER IV

COURSE CODE	Category	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BSCBT401	**Major**	**Genetics and Molecular Biology**	60	20	20	30	20	4	-	4	6

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment shall be based following components: Quiz / Assignment / Project / Participation in Class, given that no component shall exceed more than 10 marks.**

Course Objectives:

1. Knowledge of basics in genetics and classical genetics covering prokaryotic / phage genetics to yeast and higher eukaryotic domains.
2. Concepts of Mendelian genetics, population genetics, quantitative genetics encompassing complex traits, clinical genetics and genetics of evolution.
3. Study of Genome Organization and its dynamics
4. Study of DNA replication, damage and repair
5. Study of transcription and translation

Course Outcomes:

1. Understanding of fundamental molecular principles of genetics and the relationship between phenotype and genotype.
2. Understanding the basics of genetic mapping and regulation of gene expression.
3. Understanding the basic genetic mechanisms at the molecular level
4. Understanding the molecular mechanism of mutation
5. Understanding the process of transcription and translation

Unit – I

A. Genetics

Mendelian Laws of genetics, Dominance, Segregation, Independent Assortment; Epistasis, Complementary ratio and supplementary ratio,
Cytoplasmic inheritance; plastid and kappa particles.

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BSCBT401 Genetics and Molecular Biology

Linkage and crossing over (Coupling and repulsion hypothesis) Mechanism of crossing over and its significance.
Mechanism of sex determination (Chromosomal theory), sex linked inheritance.

Unit-II
Chromosome morphology, classification, karyotyping; Specialized chromosomes-Polytene and Lamp brush chromosome,
Structural and numerical chromosomal aberrations.
Chromosome related disorders: Kleinfelter's syndrome, Turner's syndrome,Down's syndrome and Cri-du-chat syndrome
Mutations- Spontaneous and induced, Chemical and physical mutagens, Molecular basis of mutation.

Unit-III
B. Molecular Biology
Transformation, Conjugation and transduction in bacteria; Gene mapping in bacteria;
Prokaryotic and eukaryotic DNA replication and Transcription, Processing of m-RNA, Splicing, DNA and RNA polymerases

Unit-IV
Prokaryotic and Eukaryotic Translation - Mechanism of initiation, elongation and termination.
Gene regulation in Eukaryotic system – Promoters, enhancers elements and gene amplification.

Unit –V
Genetic Code and Translation
Correspondence of amino acid sequence in proteins; Properties of genetic code- universal code, degeneracy and redundancy, Wobble hypothesis;
Co- and post-translational modifications- Antisense RNA.

PRACTICAL II [Genetics + Molecular Biology]
1. Solving problems on monohybrid and dihybrid ratios, multiple alleles, epistasis.
2. Solving problems on quantitative inheritance.
3. Inheritance patterns in human – Pedigree analysis.
4. Solving problems on localization of genes

5. Isolation of plasmid DNA.
6. Isolation of DNA from plant cells.
7. Isolation of DNA from human whole blood.
8. Determination of purity and concentration of DNA - Spectrophotometric method.

BOOKS:

1. Gardner, E. J., Simmons, M. J., & Snustad, D. P. (2006). Principles of Genetics. (8th Ed.). John Wiley & Sons.
2. Griffiths, A. J.F., Doebley, J., Peichel, C., & Wassarman, D. A. (2020). An introduction to Genetic Analysis. (12th Ed.).W.H. Freeman publication.
3. Hartl, D. L., & Jones, E. W. (1998). Genetics: Principles and Analysis. (4th Ed.). Sudbury, MA: Jones and Bartlett.
4. Alberts, B., Johnson, A. D., Lewis, J., Morgan D., Raff, M., Roberts, K., & Walter, P. (2015). Molecular Biology of the Cell. (6th Ed.). New York: Garland Science.
5. Brown, T. A. (2017). Genomes 4. (4th Ed.). Wiley Publishers (Asia Pvt Ltd).
6. Freifelder, D. (2012). Molecular Biology. (5th Ed.). Narosa Publishing House, India.
7. Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2017). Lewin's Genes XII. (12th Ed.). Jones and Barlett Inc. USA.

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SEMESTER IV

COURSE CODE	Category	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BSCCH401	Minor	Applied Chemistry	60	20	20	30	20	4	-	4	6

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment shall be based following components: Quiz / Assignment / Project / Participation in Class, given that no component shall exceed more than 10 marks.**

Course Educational Objectives (CEOs):
After completion of this course the students are expected to demonstrate the following skills, knowledge, and attitudes.

1. Enable the students to apply basic concepts, and applications of Heavy inorganic chemicals.
2. To study the preparation and applications of different types of catalysts and solvents.
3. To provide the theoretical understanding of applied industrial techniques as Bio-transformation, MAOS and their practical applications.
4. The purpose of the course is to make the students to understand the determination of cations, anions, analysis of Water quality as DO, BOD, COD, and analysis of Oils, Fats, Paint.

Course Outcomes (COs):
After completion of this course the students are expected to demonstrate the following skills, knowledge, and attitudes. Student will be able to understand:
1. Theoretical understanding of microwave induced reactions, sonochemistry and applications
2. The preparation and industrial application of different catalysts and solvents.
3. The industrial manufacturing process, and applications of economically important heavy inorganic chemicals.
4. Sampling and analytical procedure of water and wastewater, oils, fats, paints.

Syllabus

Unit I: Heavy Inorganic Chemicals
Basic concept of heavy inorganic chemicals and manufacture of following with reference to: (i) Raw material, (ii) Production process, (iii)Quality control, (iv)Hazards and safety, of the following chemicals - Ammonium phosphates, super phosphate, triple super phosphate, carbon blacks, manufacture of graphite and carbon, calcium carbide, silicon carbide, sodium thiosulphate, borax and boric acid.

Unit II: Catalysts and Solvents
Introduction, preparation, synthetic application of the following catalysts - Raney Nickel,

Palladium, Copper chromate, Vanadium, and Platinum-based catalyst. Aluminium alkoxides, and Titanium tetrachloride. Industrial solvents (specialty): Synthesis, properties, and uses of Dimethyl-formamide (DMF), Dimethyl sulfoxide (DMSO), Tetrahydrofuran (THF), and Chlorinated hydrocarbons

Unit III: Analysis of Oils, Fats, and Paint:
Introduction, classification of oils and fats, physical and chemical properties of oils and fats. Determination of viscosity, density, thermal properties, and flash point, saponification number, iodine number and acid number. Introduction to paints, definition, varnishes, enamels, lacquers and thinners, formulation and manufacturing of paints, different types of paints, surface coatings, analysis of paints and varnishes, applications of paints.

Unit IV: Assessment of Water Quality:
Sources of water, sampling procedure of water and wastewater, classification of water for different uses, types of water pollutants and water quality standards for drinking water. Analytical methods for the determination of the following ions in water: Anions: CO_3^{2-}, HCO_3^- F^-, $C1^-$, SO_4^{2-}, PO_4^{3-}, NO^{3-}, NO^{2-}, Cations: Fe^{2+}, Fe^{3+}, Ca^{2+}, Mg^{2+}, Cr^{3+}. Determination of Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

Unit V: Applied industrial techniques:
Introduction of Bio-transformations, types and examples, enzyme catalyzed reactions, different types, examples, mechanism of Bio-transformations with examples, industrial applications of Biotransformation, advantages, and limitations. Microwave induced reactions- theory, principle, advantages, mechanism, examples. MAOS-Industrial applications. Sonochemistry - theory, examples, industrial applications.

Guidelines for Practical:
A two-credit lab is to be conducted by covering the most relevant and useful topics from above mentioned syllabus.

References
1. Admson, A.W., Physical Chemistry of Surfaces, 4th Edition, Pubs: John Wiely & Sons, New York.
2. Austin H. T., Shreve's Chemical Process Industries, Pubs: McGraw Hill Book Co., New York.
3. Rao, C. N. R, Muller,A and Cheetam, A.K. (Eds) : The Chemistry of Nanomaterials, Vol.1, and 2, Wiley–VCH, Weinheim.
4. Poole,C.P. & Owens, Jr: F.J.: Introduction to Nanotechnology Wiley Interscience, New Jersey
5. Shreve R.N., Chemical process industries, 5th Ed., McGraw Hill Book Company, New York.
6. Sharma, B.K., Industrial chemistry 7th Edition, Krishan Prakashan, 2014
7. Rells, K.M., Courtney, T., and Wulff, J., Introduction to material science and engineering, 9th Edition, Wiley Eastern Pvt. Ltd., New Delhi, 2016.