Course	**Discipline Specific Elective**
Semester	V
Paper Number	MBTDS5022T & MBTDS5022P
Paper Title	CHEMISTRY 3 & ENZYME KINETICS
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	4 Theory + 4 Practical
Course description/objective	1.Students will be introduced to fundamentals of organic reaction mechanisms. 2.Students will study the application of various kinds of reaction mechanisms to biotechnological and biological systems. 3.An overview of bioinorganic chemistry and its application to biological systems will be provided. 4.Students will learn aboutkinetic characterization of enzymes and enzyme inhibitors. 5. An overview of multi-substrate systems and multi-enzyme complexes will be provided. 6. In the practical module students will study various aspects of enzyme kinetics and enzyme action.
Syllabus	**Theory** **Module A: (25 marks)** **Unit I: Fundamentals of Organic Reaction Mechanism:** Bond cleavage and bond formation. Reaction intermediates- Structure, stability, formation and fates of carbon radicals, carbocations, carbanions. Types of reagents- electrophiles, nucleophiles. Classification of reactions. Nucleophilic Substitution Reactions: Nucleophilic substitution reactions of alkyl halide (S_N1, S_N2), Effect of substrate structure, solvent, leaving group, nucleophiles, Substitution involving NGP. Elimination Reactions: E1, E2, E1cB mechanism, Reactivity, Substitution vs. elimination. Electrophilic and Nucleophilic Aromatic Substitution Reactions: Mechanisms, Reactivity, π-complexes and σ-complexes, Orientation effect of groups. Addition Reactions: Electrophilic addition to C=C- Mechanism, Reactivity, Electrophilic addition of halogens, Electrophilic addition of hydrogen halides. Hydration of alkenes, Hydration of alkynes. Nucleophilic addition to carbon-carbon multiple bonds- Mechanism, Reactivity, Cyanoethylation, Michael addition. Nucleophilic addition to C=O bond- Addition of HCN, acetylides, $NaHSO_3$, alcohols, Formation of acetal, ketal. Cannizzaro reaction, Internal Cannizzaro reaction, Aldol condensation, Claisen condensation. **Unit II: Bioinorganic Chemistry:** A brief introduction to Bioinorganic chemistry. Elements of life, Essential major, trace and ultratrace elements. Role of metal ions present in biological systems (Na^+, K^+, Ca^{2+}, Mg^{2+}, $Fe^{3+/}Fe^{2+}$, Cu^{2+}/Cu^+, Zn^{2+}). Metalloproteins and Metalloenzymes. Oxygen carrying proteins- structure and physiological role of haemoglobin, myoglobin. Electron transport proteins- iron-sulfur proteins, cytochromes. Redox enzymes- Fe, Cu,

	Zn-containing redox enzymes. Hydrolytic enzymes- carboxypeptidase A, carbonic anhydrase. Phosphate transfer and metabolic energy. **No. of Classes:** 2 Classes per week **Module B: (25 marks)** **UNIT III: Enzyme kinetics:** concept of active-site, substrate binding site - specificity, enzyme-substrate complex, principle of transition state stabilization, reaction co-ordinate diagram - significance of activation energy and free energy, binding energy and lowering of activation energy barrier; mechanism of enzyme action - general mechanistic principle, factors associated with catalytic efficiency - proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Steady state kinetics – Michaelis-Menten equation – derivation, physiological significance of Km (Michaelis constant), Vmax (maximum velocity), Kcat (turnover number), and Kcat/Km (catalytic efficiency), catalytic perfection; Lineweaver-Burke plot; enzyme inhibition – reversible inhibition (types and determination of Ki from kinetics), irreversible and suicide inactivation; effect of pH and temperature on enzyme rates (qualitative); **UNIT IV: Multi-substrate systems and Multi-enzyme complexes**– bisubstrate reactions – sequential (random and ordered) and ping pong; isotope effects – its application to decipher mechanisms of bisubstrate reactions; Integration of kinetic, chemical and structural data towards study of enzyme mechanisms – lysozyme and triose phosphate isomerase; isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase; multienzyme complexes – e.g. pyruvate dehydrogenase complex; common diagnostic enzymes for various pathogenesis. **No. of Classes:** 2 Classes per week **Practical** 1. To study activity and specific activity of an enzyme (alkaline phophatase) under optimum conditions. 2. Determination of Km and Vmax. 3. Determination of turnover number (Kcat). 4. Determination of pH optima 6. Effect of inhibitor EDTA on the enzyme activity.
Readings	Theory Module A 1. S. K. Ghosh, Advanced General Organic Chemistry- A Modern Approach, New Central Book Agency (P) Limited, 2010. 2. P. Sykes, A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988). 3. G. N. Mukherjee and A. Das, Elements of Bioinorganic Chemistry, 4. U. N. Dhur & Sons Pvt. Ltd., 3rd edition, 2008.

	Module B 5. Lehninger Principles of Biochemistry - Cox & Nelson (5th ed.) 6. Biochemistry - Voet and Voet (3rd ed.) 7. Biochemistry Berg – Tymoczko & Stryer (6th edition).
Evaluation	Theory: Continuous Internal Assessment: 10 marks End-Semester Theory Examination: 50 marks Practical: Continuous Internal Assessment: 32 marks End-Semester Examination: 8 marks
Paper Structure for End Sem Theory	Module A (25 marks) Section A: Any one from two questions with subparts: 15×1 = 15 marks. Section B: Any one from two questions with subparts: 10×1 = 10 marks. (No subpart will be less than 1 mark or more than 5 marks) Module B (25 marks) Q.5. Compulsory Objective questions of 5 marks. Any two questions of 10 marks from Q.6-Q.8. No part would be of more than 5 marks.