DEPARTMENT OF CHEMISTRY

ANNA UNIVERSITY, CHENNAI

VISION

The Department of Chemistry at Anna University shall strive towards attaining world class status and recognition by producing students with sound knowledge, professionalskills, high levels of integrity and ethical values. The Department shall provide an outstanding ambience for teaching, research and consultancy. The Department shall perform frontier research and create knowledge base in theoretical and applied chemistry, polymeric and catalytic materials, fuel and energy related processes and materials, environmental chemistry and other trans disciplinary areas of technological importance.

MISSION

The Department of Chemistry, Anna University shall contribute to the educational, economic and social development by:

- producing Postgraduates and Doctorates who are equipped with thorough knowledge in Chemistry, analytical thinking, practical skills and ethics by enabling interaction with experts from around the world in the fields of Chemistry.
- inspiring the students to be creative thinkers, inspirational role models and citizens with environmental and social consciousness.
- ensuring a supportive ambience in the Department with dynamic leadership and growth opportunities to meet the needs of the students, faculty and staff.
- promoting the development of technologically and socially relevant processes and products in the fields of catalysis, polymers, corrosion resistance coatings and energy conversion through academic and sponsored research, in collaboration with global research groups.
- facilitating collaborative partnership with industries and other institutions and catalyse innovation, transfer of technology and commercialization towards fulfilling societal developments.

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS

M. Sc. APPLIED CHEMISTRY (2 YEARS)

REGULATIONS 2023

CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Master of Science in Applied Chemistry curriculum is designed to impart Knowledge, Skill and Attitude on the graduates to:

1. Master the fundamental, advanced and applied aspects of chemistry and enable them to pursue research and career as a quality control, analytical and research scientist in the Chemical and allied industries.
2. Have fundamental knowledge and practical skills in the areas of synthesis, characterisation and applications of polymeric, catalytic, corrosion resistant and energy storage materials.
3. Contribute towards scientific development through academic research and industrial practices.
4. Practice their profession with good communication, leadership, ethics and social responsibility.
5. Graduates will adapt to evolving advancement in the inter-disciplinary areas of chemistry through life-long learning.

2. PROGRAMME OUTCOMES (POs):

After going through the two years of study, our Master of Science in Applied Chemistry graduates will exhibit the ability to:

PO	Programme Outcome
PO1	Identify, formulate and solve challenges in the inter-disciplinary fields of chemistry using the principles of chemical sciences.
PO2	Design and develop chemical components, processes or materials suitable for applications in science and technology,that meet specified needs with appropriate significance for public health and safety, cultural, societal and environmental considerations.
PO3	Select and apply appropriate, advanced spectroscopic, thermal analysis, chromatographic, electron microscope and electro analytical techniques and resources for chemical and material formulations, characterization of novel materials and qualitative & quantitative assessments, with an understanding of their limitations.
PO4	Understand and evaluate the impact of chemical processes and materials in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO5	Commit and conform to professional ethics, responsibilities and norms in their professional and societal interactions.
PO6	Recognize the need for, and engage in independent and life-long learning in the broadest context of scientific advancement.

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3. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
I	3	2	3	-	1	2
II	3	3	3	2	1	2
III	1	3	2	2	2	2
IV	1	2	-	2	3	2
V	3	3	3	1	1	3

4. Mapping of Course Outcome and Programme Outcome

		Course Name	PO1	PO2	PO2	PO4	PO5	PO6
YEAR 1	Semester 1	Organic Chemistry - I	3	2	1.5	2	2	1.5
		Inorganic Chemistry - I	2.3	2.6	1.6	1	3	2.5
		Physical Chemistry - I	2.4	2.4	2.6	2	1.5	1.5
		Analytical Chemistry	2	1.5	2.6	1	-	2
		Professional Elective I						
		Inorganic Chemistry Laboratory	1.8	2.6	1.8	2.5	1	2.4
	Semester 2	Organic Chemistry - II	2.2	3	1.3	2	1	2
		Inorganic Chemistry - II	2.4	1.6	2	2	2	2.2
		Physical Chemistry - II	1.75	1.5	2.6	1	1	1.6
		Chemistry of Industrial Materials	2	2	1.6	1.8	1	2
		Professional Elective II						
		Organic Chemistry Laboratory	2.2	1.75	2.6	1.3	1	1.5
		Seminar						
YEAR 2	Semester 3	Organic Chemistry - III	2.5	2.4	3	2.3	1	1.4
		Inorganic Chemistry - III	2.5	2.25	2.75	2	-	1.2
		Physical Chemistry - III	3	1.6	1	-	-	1
		Molecular Spectroscopy	2.4	1.25	2.4	1	-	1.8
		Program Elective III						
		Physical Chemistry Laboratory	1.8	1.4	2.8	2	-	1.3
	Semester 4	Professional Elective IV						
		Professional Elective V						
		Project Dissertation						

Mapping of Course Outcome and Programme Outcome of Programme & Open electives

		Course Name	PO1	PO2	PO3	PO4	PO5	PO6
YEAR 1	Semester 1 (Program Elective II)	Industrial Catalysis	1	2	2	2	1	1.5
		Bio-organic Chemistry	1	1.75	2.75	-	-	1
		Bio-process Technology	1.3	1.5	2.6	2	1	1.5
		Chemical Process Equipment and Instrumentation	1	2	1.5	2	-	1
			1.25	2.3	2	-	2	1

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		Pharmaceutical Chemistry						
		Environmental Chemistry	1.8	1	2.2	2.5	1	1.5
		Chemistry of Nano-Materials	1	2	2.4	-	-	2
YEAR 2	**Semester 3** (Program Elective III)	Green Chemistry	2.6	2	-	3	1	2
		Biomaterials	1.4	2.6	2.2	2	2	2
		Food Chemistry	2	1.8	3	2.5	1	1.2
	Semester 4 (Program Electives IV & V)	Corrosion and Corrosion Control	1.4	1.4	2.5	2.3	-	1.25
		Polymer Chemistry andTechnology	1	1.6	2.8	1	-	1
		Industrial Electrochemistry	1.25	1.6	2.5	1.5	1	1.6
		Water and Wastewater Treatment	1.5	1.4	3	2.6	-	1
		Forensic Chemistry	1.75	2	2.5	1	-	1.4
		Textile Chemistry andTechnology	1.75	1.8	2.6	2	1	1.5
		Agricultural Chemistry	1	1.75	2.4	2.8	2.2	1.8

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ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

M.Sc. APPLIED CHEMISTRY (2 YEARS)

REGULATIONS 2023

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AC3101	Organic Chemistry - I	PCC	3	0	0	3	3
2.	AC3102	Inorganic Chemistry - I	PCC	3	0	0	3	3
3.	AC3103	Physical Chemistry - I	PCC	3	0	0	3	3
4.	AC3104	Analytical Chemistry	PCC	3	0	0	3	3
5.		Professional Elective - I	PEC	3	0	0	3	3
PRACTICAL								
6.	AC3111	Inorganic Chemistry Laboratory	PCC	0	0	12	12	6
			TOTAL	**15**	**0**	**12**	**27**	**21**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AC3201	Organic Chemistry - II	PCC	3	0	0	3	3
2.	AC3202	Inorganic Chemistry - II	PCC	3	0	0	3	3
3.	AC3203	Physical Chemistry - II	PCC	3	0	0	3	3
4.	AC3204	Chemistry of Industrial Materials	PCC	3	0	0	3	3
5.		Professional Elective II	PEC	3	0	0	3	3
PRACTICAL								
6.	AC3211	Organic Chemistry Laboratory	PCC	0	0	12	12	6
7.	AC3212	Seminar	EEC	0	0	2	2	1
			TOTAL	**15**	**0**	**14**	**29**	**22**

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SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AC3301	Organic Chemistry - III	PCC	3	0	0	3	3
2.	AC3302	Inorganic Chemistry - III	PCC	3	0	0	3	3
3.	AC3303	Physical Chemistry - III	PCC	3	0	0	3	3
4.	AC3304	Molecular Spectroscopy	PCC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
PRACTICAL								
6.	AC3311	Physical Chemistry Laboratory	PCC	0	0	12	12	6
			TOTAL	**15**	**0**	**12**	**27**	**21**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective IV	PEC	3	0	0	3	3
2.		Professional Elective V	PEC	3	0	0	3	3
PRACTICAL								
3.	AC3411	Project Work	EEC	0	0	24	24	12
			TOTAL	**6**	**0**	**24**	**30**	**18**

TOTAL NO. OF CREDITS: 82

PROGRAM CORE COURSES (PCC)

Sl.No	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AC3101	Organic Chemistry - I	3	0	0	3	1
2.	AC3102	Inorganic Chemistry - I	3	0	0	3	1
3.	AC3103	Physical Chemistry - I	3	0	0	3	1
4.	AC3104	Analytical Chemistry	3	0	0	3	1
5.	AC3111	Inorganic Chemistry Laboratory	0	0	12	6	1
6.	AC3201	Organic Chemistry - II	3	0	0	3	2
7.	AC3202	Inorganic Chemistry - II	3	0	0	3	2
8.	AC3203	Physical Chemistry -II	3	0	0	3	2
9.	AC3204	Chemistry of Industrial Materials	3	0	0	3	2

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10.	AC3211	Organic Chemistry Laboratory	0	0	12	6	2
11.	AC3301	Organic Chemistry - III	3	0	0	3	3
12.	AC3302	Inorganic Chemistry - III	3	0	0	3	3
13.	AC3303	Physical Chemistry - III	3	0	0	3	3
14.	AC3304	Molecular Spectroscopy	3	0	0	3	3
15.	AC3311	Physical Chemistry Laboratory	0	0	12	6	3
					Total Credits	54	

PROFESSIONAL ELECTIVE COURSES (PEC)

Sl.No	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			Lecture	Tutorial	Practical		
1.	AC3001	Industrial Catalysis	3	0	0	3	1
2.	AC3002	Bio-organic Chemistry	3	0	0	3	1
3.	AC3003	Bio-process Technology	3	0	0	3	1
4.	AC3004	Chemical Process Equipment and Instrumentation	3	0	0	3	1
5.	AC3005	Pharmaceutical Chemistry	3	0	0	3	2
6.	AC3006	Environmental Chemistry	3	0	0	3	2
7.	AC3007	Chemistry of Nano-Materials	3	0	0	3	2
8.	AC3008	Corrosion and Corrosion Control	3	0	0	3	3
9.	AC3009	Industrial Electrochemistry	3	0	0	3	3
10.	AC3010	Water and Wastewater Treatment	3	0	0	3	3
11.	AC3011	Biomaterials	3	0	0	3	3
12.	AC3012	Forensic Chemistry	3	0	0	3	4
13.	AC3013	Textile Chemistry and Technology	3	0	0	3	4
14.	AC3014	Agricultural Chemistry	3	0	0	3	4
15.	AC3015	Polymer Chemistry andTechnology	3	0	0	3	4

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl.No	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1	AC3212	Seminar	0	0	2	1	3
2	AC3411	Project Work	0	0	24	12	4
					Total Credits:	**13**	

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SUMMARY

	M.Sc. APPLIED CHEMISTRY (2 YEARS)					
	Subject Area	Credits per Semester				Credits Total
		I	II	III	IV	
1.	PCC	18	18	18	00	**54**
2.	PEC	03	03	03	06	**15**
3.	EEC	00	01	00	12	**13**
	Total Credit	**21**	**22**	**21**	**18**	**82**

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AC3101 **ORGANIC CHEMISTRY – I** **L T P C**
3 0 0 3

OBJECTIVES

- To familiarise the basics of photochemistry, photochemical reactions of organic compounds and aromaticity.
- To provide understanding of the feasibility, mechanism and applications of pericyclic reactions for organic synthesis.
- To impart knowledge on various aspects of stereo chemistry like opticaland stereoisomerism, conformational analysis and asymmetric synthesis.
- To provide understanding of the reactions/methodologies used for the synthesis of organic molecules in multiple steps.
- To impart knowledge on various reagents available for carrying out various organic reactions like oxidation, reduction, substitution etc.

UNIT I PHOTOCHEMISTRY AND AROMATICITY 9

Photochemistry –Jablonski diagram – photochemistry of olefins and carbonyl compounds - photo oxidation and reduction, cis – trans isomerism, Paterno – Buchi, Barton, Norrish type I and II reactions, di-pi- methane rearrangement. Aromaticity - concept – Huckel and Craig rules – NMR and X – ray diffraction as a tool – diatropy and paratropy. Aromatic and anti-aromatic compounds. Benzenoid, non-benzenoid and homo aromatic compounds. Alternant and non- alternant hydrocarbons. Annulenes - Aromaticity in ferrocenes, fullerenes, heterocyclic rings and charged ring systems.

UNIT II PERICYCLIC REACTIONS 9

Definition - electrocyclic, cycloaddition, sigmatropic and ene reactions. Woodward – Hoffmann rules – Frontier orbital, Mobius- Huckel and orbital symmetry correlation approaches. Stereo-specificity and regiospecificity of pericyclic reactions - pericyclic reactions in organic synthesis. Diels –Alder reaction, 1,3 dipolar cycloaddition, Claisen, Cope, chelotropic reactions. Fluxional molecules.

UNIT III STEREOCHEMISTRY 9

Optical activity and chirality – chiral/asymmetric molecules - Newman, Sawhorse Wedge and Fischer projection formulae and interconversion - R,S nomenclature - diastereoisomerism in acylic and cyclic systems - enantiotopic, homotopic and diastereotopic hydrogens and prochiral carbons -optical activity of biphenyls, allenes and spirans - stereospecific and stereoselective syntheses-asymmetric synthesis - Cram's rule - Prelog's rule - conformational analysis of cyclic and acyclic compounds - conformation and reactivity - conformation and stereochemistry of cis and trans decalin and 9-methyl decalin - E,Z- nomenclature - E,Z-isomerism of olefins containing one double bond and more than one double bond - determination of configuration of geometrical isomers using physical and chemical methods.

UNIT IV MULTISTEP SYNTHESIS 9

Concepts in multistep synthesis : C-C, C═C bond forming reactions, control of stereochemistry, synthetic equivalents, protective groups - hydroxyl, amino, carbonyl and carboxylic acid groups. Strategies for retrosynthetic analysis, synthon and planning - functional group introduction - removal and interconversion - retrosynthetic analysis - disconnections - a,d synthons.

UNIT V REAGENTS IN ORGANIC SYNTHESIS 9

Diborane-lithium aluminium hydride- sodium borohydride – osmium tetroxide- phenyl isothiocyanate - N-bromosuccinamide (NBS) - lead tetraacetate - dicyclohexylcarbodiimide (DCC)

- pyridinium cholorochromate (PCC) - Swern oxidation – ptoluenesulphonyl chloride - trifluoroacetic acid - lithium diisopropylamide (LDA) - 1,3-dithiane (reactive umpolung) - crown ethers - trimethylsilyl iodide - Gilman reagent - lithium dimethylcuprate - tri-n-butyltin hydride - di-tertbutoxydicarbonate - dihydropyran - phase transfer catalysts - Wilkinson's catalysts – Peterson synthesis - and diethylaluminium cyanide- IBX.

TOTAL: 45 PERIODS

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OUTCOMES

CO1: Will a general understanding of photochemical processes and aromaticity and their significance.
CO2: Will develop capability to predict the feasibility of pericyclic reactions
CO3: Will be able to plan synthesis of complicated molecules using cycloaddition, sigmatropic reactions and electrocyclic rearrangements.
CO4: Will be able to clearly understand the stereochemistry of organic reactions
CO5: Will be conversant in applying available reagents in organic synthesis which will be useful forsynthesis of important molecules in the industry/academia.

REFERENCES

1. E.L. Eliel, S.H. Wilen and L.N. Mander, Stereochemistry of Carbon Compounds, John Wileyand Sons, New York (2005).
2. F.A.Carey and R.J. Sundberg, Advanced Organic Chemistry, Part A and Part B, 5th edition, Springer, New York (2007).
3. Michael B. Smith ,March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 7th Edition, Wiley, New York (2013)
4. P. Wyatt, S. Warren, Organic Synthesis: Strategy and Control, Wiley pvt ltd. (2007).
5. R.O.C.Norman and J.M.Coxon, Principles of Organic synthesis, New York, CRC Press, 2009.
6. S. Sankararaman, Pericyclic Reactions - A Textbook: Reactions, Applications and Theory, 1st Edition, John Wiley & Sons, Ltd, New York, 2005.

CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	1	-	-	3
CO2	3	2	-	-	-	1
CO3	3	2	2	1	-	1
CO4	3	2	-	-	-	-
CO5	3	-	-	3	2	1
Avg	3	2	1.5	2	2	1.5

AC3102 INORGANIC CHEMISTRY- I **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the basic concepts and terms associated with each column and group of elements in the periodic table
- To impart knowledge on the nature of ionic bonding in molecules, their properties and energy involved in bond formation
- To introduce the structures of various crystal systems of ionic compounds and their applications in different fields
- To inculcate sound understanding of different types of bonding in diatomic and polyatomic covalent compounds
- To facilitate the understanding of the different solvents used for chemical reactions based on their properties

UNIT I PERIODIC PROPERTIES **9**

Electronic configuration of atoms – Aufbau principle - Hund's rule - Pauli exclusion principle - Term symbols. Periodic properties of elements - atomic size, ionization energy, electron affinity, electronegativity, covalent and ionic radii, magnetic properties; f-block elements – lanthanides: configuration, oxidation states, lanthanide contraction; Actinides-configuration,properties. Recovery, spectra and magnetic properties.

UNIT II IONIC BONDS AND NON-VALENCE FORCES 9

Ionic solids – lattice energy – Born-Haber cycle; non-valence forces: Van der Waals'forces. Hydrogen bond – characteristics, hydrogen bond in water and effect of hydrogen bonding on properties. Crystalline hydrates and clathrates - noble gases, phosphazines, hydrogen bonding in clathrates, Phosphorous and Oxygen cage compounds - applications. Metallic bond – free electron theory and band theory of metals.

UNIT III CRYSTAL STRUCTURE 9

Crystalline and amorphous solids; crystal systems and lattices; types of close packing - hcp and ccp, packing efficiency - Cubic, BCC& FCC. Radius ratio, structures of AX, AX_2, A_2X_3, ABX_3 and A_2BX_4 type solids. Defects in solids – origin and types of defects, non - stoichiometry; Defect -property correlation in solids; Layer structure - cadmium iodide, Covalent solids – diamond, graphite.

UNIT IV COVALENT BOND 9

Lewis structure-octet theory- Valence bond theory – hybridization and resonance – diatomic and polyatomic systems - Hitler London, Pauling and Slater refinements, VSEPR theory - shapes of molecules; molecular orbital theory – LCAO approximation for diatomic and polyatomic systems. Bonding in Noble gas compounds - $XeCl_2$, XeF_4, $XeOF_4$, XeF_6.

UNIT V AQUEOUS AND NON-AQUEOUS CHEMISTRY 9

Solvents – classification - function and selection. Acid-base concepts and HSAB-super acids and super bases. Non-aqueous solvents – reactions in liquid ammonia, sulphuric acid - aprotic solvents, non-aqueous titrations - molten salts .

TOTAL: 45 PERIODS

OUTCOMES

CO1: The students will be able to summarize and apply basic knowledge on the periodic table and its properties to understand Inorganic concepts for further studies.

CO2: The students will be able to analyze different types of bonding in chemical compounds and apply them to study new chemical compounds.

CO3: The students will be able to distinguish between the crystal structures of different ionic compound

CO4: The students will be able to examine the bonding in covalent compounds and correlate their properties to new compounds synthesized.

CO5: The students will be able to appraise the reactions involved in different types of solvents and select suitable solvents for chemical reactions in industries.

REFERENCES

1. A.G. Sharpe, "Inorganic Chemistry", 3rd Edn., 2nd Impression, Pearson Education (2009).
2. B. Sivasankar, "Inorganic Chemistry", Pearson Education, 2013.
3. D.F. Shriver and P. W. Atkins, "Inorganic Chemistry", 5th Edn. Oxford University Press (2011).
4. F. A. Cotton, G. Wilkinson and P. L. Gaus, "Basic Inorganic Chemistry", 3rd Edn. John Wiley and Sons, 2004.
5. J. D. Lee, Concise Inorganic Chemistry, 5th Edn. Wiley-India Edition (2009).
6. J. E. Huheey, E. A. Keiter, R. L. Keiter and Okhil K Medhi, "Inorganic Chemistry: Principles structure and reactivity", 4th Edn. Pearson Education (2011).

CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	1	-	-	3
CO2	1	3	2	-		2
CO3	-	3	2			
CO4	3	2	-			3
CO5	3	3	-	1	3	2
Avg	2.3	2.6	1.6	1	3	2.5

AC3103 **PHYSICAL CHEMISTRY- I** **L T P C**
3 0 0 3

OBJECTIVES

- To provide exposure to understand the laws and concepts of chemical thermodynamic
- To familiarize the students with partial molar properties, chemical potential and fugacity
- To acquire the laws of photochemistry, photo physical process and its applications
- To make the students acquire basic and advanced concepts of electrochemistry, various models of electrical double layer and kinetics of electrode process
- To impart knowledge on batteries and super capacitors

UNIT I CHEMICAL THERMODYNAMICS **9**

First law of thermodynamics– mathematical formulation - Joule Thomson effect– mathematical treatment of Joule-Thomson effect - second law of thermodynamics –spontaneous process- criteria of spontaneity- entropy –mathematical expression – entropy change in reversible and irreversible process - free energy – Gibbs free energy and Helmholtz work function -significance – Gibb's Helmholtz equation – applications – Maxwell's relations -Van't Hoff equation – third law of thermodynamics

UNIT II PARTIAL MOLAR QUANTITIES **9**

Concepts of partial molar properties – partial molar free energy and partial molar volume. Gibbs-Duhem equation – Chemical potential - Variation of chemical potential with temperature and pressure - applications of chemical potential - Henry's law - Nernst distribution law - Raoult's law. Fugacity – Determination of fugacity of gases by graphical method – Variation of fugacity with temperature and pressure – Lewis Randal rule – Duhem -Margules equation.

UNIT III PHOTOCHEMISTRY **9**

Laws of photochemistry, Photophysical process (Jablonski diagram) – primary and secondary process, quantum yield – high and low – photochemical reactions based on quantum yield - determination of quantum yield by chemical actinometer. Kinetics of collisional quenching – Stern Volmer equation. Photosensitization and quenching – chemiluminescence, solar energy conversion – semiconductor photocatalysis.

UNIT IV ELECTROCHEMISTRY **9**

Electrochemical cells - electrical double layer–various models–Helmholtz model-Guoy-Chapman's model and Stern's model-electro capillary phenomena–electro-osmosis-Electrophoresis – Factors affecting electrophoretic mobility- paper electrophoresis -cellulose acetate electrophoresis-gel electrophoresis (starch, polyacrylamide and agarose) – kinetics of electrode processes – Butler-Volmer equation – Tafel equation

UNIT V ENERGY STORAGE DEVICES **9**

Batteries – requirements of batteries –Primary and secondary-dry cells–lead-acid and lead-acid gel batteries-Factors affecting the performance of lead acid batteries-Nickel-Cadmium battery - metal-hydride batteries, lithium-ion battery and fuel cells(H_2-O_2) - Super capacitors – advantages and limitations.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Will be in a position to identify spontaneous reaction along with its thermodynamic principles.
CO2: Will be able to understand the influence of chemical potential and fugacity.
CO3: Will be conversant with photo physical process, quantum yield and its determination
CO4: Will be conversant in the theories involved in electrochemistry, various models of double layers and kinetics of electrode potential.
CO5: Can apply electrochemical principles to the benefit of mankind.

REFERENCES

1. E.V.Anslyn and D.A.Dougherty, “Modern Physical Chemistry”, University Science Books, Sausalito, USA (2006).
2. J.C. Kuriacose and J.Rajaram, Thermodynamics for students of Chemistry, 4rd Edn. S.Chand & Co., New Delhi (2002)
3. Ira N. Levine, ‘Physical Chemistry’ Tata Mc Graw, 6th Edn., Hill Publishing Company Limited, New Delhi (2013)
4. Brian Wardle, “Principles and applications of photochemistry” Wiley, (2009)
5. John O’M Bockris, Amula K. N. Reddy, and Maria Gamboa–Aldeco, “Modern Electrochemistry 2A, 2nd Ed, Kluwer Academic / Plenuim Publishers, NewYork, (2000)
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7. Philip H. Rieger, Electrochemistry,3rd Edition, Prentice Hall Inc., New Delhi, Edition, (2010)

CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	-	2
CO2	3	2	-	-	1	2
CO3	1	2	3	-	-	1
CO4	2	3	3	-	-	-
CO5	3	3	-	2	2	1
Avg	2.4	2.4	2.6	2	1.5	1.5

AC3104 ANALYTICAL CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To introduce basic concepts of data analysis methods to estimate and comparison of results.
- To formulate the students to know about on volumetric and gravimetric analysis.
- To facilitate the atomic spectroscopy for qualitative and quantitative analysis and also thermal techniques.
- To familiarize the operating principles, processes and applications of electro analytical methods.
- To make the student conversant with different separation techniques and its applications.

UNIT I ANALYTICAL DATA ANALYSIS 9

Introduction-true value, precision, accuracy, mean, median, average deviation, Errors in Chemical Analysis - Classification of errors - Significant figures - Statistical treatment-standard deviation, variance, confidence limits, correlation coefficient and regression analysis - student-t and f tests, detection of gross errors, rejection of a result-Q test, estimation of detection limits. Least square method, correlation coefficient and its determination - Fitting of data to hypothesis.

UNIT II WET CHEMICAL METHODS OF ANALYSIS 9

Volumetric analysis – neutralization, precipitation, complexometric and redox titrations - theoretical titrations curves - theory of indicators; Gravimetric analysis - volatilization and precipitation methods - homogeneous precipitation.

UNIT III ATOMIC SPECTROSCOPY AND THERMAL METHODS 9

Atomic spectroscopy: Principle, instrumentation and applications – atomic absorption spectrometry; Emission spectroscopy - flame photometry and ICP-AES; Atomic fluorescence spectroscopy. Thermal analytical techniques: Principles, instrumentation and applications – TGA, DTA and DSC - factors affecting the shape of thermograms..

UNIT IV ELECTROANALYTICAL TECHNIQUES 9

Conductometry, Potentiometry, pH-metry, Ion selective electrodes; Electrogravimetry and coulometry, Voltammetry – polarography, amperometric titrations - principles, practice and applications.

UNIT V SEPARATION TECHNIQUES 9

Chromatographic techniques: Principles, techniques and applications – adsorption chromatography, thin layer chromatography, paper chromatography, ion-exchange chromatography and size exclusion chromatography (GPC); Supercritical fluid chromatography. Principles, Instrumentation and applications: Gas chromatography, high performance liquid chromatography.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course, the students will be able:

- To recognize and apply basic knowledge on different types of data analysis methods
- To identify and apply basic concepts of volumetric and gravimetric analysis
- To identify suitable spectroscopic technique for qualitative and quantitative analysis and apply them to handling the instrumentation.
- To recognize the characterization techniques for thermal properties of materials and apply them for suitable applications.
- To demonstrate the knowledge on operating principles of different electro analytical methods and apply for different applications.

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CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	2	1	-	2
CO2	2	1	2	1	-	2
CO3	2	1	3	1	-	2
CO4	2	1	3	1	-	2
CO5	2	-	3	1	-	2
Avg	2	1.5	2.6	1	-	2

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AC3111 INORGANIC CHEMISTRY LABORATORY L T P C
0 0 12 6

OBJECTIVES

To facilitate in understanding the basic concepts and impart practical training on:

- Quantitative inorganic analysis of ores, alloys and industrial chemical products.
- Calculation of compounds present in cement
- Analysis of important water quality parameters such as hardness, dissolved oxygen, COD and BOD so as to enable complete quality assessment of water for domestic and industrial use.
- Qualitative inorganic semi-micro analysis and preparation of complexes.
- Qualitative estimation of familiar and less familiar elements in the periodic table

UNIT I QUANTITATIVE INORGANIC ANALYSIS 48

(i) Ores: carbonate ores (dolomite)
(ii) Alloys: ferrous and nonferrous alloys (brass and solder)
(iii) Spectrophotometry- estimation of copper, nickel, iron and manganese
(iv) Bleaching powder for its available chlorine content by iodometric method.

UNIT II ESTIMATION OF INDUSTRIAL PRODUCTS 42

(i) Analysis of cement - silica, mixed oxide – Fe_2O_3, Al_2O_3 & CaO/MgO
(ii) Analysis of stainless steel - Chromium, manganese and nickel

UNIT III WATER ANALYSIS 18

(i) Carbonate and non-carbonate hardness by EDTA
(ii) Dissolved oxygen by Winkler's method

UNIT IV PREPARATION OF TYPICAL INORGANIC COMPLEXES 36

Tris- thiourea copper (I) sulphate, bisthiocyanato pyridine copper (II) sulphate, tris (ethylene diamine) copper (II) sulphate, chloropentammine cobalt (III) chloride

UNIT V QUALITATIVE INORGANIC SEMI-MICRO ANALYSIS 36

Detection of at least four cations (2 common and 2 uncommon) in a mixture of salts.

TOTAL: 180 PERIODS

OUTCOMES

- The students will be able to design different types of alloys to be used for industrial and domestic applications.
- The students will be able to use right combination of ingredients of cement material for different environment.
- The students will be able to estimate water quality parameters and apply their usage and design properly at chemical industries.
- The students will be able to identity right and appropriate coordination complexes for biological and chemical applications.
- The students will be able to predict the nature of elements present qualitatively and use them for further studies.

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Attested

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CO-PO Mapping

COs	POs					
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CO1	1	3	1	2	-	2
CO2	2	3	2	3	-	3
CO3	3	3	2	3	-	2
CO4	1	2	1	-	1	2
CO5	2	2	3	2	1	3
Avg	1.8	2.6	1.8	2.5	1	2.4

AC3201 ORGANIC CHEMISTRY - II L T P C
3 0 0 3

OBJECTIVES

- To learn the involvement of reactive intermediates, addition reactions in organic chemistry.
- To provide comprehensive knowledge on substitution reactions in organic chemistry.
- To make the students knowledgeable in various elimination reactions.
- To acquaint the students with various name reactions and mechanism.
- Learn to apply rearrangement reactions in organic synthesis.

UNIT I ADDITION REACTIONS 9

Reactive intermediates - formation and stability of carbonium ions, carbanions, carbenes and nitrenes, radicals and arynes - addition to carbon-carbon and carbon-hetero multiple bonds - electrophilic, nucleophilic and free radical additions - stereochemistry of addition to carbon-carbon multiple bonds - orientation and reactivity - addition to conjugated systems and carbonyl compounds.

UNIT II SUBSTITUTION REACTIONS 9

Aliphatic nucleophilic substitutions - SN1, SN2 mechanisms - effects of substrate, attacking nucleophile, leaving group and solvent - stereochemistry of nucleophilic substitution reactions - mechanism of ester hydrolysis - alkylation of active methylene compounds - substitutions at carbonyl, bridgehead, vinylic and allylic carbons - ambident nucleophiles - O versus C alkylation - aromatic nucleophilic substitution - mechanisms - effects of substrate, structure, leaving group and attacking nucleophile - reactions of aryl diazonium salts with various nucleophilic substitution (VNS) - aromatic electrophilic substitution reactions and mechanisms.

UNIT III ELIMINATION REACTIONS 9

E1, E2 and ElcB mechanisms - stereochemistry of E2 elimination - Hofmann and Saytzeff rule - competition between elimination and substitution reactions - orientation effects in elimination reactions - effects of substrate structures, attacking base, leaving group and medium on E1 and E2 reactions - pyrolytic eliminations - Bredt's rule.

UNIT IV NAME REACTIONS 9

Birch, Clemmensen, Wolff-Kishner and Meerwein-Ponndorf - Verley reductions - Oppenauer oxidation - Claisen, Dieckmann, Benzoin, Darzens and Stobbe condensations - Chugaev and Cope eliminations - Michael addition - Mannich reaction - Wittig reaction - Chichibabin reaction - Robinson annulation - Hell-Volhard-Zelinsky reaction - Stork enamine alkylation - Ziegler alkylation - Vilsmeier-Haack reaction - Heck reaction - Sharpless asymmetric epoxidation - Reformatsky reaction - Simmons-Smith reaction - Gattermann-Koch reaction - Ullmann reaction - Thorpe reaction.

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UNIT V REARRANGEMENTS 9

General mechanistic considerations - nature of migration - migratory aptitude - nucleophilic, electrophilic and free radical rearrangements - Wagner-Meerwein, McLafferty, Demyanov, Benzilbenzilic acid, Favorskii, Neber, Hofmann, Curtius, Beckmann, Schmidt, Lossen, Wolff, Baeyer-Villiger, Dienone-phenol, Pinacol, Stevens, Wittig rearrangements.

TOTAL: 45 PERIODS

OUTCOMES

- Apply the knowledge of basic as well as advanced and applied chemistry to the solution of complex research problems
- Identify industrial chemistry problems and give solutions
- Identify, formulate and solve challenges in the inter-disciplinary fields of chemistry
- Identify and create inter-disciplinary fields of chemistry using various chemical reaction
- Design and develop chemical compounds, and make new synthetic methodology for new molecules and mechanism.

REFERENCES

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CO-PO Mapping

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CO1	3	3	1	-	-	2
CO2	3	3	-	-	-	2
CO3	3	3	-	-	-	2
CO4	1	3	1	2	-	2
CO5	1	3	2	2	1	2
Avg	2.2	3	1.3	2	1	2

AC3202 INORGANIC CHEMISTRY - II L T P C
3 0 0 3

OBJECTIVES

- To introduce the isomerisation geometry and absolute configuration of coordination compounds.
- To teach the various theoretical treatments of bonding in coordination compounds
- To facilitate the understanding of the spectral, magnetic and thermodynamic properties of coordination compounds
- To instruct on the different reactions of complexes and their mechanistic aspects. transition metal complexes through energy correlations.
- To familiarize about the biologically important coordination compounds and their applications.

UNIT I COORDINATION COMPOUNDS 9

Coordination complex-ligands-classification. Nomenclature; coordination geometry – three, four, five, six, seven and higher coordinate complexes; Isomerism – structural and stereoisomerisms; absolute configuration: ORD and CD spectra, cotton effect.

UNIT II THEORIES OF METAL LIGAND BOND 9

Werner theory –Sidgwick's theory – EAN rule - Valence bond theory – hybridization; crystal field theory – crystal field splitting, crystal field stabilization energy – applications - colour and magnetic characteristics.Jahn-Teller effect, Ligand field theory – pi bonding. MOT – MO theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes. Nephlauxetic effect.

UNIT III SPECTRAL CHARACTERISTICS OF COORDINATION COMPOUNDS 9

Spectral characteristics - Free ion terms, transformations in crystal field, energy diagrams in weak and strong field cases – Tanabe-Sugano diagrams, selection rules; magnetic properties – Van Vleck equation. Magnetic susceptibility - Guoy and Faraday methods. IR and ESR spectra of transition metal compounds.

UNIT IV PREPARATION & REACTIONS OF COORDINATION COMPOUNDS 9

Preparation of coordination compounds; Inert and labile complexes; stability of complexes – successive and overall formation constants – thermodynamic aspects., substitution reactions in square-planar and octahedral complexes – factors affecting reactivates; electron transfer reactions-outer sphere and inner sphere mechanisms; photochemical reactions of coordination compounds – substitution, red-ox and rearrangement reactions.

UNIT V COMPLEXES OF BIOLOGICAL SIGNIFICANCE 9

Metallo biomolecules- Introduction and classification, Metal storage and transport : Ferritin, Transferrin And Siderophores, Myoglobin And Hemoglobin-Perutz Mechanism Models of oxygen carriers,Photosynthesis -PSI And PSII Systems, Metaloenzymes, Carboxy Peptidase, Carbonic Anhydrase, Catalase, Coenzyme- Vitamin B12, metal complex- nucleic acid interactions, Metal Deficiency and Disease , Toxic Effects of Metals, Biomedical Applications ; Metals Used For Diagnosis Chelation and Chemotherapy In Cancer Treatment ; Medical Imaging

TOTAL : 45 PERIODS

OUTCOMES

- To identify the nomenclature and isomerism of different coordination compounds
- To analyze the bonding in coordination compounds and interpret their magnetic and spectral properties
- To interpret the influence of different ligands on the geometry of the complexes and study their spectral properties
- To recall the chemical reactions of the complexes and use them for different applications
- To devise different methods of preparation of biologically important complexes for biomedical applications.

REFERENCES

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CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	-	2
CO2	2	1	3	-	-	2
CO3	2	1	3	-	-	2
CO4	3	1	1	2	2	2
CO5	2	3	-	2	2	3
Avg	2.4	1.6	2	2	2	2.2

AC3203 **PHYSICAL CHEMISTRY - II** **L T P C**
3 0 0 3

OBJECTIVES

- To make the student conversant with kinetics and catalysis
- To impart knowledge on the reactions in solution and gas phase.
- To provide exposure to the students to understand theory of unimolecular reactions and kinetics of fast reactions
- To make the student aware of surface reactions.
- To expose the students to various characterization techniques

UNIT I CHEMICAL KINETICS AND CATALYSIS 9

Rates of chemical reaction, order and molecularity concepts, methods for determination of order of a reaction, kinetics of first, second and third order reactions–complex reactions- reversible, consecutive and parallel, collision theory, transition state theory and its modifications–thermodynamic formulation of reaction rates. Acid base catalysis-Bronsted relations, catalytic coefficients and their determination. Enzyme catalysis and its mechanism, Michaelis-Menten equation, effect of pH and temperature on enzyme catalysis, mechanism of enzyme inhibition.

UNIT II REACTIONS IN SOLUTIONS AND GAS-PHASE 9

Reactions in solution: factors determining reaction rates in solutions, effect of dielectric constant and ionic strength, - Bronsted –Bjerrum equation-Primary and Secondary salt effect, influence of solvent on reaction rates. Linear free energy relationship-Hammett equation, Taft equation-Separation of polar, resonance and steric effects. Gas phase combustion-H_2-O_2 reaction and Hydrocarbon Combustion- explosion limits.

UNIT III CHEMICAL DYNAMICS 9

Potential energy surfaces-Dynamics of unimolecular reactions-Lindemann Hinshelwood, Rice-Ramsperger- Kassel(RRK) theory. Rice-Ramsperger-Kassel -Marsus (RRKM) theory. Study of fast reactions by stopped flow techniques, relaxation method, flash photolysis and the nuclear magnetic resonance method.

UNIT IV SURFACE REACTIONS 9

Adsorption, Adsorption Isotherms -Freundlich, Langmuir Isotherm, Adsorption with Dissociation, Competitive Adsorption, BET isotherm - Determination of Surface area, pore volume and pore size-Non ideal adsorption (Multilayer), Thermodynamics and statistical mechanics of adsorption, kinetics of surface reactions- unimolecular reactions-Bimolecular reactions-Langmuir Hinshelwood and Elay-Rideal mechanism.

UNIT V SURFACE CHARACTERIZATION TECHNIQUES 9

Principles, Instrumentation and Applications - XRD, XPS, XRF, AES spectroscopy, Electron microscopy (SEM,TEM and AFM) and probe molecule characterizations (pyridine, ammonia, NO and CO adsorption) - TPD, TPR, DRIFT.

TOTAL: 45 PERIODS

OUTCOMES

- Will be competent in analyzing the rates of chemical reactions and mechanism involved in catalysis
- Will be familiar with the significant mechanisms and its theories.
- Will understand the concepts of surface chemistry and the methods of analysis.
- Will be familiar with adsorption isotherms and mechanism of unimolecular reactions.
- Will identify and apply suitable characterization technique for material analysis.

REFERENCES

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7. R. G. Frost and Pearson, Kinetics and Mechanism, Wiley New York, 1961.

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COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	-		2
CO2	-	2	-	-	-	2
CO3	2	1	3	-	-	1
CO4	1	2	2	-	-	1
CO5	1	1	3	1	1	2
Avg	1.75	1.5	2.6	1	1	1.6

AC3204 CHEMISTRY OF INDUSTRIAL MATERIALS L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on macromolecular chemistry.
- To make the student conversant with the use of organic semiconductor materials.
- To teach the students to appreciate the use of electrochemical sensors.
- To develop an understanding of the drugs and their targets.
- To understand the properties of important pesticides and their toxicity.

UNIT I MACROMOLECULAR CHEMISTRY 9

Basic concepts, molecular weight - number average, weight average, polydispersity index, size of polymer molecules – Freely jointed chain model. Glass transition temperature – factors, Interrelationship between Tg and Tm - importance, Crystallisable polymers- factors, polymer single crystals,Polymer dissolution – thermodynamics of polymer dissolution, Flory- Huggin’stheory, Size and shape of macromolecules in solution, Polymer degradation – thermal, mechanical, ultrasonic, photodegradation, oxidative, hydrolytic and high energy radiations.

UNIT II ORGANIC SEMICONDUCTOR MATERIALS 9

Structureand properties of organic solids, Basic concepts of electronic process in conjugated polymers, Organic/Polymeric field effect transistors – Thin film, Single crystal, Polymer light emitting diodes (PLEDs) from conjugated polymers, electrophosphorescent and white light PLEDs, polymer solar cells – donor and acceptor materials, Dye-Sensitized Solar cells (DSSCs) – small molecule dyes, polymer dyes, p-type DSSC.

UNIT III ELECTROCHEMICAL SENSORS 9

Electrochemical biosensors, enzyme electrodes – Glucose sensors, Ethanol electrodes, urea electrodes, toxin biosensors, tissue and bacteria electrodes, immunosensors, receptor-based sensors, electrochemical sensors based on molecularly imprinted polymers, gas sensors – carbon dioxide sensors, oxygen electrodes, Solid state devices – solid state sensor assemblies, microfabrication techniques.

UNIT IV DRUGS AND DRUG TARGETS 9

Drugs – Enzymes as drug targets, Inhibitors at: active site of an enzyme, allosteric binding site, uncompetitive and non-competitive inhibitors, renin inhibitors, suicide substrates, medicinal uses of enzyme inhibitors, targeting drugs – tumour cells and gastrointestinal infections, preclinical and clinical trials of getting drug to market, Quantitative structure activity relationships (QSAR) – Hansch equation, Craig plot, Topliss scheme, Free-Wilson approach.

UNIT V PESTICIDE CHEMISTRY AND TOXICOLOGY 9

Pesticides, classification, chemical characteristics of pesticides, organochlorine, organophosphorus, carbamate, pyrethroid, plant origin pesticides, biopesticides. Toxicity classification of pesticides, NOEL, NOAEL, LOAEL, ADI tolerance level, RfD, Measurement of toxicity, LD50 and related parameters.

TOTAL: 45 PERIODS

OUTCOMES

- Will understand the chemistry of macromolecules.
- Will appreciate the apt usage of organic semiconductor materials.
- Will obtain awareness about electrochemical sensors.
- Will be aware of the drugs and drug targets.
- Will be appreciative of the knowledge of toxicity of pesticides.

REFERENCES

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CO2	2	2	1	2	-	2
CO3	2	2	2	2	-	2
CO4	2	2	2	2	-	2
CO5	2	2	1	2	1	2
Avg	**2**	**2**	**1.6**	**1.8**	**1**	**2**

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AC3211 ORGANIC CHEMISTRY LABORATORY L T P C
0 0 12 6

OBJECTIVES

- To make the student conversant with the quantitative organic analysis of compounds.
- To make the student gain experimental skills on the separation of organic compounds from mixture
- To acquaint the student with the synthesis of organic compounds in single step and their characterisation.
- To acquaint the student with the synthesis of organic compounds in double step and their characterisation.
- To characterize the compounds by spectroscopic techniques.

UNIT I QUANTITATIVE ORGANIC ANALYSIS 36

Percentage purity of aniline, phenol, glucose and glycerol. Determination of saponification value and iodine value of oils. Determination of fatty acid content, total alkali content and moisture content of soap.

UNIT II QUALITATIVE ANALYSIS OF TWO-COMPONENT MIXTURES 36

Separation of two component mixture, analysis for hetero atoms, functional group analysis, derivative preparation and confirmatory tests.

UNIT III ORGANIC PREPARATIONS –SINGLE STAGE 36

Synthesis of 1) chalcone derivatives 2) Schiff base derivatives 3) Synthesis of azo dyes 4) Purification of solids by recrystallization 5) Determination of melting point 6) TLC analysis of synthesized compounds.

UNIT IV ORGANIC PREPARATIONS-DOUBLE STAGE 36

Synthesis of p-bromo aniline from acetanilide, Synthesis of p-nitroaniline from acetanilide, About 5 preparations involving two or three stages involving the following processes, nitration, acylation, halogenation, diazotization, rearrangements, hydrolysis, reduction, alkylation and oxidation. Purification of solids by re-crystallization, Determination of melting point, TLC analysis of synthesized compounds.

UNIT V IDENTIFICATION OF ORGANIC COMPOUNDS BY INSTRUMENTAL METHODS 36

UV-Visible Spectroscopy, Infra Red Spectroscopy, Nuclear Magnetic Resonance (NMR) Spectroscopy, Mass spectroscopy, Gas Chromatography (GC), High Pressure Liquid Chromatography (HPLC) and Thermogravimetric Analyser (TGA).

TOTAL: 180 PERIODS

OUTCOMES

- Will be able to quantify the purity of organic compounds.
- Will be competent in separation and purification techniques.
- Will gain skill in single step synthesis of organic compounds.
- Will gain skill in double step synthesis of organic compounds
- Will be get competency in instrumental and spectroscopic analysis of organic compounds

REFERENCES

1. Bansal, R. K., Laboratory Manual in Organic Chemistry, Wiley, 2006.
2. Daniel R.Palleros, “Experimental Organic Chemistry” John Wiley & Sons, Inc., New York (2001).
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CO-PO Mapping

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CO3	3	2	2	1	-	1
CO4	3	2	2	1	-	1
CO5	1	-	3	-	-	2
Avg	2.2	1.75	2.6	1.3	1	1.5

AC3301 ORGANIC CHEMISTRY - III L T P C
3 0 0 3

OBJECTIVES

- To provide comprehensive information about the Organic reagents and its applications.
- To give overall exposure and detailed reaction of Organometallic reagents in synthesis.
- To impart thorough knowledge on organic oxidation reactions and its applications.
- To learn various reducing agents used in organic synthesis.
- To introduce advanced level study in organic spectroscopic techniques.

UNIT I ORGANOMETALLIC REAGENTS IN ORGANIC SYNTHESIS 9

Organometallic reagents - Organomagnesium - Organolithium - Organozinc - Organocopper - Organoboranes - Organosilicon - Organotin - Organopalladium - Organonickel - Organorhodium - Organoruthenium - Organozirconium - Organoiron - Organochromium - Organotitanium.

UNIT II REAGENTS IN ORGANIC SYNTHESIS 9

N-Bromosuccinimide (NBS) - N,N-Dicyclohexylcarbodiimide (DCC) - Diazomethane (CH2N2) - Various reagents of Phosphorus - Sulfur - Selenium - Tellurium - Cerium - Samarium - Ytterbium.

UNIT III OXIDATION REACTIONS 9

Osmium Oxidants - Manganese Oxidants - Chromium Oxidants - Selenium Oxidants - Aluminium Oxidants - Peracids - Peroxides - Ozone - Lead Tetraacetate - Sodium Periodate - Molecular Oxygen - Other Metal Oxidants (Ag, Ru, Pd, etc.) - Other Nonmetal Oxidants (Dess-Martin, TEMPO and Dioxiranes) - Other Nonmetal Oxidants (IBX and DDQ) - Other Oxidants (NMO, I2/RCO2Ag and NBS) - Bio-oxidations (Enzymatic or Microbial Oxidations).

UNIT IV REDUCTION REACTIONS 9

Oxidation with Cr and Mn reagents – oxidation with LTA, DDQ and SeO_2 – oxidation using DMSO Lithium Aluminum Hydride (LAH) - Lithium Trialkoxyaluminum Hydride [LiAlH(OR)3] - Sodium bis(2-Methoxyethoxy)aluminum Hydride [NaAlH2(OCH2CH2OMe)2] - Diisobutylaluminum Hydride (DIBAL-H) - Borohydrides - Dissolving Metal Reductions (Na, Li) - Metal based reductions (Pt, Pd, Ni) - Molecular Hydrogen - Miscellaneous Reducing Agents - Photoreductions and Bio-reductions.

UNIT V IDENTIFICATION OF ORGANIC COMPOUNDS 9

Ultraviolet - Visible (UV - Vis) Spectroscopy - Infrared (IR) Spectroscopy - Nuclear Magnetic Resonance (NMR) Spectroscopy : ^{1}H NMR - ^{13}C NMR - Mass Spectrometry.

TOTAL : 45 PERIODS

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OUTCOMES

- Apply the knowledge of basic, advanced and organic chemistry to the solution of complex.
- Identify, formulate and solve challenges in the fields of organic chemistry using the research and industrial chemistry problems.
- Design and develop chemical compounds, which are suitable for industrial applications.
- Conduct investigation on chemical compounds and their analogues, including synthetic methods.
- Analysis & evaluate the impact of advanced organic chemistry in societal and interpretation of data in different fields of chemistry.

REFERENCES

1. V. K. Ahluwalia, R. K. Parashar, Organic Reaction Mechanisms, Narosa, New Delhi, 4th edition, 2011.
2. M. B. Smith, Organic Synthesis, 4th edition, McGraw Hill, New York, 2016.
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CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	2
CO2	3	1	-	-	-	1
CO3	-	3	-	2	-	1
CO4	2	3	-	2	-	2
CO5	2	3	3	3	1	1
Avg	2.5	2.4	3	2.3	1	1.4

AC3302 INORGANIC CHEMISTRY - III L T P C 3 0 0 3

OBJECTIVES

- To introduce the basic concepts of bonding and structure in organometallic compounds.
- To impart knowledge on the reactions and industrial catalytic applications of organometallic compounds
- To instruct on the basic principles of preparation and characterization of inorganic solids and defects-property correlation in solids.
- To explore and learn electrical, magnetic, Optical properties of solids.
- To inculcate sound understanding of crystal structure of solids.

UNIT I BASIC ORGANOMETALLIC CHEMISTRY 9

Infrared spectra of metal carbonyls and olefins. Neutral spectator ligands: phosphines and N-heterocyclic carbenes. Metal clusters, Low and high nuclearity clusters, clusters having interstitial atoms, electron counting schemes: polyhedral skeletal electron pair theory/Mingo's rule. Structure and Isolobal analogies. Metallocenes and bent-metallocenes. Fluxionality and dynamics in organometallic chemistry Reactions of organometallic complexes: Substitution, oxidative addition, reductive elimination, insertion and deinsertion.

UNIT II REACTIONS AND APPLICATIONS OF ORGANOMETALLIC COMPOUNDS 9

Reactions of organometallic compounds: Substitution, oxidative addition, reductive elimination, Insertion, Elimination, nucleophilic and electrophilic attack on coordinated ligands; Catalysis by organometallic compounds - Homogeneous catalysis - hydrogenation, hydroformylation, stereoregular polymerization, Wacker and Monsanto processes, water gas shift reaction, alkene metathesis.

UNIT III PREPARATION AND CHARACTERISATION OF CRYSTALLINE SOLIDS 9

Preparatory methods – solvothermal, ceramic, sol-gel, co-precipitation, intercalation, chemical vapour deposition, chemical vapour transport, electrochemical deposition, laser ablation and ion-exchange methods. Characterisation – XRD, electron microscopy.

UNIT IV PROPERTIES OF CRYSTALLINE SOLIDS 9

Physical properties – polymorphism, anisotropy; Electrical properties: Band theory of solids – conductors, semiconductors and insulators; Solid electrolytes; Superconductivity – BCS theory, types of superconductors, applications; Thermoelectric properties: Thomson, Peltier, Seebeck and Hall effects; Dielectric properties: ferroelectric, ferrielectric, pyroelectric and piezoelectric materials and their applications; Magnetic properties, magnetic ordered solids – soft and hard materials. Optical and mechanical properties of solids.

UNIT V INORGANIC COMPOUNDS AND CLUSTERS 9

Chemistry of boron – boranes, higher boranes, borazines , boron nitrides, Preparation, properties and structure. Carboranes- Types such as nido-closo, arachno-preaprtion properties and Structure. Metallocarboranes. Silicates- Structure of silicates - classification - ortho, meta and pyro silicates – one dimensional, two dimensional and three dimensional silicates. silanes, higher silanes. Metal clusters: Chemistry of low molecularity metal clusters, Structure of Re_2Cl_8; multiple metal-metal bonds.

TOTAL : 45 PERIODS

OUTCOMES

- Will be able to analyse the bonding and structure in organometallic compounds.
- Will identify and formulate suitable organometallic catalysts for industrial reactions.
- Will be able to design appropriate methods for the preparation and characterization of inorganic solids.
- Will explore the electrical, magnetic, spectral and thermoelectric characteristics for proposing
- Will have knowledge on crystal structures.

REFERENCES

1. Anthony R West, “Solid state chemistry and its applications” 2nd Edition: Student edition, Wiley-Blackwell (2014).
2. B. Sivasankar, “Inorganic Chemistry”, Pearson Education (2013).
3. D.F. Shriver and P.W.Atkins, “Inorganic Chemistry”, 5rdEdn. Oxford University Press(2011).
4. F.A.Cotton, G.Wikinson, C.A.Murillo and M.Bochmann, “Advanced Inorganic Chemistry”,6th Edn. John Wiley and Sons (2003).
5. E. L. Mutteri, Polyhedral Boranes, Academic Press, NY, 1975.

CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	3	-	-	1
CO2	3	2	-	3	-	1
CO3	-	3	3	1	-	2
CO4	2	-	3	-	-	1
CO5	-	2	2	-	-	1
Avg	2.5	2.25	2.75	2	-	1.2

AC3303 **PHYSICAL CHEMISTRY - III** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the essential characteristics of wave functions and need for the quantum mechanics.
- To know the importance of quantum mechanical models of particle in a box, rigid rotor and harmonic oscillator.
- To familiarize the symmetry in molecules and predict the point groups.
- To predict the vibrational modes, hybridization using the concepts of group theory
- To understand the statistical approach of the functions and to compare the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein

UNIT I QUANTUM CHEMISTRY **9**

Introduction to quantum mechanics-black body radiation, photoelectric effect, hydrogen spectrum. Wave particle duality, Uncertainty principle, Standing waves, Particle wave and Schrodinger wave equation, wave function, Properties of wave function, Normalized, Orthogonal, orthonormal, Eigen values, Eigen functions, Hermitian properties of operators, Postulates of Quantum Mechanics, Schrodinger wave equation.

UNIT II QUANTUM MODELS **9**

Particle in a box-1D and three-dimensional, degeneracy, application to linear conjugated molecular system, Harmonic Oscillator-wave equation and solution, anharmonicity, force constant and its significance. Rigid Rotor-wave equation and solution, calculation of rotational constants and bond length of diatomic molecules.

UNIT III GROUP THEORY-I **9**

Symmetry elements; symmetry operations, Abelian group-point groups-determination of point group- Group multiplication table - Matrix representation of symmetry operations-Similarity transformations; Space groups of crystals-Mulliken symbols-reducible and irreducible representations; Symbols and rules of irreducible representations-reduction formula-direct product representation; Great orthogonality theorem; character table-construction of character tables.

UNIT IV GROUP THEORY-II **9**

Applications of group theory- Determination of representations of vibrational modes in nonlinear molecules such as water, ammonia, BF3, CH4 and XeF4.Determination of Hybrid orbitals in non-linear molecules – Examples: H2O, NH3, BF3, CH4 and XeF4. SALC procedure-evaluation of energies and molecular orbitals for systems like ethylene and butadiene. Selection rules for spectral transitions. Electronic spectra of formaldehyde and ethylene.

UNIT V STATISTICAL THERMODYNAMICS **9**

Objectives of statistical thermodynamics, Concept of distributions, Types of ensembles. Thermodynamic probability, Most probable distribution Law- Classical statistics-Maxwell Boltzmann (MB) statistics-Quantum statistics-Bose-Einstein (BE) and Fermi-Dirac (FD) statistics. Derivation of distribution function-MB, BE and FD statistics-comparison-Partition functions Translational, rotational, vibrational and electronic partition function –Calculation of thermodynamic parameters and equilibrium constants in terms of partition function; Debye and Einstein heat capacity of solids.

TOTAL: 45 PERIODS

OUTCOMES

- To have basic knowledge on the evolution of quantum chemistry and understand the postulates of quantum mechanics.
- To apply basic understanding of quantum mechanics to various models explaining the various energy levels in a molecule.
- To understand the basic concepts about group theory and its application in predicting the spectroscopic nature of molecules
- To apply basic understanding about group theory to various types of molecules and also its application in evaluating the molecular orbitals for various systems.
- To understand the basic concepts and laws of thermodynamics and to understand about various functions used in thermodynamics

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REFERENCES

1. R.K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi, 2010, 4th revised edition.
2. F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 2003, 2nd edition.
3. D.A. McQuarrie, Quantum Chemistry, Viva Books PW. Ltd, 2013, 2nd edition.
4. N. Levine, Quantum Chemistry, Allyn& Bacon Inc, 1983, 4th edition.
5. R.L. Flurry. Jr, Symmetry Group Theory and Chemical applications, Prentice Hall. Inc, 1980 5. J. M. Hollas, Symmetry in Molecules, Chapman and Hall, London, 2011, Reprint
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7. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, 1995.

CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	-	-	-	1
CO2	3	2	1	-	-	-
CO3	3	1	1	-	-	1
CO4	3	2	1	-	-	1
CO5	3	2	-	-	-	-
Avg	**3**	**1.6**	**1**	**-**	**-**	**1**

AC3304 MOLECULAR SPECTROSCOPY L T P C
3 0 0 3

OBJECTIVES

- To provide a basic idea of different electromagnetic regions and instrumentation of various modern spectrometers
- To acquire the skill to determine the functional groups present in unknown molecules using vibrational (IR) spectra and to calculate maximum (λmax) absorption of molecules in Electronic (UV-Visible) region using Woodward-Fischer rule
- To identify the magnetic properties of electrons and nucleus of atoms and free radicals, using spin angular momentum with the help of nuclear magnetic resonance and electron spin resonance spectra
- To identify and analyze the hyperfine interactions of nuclei present in a molecule
- To identify the unknown molecular formula of fragmented metastable ions of organic compounds.

UNIT I ELECTROMAGNETIC RADIATION AND ROTATIONAL SPECTROSCOPY 9

Characterization of electromagnetic radiation – regions of the spectrum - basic elements of practical spectroscopy– signal to noise ratio and resolving power - factors affecting line width and intensity - Microwave spectroscopy – Principle, Instrumentation and applications – rotation of molecules - determination of the bond length from rotational constants, Stark effect, selection rules, rotational spectra of polyatomic molecules.

UNIT II ABSORPTION SPECTROSCOPY 9

Infra-red spectroscopy - Principle, Instrumentation and applications –harmonic and anharmonic oscillators – Diatomic Vibrating Rotator - Vibrations of polyatomic molecules-Molecular vibrations, types of molecular vibrations. Fundamentals, overtones, combination bands and Fermi resonance-FT-IR- Raman spectroscopy –mutual exclusion principle - selection rules UV–vis spectroscopy – Principle, Instrumentation and applications, electronic transitions–solvent effects– Woodward's rule.

UNIT III NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY 9

Principle, Instrumentation and applications, Nuclear spin states and NMR active nuclei, nuclear magnetic moments -mechanism of Resonance absorption – population of nuclear spin states, - chemical shift - coupling– simplification of complex NMR spectra – ^{13}C NMR spectra – NOE effects, MRI, Solid state NMR.

UNIT IV ELECTRON SPIN RESONANCE SPECTROSCOPY/ PARAMAGANETIC RESONANCE SPECTROSCOPY AND MOSSBAUER SPECTROSCOPY 9

EPR: Principle, Instrumentation and applications, Electron spin -Electronic Zeeman effect – Presentation of the spectrum-EPR spectrum of hydrogen atom (first order treatment) - g factors -Hyperfine splitting -EPR spectra of organic radicals, heteronuclear compounds - McConnell's relation – zero field splitting –Kramer's degeneracy.

Mössbauer spectroscopy –Introduction, principle, instrumentation, magnetic hyperfine splitting - applications to ^{57}Fe, ^{119}Sn and ^{129}I compounds.

UNIT V MASS SPECTROMETRY 9

Mass spectrometry: Principles and techniques, types of ions and their role in structure determination, various ionization methods – EI, CI, ESI and MALDI methods, - effect of isotopes– nitrogen rule-determination of molecular formula – fragmentations and rearrangements - metastable ions– fragmentation of organic compounds.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course, the students will be able:

- To apply the theoretical knowledge of the various spectroscopic methods on the basis of the examples from the science and industry
- To recognize the modern spectrometers and methods, which are applied in industrial and scientific laboratories in the field of synthesis and structural determination
- Identify and use technologies/instrumentation to collect and analyze data
- To recognize basic light-matter interactions in molecules
- Quantitatively analyze absorption and scattering spectra of simple molecules, and extract the relevant molecular parameters.

REFERENCES

1. C.N. Banwell and E.M. McCash, "Fundamentals of molecular spectroscopy", 5th Edn., Tata McGraw Hill, New Delhi, 2006.
2. D.H. Williams and I. Fleming, "Spectroscopic methods in organic chemistry", 6th Edn., McGrawHill, New York, 2007.
3. E. Derome: Modern NMR Techniques for Chemical Research, Pergamon Press, 1987.
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5. H. Gunther, NMR Spectroscopy, Basic Principles, Concepts and Applications in Chemistry,3rd Edition, Wiley VCH, 2013.
6. J.A. Weil and J.R. Bolton,(Rds), "Electron Paramagnetic Resonance: Elementary Theory and Practical Applications", 2nd Edn., Wiley Interscience, John Wiley & Sons, Inc., 2007.
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13. James Keeler, Understanding NMR Spectroscopy, Wiley India Pvt. Ltd; 2nd Edn., 2013.

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CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	-	1
CO2	3	1	2	1	-	2
CO3	2	1	3	1	-	2
CO4	2	1	3	1	-	2
CO5	2	-	3	1	-	2
Avg	2.4	1.25	2.4	1	-	1.8

AC3311 PHYSICAL CHEMISTRY LABORATORY L T P C
0 0 12 6

OBJECTIVES

- To impart hands-on training on electrochemical analysis techniques.
- To make the students conversant with the experimental methods for kinetics and phase equilibria.
- To acquire the skills to determine the molecular weight of polymers.
- To make the student conversant in spectroscopic analysis.
- To enable the application of the theoretical principles to adsorption, optical property, thermal methods and molecular weight determinations.

UNIT I CONDUCTOMETRY 20

Equivalent conductance of strong electrolytes and verification of Debye-Huckel-Onsager equation. Basicity of an acid.Verification of Ostwald dilution law using weak acid and determination of its dissociation constant.Conductometric titrations – acid- base, mixed acid-base, precipitation titrations. Determination of critical micelle concentration

UNIT II POTENTIOMETRY AND pH-METRY 20

EMF measurement - Potentiometric titrations – red-ox and precipitation titrations; pH measurement, pH-metric titrations – acid-base reactions.

UNIT III KINETICS 20

Determination of order - acetone-iodine reaction; Study of primary salt effect on the kinetics of ionic reaction

UNIT IV HETEROGENEOUS EQUILIBRIA 20

Determination of CST in phenol-water system; Phase diagram of a ternary system-nitrobenzene–acetic acid–water or water- acetic.Two component solid solutions – eutectic formation, Transition Temperature determination.

UNIT V THERMODYNAMICS 20

Activity coefficients of weak or strong electrolyte by solubility method. Determination of activity coefficients of an electrolyte at different molalities.

UNIT VI SPECTROPHOTOMETRIC AND FLAME PHOTOMETRIC METHODS 10

Determination of molar absorptivity – verification of Beer-Lambert equation – Simultaneous estimation of Mn and Cr in solutions containing KMnO4 and K2Cr2O7. Photometric titration of Fe(III) by EDTA; Estimation of Na/K by flame photometer.

UNIT VII ELECTRO-CHEMICAL METHODS 20

Cyclic voltammetric (CV) studies of redox systems, Corrosion rate determination of materials using Tafel extrapolation method.

UNIT VIII OPTICAL METHODS 20

Polarimetry - Determination of sucrose content in cane sugar / cane juice Kinetics of hydrolysis of sucrose - effect of acid strength. Abbe's refractometer- Percentage composition of binary mixtures

UNIT IX ADSORPTION STUDIES 10

Verification of Freundich isotherm – adsorption of acetic acid, oxalic acid on carbon– determination of surface area of a solid by BET method.

UNIT X MISCELLANEOUS 20

Molecular weight of a polymer by viscometry, Demonstration experiments-TGA and DTA, Atomic absorption spectrometry, G.C, HPLC, TOC analyser, FT-IR spectrophotometer, X-Ray DiffractionSEM, NMR and GPC

TOTAL : 180 PERIODS

OUTCOMES:

- Will attain excellent experimental skills.
- Will have the capability to determine the corrosion rate.
- Will be able to apply the theoretical concepts in the lab.
- Will appreciate the importance of instrumental methods available for analysis.
- Will have the ability to operate various sophisticated instruments

REFERENCES:

1. B. Viswanathan and P.S. Ragavan, Practical Physical Chemistry, 1st Edn. Viva Books (P)Ltd., Chennai 2005
2. Khosla, A.Gulnti and V.C. Garg, Senior Practical Physical Chemistry, 7th Edn. S.Chand &Co., New Delhi 1994.
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5. V.D. Athawale and P. Mathur, Experimental Physical Chemistry, New Age International Publishers 2001.
6. Shailendra K. Sinha, Physical Chemistry- A Laboratory Manual, 1st Edn, Narosa Publishing House, New Delhi (2014).

CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	-	2
CO2	2	2	2	2	-	1
CO3	2	1	3	-	-	1
CO4	1	1	3	-	-	-
CO5	1	1	3	-	-	-
Avg	1.8	1.4	2.8	2	-	1.3

AC3001 INDUSTRIAL CATALYSIS L T P C
3 0 0 3

OBJECTIVES

- To provide basics of catalyst preparation and characterization techniques.
- To explain the principles and operations of catalytic reactors.
- To impart thorough knowledge on the environmental and industrial applications of catalytic processes.

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UNIT I INTRODUCTION TO CATALYSIS 9

Homogeneous and Heterogeneous catalysis- definitions - catalysts, kinetics, promoters and inhibitors, activation energy, catalytic activity, conversion, selectivity, contact time, TON, TOF, time on stream. Autocatalysis, phase transfer catalysis, enzyme catalysis, green catalysis - nano catalysis, photo catalysis-Porphyrins -phthalocyanines and semiconductor as photo catalysts in photolysis reactions - generation of hydrogen by photo catalysts - photocatalytic break down of water and harnessing solar, acid-base catalysis.

UNIT II CATALYST PREPARATION, ACTIVITY AND CATALYTIC REACTORS 9

Synthesis of micro porous and meso porous materials (Sol-gel, Hydrothermal, Solvothermal, Co-precipitation, Impregnation, Adsorption and Ion-exchange methods), Reactors: batch reactor, flow reactor, trickle bed and fluidized bed and high pressure down flow reactor. Poisons, fouling, coking, attrition, sintering of catalysts - Pore mouth plugging and uniform poisoning models - catalyst regeneration.

UNIT III CATALYST CHARACTERIZATION 9

Characterization of solid catalysts: Surface area - structure - surface morphology - porosity - pore volume - diameter - particle size - X-ray diffraction - SEM, TEM, X-ray absorption spectroscopy, XPS and Auger spectroscopy to surface studies - TPD, TPR for acidity and basicity of the catalysts.

UNIT IV ALTERNATIVE FEEDSTOCK OPTIONS FOR PETROCHEMICALS 9

Crude oil distillation/separation, Catalysts and process for high quality fuels: Hydro treating, hydrodesulphurization, Hydrodenitrogenation- Hydrodeoxygenation and hydrodemetallation. Hydrocracking, reforming, alkylation and isomerization. Renewable resources; categorization of resources; chemicals from edible renewable resource; Chemicals from non-edible renewable resources; alternate fuels; fuels derived from renewable resources; biodiesel, bioethanol, biobutanol; Hydrogen generation from renewable feed stocks, Alternate Options; from Refineries sources, Natural Gas/Methane as an Option and other Non Refinery sources, CO_2 utilization.

UNIT V BIOMASS CONVERSION 9

Feed stock – Gasification, pyrolysis, liquefaction, pre-treatment and hydrolysis, transesterifcation, de-etherification - lignocellulosic biomass conversion - JP-8 fuel production - selective oxidation/reduction reactions. Catalysis in the utilization of renewable feedstocks and concepts of sustainable chemistry.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Will have in-depth knowledge about the catalyst available and their application.
CO2: Will know the characterization techniques.
CO3: Will be able to define conditions of catalytic activity in the industrial environment.
CO4: Will have the knowledge about industrial biomass conversion process.
CO5: Will attain a brief knowledge about petroleum and its refining processes.

REFERENCES

1. J.D. Burrington “Industrial Catalysis: Chemistry And Mechanism”, World Scientific Publishing Company, 2016.
2. Jens Hagen “Industrial Catalysis: A Practical Approach” 3rd Edition by, Wiley-VCH, 2017.
3. B. Viswanathan, S.Sivashankar, A.V.Ramaswamy, “Catalysis: Principles And Applications”, Narosa Pub, 2020.
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6. B. Viswanathan, S. Kannan, R.C. Deka, “Catalysts & Surfaces: Characterization Techniques”, Alpha Science International, 2010.

CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	-	1	-	2
CO2	-	1	3	-	-	1
CO3	-	1	-	4	-	2
CO4	1	3	1	-	-	1
CO5	-	2	2	1	1	-
Avg	**1**	**2**	**2**	**2**	**1**	**1.5**

AC3002 BIO-ORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge about structure and functions of proteins, nucleosides and nucleic.
- To make the students conversant with biomolecular cell structures and functions.
- To make the students conversant with biomacromolecules and their interactions.
- To make the students aware of enzymes, lipids and membranes.
- To facilitate correlation between the properties of biomolecules and bioenergetics.

UNIT I CELL STRUCTURE AND FUNCTION 9

Cell structure and function: Molecular logic of living matter, Origin of biomolecules, cell structure–structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells.

UNIT II INTRODUCTION TO BIOMOLECULES 9

Introduction to biomolecules: Examples of biomolecules, building blocks of biomacromolecules, Nature of biomoleculear interactions. Types of reactions occurring in cells.

UNIT III PROTEINS, NUCLEOSIDES AND NUCLEIC ACIDS 9

Proteins, Nucleosides and nucleic acids: Primary structure of proteins, end group determination, secondary structure of proteins tertiary structure, oligomeric proteins, ribonucleotides and deoxyribonucleotides, RNA and DNA, Base pairing, double helical structure of DNA and genetic code, transcription, Ribosomes.

UNIT IV ENZYMES LIPIDS AND MEMBRANES 9

Enzymes lipids and membranes: Enzymes categorization catalysis, kinetics–single substrate enzyme catalysed reactions, Inhibition, common class of lipids, self-association of lipids, Formation of micelles, membranes, bilayer and hexagonal phases. Membrane bound proteins structure, properties and transport phenomena.

UNIT V BIOENERGETICS 9

Bioenergetics: Basic principles, glycolytic pathways, Kreb's cycle, oxidative phosphoylation, hydrolysis of esters and amids, C–C and C=C bond formation, oxidation, reduction, decarboxylation, biomimetic reactions, drug design.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Will have the knowledge about proteins, nucleosides
CO2: Will understand about product recovery and purification operations in industries.
CO3: Will gain the knowledge of microbial processes, their kinetics and action in general.
CO4: Will be familiar with concepts of bio-process principles and enzyme technology.
CO5: Will be familiar with enzymes, lipids membranes and nucleic acids.

Attested

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REFERENCES

1. A.L. Lehninger, Biochemistry: The molecular Basis of cell structure and function, Worth Publishers (1982).
2. D.E. Metzier, Biochemistry – The chemical reactions of a living cell, Volume 2, 2nd Edn, Academic Press (2003).
3. H. Dugas, Bio organic Chemistry, A. Chemical approach to enzyme action, 2nd Edn. Springer, Verlay (1989).
4. Lehninger, Nelson, and Cox, Principles of Bio chemistry, 2nd Edn. CBS Publishers, (1993).
5. R.J. Simond, Chemistry of Biomolecules, Royal Society of Chemistry, U.K. London (1992).

CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	-	-	-	1
CO2	1	-	3	-	-	1
CO3	1	1	2	-	-	-
CO4	1	2	3	-	-	1
CO5	-	2	3	-	-	1
Avg	1	1.75	2.75	-	-	1

AC3003 BIO-PROCESS TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- To facilitate the understanding of bioprocess principles and enzyme technology.
- To make the student conversant with the microbial processes, product recovery and purification operations in industries
- To be acquainted with fundamentals of bioreactor and their types.
- To be proficient in product recovery and purification operations.
- To make the student abreast with bioprocess and enzyme technology.

UNIT I BIOPROCESS PRINCIPLES 9

Bioprocess principles – components and objectives; microorganisms – bacteria, yeasts andmolds, animal and plant cells – cell structure, biomolecules, cellular organization, metabolic processes, stoichiometry and energetics elementary aspects of molecular genetics.

UNIT II ENZYME TECHNOLOGY 9

Enzyme technology – classification of enzymes, enzyme activity; kinetics of enzyme catalysis; modulation and regulation; immobilization of enzymes; applied enzyme catalysis.

UNIT III MICROBIAL PROCESSES 9

Microbial processes – bacterial and yeast strains for industrial processes; fermentation – aerobic and anaerobic fermentation; fundamentals of bioreactors– types – batch, fed-batch and CSTR; substrate utilization, product formation and bio-oil production.

UNIT IV PRODUCT RECOVERY AND PURIFICATION OPERATIONS 9

Product recovery and purification operations–principles of filtration, centrifugation, cell disruption, extraction, adsorption, precipitation, membrane separation, chromatographic and affinity technique.

UNIT V BIOPROCESSES AND ENZYME TECHNOLOGY IN INDUSTRIES 9

Bioprocesses and enzyme technology in industries-fuel generation ethanol and methane production; industrial enzymes; food production and processing-SCP, fermented foods, and beverages, dairy products, vegetable fruit products-pharmaceuticals – antibiotics and monoclonal antibodies.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Will be familiar with concepts of bioprocess principles and enzyme technology.
CO2: Will gain the knowledge of microbial processes, their kinetics and action in general.
CO3: Will understand product recovery and purification operations in industries.
CO4: Will know about purification operations in product separation.
CO5: Will have the ability to generate fuel from enzyme bioprocesses.

REFERENCES

1. B. Sivasankar, "Bioseparations – Principles and Techniques", 5th Edn., PHI Learning Private Limited, (2009).
2. B. Sivasankar, "Food Processing and Preservation", 7thEdn. PHI Learning Private Limited, (2010).
3. B. Sivasankar, "Instrumental Methods of Analysis", 1st Edn., Oxford University press, (2012).
4. J.E.Bailey and D.F.Ollis, "Biochemical Engineering Fundamentals", McGraw Hill Book Co., (1986).
5. Michael L. Shuler and FikretKargi, "Bioprocess Engineering Basic Concepts", PHI, 2nd Ed., (2005).

CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	-	-	-	1
CO2	-	1	3	-	-	1
CO3	-	1	3	-	-	2
CO4	1	1	2	-	-	-
CO5	1	3	-	2	1	2
Avg	1.3	1.5	2.6	2	1	1.5

AC3004 CHEMICAL PROCESS EQUIPMENT AND INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES

- To provide basic understanding of chemical reactor.
- To familiarize the students with equipments.
- To expose the students about measuring devices.
- To impact knowledge on physical properties.
- To make the conversant with computer instrumentation.

UNIT I CHEMICAL REACTOR 9

Chemical reactors – Batch reactor – Flow reactor – fixed bed,fluidized bed and slurry reactor –fluid moving machinery – pumps – blowers – compressors.

UNIT II PROCESS EQUIPMENT 9

Storage vessels – humidification – cooling towers .Agitation – Mixing – Industrialdriers, crystallisers, absorbers. Extractors – Absorbers – Distillation – Extractive distillation.

UNIT III MEASURING DEVICES **9**

Industrial measurement of temperature – pressure – level – flow – humidity – density – pH – characteristics of measuring devices – concepts of automatic control recorders.

UNIT IV PHYSICAL PROPERTIES **9**

Measurement of physical parameters like surface tension –viscosity – melting point – Boiling point – optical rotation – Refractive Index – Thermal properties – molecular wt determination.

UNIT V COMPUTER INSTRUMENTATION **9**

Elements of analogue and digital computers – computer instrumentation interfacing – microprocessor – controlled instruments – outlines of on-line and automatic analyzers.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Will have a basic understanding of the engineering concepts involved in the chemical industry.
CO2: Will familiar the process equipment
CO3: Knows the importance of heat and mass transfer in the industrial operations.
CO4: Can associate the reactions that one has already learnt with the actual process in the industry.
CO5: Aquire knowledge in computer in instrumentation

REFERENCES

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4. Richard M. Felder Ronald W. Rousseau "Elementary Principles of Chemical Processes", 3rd Update Edition. John Wiley and Sons, (2005).
5. Scott Fogler. H**, "**Elements of Chemical Reaction Engineering", 5th Edition, Prentice Hall,(2016).

CO-PO Mapping

COs	Pos					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	3	-	-	-	-
CO2	-	2	1	-	-	1
CO3	-	3	-	-	-	1
CO4	-	1	-	2	-	1
CO5	1	1	2	-	-	1
Avg.	**1**	**2**	**1.5**	**2**	**-**	**1**

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AC3005 **PHARMACEUTICAL CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

- To make the student conversant with the principles of drug design.
- To impart knowledge on the role of chemistry in clinical process
- To provide basic knowledge on the preparation and pharmaceutical properties of classes ofdrugs such as, antibiotics, antibacterial agents.
- To provide knowledge base on the importance of synthesis of anesthetics and its effects to the health
- To familiarize the students with drug discovery process through enzyme inhibition method

UNIT I DRUG DESIGN **9**

Drug discovery: Stages of drug discovery, lead discovery, identification, validation and diversity of drug targets. Drug designing - Factors governing drug design – drug design through disjunction and conjunction – molecular hybridization - rigidity and flexibility vs drug design – tailoring of drugs. Factors governing ability of drugs to reach active sites (ADME pathway). Stereochemistry and drug action.

UNIT II CLINICAL CHEMISTRY **9**

Determination of sugar (glucose) in serum – Folin and Wu's method, Nelson – Somogyi method, O-toluidine method – determination of Serum cholesterol – Sackett's method – Esitmation of glucose in urine –Diagnostic test for salts in urine and serum – Estimation of haemoglobin – Estimation of RBC.

UNIT III ANTIBIOTICS AND ANTIBACTERIALS **9**

Antibiotics - penicillin, D-pencillamine, Phenoxy methyl pencillin –chloramphenicol-Antibacterials - norfloxacin, ciprofloxacin, Trimethoprim sulphadrugs – mode of action – preparation of sulphanilamide, sulphadiazine, sulphathiazole, sulphapyridine, sulphadimidine, sulphagauidine, sulphamethoxazole Antifungals – action, use and synthesis of clotrimazole, micronazole, Isoconazole.

UNIT IV ANESTHETICS **9**

General anesthetics – classification –inhalation anesthetics, intravenous anesthetics and basal anesthetics – mode of action – mechanism of action of nitrous oxide and halothane.Local anesthetics – classification – chemical considerations of local anesthetics – mode of action of lidocain and prelocain hydrochloride.

UNIT V DRUG DISCOVERY VIA ENZYME INHIBITION **9**

Enzyme inhibition, enzyme inhibition vs. new drugs – classification of enzyme inhibitors – mechanism of reversible inhibition – simple competitive inhibitors – humoral mechanism for hyper tension – dual acting drugs – lead discovery and modification – mechanism of action – drug resistance and synergism.

TOTAL: 45 PERIODS

OUTCOMES

CO1: To be familiar with principles of drug design.
CO2: To understand the various clinical methods used for biological systems.
CO3: To be gain the knowledge of preparation and pharmaceutical properties of various drugs.
CO4: To be acquainted with antibiotics and antibacterial agents and its uses
CO5: To know the importance of enzyme inhibition in drug discovery process

REFERENCES

1. Asutoshkar, "Medicinal Chemistry", Wiley Eastern Ltd., Chennai, (2010).
2. Bentely and Driver's, "Textbook of Pharmaceutical Chemistry", Oxford Univ. Press., (1985).
3. Berger, A. "Medicinal chemistry", Vol 1&2, Wiley Interscience, New York, (1990).
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5. D.Cairns, Essentials of Pharmaceutical Chemistry, 4th edition, Pharmaceutical press (2012)
6. H.J Roth, A. Kleemann, "Pharmaceutical chemistry", vol.1, Drug synthesis, (2001).
7. Jayashree ghosh " A textbook of PHARMACEUTICAL CHEMISTRY" (2010)

CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	3	-	-	2	1
CO2	2	2	3	-	2	1
CO3	1	2	2	-	-	1
CO4	1	-	1	-	-	-
CO5	1	-	2	-	-	-
Avg.	1.25	2.3	2	-	2	1

AC3006 ENVIRONMENTAL CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To introduce the basic concepts of chemistry usedin environmental studies and the causes of pollution.
- To impart knowledge on the applications of environmental chemistry in managing environmental problems related to atmosphere.
- To create awareness of the current environmental issues and toxic effects on plants and animals.
- To familiarize the analytical and characterization methods adopted for air, water and soil based on the standard methods like APHA, NAAQS etc. to know their discharge limits.
- To inculcate the various applications of treatment systems for pollutant removal in different streams such as air, water and soil.

UNIT I CHEMISTRY AND THE ENVIRONMENT 9

Chemistry and the environment - environmental pollution - causes of pollution - Environmental fate of pollutants - environmental fate of organic pollutants-octanol/water partition coefficient-Carbon-normalised sorption coefficient - Environmental chemistry of Colloids and Surfaces —Electrical double Layer theory- Electrostatic precipitation – Specific adsorption – Redox process- pH – pE – Diagrams.

UNIT II ATMOSPHERIC CHEMISTRY 9

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, – Acid rain- origin and composition of particulates. Air quality standards-sampling of air pollutants.

UNIT III TOXIC EFFECTS OF POLLUTANTS 9

Toxic effects of pollutants - toxicity - carcinogenicity - mutagenecity- teratogenicity - Classification of metals (Speciation) - biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur dioxide, ozone and pan, cyanide, pesticides, asbestos.

UNIT IV POLLUTANT ANALYSIS 9

Water pollution - water quality parameters-Significance and monitoring - turbidity, colour, pH, alkalinity, solids, hardness, chlorides, DO, BOD, COD, nitrogen –Analysis of air pollutants-In-Situ ozone and carbondioxide, Pararosaniline spectrophotometric method for SO_2determination – Monitoring particulate emissions by XRF spectrometry- Soil pollution –heavy metals by x-ray fluorescence-Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

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UNIT V REMEDIATION CHEMISTRY 9

Water pollution-municipal wastewater treatment-chemical coagulation-ASP-activated carbon filters- Membrane separation processes – capillary flow model – solution diffusion moderetention coefficient – Factors affecting membrane processes – Pervaporation –Air pollution control measures-solid waste management-segregation-landfill-incineration.

TOTAL: 45 PERIODS

OUTCOMES

CO1: To gain competency and understanding the significance of chemical reactions in environmental problems and solutions.
CO2: To identify the atmospheric pollutants and air pollution monitoring.
CO3: To identify the environmental issues and identify the solutions based on theoretical knowledge.
CO4: To perform the suitable technique for the analysis of wastewater and spectroscopic technique for heavy metal analysis.
CO5: To recognize the application of various treatment systems in context with different streams of pollution.

REFERENCES

1. A.K. De, Environmental Chemistry, 7th Ed, New age International 2010.
2. Sawyer and McCarty, Chemistry for Environmental Engineering and Science, 5th Ed, TataMcGraw-Hill, 2017.
3. James E. Girard, Pr inciples of Environmental Chemistry, Jones and Bartlett Publishers, 2ndEd., 2005.
4. Stanley E. Manahan, Environmental Chemistry, Ninth Edition, CRC Press (2009)

CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	3	-	1
CO2	2	-	2	3	-	2
CO3	2	-	1	3	-	-
CO4	1	1	3	1	1	1
CO5	1	-	3	-	-	2
Avg.	1.8	1	2.2	2.5	1	1.5

AC3007 CHEMISTRY OF NANO-MATERIALS L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge to the students on nanotechnology and types of synthesis.
- To aculeate the size dependence property of nanomaterials with diff synthetic troubles.
- To make the student conversant with the nanotube, nanowires, and nanocomposites.
- To comprehend the synthesis with the fabrication of nanostructured materials.
- To familiarize the student with applications of nanomaterials instrumentation.

UNIT I INTRODUCTION TO NANOSCIENCE 9

Nanoscience–scope and emerging trends-bottom-up and top-down approaches; chemistry of solid surfaces–surface energy –the chemical potential of curved surfaces; assembly of nanomaterials different types of nanomaterials- carbon nanostructure.

UNIT II SYNTHESIS AND CHARACTERISATION OF NANOPARTICLES 9

General methods of synthesis of zero-dimensional nanoparticles –homogeneous nucleation and heterogeneous nucleation, growth of nuclei, size control; synthesis and properties of metallic, semiconductor and metal oxide nanoparticles and characterisation techniques.

UNIT III NANOTUBES: SYNTHESIS AND NOVEL PROPERTIES OF NANOMATERIALS 9

Nanotubes -carbon nanotubes, fullerene, BNNT – synthetic methods; Chemical properties hybridization, solubility, stability and functionalization; physical properties-optical, mechanical, magnetic, dielectric, origin of plasmon band, Mie theory, the influence of various factors on the plasma absorption; catalytic and electrical properties, quantum size effects, Inorganic nanotubes– synthesis and properties.

UNIT IV NANOWIRES AND NANOCOMPOSITES 9

One-dimensional Nanowires and nanorods, two-dimensional thin films, nano composites and nano-structured polymers, nano catalysts, nano clusters, quantum well, dots and wire– preparation and properties.

UNIT V APPLICATIONS OF NANO MATERIALS 9

Physical techniques for fabrication of nanostructures – photolithography, electron beam lithography and related techniques – Applications of nanomaterials in catalysis, sensors, medicine, electronics, solar and optoelectronic devices.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Will be aware of the synthetic methods of nanomaterials.
CO2: Will be familiar with nanotube, nanowires and nanocomposites.
CO3: Will interact nanotechnologies in various fields where nanotechnology can be applied.
CO4: Will acquaint information of nanoscience of nonmaterial.
CO4: Will be able to correlate the influence of size and the properties of nano materials.

REFERENCES

1. Frank J.Owens, Charles P.Poole Jr “The physics and chemistry of nanosolids”, Wiley-Interscience, 2008.
2. G.B. Sergeev “Nanochemistry”, Elseveir, 2010.
3. C.N.Rao, A. Muller, A.K. Cheetham “Nanomaterials Chemistry”, Wiley-VCH, 2005.
4. G.A. Ozin, A.C. Aresnault, L. Cadematriri “Nanochemistry: A chemical approach to nanomaterials”, RSC Publishing, 2008.
5. G. Cao “Nanostructures and Nanomaterials- Synthesis, Properties and Application” , Imperial College Press, London, 2004.
6. Liming Dai “Carbon Nanotechnology”, Elsevier, 2006.

CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	-	1	2
CO2	-	2	3	-	-	2
CO3	-	2	3	-	-	2
CO4	-	2	2	-	-	2
CO5	-	2	2	-	-	2
Avg	**1**	**2**	**2.4**	**-**	**-**	**2**

AC3008 CORROSION AND CORROSION CONTROL L T P C
3 0 0 3

OBJECTIVES

- To make the student understand the types and mechanism of corrosion.
- To impart knowledge to students on various forms of corrosion
- To familiarize the student with corrosion testing methods.
- To make students be familiar with the factors influencing corrosion process
- To update the students on latest coating techniques.

UNIT I BASICS OF CORROSION 9

Causes and effects of corrosion- Acid theory, Chemical theory- oxidation - direct atmospheric effect - electrochemical corrosion theory - hydrogen evolution - presence and absence of oxygen - corrosion by gaseous reduction.

UNIT II FACTORS INFLUENCING CORROSION 9

Nature of metal - overvoltage - areas of anodic / cathodic - purity of metal - physical state of metals - passive nature of metal - solubility - volatility of corrosion products - corroding environment - influence of pH - ions - formations of cells - polarization of electrodes.

UNIT III FORMS OF CORROSION 9

Uniform corrosion-galvanic bimetal corrosion - differential aeration corrosion - concentration cell corrosion - erosion corrosion - pitting corrosion - underground soil corrosion - intergranular corrosion - stress corrosion - seasonal cracking of alloys - caustic embrittlement - corrosion fatigue - bio fouling - microbiologically influenced corrosion (MIC).

UNIT IV CORROSION TESTING AND MONITORING 9

Potential measurement - electrochemical series - redox reactions- Pourbaix and Evans diagrams- ASTM(G1-90) for Preparing and Cleaning the test Specimens- ASTM for potentiodynamic polarization methods, Tafel extrapolation, anodic polarization, cyclic Polarization, polarization resistance- electrochemical impedance spectroscopic technique- Scanning electrochemical microscopic studies.

UNIT V CORROSION CONTROL 9

Design - selection of materials - pure metals and alloys - annealing - elimination of galvanic action - modification of environment - inhibitors - preparation of materials for coating - metallic and non-metallic - protective coatings - physical vapor deposition - chemical vapor deposition-anodic oxidation - plasma nitriding - plasma spray coating - thermal spray coating - organic coatings - paints**.**

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, the student will be able :

CO1: To describe the basics of corrosion theories
CO2: To understand the various factors that influence corrosion
CO3: To comprehend the different forms of corrosion
CO4: To analyze the corrosion test methods as per ASTM standards
CO5: To suggest suitable corrosion protection methods for various environments

REFERENCES

1. M. G. Fontana, Corrosion Engineering, Third Edition, Tata McGraw Hill Edition, New York (2005).
2. R. Winston Revie, UHLIG's Corrosion Handbook, 3rd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey (2011).
3. E. Mc Cafferty, Introduction to Corrosion Science, Springer, New York (2010).
4. Robert G. Kelly, John. R. Scully, David W. Shoe smith, Rudolph G. Buchheit, Electrochemical Techniques in Corrosion Science and Engineering, CRC Press, Taylor & Francis Groups, Brocken Sound parkway NW, Suite (2003).
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CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	-	-	-	-
CO2	2	1	2	2	-	1
CO3	1	1	2	-	-	1
CO4	1	1	3	2	-	2
CO5	1	2	3	3		1
Avg	1.4	1.4	2.5	2.3	-	1.25

AC3009 INDUSTRIAL ELECTROCHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge about the general principle and processes in chloralkali industry.
- To provide overall information on the processes, practices and significance ofelectrochemical operations in industries.
- To familiarize the students about metal finishing techniques.
- To make the student conversant in electro synthesis.
- To provide comprehensive knowledge about industrial electrochemical processes.

UNIT I CHLORALKALI INDUSTRY 9

General concepts of brine electrolysis – modern cell technologies – diaphragm cell process – Nelson cell – Hooker's cell. Mercury cell process – Castner and Kellner cells – Kellner Solvay cell - De Nora cell – membrane cell process. Processing - Chlorine and hydrogen.

UNIT II ELECTROMETALLURGY 9

Introduction to Metal extraction and refining – Electrowinning –Limitations of electrowinning - Electrowinning of aluminum, sodium, lithium and magnesium – Electro refining – aqueous and molten salt electro refining- Hydrometallurgical processes – Advantages and Disadvantages.

UNIT III METAL FINISHING 9

Pretreatment – conversion coatings – phosphating – types –methods – properties and influencing factors – evaluation and testing – applications – anodizing – principle – applications. Electroplating – objectives – theory – method – electroplating of nickel (only) – electroless plating – galvanizing – tinning.

UNIT IV ELECTRO SYNTHESIS 9

Electrosynthesis of inorganic compounds – fluorine – KMnO4 -- K2Cr2O7 – Cuprous Oxide – Manganese dioxide – Sodium and Potassium per Chlorates- Sodium hypochlorite –. Electrosynthesis of organic compounds – Hydromerisation of acrylonitrile – Monsanto process- Anthraquinone.

UNIT V INDUSTRIAL ELECTROCHEMICAL PROCESSES 9

Water treatment and environmental protection – metal ion removal and metal recovery – electro-filtration of particulates from gases – electro dialysis – desalination – electro flotation.

TOTAL: 45 PERIODS

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OUTCOMES

CO1: Will know about the general principle and processes in chloralkali industry.
CO2: Will be familiar about the electrometallurgical process
CO3: Will have basic information on the processes, practices and significance of electrochemical operations in industries.
CO4: Will have the ability to synthesize organic and inorganic chemicals by applying electric current.
CO5: Will be able to develop formulations for corrosion protection of metals.

REFERENCES

1. B. K. Sharma, Industrial Chemistry, Goel Publishing House, New Delhi (2014).
2. C.Rajagopal and K. Vasu, Conversion Coatings, 1st Edn. Tata McGraw Hill, New Delhi (2000).
3. D Pletcher,F.C.Walsh Industrial electrochemistry, Chapman and Hall, London (1990).
4. I. Konstantin, Popov, S. Stojan, Djokic and B. N. Grgur, Aspects of Electrometallurgy, KluwerAcademic Publishers, New York (2002).
5. John O'M. Bockris, Comprehensive Treatise of Electrochemistry Vol. 2., Electrochemical
6. processing, Plenum Press (1981).

CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	1	-	2
CO2	1	2	2	-	-	1
CO3	-	1	-	2	-	2
CO4	1	2	2	1	-	2
CO5	1	2	2	2	1	1
Avg	1.25	1.6	2.5	1.5	1	1.6

AC3010 WATER AND WASTEWATER TREATMENT L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on water pollution and wastewater treatment.
- To provide basic under standings about the requirements of water, its preliminary treatment.
- To make the student conversant with the water treatment methods in industries
- To impart knowledge on adsorption and advance oxidation process for wastewater treatment
- To know the students about Sludge handling and disposal.

UNIT I REQUIREMENTS OF WATER AND PRELIMINARY TREATMENT 9

Water Quality-Physical, chemical and biological parameters of water- Water quality requirement Potable water standards -Wastewater effluent standards -Water quality indices. Water urification systems in natural systems-Physical processes-chemical processes and biological processes-Primary, Secondary and tertiary treatment-Unit operations-unit processes.Mixing, Clarification - Sedimentation; Types; Aeration and gas transfer – Coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids- transport of colloidal particles, Clariflocculation.

UNIT II INDUSTRIAL WATER TREATMENT 9

Filtration – size and shape characteristics of filtering media – sand filters hydraulics of filtration – design considerations – radial, upflow, highrate and multimedia filters, pressure filter. Water softening – lime soda, zeolite and demineralization processes – industrial water treatment for boilers.

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UNIT III TREATMENT METHODS **9**

Taste and odour control – adsorption – activated carbon treatment – removal of color – iron and manganese removal – aeration, oxidation, ion exchange and other methods – effects of fluorides –fluoridation and defluoridation –desalination - corrosion prevention and control – factors influencing corrosion – Langelier index – corrosion control measures.

UNIT IV WASTEWATER TREATMENT **9**

Wastewater treatment – pre and primary treatment – equalization neutralization – screening and grid removal – sedimentation – oil separation gas stripping of volatile organics – biological oxidation – lagoons and stabilization basins – aerated lagoons – activated sludge process –trickling filtration – anaerobic decomposition.

UNIT V ADSORPTION AND OXIDATION PROCESSES **9**

Chemical process – adsorption – theory of adsorption – ion exchange process – chemical oxidation – advanced oxidation process – sludge handling and disposal – miscellaneous treatment processes.

TOTAL: 45 PERIODS

OUTCOMES

CO1: To gain idea about various methods available for water treatment.
CO2: To appreciate the necessity of water and acquire knowledge of preliminary treatment.
CO3: To identify the physical and chemical properties of wastewater.
CO4: To familiar with the steps involved in wastewater treatment process.
CO5: To have knowledge about adsorption and oxidation process.

REFERENCES

1. W. Wesley Eckenfelder, Jr. - Industrial water pollution control, 2nd Edn., McGraw Hill Inc (1989).
2. C.S. Rao – Environmental pollution control engineering, Wiley Eastern Ltd. (1994).
3. S.P. Mahajan – Pollution control in process industries, Tata McGraw Hill Publishing Company Ltd. (1994).
4. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous – Environmental Engineering, McGraw-Hill Inc. (1985).
5. M. Lancaster, Green Chemistry: An Introductory Text, 2nd edition, RSC publishing (2010).
6. Metcalf & Eddy – Wastewater engineering, 3rd ed., McGraw Hill Inc. (1991).

CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	3	3	-	1
CO2	-	1	3	3	-	-
CO3	1	2	3	2	-	-
CO4	2	1	3	-	-	1
CO5	-	1		-	-	1
Avg.	1.5	1.4	3	2.6	-	1

AC3011 BIOMATERIALS **L T P C**
3 0 0 3

OBJECTIVES

- To understand the definition, classification and general applications of biomaterials.
- To know the properties and applications of metals, metallic alloys and ceramic biomaterials.
- To perceive the properties of dental composites.
- To learn about the clinical study of soft polymers, biocompatibility and blood compatibility of polymers.
- To realize the importance of In vitro and In vivo testing of biomaterial

UNIT I INTRODUCTION TO BIOMATERIALS 9

Biomaterials, types of biomaterials- biocompatibility- biological materials- biodegradable materials – bioresorbable materials , biointert materials, bioacative material, pyrogenicity, minimum requirements of biomaterials, surface properties of biomaterials, desirable properties of biomaterial, applications of biomaterials with examples.

UNIT II METALS, METALLIC ALLOYS & CERAMICS 9

Stainless Steel, Titanium & Titanium Alloys, cobalt based alloys, nitinol, ceramics introduction to bio medical usages-bonding natural tissue. bio-active glass, high density alumina , calcium phosphate ceramics-porous materials, biological interactions, dental ceramics-high strength materials-thermal expansions, fracture toughness. drug delivery from ceramics. wet chemical synthesis.

UNIT III COMPOSITE BIOMATERIALS 9

Soft Composites, dental composites, saline, coupling agents, microfield materials, white –light systems bonding to teeth. clinical trials, synthesis of fillers, matrix resins, mechanical & physical evaluation.

UNIT IV POLYMERIC BIOMATERIALS 9

Polymerization, polyethylene, prosthodontic polymers, clinical study of soft polymers, bioerodible polymers, blood compatible polymers, bioactive polymers, hydrogels, hard methacrylates, drug incorporation polymer gels, biocompatibility of polymers-blood compatibility improvement, compatibility evaluation.

UNIT V TESTING OF BIOMATERIALS 9

Biocompatibility, blood compatibility, tissue compatibility test, toxicity test, sensitization, carcinogenicity, mutagenicity and special test, Invitro and Invivo testing, sterilization of implants: gamma radiation and autoclaving.

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, the student will be able to:

CO1: Identify different types of Biomaterials, classification, properties and applications of biomaterials.
CO2: Analyse the significant gap required to overcome challenges and further development in metallic and ceramic materials.
CO3: Recognise the dental composites bonding to teeth and their physical evaluation.
CO4: Investigate the different types polymers in medical field and their biocompatibility.
CO5: Understand the biocompatibility, toxicity and carcinogenicity of biomaterials.

REFERENCES

1. Sujata V. Bhatt, Biomaterials, Narosa Publishing House, New Delhi, 4th Edition, 2010
2. Joon Park and R. S. Lakes, Biomaterials: An introduction, Third edition, Springer New York, NY, 2010
3. J.B. Park and J.D. Bronzino. Biomaterials: Principles and Applications, Ist Edition, CRC Press, 2002
4. Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O.Soboyejo, “Biomaterials: A Nano Approach”, CRC Press, 2010.
5. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. “Implant biomaterials: A comprehensive review”, World Journal of Clinical Cases, 2015.

CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	1	2	1	2
CO2	1	3	2	1	-	3
CO3	2	3	2	-	-	2
CO4	1	2	3	3	-	2
CO5	1	2	3	2	3	1
Avg.	1.4	2.6	2.2	2	2	2

AC3012 **FORENSIC CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the possibilities of explosion, different types of detectors, analysis of body parts and cranial analysis
- To impart knowledge on the various contaminants in food and neutron analysis for poison detection.
- To understand the accidents caused by drunk and drive, techniques to detect and defuselive bomb and pain analysis.
- To familiarize the methods to detect forgery cases in cheques, currency notes and purity of expensive ornaments by employing various analysis.
- To understand briefly about AIDS and the concepts of procedures in plastic surgery using chromatographic techniques.

UNIT I CRIME DETECTION **9**

Accidental explosions during manufacture of matches and fire-works (as in Sivakasi). Human bombs, possible explosives (gelatin sticks,RDX). Metal detector devices and other security measures for VVIP. Composition of bullets and detection of powder burns.Scene of crime: finger prints and their matching using compuetr records. Smell tracks and policedogs. Analysis of blood and other body fluids in rape cases.Typing of blood. DNA fingerprinting for tissue identification in disembered bodies.Blood stains on clothing. Cranialanalysis (head and teeth).

UNIT II FOOD ADULTRATION **9**

Contamination of wheat, rice, dhal, milk, butter, etc. With clay, sand, stone, water and toxic chemicals (e.g. Kasseri dhal with mentanil yellow). Food poisons: natural poisons (alkaloids, nephrotoxins), pesticides (DDT, BHC, Follidol),Chemical poisons (KCN). First aid and Antidotes for poisoned persons.Heavy metal (Hg, Pb, Cd) Contamination of Sea food. Use of neutron activation analysis indetecting poisoning (e.g., As in human hair)

UNIT III TRANSPORTAION **9**

Drunken driving: brath analyzer for ethanol. Incendiary and timed bombs in road and railway tracks. Defusing live bombs. Hit -and-go traffic accidents : paint analysis by AAS. Soill of toxic and coorosivechemicals (e.g., conc.acids) from tankers.

UNIT IV FORGERY AND COUNTERFEITING **9**

Detecting forgery in bank cheques / drafts and educational records (mark lists, certificates), using UV-light. Alloy analysis using AAS to detect counterfeit coins. Checking silverline wter mark in currency notes.Jewellery : detection of gold purity in 22 carat ornaments, detecting gold plated jewels,authenticity of diamonds (natural, synthetic, glassy).

UNIT V MEDICAL ASPECTS **9**

AIDS : Cause and prevention . Misuse of scheduled frugs. Burns and their treatment by plastic surgery.Metabolite analysis, using mass spectrum - gas chromotography. Detecting steroid consumptionamong athletes and race horses.

TOTAL: 45 PERIODS

OUTCOMES

CO1: To recognize the crime scene in bomb explosion and rape case.
CO2: To identify the contaminants present in the food and chemical poisoning.
CO3: To identify the way to defuse the live bomb and possible cause of accidents in roads.
CO4: To detect the forgeries in cheques, academic certificates, currencies and detection of impurities in precious elements .
CO5: To have knowledge on AIDS

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CO-PO Mapping

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	-	-	1
CO2	2	2	3	1	-	1
CO3	-	2	2	-	-	1
CO4	2	-	3	-	-	2
CO5	1	2	-	-	-	2
Avg.	1.75	2	2.5	1	-	1.4

AC3013 TEXTILE CHEMISTRY AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- To make the students conversant with the properties of textile fibres and their processing
- To explain the significance and practice of dyeing, printing and finishing operations.
- To impart knowledge on the preparation of textile materials for processing.
- To expose the students to the machineries and processing techniques used in dyeing, printing and finishing operations.
- To make the students conversant about the textile material finishing.

UNIT I PROPERTIES OF TEXTILE MATERIALS 9

Classification of textile fibres – chemical structure, physical and chemical properties of textile fibers

- cotton, wool, silk, viscose, rayon, synthetic fibres.

UNIT II PREPARATORY PROCESSES 9

Brief outline on desizing, singeing and mercerization, scouring – bleaching with hypochlorite's and peroxides.

UNIT III DYEING 9

Theory of colours – dye chemistry - preparation of simple dyes. Introduction to theory of dyeing. Application of direct, vat, azoic, reactive, sulphur, disperse and acid dyes and mineral colours. Machines used for preparation and dyeing processes- singeing, mercerizing, scouring machines - bleaching ranges dyeing machines – jigger, winch padding- ranges, HTHP machines, jet dyeing machines and overflow dyeing machines.

UNIT IV PRINTING 9

Stages involved in printing –printing paste ingredients, methods and styles – direct, discharge and resist styles, block, roller and screen printing. Printing of various classes of dyes and pigments – printing of natural and synthetic materials with direct, reactive, disperse and other dyes – pigment printing. Printing machinery and post printing operations – roller printing machinery, hand, flat and rotatory screen printing machines – transfer printing machine – dryers, steamers, curing chambers and washing ranges.

UNIT V FINISHING 9

Finishing of textile materials – scotching, calendaring, starching, creeping, anti-shrinking, crease-proofing, wool-finishing and other finishes.

TOTAL : 45 PERIODS

OUTCOMES

CO1: Will be aware of the preparation and properties of fibers.
CO2: Will have clear understanding of the concept of dyeing.
CO3: Will be familiar with the stages involved in textile processing.
CO4: Will be able to identify and solve problems associated to textile processing.
CO5: Will know the techniques, skills and modern tools mandatory for practicing in textile technology.

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4. Joseph Merritt Matthews, Laboratory Manual of Dyeing and Textile Chemistry, 2018.
5. Robert R Mather and Roger H Wardman, The Chemistry of Textile Fibres , 2015.

CO-PO Mapping

COs	Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	3	2	1	2
CO2	2	3	2	2	-	1
CO3	-	2	3	2	-	-
CO4	3	1	2	-	-	1
CO5	1	1	3	-	-	2
Avg	1.75	1.8	2.6	2	1	1.5

AC3014 AGRICULTURAL CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To introduce the basic concepts of composition, formation and properties of soil.
- To impart knowledge on the composition and application of the natural and artificial fertilizers.
- To understand the effects of pesticides, pest management and sustainable agriculture.
- To familiarize the plant growth regulators and plant hormones.
- To understand the soil biochemistry, composting and biofertilizers.

UNIT I SOIL CHEMISTRY 9

Soil analysis . Composition of soil : Organic and Inorganic constituents. Soil acidity : buffering capacity of soils. Limiting of soil.Absorption of cations and anions : availability of soil nutrients to plantsand contaminants in soils; aqueous chemistry of soil solutions and mineral dissolution; oxidation and reduction reactions in soils; soil mineral formation processes and properties; the formation and reactivity of soil organic matter; surface chemistry and cation, anion, and organic compound adsorption reactions.

UNIT II FERTILIZERS 9

Peat and organic manures (composts). Role of humus. Effluent form gobar gas plants. Use of fertilizers : urea, DAP, Super phosphate, Gypsum, NPK-mixed fertiizers, Optimal addition of Fertilizers to obtain estimated yields.

UNIT III PESTICIDES **9**

Insecticides: stomach and contact poisons. Plant derivatives :pyrethrine, Nicotine and rotenone Synthetic organic: carbophos, carbaryl, p-DCB, dimethoate, butachlor, Endrin, Aldrin (Chemical name and uses). Rodenticdes. Fungicides : Inorganic (Bordeaux Mixture) and organic(dithiocarbamate). Industrial fungicides: creosote fractions. Herbicides and weedicides : Selective and non-selective, 2, 4-D and 2, 4, 5-t (structure and function) Intenerated pest management. Sex attractants for insect control. Sustainable agriculture.

UNIT IV PLANT GROWTH REGULATORS **9**

3-Indole acetic acid: NAPHTHALENE ACETIC ACID: Ethepon (2-chloroethyl phosphoric acid): Alar (succinin acid-2, 2-dimethyhydrzine :) their function. Plant hormones: Gibberlin, Cyclocel, Phosphon, dwarfing compound (CCC: 2-Chlorethyltrimethyl ammonium chloride). Defoliants.

UNIT V SOIL BIOCHEMISTRY **9**

Biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important nutrients.Biodegradation of pesticides, organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the soil.Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost, biodynamic compost. Biofertilizers – definition, classification, specifications, method of production and role in crop production.

TOTAL: 45 PERIODS

OUTCOMES

CO1: To conduct soil analysis and to check the acidity of soil based on the absorption andadsorption reactions.
CO2: To apply the knowledge for the optimum use of natural and man-made fertilizers.
CO3: To find the way for sustainable agriculture by minimizing the use of pesticides.
CO4: To understand the different types of plant growth regulators and plant hormones for the growth of the plants
CO5: To know about the soil condition and its usability

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6. Sylvia DN. Principles and Applications of Soil Microbiology. Pearson Edu, 2005
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CO-PO Mapping

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CO1	1	2	3	3	1	2
CO2	1	-	2	3	3	2
CO3	1	2	3	3	3	2
CO4	1	2	3	2	2	2
CO5	-	1	1	3	2	1
Avg.	1	1.8	2.4	2.8	2.2	2.2

AC3015 POLYMER CHEMISTRY AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- To make students be conversant with the classes of polymer, significance of Molecular masses and polymerization reaction.
- To impart knowledge to students on polymeric materials and their application.
- To provide students a brief understanding of elastomers and its processing methodology and learn the importance of high performance polymers.
- To make students to understand principle and practice polymer process moulding
- To provide students a comprehensive knowledge on the characterization of polymeric techniques, materials and correlation to the properties.

UNIT I POLYMERS 9

Polymers - definition - types of polymers -.DP, Molecular mass - number and mass average molecular mass - determination of molecular mass (osmometry, viscosity, diffusion, light scattering, and sedimentation methods).viscoelasticity, Kinetics of linear stepwise polymerization - addition polymerization - free radical, cationic and anionic polymerization. Co-poymer- examples, Co-ordination polymers- stereochemistry aspect.

UNIT II PLASTICS MATERIALS 9

Introduction – classification – thermoplastics - cellulose derivatives - LDPE, LLDPU, HDPE, PVC, PMMA, PTFE, PET, Nylons – thermosetting resins – phenolic resins, epoxy resins, silicones, polyurethanes – polymer blends and alloys reinforced plastics.

UNIT III ELASTOMERS 9

Natural rubber – processing – vulcanization – synthetic rubber – SBR, neoprene, butyl, thiocol rubber – thermoplastic elastomers – high performance polymers – polyethers – PEEK, polysulphones, polyimides.

UNIT IV MOULDING TECHNIQUES 9

Moulding constituents – functions –moulding techniques – compression – injection - extrusion – blow moulding – thermoforming – vacuum forming – pultrusion – casting – calendering – RIM– lamination.

UNIT V CHARACTERIZATION AND TESTING 9

Characterization of polymers by IR and NMR – Thermal properties by TGA and DSC, Testing-tensile strength, Izod impact, Compressive strength, Rockwell hardness, Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength – water absorption.

TOTAL : 45 PERIODS

OUTCOMES

- Have acquired basic knowledge on polymers and its reaction.
- Have gained knowledge on structure-property relationship of various plastic materials. applications.
- Will be able to know the processing of rubber and gain knowledge on various high performance polymers.
- Be able to methodically discuss moulding operations and techniques.
- Have acquired knowledge on characterization and testing methods of polymeric materials

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COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	2	-	-	1
CO2	1	2	3	1	-	1
CO3	-	1	3	-	-	1
CO4	1	-	3	-	-	-
CO5	1	-	3	-	-	-
Avg	**1**	**1.6**	**2.8**	**1**	**-**	**1**