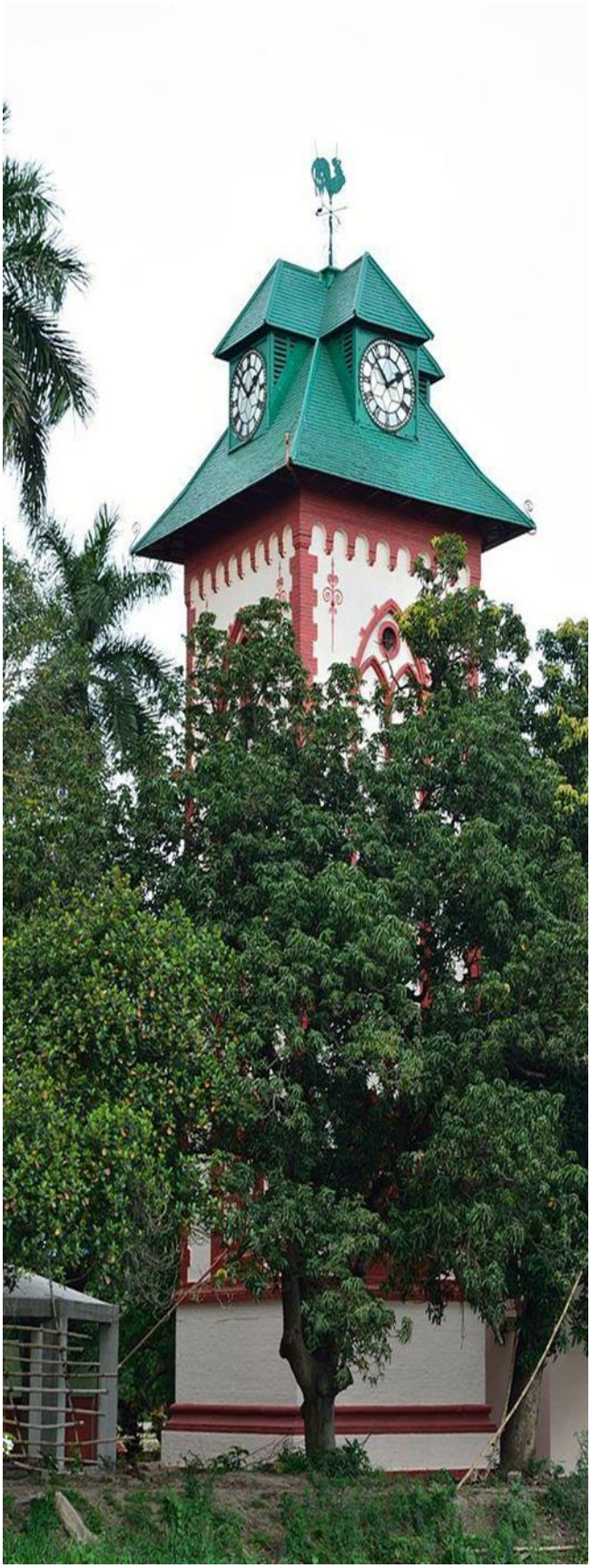

Department of Chemistry

Undergraduate Programmes

Course Structure and Syllabus

(Effective from 2025-26 admitting batch onwards)

Indian Institute of Engineering Science and Technology (IIEST), Shibpur

Botanic Garden, Howrah

Course Code	CH 1101/ CH1201	Course Name	Engineering Chemistry Theory	Course Category	BSC	L	T	P
						3	0	0

Pre-requisite Courses	NA	Co-requisite Courses	NA	Progressive Courses	NA
Course Offering Department		*Chemistry*		Data Book / Codes/Standards	

Course Objective	CO1: To understand how certain cyclic, planar, and conjugated molecules exhibit enhanced stability due to the delocalization of pi electrons CO2: Fundamental concepts of spectroscopy and its applications CO3: Basic concepts and applications of polymers CO4: The significance of photochemistry CO5: To provide students with the knowledge and abilities to design, synthesize, and understand the biologically active molecules with medicinal or therapeutic potential CO6: To understand the origin of color, the electronic and magnetic properties of transition metal complexes CO7: To develop the ability to understand organometallic complexes and catalysts used in the Industry CO8: To understand the fundamental laws of thermodynamics, the feasibility of processes, phase equilibrium, and their applications in various engineering fields. CO9: To give foundational knowledge on how solution conducts electricity and their applications, also how a spontaneous reaction leads to working electrochemical cells or batteries.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Aromaticity:** Aromatic, Non-aromatic, and Antiaromatic Compounds.	01	Students will be able to apply the key principles of aromatic compounds
2	**UV-VIS and IR Spectroscopy:** UV-VIS spectroscopy: Introduction, Beer–Lambert's law and applications, instrumentation, classification of electronic transitions, chromophores, substituent effects, effect of conjugation, empirical rule for calculation of λ_{max} ; IR spectroscopy: theory and applications, Hooke's Law, vibration modes, stretching frequencies of some important functional groups, various electronic effects for	06	Students will have the ability to interpret, and apply various spectroscopic techniques to analyze and explore the structure of organic compounnds

	different stretching frequencies value.		
3	**Polymer Chemistry and Composites:** Basics of Polymer Chemistry, classification, properties (thermosetting and thermoplastics), tacticity, types of polymerization mechanisms, molecular weight of polymer, conducting polymers, flame retardant polymers, dental polymers, composite materials, rubbers.	03	Students will learn the properties, processing, and applications of both polymers and polymer composites
4	**Photochemistry and Applications:** Introduction to photochemistry, Jablonski diagram, fluorescence, phosphorescence, applications of photochemistry, light-emitting diodes (LED).	02	Students should be able to learn about the importance of photochemistry
5	**Synthesis of selected bio-active molecules:** Ibuprofen, naproxen, paracetamol, metronidazole, fluconazole, coumarin, jasmone, etc.	02	Students will learn the structure, mechanism, and function of bioactive molecules
6	**Coordination Chemistry** Crystal Field Theory; d-orbital splitting in Octahedral and tetrahedral ligand field; CFSE, Jahn-Teller distortion; factors influencing magnitude of crystal field splitting; Spectrochemical Series, colour and magnetic properties of complexes, Introduction to LFT, Applications of coordination compounds in medicine: platinum containing anticancer drugs (structure and function).	07	Students will understand the chemistry of transition metal complexes and their application
7	**Organometallic Chemistry and Catalysis** EAN rule - 16 & 18 electron rule and its applications, Organometallic complexes and concept of Homogeneous Catalysis, hydroformylation, Wilkinson catalysis, Ziegler-Natta catalysis, Heterogeneous Catalysis, Catalysis for sustainable energy generation.	06	Students will learn about organometallic complexes along with homogeneous and heterogeneous catalytic processes
8	**Thermodynamics:** Carnot Engine, Second law of thermodynamics, Third Law of Thermodynamics, entropy change accompanying various processes, Gibbs energy, Gibbs Helmholtz equation, Chemical potential, Criteria of spontaneity, Applications of thermodynamics in phase equilibrium (one- and two-component systems), Clapeyron and Clausius-Clapeyron equations.	07	Students will understand the thermodynamic principle for various chemical and physical processes

9	**Electrochemistry:** Conduction in solution, Electromotive force, Different type of electrodes, Nernst equation, Relationship between thermodynamic properties and EMF of a cell, Battery, Fuel cell, Photovoltaic cell, Corrosion, Corrosion Control.	06	Students will understand the electrochemical processes and the application of electrochemistry for energy generation

Course Outcome	CO1: Students should be able to understand and apply the key principles of aromatic compounds, including their structure, stability, and reactivity CO2: Students will have the ability to understand, interpret, and apply various spectroscopic techniques to analyze and explore the structure and properties of matter CO3: Students should be able to learn to understand the properties, processing, and applications of both polymers and polymer composites CO4: Students should be able to learn about the importance of photochemistry CO5: Students should be able to understand the structure, mechanism, and function of bioactive molecules, along with the ability to synthesize them CO6: Students should be able to understand the chemistry of transition metal complexes and their application CO7: Students should be able to understand the chemistry of organometallic complexes, and homogeneous and heterogeneous catalytic processes. CO8: Students should be able to explain the thermodynamic principle for various chemical and physical processes CO9: Students should be able to understand the electrochemical processes and the application of electrochemistry for energy generation

Learning Resources	1. Organic Chemistry, Volume 1, I L Finar 2. Organic Chemistry, J. CLayden, N. Greeves, S. Warren, P. Wother, Oxford University Press, 2000. 3. D. L. Pavia, G. M. Lampman, G. S. Kriz, J. A. Vyvyan, Introduction to Spectroscopy, 5th Edition, Cengage Learning, 2013. 4. W. Kemp, Organic Spectroscopy, 3rd Edition, Macmillan, 2019 5. C. N. Banwell, and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw-Hill, 1962 6. F.W. Billmayer, Textbook of Polymer Chemistry, 3rd Edition, Wiley, 2007 7. Hand Book of Polymer Science & Technology – M.H. Ferry & A.V. Becker 8. Principles of Polymer Chemistry - Paul J. Flory. 9. Principles of polymerization, George G. Odian, 4th Edn, John Wiley & Sons, Inc., Publication, 2004. 10. Conducting Polymers: A New Era in Electrochemistry, György Inzelt 11. Organic Photochemistry – J. Coxon & B. Halton 12. Halton Introductory Photochemistry – A. Cox & T. Camp

	13. K.K. Rohatgi-Mukherjee, Fundamentals of Photochemistry, 3rd Edition, New Age International Publishers, 2017 14. Shriver Atkin's Inorganic Chemistry by P. Atkins, T. Overton, J. Rourke, M. Weller, M. Armstrong, 5th Edn, Oxford University Press, 2009 15. Inorganic Chemistry by C.E. Housecroft, A. G. Sharpe, 4th Edn, Pearson Education, 2017 16. Advanced Inorganic Chemistry by Cotton, Wilkinson, Murillo, Bochmann, 6th Edn, Wiley, 2007 17. Physical Chemistry by G. W. Castellan 18. Atkins' Physical Chemistry by Peter Atkins and Julio de Paula 19. Heat and Thermodynamics by Mark W. Zemansky and Richard H. Dittman 20. Thermodynamics for Chemists by Samuel Glasstone 21. Molecular Thermodynamics by Donald A. McQuarrie and John Douglas Simon

Course Code	CH1171/ CH1271	**Course Name**	**Engineering Chemistry Practical**	**Course Category**	BSC	L	T	P
						0	0	3

Pre-requisite Courses	NA	**Co-requisite Courses**	CH 1101/ CH1201	**Progressive Courses**	NA
Course Offering Department		***Chemistry***		**Data Book / Codes/Standards**	

Course Objective	To provide the students with a practical experience of the various techniques used in chemistry. The students will be trained both quantitatively and qualitatively during the practical work so that their understanding and problem-solving abilities can be enhanced.

Module	**Syllabus**	**Duration (class-hour)**	**Module Outcome**
1	Preparation of primary standard solutions and Determination of Fe^{3+} in the supplied solution	6	Students will learn to apply basic techniques used in the chemistry laboratory and will be to estimate the ions/metal ions, partition coefficient, and organic functional groups. Students will also learn basic safety rules in the laboratory
	Estimation of Cu^{2+} in the supplied solution	3	
	Estimation of hardness in water by the EDTA method	3	
	Determination of the partition coefficient of benzoic acid in toluene and water	6	
	Detection of non-nitrogenous functional groups in known and unknown organic compounds	21	

Course Outcome	To learn and apply basic techniques used in the chemistry laboratory. To be able to estimate the ions/metal ions. To learn safety rules in the practice of laboratory investigations.

Learning Resources	1. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, "Vogel's Text Book of Quantitative Chemical Analysis" 2. O.P. Vermani & Narula, "Theory and Practice in Applied Chemistry", New Age International Publishers. 3. Gary D. Christian, "Analytical chemistry", 6th Edition, Wiley India.