Course Code	Course Title	L	T	P	C
	Applied Chemistry	**3**	**0**	**2**	**4**
Pre-requisite		**Syllabus Version**			
		1.0			

Course Objectives

1. To enable students to learn fundamental concepts in different branches of chemistry
2. To be well-versed in analytical and computational skills in chemistry
3. To teach practical skills in chemistry and apply knowledge for societal applications

Course Outcomes

Upon completion of this course, students will be able to

1. Explain the fundamental concepts in physical, analytical, and materials chemistry.
2. Apply chemical concepts for the advancement of materials in electrical, magnetic, and energy domains
3. Demonstrate instrumental techniques in chemistry
4. Solve chemical problems by applying computational chemistry
5. Experiment to quantify the metal ions, to prepare nanomaterials, and to visualize molecules using computational tools.

Module:1	**Chemical thermodynamics and kinetics**	**9 hours**

Introduction-Terminologies- Zeroth law- First law of thermodynamics – Enthalpy and heat capacity – Applications of first law of thermodynamics – Second law of thermodynamics – Carnot cycle- Third law of thermodynamics – Gibbs Helmholtz equation. Chemical Kinetics – Rate equation – Order of the reaction – Integral rate equations – Half life time of reactions- Molecularity – Collision theory of reaction rate – Effect of temperature and catalysts on reaction rate -Numericals.

Module:2	**Energy devices**	**8 hours**

Electrochemical and electrolytic cells —electrode materials with examples (semi-conductors), classifications of batteries - chemistry of Li - ion secondary batteries, Fuel cells: H_2-O_2 and solid oxide fuel cell (SOFC); Solar cells - photovoltaic cell (silicon based), photoelectrochemical cells and dye-sensitized cells.

Module:3	**Functional materials**	**10 hours**

Electrical materials: Ohm's law, resistivity, classification - metals, semiconductors (intrinsic & extrinsic-Si), insulators, superconductors. Magnetic materials: para, dia, ferro & anti-ferro magnetism, applications in storage devices. Liquid cooling – types of coolants, thermal conductivity, and applications. Nanomaterials: introduction, top-down and bottom-up approaches for synthesis - bulk *vs* nano (gold), quantum dots.

Module:4	**Spectroscopic and diffraction techniques**	**6 hours**

Fundamental concepts in spectroscopic and diffraction techniques – Principle, instrumentation, and applications of UV-Visible and powder XRD (determination of crystallite size, numericals)

Module:5	**Computational Chemistry: Basics to Applications**	**10 hours**

Introduction-Quantum mechanical calculations. Molecular orbital theory: atomic orbitals, molecular orbitals. Orbital interactions- chemical bonding. Potential energy curve/surface, electrostatic potentials, geometry optimization, frequency, reaction mechanism, application of AI to screen semiconductors

Module:6	**Contemporary Topics** Industry Expert Lecture	**2 hours**
	Total Lecture hours:	**45 hours**

Text Books	
1	Theodore E. Brown, H Eugene, LeMay Bruce E. Bursten, Catherine Murphy, Patrick Woodward, Matthew E. Stoltzfus, Chemistry: The Central Science, 2017, 14th edition, Pearson Publishers, 2021. UK
2	Frank Jensen, Introduction to computational chemistry, 2022, 3rd edition, Wiley
Reference Books	
1.	A.R West, Solid State Chemistry and its Applications, 2021, 2nd edition, Wiley, UK.
2.	Lawrence S. Brown and Thomas Holme, Chemistry for engineering students, 2020, 4th edition.
Mode of Evaluation: Quiz, Assignment, CAT and FAT	
Recommended by BoS - **Approved by Academic Council -**	

S. No.	Indicative List of Laboratory Experiments
1	Construction of galvanic cells using waste metal and evaluation of Thermodynamic functions (enthalpy, entropy, and free energy) from EMF measurements.
2	Determination of reaction rate, order and molecularity – ester hydrolysis (ethylacetate).
3	Colorimetric estimation of Ni^{2+} using conventional and smartphone digital-imaging method.
4	Assessment of the Fe^{2+} content using potentiometry.
5	Preparation of ZnO semiconductor and its characterization.
6	Estimation of sulfate ion in water by the conductivity method.
7*	Build atoms and molecules, visualization of atomic orbitals and hybridized orbitals. Calculating the orbital contributions.
8*	Conformational analysis of cyclohexane and ethane molecules and plotting the potential energy profile.
9*	Application of AI to screen semiconductors, materials, medicinal compounds - case study.
10	Size-dependent colour variation of Cu_2O nanoparticles by spectrophotometer
11	Synthesis of hydroxyl apatite from biowaste and its use for the removal of heavy metals
12	Fabrication of DSSC as a renewable energy resource using a natural dye.
13	Colorimetric estimation of Fe^{2+} using conventional and smartphone digital-imaging method
14.	Determination of reaction rate, order, and molecularity following sucrose hydrolysis by the amylase enzyme.
	#Concepts of Molarity, Molality and Normality will be discussed appropriately ** For experiments 7, 8 & 9, minimum four molecules to be studied.*

Total hours:			**30 hours**
Mode of Evaluation: CAT, FAT, Quiz			
Recommended by the Board of Studies			
Approved by the Academic Council	**No**	**Date**	