

UNIVERSITY OF MADRAS
B.Sc. DEGREE PROGRAMME IN CHEMISTRY
 SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Course	GENERAL CHEMISTRY-IV						
Paper No.	Core VII (CC7)						
Category	Core	Year	II	Credits	5	Course Code	224C4A
		Semester	IV				
Instructional hours per week	Lecture	Tutorial	Lab Practice		Total		
	4	1	-		5		
Prerequisites	General Chemistry III						
Objectives of the course	This course aims to provide a comprehensive knowledge on <ul style="list-style-type: none"> • thermodynamic concepts on chemical processes and applied aspects. • thermo chemical calculations • transition elements with reference to periodic properties and group study of transition metals. • the organic chemistry of ethers, aldehydes and ketones • the organic chemistry of carboxylic acids 						
Course Outline	UNIT I Thermodynamics I Terminology – Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes; First law of thermodynamics – Concept and significance of heat (q), work (w), internal energy (E), enthalpy (H); calculations of q, w, E and H for reversible, irreversible expansion of ideal and real gases under isothermal and adiabatic conditions; relation between heat capacities (Cp & Cv); Joule Thomson effect- inversion temperature. Thermochemistry - heats of reactions, standard states; types of heats of reactions and their applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions; Hess's law and its applications; determination of bond energy; Measurement of heat of reaction – determination of calorific value of food and fuels Zeroth law of thermodynamics-Absolute Temperature scale.						

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Unit II

Thermodynamics II

Second Law of thermodynamics - Limitations of first law, spontaneity and randomness; Carnot's cycle; Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing, calculation of entropy changes of an ideal gas and a van der Waals gas with changes in temperature, volume and pressure, entropy and disorder.

Free energy and work functions - Need for free energy functions, Gibbs free energy, Helmholtz free energy - their variation with temperature, pressure and volume, criteria for spontaneity; Gibbs-Helmholtz equation – derivations and applications; Maxwell relationships, thermodynamic equations of state; Thermodynamics of mixing of ideal gases, Ellingham Diagram-application.

Third law of thermodynamics - Nernst heat theorem; Applications of third law - evaluation of absolute entropies from heat capacity measurements, exceptions to third law.

UNIT III

General Characteristics of d-block elements

Transition Elements- Electronic configuration - General periodic trend variable valency, oxidation states, stability of oxidation states, colour, magnetic properties, catalytic properties and tendency to form complexes. Comparative study of transition elements and non-transition elements – comparison of II and III transition series with I transition series. Group study of Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel and Zinc groups

UNIT IV

Ethers, Thio ethers and Epoxides

Nomenclature, isomerism, general methods of preparations, reactions involving cleavage of C-O linkages, alkyl group and ethereal oxygen. Zeisel's method of estimation of methoxy group. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH_4 Thioethers - nomenclature, structure, preparation, properties and uses.

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	<p>Aldehydes and Ketones</p> <p>Nomenclature, structure and reactivity of aliphatic and aromatic aldehydes and ketones; general methods of preparation and physical properties. Nucleophilic addition reactions, base catalysed reactions with mechanism- Aldol, Cannizzaro's reaction, Perkin reaction, Benzoin condensation, Haloform reaction, Knoevenagel reaction. Oxidation of aldehydes. Baeyer - Villiger oxidation of ketones. Reduction: Clemmensen reduction, Wolf - Kishner reduction, Meerwein – Pondorf Verley reduction, reduction with LiAlH_4 and NaBH_4.</p> <p>Addition reactions of unsaturated carbonyl compounds: Michael addition.</p> <p>UNIT V</p> <p>Carboxylic Acids: Nomenclature, structure, preparation and reactions of aliphatic and aromatic monocarboxylic acids. Physical properties, acidic nature, effect of substituent on acidic strength. HVZ reaction, Claisen ester condensation, Bouveault Blanc reduction, decarboxylation, Hunsdiecker reaction. Formic acid-reducing property.</p> <p>Reactions of dicarboxylic acids, hydroxy acids and unsaturated acids.</p> <p>Carboxylic acid Derivatives: Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Nucleophilic substitution reaction at the acyl carbon of acyl halide, anhydride, ester, amide. Schotten - Baumann reaction. Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement.</p> <p>Active methylene compounds: Keto – enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate</p> <p>Halogen substituted acids – nomenclature; preparation by direct halogenation, iodination from unsaturated acids, alkyl malonic acids, hydroxyl acids</p>
<p>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</p>	<p>Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)</p>

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Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	<ol style="list-style-type: none"> 1. B.R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., thirty-three edition, 1992. 2. K. L. Kapoor, A Textbook of Physical chemistry, (volume-2 and 3), Macmillan, India Ltd, third edition, 2009. 3. P.L. Soni and Mohan Katyal, Textbook of Inorganic Chemistry, Sultan Chand & Sons, twentieth edition, 2006. 4. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Vishal Publishing, fourth reprint, 2003. 5. S.M. Mukherji, and S.P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., third edition, 1994.
Reference Books	<ol style="list-style-type: none"> 1. Maron, S.H. and Prutton C.P. Principles of Physical Chemistry, 4th ed.; The Macmillan Company: New York, 1972. 2. Lee, J. D. Concise Inorganic Chemistry, 4th ed.; ELBS William Heinemann: London, 1991. 3. Gurudeep Raj, Advanced Inorganic Chemistry, 26th ed.; Goel Publishing House: Meerut, 2001. 4. Atkins, P.W. & Paula, J. Physical Chemistry, 10th ed.; Oxford University Press: New York, 2014. 5. Huheey, J. E. Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed.; Addison Wesley Publishing Company: India, 1993.
Website and e-learning source	<p>MOOC components</p> <p>https://nptel.ac.in/courses/112102255 Thermodynamics</p> <p>https://nptel.ac.in/courses/104101136 Advanced transition metal chemistry</p>
<p>Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to</p> <p>CO1: explain the terms and processes in thermodynamics; discuss the various laws of thermodynamics and thermo chemical calculations.</p> <p>CO2: discuss the second law of thermodynamics and its application to heat engine; discuss third law and its application on heat capacity measurement.</p> <p>CO3: investigate the chemistry of transition elements with respect to various periodic properties and group wise discussions.</p> <p>CO4: discuss the fundamental organic chemistry of ethers, epoxides and carbonyl compounds including named organic reactions.</p> <p>CO5: discuss the chemistry and named reactions related to carboxylic acids and their derivatives; discuss chemistry of active methylene compounds, halogen substituted acids and</p>	

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

CO-PO Mapping (Course Articulation Matrix)

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's