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, professional skills, 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 appliedchemistry, polymeric and catalytic materials, fuel and energy related processes and materials, environmental chemistry and other transdisciplinary 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 inspiring the students to be creative thinkers, inspirational role models and citizens with environmental and social consciousness.
- By introducing high quality academic and research programmes in Chemistry and enabling interaction with experts from around the world in the fields of Chemistry.
- By ensuring a supportive ambience in the Department with dynamic leadership and growth opportunities to meet the needs of the students, faculty and staff.
- By 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.
- By sharing the intellectual resources and infrastructural facilities of the Department of Chemistry among the academic fraternity of the University campus and other Institutions, among the industrial research groups, funding agencies and the Government.
- By facilitating collaborative partnership with industries and other institutions and catalyseinnovation, transfer of technology and commercialization towards fulfilling societal developments.
- By benchmarking the teaching-learning and research processes and their outcomes against the Global standards and improvising on them with a clear view towards continuous development.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

M. Sc. APPLIED CHEMISTRY (2 YEARS)

REGULATIONS 2019

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#	Graduate Attribute	Programme Outcome
1	Engineering/Scientific knowledge	Apply the knowledge of basic, advanced and applied chemistry to the solution of complex research and industrial chemistry problems.
2	Problem analysis	Identify, formulate and solve challenges in the inter-disciplinary fields of chemistry using the principles of chemical sciences.
3	Design/development of solutions	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.
4	Conduct investigations of complex problems	Conduct investigation on chemical materials and their characteristics, including design of experiments, analysis & interpretation of data and processing of information to provide valid conclusions, based on the principles of different fields of chemistry.
5	Modern tool usage	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.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

6	The Engineer and society	Apply reasoning informed by the contextual knowledge to assess societal and health issues and the consequent responsibilities relevant to the career in chemistry.
7	Environment and sustainability	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.
8	Ethics	Commit and conform to professional ethics, responsibilities and norms in their professional and societal interactions.
9	Individual and team work	Function effectively as an individual and as a member or a leader in diverse teams and in multi-disciplinary groups.
10	Communication	Communicate effectively on the challenges and solutions of chemical processes and materials among the fellow professionals and the society at large, through comprehension of facts, writing scientific reports, documentation and effective presentations.
11	Project management and finance	Demonstrate the knowledge and understanding of different aspects of chemistry, economic decision-making and apply these to manage individual as well as team-based projects.
12	Life-long learning	Recognize the need for, and engage in independent and life-long learning in the broadest context of scientific advancement.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of the Master of Science in Applied Chemistry programme, the student will be able to:

1. Design and synthesize novel organic, inorganic, polymeric and nano materials as per needs and specifications of industrial and academic research.
2. Carry out elaborate qualitative and quantitative analysis of chemical materials as per standard procedures and testing protocols.
3. Utilize modern instrumental analytical tools and customize their use for advanced applications.
4. Prepare and execute projects for solving scientific challenges in the spheres of materials and environmental chemistry.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓				✓	✓					✓
II	✓	✓	✓	✓	✓							✓
III	✓	✓		✓		✓						✓
IV	✓		✓			✓		✓		✓		✓
V		✓			✓							✓

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Mapping of Course Outcome and Programme Outcome

		Course Name	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
YEAR 1	Semester 1	Analytical Chemistry	✓		✓	✓	✓							
		Chemical Thermodynamics and Electrochemistry	✓	✓	✓	✓	✓	✓						✓
		Concepts in Inorganic Chemistry	✓	✓	✓	✓			✓					✓
		Organic Synthesis and Stereochemistry	✓	✓	✓							✓	✓	✓
		Program Elective I												
		Audit Course – I												
		Inorganic Chemistry Laboratory	✓	✓	✓	✓	✓	✓						✓
	Semester 2	Co-ordination Chemistry	✓	✓	✓	✓			✓					✓
		Chemistry of Industrial Materials	✓	✓	✓			✓						✓
		Organic Reactions and Mechanisms	✓	✓	✓	✓			✓		✓			
		Quantum Chemistry and Statistical Thermodynamics	✓	✓	✓	✓	✓							✓
		Program Elective II												
		Audit Course –II												
		Organic Chemistry Laboratory	✓	✓	✓	✓			✓					✓
		Seminar	✓	✓	✓	✓	✓	✓		✓		✓		✓
YEAR 2	Semester 3	Advanced Organic Synthesis	✓	✓	✓	✓			✓					✓
		Kinetics and Surface Chemistry	✓	✓	✓	✓	✓							✓
		Molecular Spectroscopy	✓	✓	✓	✓	✓	✓						✓
		Organometallic, solid state and Photochemistry	✓	✓	✓	✓	✓		✓					✓
		Program Elective III												
		Physical Chemistry Laboratory	✓	✓	✓	✓	✓				✓			✓
	Semester 4	Open Elective												
		Program Elective IV												
		Project Dissertation	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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

		Course Name	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
YEAR 1	**Semester 1** (Program Elective I)	Industrial Catalysis	✓	✓	✓		✓	✓						
		Bio-organic Chemistry	✓	✓	✓			✓						
		Bio-process Technology	✓	✓	✓	✓		✓	✓					
		Chemical Process Equipment and Instrumentation	✓	✓	✓		✓	✓	✓					
	Semester 2 (Program Elective II)	Pharmaceutical Chemistry	✓		✓	✓								
		Environmental Chemistry	✓		✓	✓			✓					
		Chemistry of Nano-Materials	✓	✓	✓	✓	✓							✓
YEAR 2	**Semester 3** (Open Elective)	Green Chemistry	✓		✓	✓			✓					
		Food Chemistry	✓	✓	✓	✓		✓	✓					
	Semester 4 (Program Elective III& IV)	Corrosion and Corrosion Control	✓	✓	✓	✓		✓	✓					✓
		Industrial Electrochemistry	✓	✓	✓		✓	✓	✓					
		Water and Wastewater Treatment	✓		✓	✓			✓					
		Polymer Chemistry and Technology	✓	✓		✓		✓	✓					✓
		Forensic Chemistry	✓		✓	✓			✓					
		Textile Chemistry and Technology	✓	✓	✓	✓		✓	✓					
		Agricultural Chemistry	✓		✓	✓			✓					

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

M.Sc. APPLIED CHEMISTRY (2 YEARS)

REGULATIONS - 2019

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AC5101	Analytical Chemistry	PCC	3	0	0	3	3
2.	AC5102	Chemical Thermodynamics and Electrochemistry	PCC	3	0	0	3	3
3.	AC5103	Concepts in Inorganic Chemistry	PCC	3	0	0	3	3
4.	AC5104	Organic Synthesis and Stereochemistry	PCC	3	0	0	3	3
5.		Program Elective I	PEC	3	0	0	3	3
6.		Audit Course – I*	AC	2	0	0	2	0
PRACTICAL								
7.	AC5111	Inorganic Chemistry Laboratory	PCC	0	0	12	12	6
			TOTAL	**17**	**0**	**12**	**29**	**21**

***Audit Course is Optional**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AC5201	Co-ordination Chemistry	PCC	3	0	0	3	3
2.	AC5202	Chemistry of Industrial Materials	PCC	3	0	0	3	3
3.	AC5203	Organic Reactions and Mechanisms	PCC	3	0	0	3	3
4.	AC5204	Quantum Chemistry and Statistical Thermodynamics	PCC	3	0	0	3	3
5.		Program Elective II	PEC	3	0	0	3	3
6.		Audit Course –II*	AC	2	0	0	2	0
PRACTICAL								
7.	AC5211	Organic Chemistry Laboratory	PCC	0	0	12	12	6
8.	AC5212	Seminar	EEC	0	0	2	2	1
			TOTAL	**17**	**0**	**14**	**31**	**22**

***Audit Course is Optional**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AC5301	Advanced Organic Synthesis	PCC	3	0	0	3	3
2.	AC5302	Kinetics and Surface Chemistry	PCC	3	0	0	3	3
3.	AC5303	Molecular Spectroscopy	PCC	3	0	0	3	3
4.	AC5304	Organometallic, Solid State and Photochemistry	PCC	3	0	0	3	3
5.		Program Elective III	PEC	3	0	0	3	3
PRACTICAL								
6.	AC5311	Physical Chemistry Laboratory	PCC	0	0	12	12	6
			TOTAL	**15**	**0**	**12**	**27**	**21**

SEMESTER IV

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Open Elective	OEC	3	0	0	3	3
2.		Program Elective IV	PEC	3	0	0	3	3
PRACTICAL								
3.	AC5411	Dissertation	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.	AC5101	Analytical Chemistry	3	0	0	3	1
2.	AC5102	Chemical Thermodynamics and Electrochemistry	3	0	0	3	1
3.	AC5103	Concepts in Inorganic Chemistry	3	0	0	3	1
4.	AC5104	Organic Synthesis and Stereochemistry	3	0	0	3	1
5.	AC5111	Inorganic Chemistry Laboratory	0	0	12	6	1
6.	AC5201	Co-ordination Chemistry	3	0	0	3	2
7.	AC5202	Chemistry of Industrial Materials	3	0	0	3	2
8.	AC5203	Organic Reactions and Mechanisms	3	0	0	3	2
9.	AC5204	Quantum Chemistry and Statistical Thermodynamics	3	0	0	3	2

10.	AC5211	Organic Chemistry Laboratory	0	0	12	6	2
11.	AC5301	Advanced Organic Synthesis	3	0	0	3	3
12.	AC5302	Kinetics and Surface Chemistry	3	0	0	3	3
13.	AC5303	Molecular Spectroscopy	3	0	0	3	3
14.	AC5304	Organometallic, solid state and Photochemistry	3	0	0	3	3
15.	AC5311	Physical Chemistry Laboratory	0	0	12	6	3
					Total Credits	54	

PROGRAM ELECTIVE COURSES (PEC)

Sl.No	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			Lecture	Tutorial	Practical		
1.	AC5001	Industrial Catalysis	3	0	0	3	1
2.	AC5002	Bio-organic Chemistry	3	0	0	3	1
3.	AC5003	Bio-process Technology	3	0	0	3	1
4.	AC5004	Chemical Process Equipment and Instrumentation	3	0	0	3	1
5.	AC5005	Pharmaceutical Chemistry	3	0	0	3	2
6.	AC5006	Environmental Chemistry	3	0	0	3	2
7.	AC5007	Chemistry of Nano-Materials	3	0	0	3	2
8.	AC5008	Corrosion and Corrosion Control	3	0	0	3	3
9.	AC5009	Industrial Electrochemistry	3	0	0	3	3
10.	AC5010	Water and Wastewater Treatment	3	0	0	3	3
11.	AC5011	Polymer Chemistry and Technology	3	0	0	3	4
12.	AC5012	Forensic Chemistry	3	0	0	3	4
13.	AC5013	Textile Chemistry and Technology	3	0	0	3	4
14.	AC5014	Agricultural Chemistry	3	0	0	3	4

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl.No	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1	AC5212	Seminar	0	0	2	1	3
2	AC5411	Dissertation	0	0	24	12	4
					Total Credits:	**13**	

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OPEN ELECTIVE COURSES (OEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MP5491	Nuclear Energy in Health Care and Industry	OEC	3	0	0	3	3
2.	MP5492	Smart Materials for Energy and Environment Applications	OEC	3	0	0	3	3
3.	EA5491	Climate Journalism	OEC	3	0	0	3	3
4.	EA5492	Digital Photography	OEC	3	0	0	3	3
5.	AC5491	Green Chemistry	OEC	3	0	0	3	3
6.	AC5492	Food Chemistry	OEC	3	0	0	3	3
7.	AG5491	Natural Hazards and Management	OEC	3	0	0	3	3
8.	AG5492	Ocean Resources and Exploration Techniques	OEC	3	0	0	3	3
9.	MC5491	Basic Crystallography and Crystal Growth	OEC	3	0	0	3	3
10.	MC5492	Nonlinear Science	OEC	3	0	0	3	3
11.	MT5491	Statistical Methods	OEC	3	0	0	3	3
12.	HS5491	Professional Email Communication	OEC	3	0	0	3	3
13.	HS5492	Project Report Writing	OEC	3	0	0	3	3
14.	HS5493	Basic Presentation Skills	OEC	3	0	0	3	3

AUDIT COURSES (AC)

Sl.No	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1.	AX5091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX5092	Disaster Management	2	0	0	0	
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0	
4.	AX5094	Value Education	2	0	0	0	
5.	AX5095	Constitution of India	2	0	0	0	
6.	AX5096	Pedagogy Studies	2	0	0	0	
7.	AX5097	Stress Management by Yoga	2	0	0	0	
8.	AX5098	Personality Development through Life Enlightenment Skills	2	0	0	0	
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0	
					Total Credits:	**0**	

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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	03	**12**
3.	OEC	00	00	00	03	**03**
4.	EEC	00	01	00	12	**13**
5.	Non Credit/Audit course	✓	✓	00	00	
	Total Credit	**21**	**22**	**21**	**18**	**82**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AC5101 **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, error, deviation, standard deviation, significant figures- types of errors-evaluation and comparison of experimental results-standardisation of instrumental methods.

UNITII 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 SPECTROMETRIC METHODS AND THERMAL METHODS 9

Atomic spectroscopy – atomic absorption spectrometry; Emission spectroscopy - flame photometry and ICP-AES; Atomic fluorescence spectroscopy-Principles, instrumentation and analytical applications of spectral methods. Thermal analytical techniques – TGA, DTA and DSC – principles, instrumentation and applications.

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

Solvent extraction and Ion exchange techniques – principles and applications; Chromatographic techniques – adsorption chromatography, thin layer chromatography, gas chromatography, high performance liquid chromatography and size exclusion chromatography; Supercritical fluid 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.

REFERENCES

1. B. Sivasankar, “Instrumental Methods of Analysis”, Oxford University Press (2012).
2. D.A. Skoog, D.M. West, F.J. Holler and S.R.Crouch, “Fundamentals of Analytical Chemistry”, 9th Edn., Thomson Brooks/Cole Pub. (2014).
3. F.W. Fifield and D. Kealey, “Principles and Practice of Analytical Chemistry, 1st Indian Reprint, Blackwell Pub. (2004).
4. G. Svehla, G. Suehla, Arthur Israel Vogel, ‘’Vogel’s quantitative inorganic analysis”, 7th Edn., Pearson Education (2014).

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

5. H.H Willard, L.L Merritt, J.A Dean, and F.A Settle, “Instrumental Methods of Analysis”, 7th Revised edition, - Wadsworth Publishing Company (2004).
6. Robert D. Braun, “Introduction to Instrumental analysis”, Pharma Book Syndicate, Indian reprint (2006).

AC5102 CHEMICAL THERMODYNAMICS AND ELECTROCHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To provide exposure to the students to understand concepts of chemical thermodynamics and partial molar quantities
- To familiarize the students with phase equilibria
- To make the students acquire basic concepts of electro chemistry and its applications.
- To understand the theories invovled in electrochemical energy conversion.
- To impart knowledge on corrosion and its prevention.

UNIT I CONCEPTS OF CHEMICAL THERMODYNAMICS 9

First law of thermodynamics – Joule Thomson effect – second law of thermodynamics –free energy and work function - physical significance of free energy and work function - variation of free energy - pressure and temperature - variation of work function - temperature and volume – Maxwell’s relations – third law of thermodynamics - entropies of chemical reactions.

UNIT II PARTIAL MOLAR QUANTITIES 9

Partial molar properties – chemical potential – Variation of chemical potential with temperature and pressure - applications of chemical potential-Henry’s law-Nernst distribution law-Raoult’s Law-Van’t Hoff’s equation - Gibbs- Duhem equation.

UNIT III PHASE EQUILIBRIA 9

Gibb’s Phase rule- Reduced Phase rule -two component systems – classification – liquid-liquid and liquid vapour equilibria (fractional distillation) solid – gas(dehydration and rehydration of $CuSO_4.5H_2O$),solid-liquid systems (Bi-Cd benzene – picric acid systems)– three component systems involving liquid– liquid equilibria..

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 –kinetics of electrode processes – Butler–Volmer equation – Tafel equation.

UNIT V APPLIED ELECTROCHEMISTRY 9

Electrochemical energy conversion - batteries- Primary and secondary - dry cells - lead accumulators - Ni-Cd - lithium ion-fuel cells (hydrogen – oxygen). Corrosion - theories of corrosion – types of corrosion-galvanic – pitting – waterline – corrosion control – cathodic protection - sacrificial anodic protection – impressed current cathodic protection – electroforming and electrochemical machining.

TOTAL: 45 PERIODS

OUTCOMES

- Will be in a position to identify spontaneous reaction along with its thermodynamic principles
- Will be able to understand influence of chemical potential
- Can solve Phase equilibria problems and recognize changes at the phase
- Can apply electrochemical principles to the benefit of mankind
- Will be conversant in the theories involved in batteries and its application.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES

1. E.V.Anslyn and D.A.Dougherty, "Modern Physical Chemistry", University Science Books, Sausalito, USA (2006).
2. Gurudeep Raj, "Phase Rule" Goel Publishing House, Meerut, 6th Edn (2002).
3. Ira N. Levine, 'Physical Chemistry' Tata Mc graw, 6th Edn., Hill Publishing Company Limited, New Delhi (2013)
4. J.C. Kuriacose and J.Rajaram, Thermodynamics for students of Chemistry, 4rd Edn. S.Chand & Co., New Delhi (2002).
5. Philip H.Reiger, Electrochemistry, 2nd Prentice Hall Inc., New Delhi (1994).
6. Vladimir S. Bagotsky, Fundamentals of Electrochemistry, John Wiley & Sons, 02, Dec (2005)

AC5103 CONCEPTS IN INORGANIC CHEMISTRY 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 ATOMIC STRUCTURE 9

Hydrogen atom model-quantum numbers-Schrodinger wave equation – hydrogen atom and polyelectron atoms-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.

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-applications. Metallic bond – free electron theory and band theory of metals.

UNIT III CRYSTAL STRUCTURE 9

Crystalline and amorphous solids; crystal systems; 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. 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; VSEPR theory;molecular orbital theory – LCAO approximation for diatomic and polyatomic systems.

UNIT V AQUEOUS AND NON-AQUEOUS CHEMISTRY 9

Solvents – classification-function-selection. Acid-base concepts and HSAB-superacids and superbases. Non-aqueous solvents – reactions in liquid ammonia, sulphuricacid-aprotic solvents-molten salts.

TOTAL: 45 PERIODS

OUTCOMES

- To summarize and apply basic knowledge on the periodic table and its properties to understand Inorganic concepts for further studies.
- To analyze different types of bonding in chemical compounds and apply them to study new chemical compounds.
- To distinguish between the crystal structures of different ionic compounds and apply them for suitable industrial applications.
- To analysethe bonding in covalent compounds and correlate their properties to new compounds synthesized.
- 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", 3rdEdn., 2nd Impression, Pearson Education (2009).
2. B. Sivasankar, "Inorganic Chemistry", Pearson Education, 2013.
3. D.F. Shriver and P. W. Atkins, "Inorganic Chemistry", 5thEdn. Oxford University Press (2011).
4. F. A. Cotton, G. Wilkinson and P. L. Gaus, "Basic Inorganic Chemistry", 3rdEdn. John Wiley and Sons, 2004.
5. J. D. Lee, Concise Inorganic Chemistry, 5thEdn. Wiley-India Edition (2009).
6. J. E. Huheey, E. A. Keiter, R. L. Keiter and Okhil K Medhi, "Inorganic Chemistry: Principles structure and reactivity", 4thEdn. Pearson Education (2011).
7. W. L. Jolly, "Modern Inorganic Chemistry", 2ndEdn. Tata McGraw –Hill Pub.Co. (2007).

AC5104 ORGANIC SYNTHESIS AND STEREOCHEMISTRY 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 optical and 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.

UNITII 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

OUTCOMES

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

REFERENCES

1. E.L. Eliel, S.H. Wilen and L.N. Mander, Stereochemistry of Carbon Compounds, John Wiley and 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.

AC5111 INORGANIC CHEMISTRY LABORATORY L T P C
0 0 12 6

OBJECTIVES

To facilitate the understanding of the 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 42

(i) Ores: carbonate ores (dolomite)

(ii) Alloys: ferrous and nonferrous alloys (brass and solder)

(iii) Spectrophotometry- estimation of copper, nickel, iron and manganese

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 24

(i) Carbonate and non-carbonate hardness by EDTA

(ii) Dissolved oxygen by Winkler's method

(iii) Chemical oxygen demand and Biological oxygen demand

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

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

REFERENCES

1. B. Sivasankar, "Instrumental Methods of Analysis", 1st Edition, Oxford University press (2012)
2. C.H.Sorum, "Introduction to Semimicro Qualitative Analysis", Nag Press, (2007).
3. H.H. Willard, L.L. Merritt, J.A. Dean, and F. A. Settle, "Instrumental Methods of Analysis", 7th Edition, CBS Pub (2004).
4. J.Mendham, R.C.Denney, J. D. Barnes, M. Thomas and B. Sivasankar, "Vogel's text book ofquantitative chemical analysis", Pearson Education Ltd., Indian subcontinent edition (2009)
5. Svehla and B.Sivasankar, "Vogel's Qualitative Analysis", 7th Edition, Pearson Publishers(2012)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AC5201 **CO-ORDINATION CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the geometries of different coordination compounds and their structural characteristics
- To teach thevarious theoretical treatments of bonding in coordination compounds
- To facilitate the understanding of the spectral, magnetic and thermodynamic properties of transition metal complexes through energy correlations.
- To instruct on the different reactions of complexes and their mechanistic aspects.
- 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; stability of complexes – successive and overall formation constants – thermodynamic aspects.

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.

UNIT III SPECTRAL CHARACTERISTICS OF COORDINATIONCOMPOUNDS 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 REACTIONS OF COORDINATION COMPOUNDS 9

Inert and labile complexes; substitution reactions in square-planar and octahedral complexes – factors affecting reactivities; electron transfer reactions- outer sphere and inner spheremechanisms; photochemical reactions of coordination compounds – substitution, red-ox and rearrangement reactions.

UNIT V EXPERIMENTAL METHODS AND BIOLOGICAL SIGNIFICANCE 9

Preparation of coordination compounds, Measurement of successive and overall formation constants of complexes by polarography and potentiometry; Biological significance of complexes – hemoglobin and myoglobin in oxygen transport, enzyme catalysis, photosynthesis, chemotherapy.

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

REFERENCES

1. A.G. Sharpe, "Inorganic Chemistry", 3rd Edition, Pearson Education (2004).
2. B. Sivasankar, "Inorganic Chemistry", Pearson Education, 2013.
3. D. Banerjea, "Coordination chemistry", 3rd Edition, Asian Books.
4. D.F.Shriver and P.W. Atkins, "Inorganic Chemistry 5thEdition, Oxford University Press (2011).
5. F.A.Cotton, G.Wilkinson, C.A.Murillo and M.Bochmann, "Advanced Inorganic Chemistry",6th Edition, John Wiley and Sons (2003).
6. J.D.Lee, Concise Inorganic Chemistry, 5thEdn. Blackwell Science (2009).
7. J.E. Huheey, E.A. Keiter, R.L. Keiter and O.K.Medhi, "Inorganic Chemistry: Principles of structure and reactivity", 4th Edition, Pearson Education (2009).

AC5202 CHEMISTRY OF INDUSTRIAL MATERIALS L T P C
3 0 0 3

OBJECTIVES

- To make the student conversant with the biomedical application of dyes.
- To teach the student to appreciate the use of food preservatives.
- To impart the knowledge on pesticide toxicology.
- To understand the properties of important industrial inorganic chemicals such as fuels and industrial gases.
- To develop an understanding of the sugar technology and bulk sweeteners.

UNIT I DYES 9

Structure and properties, Natural food colours and their health aspects, Biomedical applications of dyes: Photodynamic therapy, Dyes in bioanalysis and medical diagnostics, DNA sequencing, Cancer detection, activity with diazonium salts, Dyes as therapeutic agents.

UNIT II FOOD PRESERVATIVES 9

Objectives and techniques of food preservation; Structure, properties and use of foods preservative: chemical preservative, bio preservative, safety concerns of food preservatives, analytical methods for determination of preservative residues.

UNIT III PESTICIDE CHEMISTRY AND TOXICOLOGY 9

Pesticides, classification, chemical characteristics of pesticides, organochlorine, organo phosphorus, carbamate, pyrethroid, plant origin pesticides, biopesticides, neonicotinoids and nitrogenoeus pesticides, Toxicity classification of pesticides, NOEL and ADI tolerance level, Measurement of toxicity, LD_{50} and related parameters.

UNIT IV FUEL AND INDUSTRIAL GASES 9

Fuel and industrial gases production and uses of producer gas, water gas, coke oven gas, acetylene, natural gas, LPG: Liquefaction of gases – noble gases, carbon dioxide, hydrogen, oxygen, nitrogen.

UNIT V SUGAR TECHNOLOGY 9

Introduction to sugar industry, Specification of raw sugar, Refining quality of raw sugar – evaluation, calculation of raw value, By-products and co-products of sugar industry. Sweeteners, Classification, Reduced calorie bulk sweeteners, Sorbitol and Mannitol.

TOTAL : 45 PERIODS

OUTCOMES

- Will appreciate the apt usage of dyes.
- Will obtain awareness about food preservatives.
- Will understand the toxic effect of pesticides.
- Will be appreciative of the utility of various fuel and industrial gases.
- Will be aware of a variety of by-products in sugar industry.

REFERENCES

1. S.H. Kim, Functional Dyes, Elsevier, (2006).
2. Klaus Hunger, Industrial Dyes-Chemistry, Properties, Applications by Wiley-VCH Verlag, (2003).
3. Gabriel J. Lauro and F. Jack Francis, Natural Food Colorants – Science and Technology, Marcel Dekker Inc, (2000).
4. V E Baikow, Manufacture and Refining of Raw Cane Sugar, 2nd edition, Elsevier, (1982).
5. Titus A. Msagati, Chemistry of food additives and Preservatives, Wiley-Blackwell, (2013).
6. Ebbe Almqvist, History of Industrial gases, Kluver Academic/Plenum publishers, (2003).
7. Simon J. Yu, The toxicology and biochemistry of Insecticides, 2nd Edition, CRC Press, (2015).

AC5203 ORGANIC REACTIONS AND MECHANISMS

L	T	P	C
3	0	0	3

OBJECTIVES

- To acquaint the students with the types and mechanisms of organic reactions.
- To make the students knowledgeable in addition, substitution and elimination reactions.
- To provide comprehensive knowledge on name reactions and rearrangements.
- To learn the involvement of reactive intermediates and understand their structure and reactivity through various organic reactions.
- To learn and understand the orbital interactions in concerted reactions.
- Learn to apply concerted and stepwise reactions in organic synthesis.

UNIT I ADDITION REACTIONS 9

Reactive intermediates - formation and stability of carbonium ions, carbanions, carbenes and carbenoids, 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 orientation -addition to , -unsaturated carbonyl compounds.

UNIT II SUBSTITUTION REACTIONS 9

Aliphatic nucleophilic substitutions - SN1, SN2 and SNi mechanisms - effects of substrate, attacking nucleophile, leaving group and solvent - stereochemistry of nucleophilic substitution reactions -mechanism of ester hydrolysis (BAC2, AAC2 and AAL1) - alkylation of active methylene compounds - substitutions at carbonyl, bridgehead, vinylic and allylic carbons - neighbouring group participation- labelling and kinetic isotope effects – norbornyl cation and other non-classical carbocations, ambident nucleophiles - O versus C alkylation - aromatic nucleophilic substitution - mechanisms -effects of substrate, structure, leaving group and attacking nucleophile - various methods of benzyne generation and reactions of benzyne, reactions of aryl diazonium salts – 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 - Hunsdiecker reaction - Robinson annulation - Hell-Volhard-Zelinsky reaction - Japp-Klingemann reaction - Stork enamine alkylation - Ziegler alkylation - Vilsmeier-Haack reaction - Heck reaction - Shapiro reaction - Polonovski reaction - Sharpless asymmetric epoxidation - Hofmann-Loffler-Freytag reaction - Reformatsky reaction - Simmons-Smith reaction - Gattermann-Koch reaction - Schiemann reaction - von Braun reaction - Ullmann reaction - Thorpe reaction.

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, Fritsch-Buttenberg-Wiechell, Neber, Hofmann, Curtius, Beckmann,Schmidt, Lossen, Wolff, Baeyer-Villiger, Dienone-phenol, Pinacol, Stevens, Wittig, Chapman,Wallach, Orton, Bamberger, Pummerer and von Richter 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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

- Design and develop chemical compounds, and make new synthetic methodology for new molecules.
- Identify and create inter-disciplinary fields of chemistry using various chemical reaction mechanism.

REFERENCES

1. Guidebook to Mechanism in Organic Chemistry (6th Edition), Peter Sykes, Longman Scientific & Technical, 1985. Mukherjee, S.M., and Singh, S.P., Reaction Mechanism in Organic Chemistry, 1st edition, Macmillan India Ltd., New Delhi, 1990.
2. Jerry March, Advanced Organic Chemistry, - Reactions, Mechanisms and Structure - 4thedition, John Wiley & Sons, New York, 2006.
3. March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Michael B. Smith, Jerry March John Wiley & Sons, 6th edition, 2007.
4. Morrison, R. T., Boyd, R. N., and Bhattacharjee, S. K., Organic Chemistry, 7th edition, Pearson Prentice Hall, 2011.
5. Pine, S. H., Organic Chemistry, Tata McGraw Hill, 5th edition, 2008.
6. R.T. Morrison and R.N. Boyd, Organic Chemistry, 7th edition, Prentice-Hall of India Private Ltd., New Delhi 2011.
7. Sanyal and Sanyal, Reactions, Rearrangements and Reagents, Bharati Bhawan Publishers & Distributors; 4th edition, 2003.

AC5204 QUANTUM CHEMISTRY AND STATISTICAL THERMODYNAMICS L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on basics of quantum chemistry and group theory.
- The student will be familiar with wave equation and its solution.
- To develop the students understanding of molecular symmetry and groups.
- To make the student conversant with the statistical thermodynamics and separation of partition functions and quantum statistics.
- To facilitate the understanding of non-equilibrium thermodynamics.

UNIT I QUANTUM CHEMISTRY 9

In adequacy of classical mechanics-blackbody radiation, photoelectric effect, heat capacity of solids- Planck's quantum theory - quantum mechanical operators- Hamiltonian operators, momentum operators, permutation operators – matrix representations –Eigen value – Eigen function equations. Schrodinger wave equation and its solution to a particle in a box, rigid rotor, harmonic oscillators.

UNIT II MOLECULAR SYMMETRYAND GROUP THEORY 9

Symmetry elements and symmetry operations–group postulates–types of groups–point groups–representation of molecular point groups–great orthogonality theorem–character tables–reduction of reducible representations–construction of character tables-applications of group theory.

UNIT III STATISTICALTHERMODYNAMICS 9

Objectives of statistical thermodynamics–probability –micro states and macro states for distinguishable and indistinguishable particles –permutation and combinations–Maxwell–Boltzmann statistics - use of partition function for obtaining thermodynamic functions and entropy

UNIT IV SEPARATION OFPARTITION FUNCTIONSAND QUANTUMSTATISTICS 9

Molar partition functions –evaluation of translational, rotational, vibrational and electronic partition functions–rotational heat capacity for the hydrogen molecule. Quantum statistics–Fermi-Dirac and Bose– Einstein statistics.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V NON-EQUILIBRIUMTHERMODYNAMICS 9

Steady state–conservation of energy and mass-entropy production and entropy flow in open system–fluxes and forces– transformation of properties of rates and affinity – microscopic reversibility and Onsager reciprocal relation, thermokinetic effect.

TOTAL: 45 PERIODS

OUTCOMES

- Will know the basics of quantum chemistry.
- Will have the ability to derive wave equation.
- Can apply symmetry operations to a given molecule.
- Will have the potential to derive the classical thermodynamics of materials in terms of the properties of their constituent particles and their interaction.
- With the help of quantum mechanical principles can have a general perception of quantum statistics.

REFERENCES

1. Cotton F.A. Chemical Application of group theory, 3rdEdn. Wiley, New York(2003)
2. D.A.McQuarrie,QuantumChemistry,1stEdn. University Science Books, Mill Valley, California(2003).
3. I.N. Levine, Quantum Chemistry, 5thEdn. Pearson Education (2000).
4. J.C. Kuriacose and J.Rajaram, Thermodynamics for students of Chemistry 3rdEdn. Shoban Lal Nagin Chand and Co. (2010).
5. L.K.Nash and Addison, Elements of Statistical Thermodynamics, Wiley PubCo.1971.
6. Molecular Symmetry and Group Theory, Robert L. Carter, Publisher: Wiley India Private Limited(12November 2009).
   Quantum Chemistry:ThroughProblemsandSolutions,R.K.Prasad,Publisher:NEWAGE (2006)

AC5211 ORGANIC CHEMISTRY LABORATORY L T P C
0 0 12 6

OBJECTIVES

- To make the student conversant with the quantitative organic analysis and also qualitative analysis of two-component mixtures.
- To acquaint the student with purification of solvents and reagents and also organic preparations.
- To teach the students, the identification of organic compounds by instrumental methods.
- Apply principles of separation and isolation techniques in organic reactions. Analyze NMR, IR and Mass spectra of organic compounds.

UNIT I QUANTITATIVE ORGANIC ANALYSIS 36

Percentage purity of aniline, phenol, acetone, glucose and glycerol. Determination of acid value, 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 PURIFICATION OF SOLVENTS AND REAGENTS 36

Purification of liquids by distillation Purification of solids by recrystallization Determination of melting point Determination of boiling point by capillary method Analysis with thin layer and column chromatographic techniques

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV ORGANIC PREPARATIONS 36

Preparation of dimethylaminopropiophenone hydrochloride by Monnicer reaction. Two-stage preparation of a few organic compounds. Phase transfer catalysis. Synthesis of azo dyes

UNIT V IDENTIFICATION OF ORGANIC COMPOUNDS BY INSTRUMENTAL METHODS 36

UV, IR, NMR, Mass spectroscopy and TGA

TOTAL: 180 PERIODS

OUTCOMES

- Will be able to analyze and quantify any given organic compound.
- Will be competent in separation and purification technique.
- Will be able to separate and purify any organic compounds
- Will be able to analyze the molecule with spectroscopic techniques
- Will be able to handle the instruments in the laboratory

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).
3. Furniss B.S, Hannaford A.J, Smith P.W.G and. Tatchel A.R., Vogel's Textbook of Practical Organic Chemistry, LBS, Singapore (2012).
4. L. M. Harwood, C J. Moody, J M. Percy 'Experimental Organic Chemistry: Standard and
5. Leonard, J., Lygo, B., Procter, G., Advanced Practical Organic Chemistry, 3rd edition, CRC press, 2013 .
6. Microscale, Publisher: Wiley India Pvt Ltd (18 March 2011).
7. Silverstein, R. M. and Webster, F. X., Spectrometric identification of organic compounds, John Wiley and Sons.Inc. , 6th edition, 1997.
8. Singh, P. R., Gupta, D. S., Bajpai, K. S., Experimental Organic Chemistry Vol 1 and 2, Tata McGraw Hill
9. Singh, P. R., Gupta, D. S., Bajpai, K. S., Experimental Organic Chemistry Vol 1 and 2, Tata McGraw Hill
10. Vogel , A.I., Tatchell, A.R., Furnis , B.S., Hannaford , A.J., Smith, P.W.G., Vogel's Practical Organic Chemistry, 5th edition, Pearson education Ltd, 1996.
11. William Horwit, "Official methods of Analysis of the Association of official Analytical Chemists",13th edition, Washington, D.C. (2004).

AC5301 ADVANCED ORGANIC SYNTHESIS L T P C
3 0 0 3

OBJECTIVES

- To provide comprehensive information about the synthesis of heterocyclic compounds
- To give overall exposure and detailed reaction and synthesis of biomolecules like alkaloids, proteins, nucleic acids
- To impart thorough knowledge on the synthesis and structural elucidation of terpenoids, steroids and vitamins.
- To learn various organic reactions and reagents used in them as tools applied in the art of organic synthesis.
- To introduce advanced level study in organometallic reagents and their uses in organic synthesis

UNIT I HETEROCYCLIC COMPOUNDS 9

Synthesis and reactivity of furan, thiophene, pyrrole, thiazole, pyridine, indole and their derivatives, quinoline, isoquinoline, pyrimidine, purine and flavone - Skraup synthesis - Fischer indole synthesis and Pachmanncoumarin synthesis.

UNIT II PROTEINS AND NUCLEIC ACIDS 9

Classification - structure and synthesis of amino acids – peptides – Merrifield solid phase peptide synthesis - structure determination - peptide sequence and synthesis of - primary, secondary, tertiary and quaternary structures- Merrifield solid phase peptide synthesis - nucleic acids - structure and synthesis of DNA - structure and synthesis of RNA-WC Model.

UNIT III BIOMOLECULES 9

Structure, Properties, reactivities and Applications of carbohydrates - alkaloids – vitamins – terpenoids -steroids.

UNIT IV OXIDATION AND REDUCTION REACTIONS 9

Oxidation with Cr and Mn reagents – oxidation with LTA, DDQ and SeO_2 – oxidation using DMSO either with DCC or Ac_2O or oxalyl chloride, oxidaion using Dess – Martin reagent – vicinal hydroxylation of olefinic double bonds – Woodward and Prevost procedures – epoxidation using peracids including Sharpless procedure, ozonolysis. Reduction using various reagents – hydrogenation, hydration of carbon – carbon double and triple bonds – asymmetric reduction of carbonyl functions.

UNIT V ORGANOMETALLIC CHEMISTRY FOR ORGANIC SYNTHESIS 9

Fundamental concepts in transition metal chemistry for organic synthetic transformations – metal carbenes, synthesis, reactivity, cycloaddition reactions of metal carbenes, synthesis of fused ring systems, Dotz reaction, mechanism of ring formation, application of cobalt carbonyls in organic synthesis, Pauson Khand reacion, Volhardt reaction, Pearson reaction, use of Organoiron complexes for stereo specific synthesis of substituted cyclic compounds.

TOTAL : 45 PERIODS

OUTCOMES

- Apply the knowledge of basic, advanced and organic chemistry to the solution of complex research and industrial chemistry problems.
- Identify, formulate and solve challenges in the inter-disciplinary fields of chemistry using the advanced organic chemistry.
- Design and develop chemical compounds, which are suitable for applications in chemical science and biology
- Conduct investigation on chemical compounds and their analogues, including synthetic methods, analysis & interpretation of data in different fields of chemistry.
- Understand the evaluate the impact of advanced organic chemistry in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

REFERENCES

1. I.L. Finar, Organic Chemistry: Stereochemistry and the Chemistry of Natural Products (Volume- 2) 5th Edition, 9th Indian reprint, ELBS Longman Group Ltd., London, (2009)
2. Jerry March Advanced Organic Chemistry 6thEdn. Wiley Interscience, New York, (2006).
3. Francis A Carey and Richard J. Sundberg, “Advanced Organic Chemistry- Part A and Part B”, 5rdEdn. Plenum Press, New York (2005).
4. Heterocyclic Chemistry- J. A. Joule, K. Mills, G. F. Smith, Blackwell publishing Ltd, 5th edition, 2010.
5. Carey F. A., and Sundberg, R. A., Advanced Organic Chemistry, Part B: Reactions and Synthesis, 5th edition, Springer, New York, 2007.
6. Paquette, L. A., Crich , D., Fuchs, P. L., Molander, G. A., Encyclopedia of Reagents for Organic Synthesis, 14 Volume Set, Wiley, 2009.
7. Schlosser, M., Organometalllics in Synthesis, A manual, John Wiley, New York, 1996.
8. V.K.Ahluwalia, L.S. Kumar Chemistry of Natural Products, Anne book Pvt ltd (2009)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AC5302 KINETICS AND SURFACE CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To make the student conversant with kinetics and mechanism of gas phase reactions.
- To provide exposure to the students to understand surface phenomena and heterogeneous catalysis.
- To help the students to gain knowledge about surface phenomena.
- To make the student aware of surface reactions.
- To expose the students to various characterization technique.

UNIT I CHEMICAL KINETICS 9

Rates of chemical reaction, kinetics of first, second and third order reactions, order and molecularity concepts, methods of determining rate laws–complex reactions- reversible, consecutive and parallel collision theory, transition state theory and its modifications– thermodynamic formulation of reaction rates, classical treatment of kinetics.

UNIT II MECHANISM OF GASPHASE REACTIONS 9

Lindeman's theory - Hinshelwood, Kassel, Slater, Marcus's extension of RRK treatments - Reaction rates in solution–effect of dielectric constant and ionic strength–substituent and correlation effects-Hammett equation– Taft equation–Techniques for fast reactions. Gas phase combustion-H_2-O_2reaction and Hydrocarbon Combustion- explosion limits.

UNIT III SURFACE PHENOMENA 9

Structure of clean surfaces, notation of surface structure, structure of adsorbate layers, stepped surface, surface relaxation and reconstruction, Dynamics and energetics of surfaces.

UNIT IV SURFACE REACTIONS 9

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

UNIT V CHARACTERIZATION TECHNIQUES 9

Principles and Applications - XRD,XPS,AES,DRSUV-Vis, MAS-NMR, ESR, Raman, FT-IR 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
- Will be familiar with the significant mechanisms and its theories.
- Understands the concepts of surface chemistry and the methods of analysis.
- Will be familiar with adsorption and adsorption isotherms.
- Will have the ability to understand the mechanism of unimolecular and bimolecular surface reaction.

REFERENCES

1. A.W. Adamson and A.P. Gast, "Physical ChemistryofSurfaces",Wiley,1997.
2. B. Viswanathan, S. Kannan and R.C. Deka, "Catalysts and Surfaces, Characterization Techniques", Narosa, 2010.
3. G.A. Somorjai and Y. Li, "Introduction to Surface Chemistry and Catalysis", Wiley, 2nd Ed., 2010.
4. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanism of Chemical Transformation, Penguin Books Ltd.,2009.
5. K.J. Laidler, "Chemical Kinetics", Pearson, 3rd Ed. 2003.
6. P. Atkins, J.de Paula and J. Keeler, "Atkin's Physical Chemistry", Oxford University Press, 2018.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AC5303 **MOLECULAR SPECTROSCOPY** **L T P C**
3 0 0 3

OBJECTIVES

- To make the students realize molecular spectroscopy as an important tool to understanding molecular structure and its characteristics
- acquire a basic idea of different electromagnetic regions and instrumentation of various modern spectrometers
- demonstrate an understanding of the rotational, vibrational and electronic spectroscopy of diatomic and polyatomic molecules
- acquire the skill to determine the functional groups present in unknown molecules using vibrational (IR) spectra and to calculate maximum (λmaximum) absorption of molecules in Electronic (UV-Visible) region using Woodward-Fischer rule
- 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
- identify the unknown molecular formula of fragmented metastable ions of organic Compounds
- identify and analyse the hyperfine interactions of nuclei present in a molecule

UNIT I ELECTROMAGNETIC RADIATION AND ROTATIONAL SPECTROSCOPY 9

Characterization of electromagnetic radiation – regions of the spectrum - basic elements of practical spectroscopy–enhancement of spectra – Microwave spectroscopy – rotational spectra of molecules - determination of the bond length from rotational constants, Stark effect, selection rules, rotational spectra of polyatomic molecules – applications.

UNIT II ABSORPTION SPECTROSCOPY 9

Applications of group theory- Infra-red spectroscopy - harmonic and anharmonic vibrations – Morse potential - dissociation energy of diatoms, calculation of force constants from vibrational spectrum, isotopic shift – vibrating rotator - PQR branches in IR spectra - Fermi resonance, – Raman spectroscopy – mutual exclusion principle - selection rules for rotation and vibrational Raman spectra – UV–vis spectroscopy – electronic transitions – solvent effects – Woodward's rule.

UNIT III SPIN RESONANCE SPECTROSCOPY 9

Proton magnetic resonance spectroscopy – relaxation processes – chemical shift – coupling – simplification of complex NMR spectra – ^{13}C NMR spectra – NOE effects, 2D NMR MRI, Solid state NMR - Electron spin resonance spectroscopy – hyperfine interactions.

UNIT IV 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, - Reactions of ions in gas phase – effect of isotopes – nitrogen rule - determination of molecular formula – fragmentations and rearrangements - metastable ions – fragmentation of organic compounds.

UNIT V MOSSBAUER SPECTROSCOPY 9

Mossbauer nuclei – Doppler effect – recoilness emission and absorption, chemical isomer shift –quadrupole splitting – magnetic hyperfine interactions.

TOTAL : 45 PERIODS

OUTCOMES

- 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”, 5thEdn. Tata McGraw Hill, New Delhi, 2006.
2. D.H.Williams and I.Fleming, “Spectroscopic methods in organic chemistry”, 6thEdn, McGrawHill, New York, 2007.
3. E. Derome: Modern NMR Techniques for Chemical Research, Pergamon Press, 1987.
4. G.Aruldhas, “Molecular structure and spectroscopy”, 2ndEdn.,Prentice – Hall of India, 2007.
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”, Second Edition, Wiley Interscience, John Wiley & Sons, Inc., 2007.
7. Jeanne L. McHAle, " Molecular Spectroscopy" Prentice Hall, 2017.
8. Norman B. Colthup , Lawrence H. Daly, Stephen E. Wiberley , Introduction to Infrared and Raman Spectroscopy, 3rd edition 1982.
9. P.F. Bernath, Spectra of Atoms and Molecules, 2nd Edition, Oxford University Press, 2005.
10. R.S.Drago, “Physical methods for chemists”, Saunders, Philadelphia, 2008.
11. W.Kemp, “Organic Spectroscopy”, 3rdEdn, ELBS, McMillan, London, 2004.

AC5304 ORGANOMETALLIC, SOLIDSTATE AND PHOTOCHEMISTRY 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 thereactions and industrial catalytic applications of organometallic compounds.
- To instruct on the basic principles of preparation and characterization of inorganic solids.
- To teach defects-property correlation in solids and explore their electrical, magnetic, spectral and thermoelectric characteristics.
- To inculcate sound understanding of the laws of photochemistry, photo processes and their applications.

UNIT I BASIC ORGANOMETALLIC CHEMISTRY 9

18 electron rule, ligands, bonding, and electron count; structure, bonding and stereo-chemical nonrigidity; Metal carbonyls and nitrosyls: Synthesis, bonding and structure – vibrational spectra of metal carbonyls and nitrosyls; Metal alkyl, allyl and aryl complexes; Synthesis and reactivity of metal carbonyls;Metallocene.

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 - hydrogenation, hydroformylation, stereoregular polymerization, Wacker and Monsanto processes, water gas shift reaction, alkene metathesis.

UNIT III SOLIDS- DEFECTS, PREPARATION AND CHARACTERISATION 9

Defects in solids – origin and types of defects, non-stoichiometry; Defect-property correlation in solids; 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.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV PROPERTIES OF 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 PRINCIPLES AND CONCEPTS IN PHOTOCHEMISTRY 9

Relevance of photochemistry; Thermal Vs Photochemical processes; Electronic transitions - electronic energy levels, selection rules for electronic transitions, Franck-Condon principle; Laws of photochemistry – quantum efficiency; Chemical actinometry; Photophysical processes –Jablonski diagram; Luminescence, chemiluminescence, photosensitization and photoquenching; Spontaneous and stimulatedemission of radiation, LASER – principle, Construction and working of Ruby laser, applications; Solar energy – thermal and photoconversion.

TOTAL : 45 PERIODS

OUTCOMES

- To analyse the bonding and structure in organometallic compounds.
- To identify and formulate suitable organometallic catalysts for industrial reactions.
- To design appropriate methods for the preparation and characterization of inorganic solids.
- To explore the electrical, magnetic, spectral and thermoelectric characteristics for proposing practical applications of solids.
- To identify the photophysical and photochemical processes in solids and solutions.

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”,6thEdn. John Wiley and Sons (2003).
5. K. K. Rohatgi-Mukherjee, “Fundamentals of photochemistry” 3rd Edition, New Age Publications (2017).
6. Lesley E. Smart, and Elaine A. Moore, “Solid state chemistry: an introduction”, 3rd edition, Taylor & Francis CRC Press(2005).

AC5311 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 Diffraction SEM, 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.

3. D.R.Satiya, Practical Chemistry, 2nd Edn. Allied Publishers, Madras 1991.
4. F.W. Fifield and D.Kealey, "Principles and Practice of Analytical Chemistry, 1st Indian Reprint, Blackwell Pub. (2004).
5. V.D. Athawale and P. Mathur, Experimental Physical Chemistry, New Age International Publishers 2001.
6. Shailendra K. Sinha, Physical Chemistry- A Laboratory Manual, 1 st Edn, Narosa Publishing House, New Delhi (2014).

AC5001 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.

UNIT I INTRODUCTION TO CATALYSIS 9

Homogeneous and Heterogeneous catalysis- definitions - catalysts, promoters and inhibitors, activation energy, catalytic activity, conversion, selectivity, contact time, time on stream. Autocatalysis, phase transfer catalysis, enzyme catalysis, photo catalysis , acid-base catalysis, catalysis by transition metal ions and their complexes.

UNIT II CATALYST PREPARATION 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.

UNIT III CATALYSTDEACTIVATION & REGENERATION 9

Poisons, fouling, coking, attrition, sintering of catalysts -Pore mouth plugging and uniform poisoning models - catalyst regeneration.

UNIT IV PETROLEUM PROCESSING 9

Crude oil distillation/separation, Catalysts and process for high quality fuels: Hydro treating, hydrodesulphurization, Hydrode nitrogenation- Hydrode oxygenation and hydro demetallation. Hydro cracking, reforming, alkylation and isomerization.

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.

TOTAL: 45 PERIODS

OUTCOMES

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

REFERENCES

1. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy, "Catalysis: Principles and Applications", Narosa Publishing House, 2002.
2. B.Viswanathan,"Catalysis: Selected applications", Alpha Science International Ltd., 1st Ed., 2009.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

3. D.W. Bruce, D. O'Hare and R.I. Walto,"Porous materials", Wiley, 1st Ed., 2011.
4. J. Hagen, "Industrial catalysis: A practical approach", Wiley-VCH, 3rd Ed., 2015.
5. K.G. Bhattacharya and A.K. Talukdar, "Catalysis in Petroleum and Petrochemical Industries", Narosa Publishing House, 2005.
6. N. Armaroli andV. Balzani,"Energy for a sustainable world", Wiley-VCH, 2010.
7. R.J. Farrauto, L. Dorazio and C.H. Bartholomew, "Introduction to catalysis and industrial catalytic processes", Wiley,2016.

AC5002 BIO-ORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

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

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, ribonuleotides 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

- Will be familiar with concepts of bioprocess principles and enzyme technology.
- Will gain the knowledge of microbial processes, their kinetics and action in general.
- Will understand product recovery and purification operations in industries.
- Will have the knowledge about Proteins, nucleosides & nucleic acids.
- Will be familiar with enzymes, lipids and membranes.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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).

AC5003 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 and molds, 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

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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES

1. B. Sivasankar, "Bioseparations – Principles and Techniques", 5thEdn., 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", 1stEdn., 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).

AC5004 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 – Industrial driers, 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

- Will have a basic understanding of the engineering concepts involved in the chemical industry.
- Will familiar the process equipment
- Knows the importance of heat and mass transfer in the industrial operations.
- Can associate the reactions that one has already learnt with the actual process in the
- industry.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES

1. Bruce Nauman. E, Chemical Reactor Design, Optimization and Scale up, 2nd Edition, John Wiley & Sons, New York, (2008).
2. Levenspiel. O, Chemical Reaction Engineering Kinetics, John-Wiley, 3rd Edition, London, (1999).
3. McCabe W.L., Smith J.C. and Harriot P, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill Book Co. (2005).
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).

AC5005 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 of drugs 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

- To be familiar with principles of drug design.
- To understand the various clinical methods used for biological systems.
- To be gain the knowledge of preparation and pharmaceutical properties of various drugs.
- To be acquainted with antibiotics and antibacterial agents and its uses
- 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).
4. D. G. Watson, Pharmaceutical Chemistry, Churchill Livingstone Elsevier (2011).
5. D.Cairns, Essentials of Pharmaceutical Chemistry, 4thedition, 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)

AC5006 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.

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 wastemanagement-segregation-landfill-incineration.

TOTAL: 45 PERIODS

OUTCOMES

- To gain competency and understanding the significance of chemical reactions in environmental problems and solutions.
- To identify the atmospheric pollutants and air pollution monitoring.
- To identify the environmental issues and identify the solutions based on theoretical knowledge.
- To perform the suitable technique for the analysis of wastewater and spectroscopic technique for heavy metal analysis.
- 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, Tata McGraw-Hill, 2017.
3. James E. Girard, Principles of Environmental Chemistry, Jones and Bartlett Publishers, 2nd Ed., 2005.
4. Stanley E. Manahan, Environmental Chemistry, Ninth Edition, CRC Press (2009)

AC5007 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 nanomamaterials with diff synthetic troubles.
- To make the student conversant with the nanotube,nanowires and nanocomposites.
- To comprehend the synthetic with fabrication of nanostructured materials.
- To familiarize the student with applications of nanomaterials. instrumentation. instrumentation.

UNIT I INTRODUCTION TO NANOSCIENCE 9

Nanoscience–scopeandemergingtrends-bottom-upandtop-downapproaches; chemistry of solid surfaces–surface energy –chemical potential of curved surfaces; stabilization of colloidal dispersions by electrostatic and steric interactions; different types of nanomaterials.

UNIT II SYNTHESIS OF NANOPARTICLES 9

General methods of synthesis of zero-dimensional nanoparticles –homogeneous nucleation and heterogeneous nucleation, growth of nuclei and factors of importance; synthesis and properties of metallic, semiconductor and metal oxide nanoparticles.

UNIT III NANOTUBES: SYNTHESIS ANS PROPERTIES 9

Nanotubes -carbon nanotubes, BNNT – synthetic methods; Chemical properties hybridization, solubility, stability and functionalization; physical properties-optical, mechanical, magnetic and electrical properties, quantum size effects, Inorganic nanotubes– synthesis and properties.

UNIT IV NANOWIRESAND NANOCOMPOSITES 9

One-dimensional Nanowires and nanorods, two-dimensional thin films, nano composites and nano-structured polymers, nanocatalysts, nano clusters –preparation and properties.

UNIT V APPLICATIONS OF NANO MATERIALS 9

Physical techniques forfabrication 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

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

REFERENCES

1. G. Cao, “Nanostructures and Nanomaterials: Synthesis, Properties and Applications” Imperial College Press, 2004
2. G.A. Ozin, A.C. Arsenault and L. Cademartiri, “Nanochemistry: A Chemical Approach to Nanomaterials”, Royal Society of Chemistry, 2009.
3. B. Viswanathan, “Nano Materials”, NarosaPublishing House, 2011.
4. T. Varghese and K.M. Balakrishna, “Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials”, Atlantic Publishers,2012.
5. C. Poole and F. Owens, “Introduction to Nanotechnology”, Wiley, 2007.
6. L.E. Foster, “Nanotechnology: Science, Innovation, and Opportunity”, Prentice Hall; 1st Ed., 2005.

AC5008 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 factors that influence corrosion process
- To familiarize the student with corrosion testing methods.
- To make students be familiar with accelerated corrosion monitoring techniques such as EIS.
- To update the students on latest coating techniques.

UNIT I CORROSION 9

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

UNIT II FORMS OF CORROSION 9

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 III CORROSION TESTING 9

Rate of corrosion - calculation of ΔG and other related thermodynamic parameters - potential measurement - electrochemical series - redox reactions - Pourbaix and Evans diagrams - potentiodynamic polarization methods - Tafel extrapolation - anodic polarization - cyclic polarization - polarization resistance - characterization of different forms of corrosion - pitting - crevice - stress corrosion cracking - electrochemical impedance spectroscopic technique for corrosion evaluation.

UNIT IV 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 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

- Have gained knowledge on corrosion mechanism and their preventive methods.
- Understand the various factors that influence corrosion
- Apply the concepts of EIS to corrosion prevention and control.
- Understand the significance of organic and inorganic coatings for corrosion prevention
- Realize the importance of design factors towards corrosion control.

REFERENCES

1. D. Satas, Arthur. A. Tracton, Coatings Technology Handbook, Second Edition, CRC press, Marcel Dekker inc., US (2001).
2. E. Mc Cafferty, Introduction to Corrosion Science, Springer, New York (2010).
3. M. G. Fontana, Corrosion Engineering, Third Edition, Tata McGraw Hill Edition, New York (2005).
4. Nestor Perez, Electrochemistry and Corrosion Science, Kluwer Academic Publishers (2004).
5. R. Winston Revie, UHLIG's Corrosion Handbook, 3rd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey (2011).
6. 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).

AC5009 INDUSTRIAL ELECTRO CHEMISTRY 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 of electrochemical 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.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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

OUTCOMES

- Will know about the general principle and processes in chloralkali industry.
- Will be familiar about the electrometallurgical process
- Will have basic information on the processes, practices and significance of electrochemical operations in industries.
- Will have the ability to synthesize organic and inorganic chemicals by applying electric current.
- 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, Kluwer Academic Publishers, New York (2002).
5. John O'M. Bockris, Comprehensive Treatise of Electrochemistry Vol. 2., Electrochemical
6. processing, Plenum Press (1981).

AC5010 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.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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.

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

- To gain idea about various methods available for water treatment.
- To appreciate the necessity of water and acquire knowledge of preliminary treatment.
- To identify the physical and chemical properties of wastewater.
- To familiar with the steps involved in wastewater treatment process.
- 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).

AC5011 POLYMER CHEMISTRY AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- To make students be conversant with the preparation and properties of various classes of polymers and elastomers.
- To impart knowledge to students on applications of characterization techniques for polymer testing and characterization
- To make students to understand principle and practice polymer process moulding techniques.
- To provide students a comprehensive knowledge on the characterization of polymeric materials and correlation to the properties.

UNIT I 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 II ELASTOMERS 9

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

UNIT III MOULDING TECHNIQUES 9

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

UNIT IV 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.

UNIT V POLYMER PROPERTIES 9

Effect of structure on mechanical, chemical, thermal, electrical and optical properties.

TOTAL : 45 PERIODS

OUTCOMES

- Have acquired knowledge on plastics, elastomers and composites for technological applications.
- Have gained knowledge on structure-property relationship of polymers.
- Be aware of characterization of polymers by spectral, thermal, electrical and mechanical tests.
- Be able to methodically discuss moulding operations and techniques.
- Have acquired knowledge on the influencing effect of polymer structures on mechanical, chemical, thermal, electrical and optical properties.

REFERENCES

1. Michael L. Berins, Plastics Engineering hand book, 5thEdn. Chapman & Hall, New York(1991).
2. R.W.Iyson, Specialty Polymers, Blackie Academic & Professional, London (1992).
3. Jacqueline.I. Kroschwitz, Concise Encyclopedia of Polymer Science and Engineering, John Wiley & sons, New York (1998).
4. ManasChanda, Advanced Polymer Chemistry, Marcel Dekker, Inc.New York (2000).
5. J. R. Fried, Polymer Science and Technology, Prentice-Hall of India Pvt. Ltd., NewDelhi, (2009).
6. Mourice Morton, Rubber Technology, Van Nostrand, Reinhold, New York (2010).
7. Catia Bastioli, Handbook of biodegradable polymers, Rapra Technology, (2006).

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AC5012 **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

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

REFERENCES

1. Jay A. Siegel, Forensic Chemistry: Fundamentals and Applications, Wiley Blackwell, 2015.
2. Lawrence Kobilinsky, Forensic Chemistry Handbook, Wiley Blackwell, 2012.
3. Suzanne bell, Forensic Chemistry, Pearson Education, 2012.

Approved

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AC5013 **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

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

REFERENCES

1. Barker North, Chemistry For Textile Students - A Manual Suitable For Technical Students In The Textile And Dyeing Industries, 2011.
2. Hossain MD Tanvir, Chemistry & Technology of Textiles, 2013.
3. J.T. Marsh, An Introduction to Textile Finishing, 1979.
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.

AC5014 **AGRICULTURAL CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the basic concepts of composition, formationand properties of soil.
- To impart knowledge on the composition and application of thenatural 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

- To conduct soil analysis and to check the acidity of soil based on the absorption and adsorption reactions.
- To apply the knowledge for the optimum use of natural and man-made fertilizers.
- To find the way for sustainable agriculture by minimizing the use of pesticides.
- To understand the different types of plant growth regulators and plant hormones for the growth of the plants

REFERENCES

1. B.A. Yagodin (Ed). Agricultural Chemistry, 2 Volumes, Mir Publishers (Moscow), 1976.
2. G. Strawn, Hinrich L. Bohn, George A. O'Connor, Soil Chemistry, 4th Edition,Daniel
3. G.T. Austin :shreve's, Chemical Process Industries, 5th edition, Mc-Graw-Hill, 1984 ISBN: 978-1-118-62923-9 June 2015
4. Jenkinson D.S. and Ladd J.N. Soil Biochemistry , MarcellDekkar, New York, (1981)
5. Stotzky G &Bollag JM, Soil Biochemistry. Vol. VIII. Marcel Dekker, 1993.
6. Sylvia DN. Principles and Applications of Soil Microbiology. Pearson Edu, 2005
7. Wild A. Soil and the Environment - An Introduction. Cambridge Univ. Press, 1993

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OPEN ELECTIVE COURSES (OEC)

MP5491 NUCLEAR ENERGY IN HEALTH CARE AND INDUSTRY L T P C
3 0 0 3

OBJECTIVES

- To provide the student about the action of radiation on living cells and the response.
- To make the student to understand the basic nuclear medicine physics and newer technology systems.
- To enable the students to understand the diagnostic and therapeutic nuclear medicine techniques.
- To provide a broad knowledge in radiation hazard evaluation and control

UNIT I BASICS OF NUCLEAR SCIENCE AND RADIATION EFFECTS 9

Radioactivity, nuclear reactions and interaction of ionizing radiation with matter, with emphasis on radiation detection, radiation shielding - photoelectric - Compton effect and pair production - biological effects on human health - Action of radiation on living cells -direct and indirect physical damage- cell response to radiation - somatic and genetic radiation effects -Radiation side effects - Acute and chronic effects of low dose effects.

UNIT II DIAGNOSTIC APPLICATIONS OF NUCLEAR ENERGY 9

Production of X rays and its applications X-ray radiography - CT scan -contrast studies in x ray imaging - fluoroscopic applications -Mammography - physics of nuclear medicine and nuclear imaging - radio isotopes in diagnosis of nuclear imaging - Tc-99m extraction - radiopharmaceuticals - scanning instruments and techniques.

UNIT III THERAPEUTIC APPLICATION OF NUCLEAR ENERGY 9

Production of nuclear radiations- alpha, beta and gamma rays and X-rays - External radiation therapy -telecobalt unit and linear accelerators - and internal radiation therapy - Iridium -192 HDR brachtherapy unit- therapeutic nuclear medicine.

UNIT IV INDUSTRIAL APPLICATIONS OF NUCLEAR ENERGY 9

Industrial applications — Non destructive testing - industrial radiography - tracing, gauging, Radiation sterilization of medical equipments - food preservation and other applications.

UNIT V NUCLEAR RADIATION SAFETY MEASURES 9

Basic concepts of radiation protection standards - ICRP recommendations - systems of radiological protection - Optimization of protection and individual dos limits - Radiation dose to individuals from natural radioactivity in the environment and man- made sources - Evaluation of external and internal radiation hazards - effect of time, distance and shielding - radioactive waste disposal and transport of radioactive nuclides.

TOTAL: 45 PERIODS

OUTCOMES

After successful completion of the course

- students will be able to handle radioactive source carefully for treatment purpose.
- will develop competence in radioactive waste disposal management
- Will be develop competency to face radiation emergency
- students will develop critical thinking skills in radiation safety and protection.
- will be able to safe guard the radioactive sources used in hospitals.

REFERENCE BOOKS

1. W. R. Handee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
2. E. J. Hall, Radiobiology for Radiologists, J. B. Lippincott Co., Philadelphia, 2000.
3. W. N. Wagner, Principles of Nuclear Medicine, W. B. Saunders Co., London, 1990.
4. R. F. Mold, Radiation Protection in Hospitals, Adam Hilger Ltd., Bristol, 1985.
5. Fred A Mettler and Milton J Guiberteau, The essentials of nuclear Medicine imaging, 2011.

Approved

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MP5492 SMART MATERIALS FOR ENERGY AND ENVIRONMENT APPLICATIONS **L T P C 3 0 0 3**

OBJECTIVES

- To provide fundamental understanding on smart and intelligent materials.
- To enhance students' understanding on the structure-property relationship.
- To enable students appreciate novel materials and their usage in current cutting edge technologies.

UNIT I BASICS OF SMART MATERIALS AND STRUCTURES 9

Introduction - components and classification of smart structures, Requirements of Intelligent Materials – Functions: Sensor, Memory, Processor, Actuator - Common smart materials - Applications of smart systems – Energy Harvesting systems: Regenerative braking - Smart polymers: Applications in drug delivery, tissue engineering. Biomimetics and bio-inspiration.

UNIT II INTELLIGENT MATERIALS FOR ENERGY GENERATION 9

Artificial Intelligence in Materials, Ferrolectricity: Introduction - Piezoelectric effect, Piezoelectric materials as sensors, Actuators and bimorphs - Transparent Conducting Materials – Band-gap and electrical conductivity, Conditions for transparency – role of defects on conductivity - Applications: Solar cells, Touch screen, etc.

UNIT III SHAPE MEMORY MATERIALS FOR ENERGY STORAGE 9

Introduction to structure types, Structure-property relationships, Shape memory effect (SME), One way and two-way SME, Shape memory alloys (SMAs), Intelligence in the form of SMA, Functional properties of SMAs. Thermal-storage, and aerospace materials. Shape-memory polymers, and their applications.

UNIT IV MULTIFERROIC MATERIALS FOR NOVEL REFRIGERATION 9

Ferromagnetism and ferroelasticity, Magneto-electric materials: Types of magnetic ordering phenomena, Conditions for multiferroicity– Applications of multiferroic materials. Magnetostrictive smart materials – Magneto-caloric materials for emission-less refrigeration - Magneto-Optic (MO) Materials: Examples (Heusler alloys, double perovskites) and Applications.

UNIT V INTELLIGENT OPTICAL MATERIALS FOR ENVIRONMENT 9

Smart optical materials for modifying spectral shift and refractive index shift. Electro-optic and Acousto-optic materials: Definitions, examples and applications –Chromogenic Materials – Types: Photochromic, Thermochromic, Electrochromic - Devices and Applications:Radiation absorption.

TOTAL: 45 PERIODS

OUTCOMES

- The student will understand the working principle of smart materials
- The student will get an overview on various types of smart materials and their application areas.
- The student will get ideas to use smart materials in green energy and environment applications
- The student will get motivated to find novel applications of these multifunctional materials in new technologies.
- The student will get an idea on different synthesis and characterization techniques

REFERENCES

1. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007.
2. M. Addington, D.L. Schodek, Smart Materials and New Technologies, Elsevier 2005.
3. K. Otsuka, C.M. Wayman (Eds.), Shape Memory Materials, Cambridge University Press, 1998.
4. M.V. Gandhi, B. S. Thompson, Smart Materials and Structures, Springer, 1992.
5. P. Ball,Made to Measure: Materials for the 21st Century, Princeton University Press, 1997.
6. Ed. M. R. Aguilar and J.S. Roman, Smart Polymers and their Applications, Elsevier 2014.
7. Ed.: Peter L. Reece, Smart Materials and Structures: New Research, Nova Science 2007.
8. Ian Baker, Fifty Materials that Make the World, Springer, 2018.
9. Ed.: Mel Schwartz, Smart Materials, CRC Press, 2008.

EA5491 **CLIMATE JOURNALISM** **L T P C**
3 0 0 3

OBJECTIVES

- To offer a comprehensive approach to reporting of climate change.
- To impart knowledge about political, economic, and ethical questions raised by the need for transformative change of societies in the wake of climate change.
- To reflect over the development of climate change as a nature and a society issue.
- To synthesize knowledge from different areas related to climate change.
- To reflect on the norms and values of journalism in the context of climate change.

UNIT I HUMAN INFLUENCES **9**

Anthropocene Era (anthropo: man, and cene: new) - Freshwater scarcity - The decline of our oceans, fish, and wildlife - Environmental health - Sustainable energy, agriculture, and food systems – Role and responsibility of journalists – Making climate change relevant as a society issue – Politics and economics of climate change – Environmental ethics – Human health – Species migration.

UNIT II PUBLIC NARRATIVES **9**

Complex science and uncertainty - Public apathy and politics - Well-funded counter-narratives - Zealous stakeholders - What can (incorrectly) appear due to a lack of news hook for stories - Two centuries of CO_2emissions.

UNIT III JOURNALISTIC CHALLENGES **9**

Environmental Journalism as a craft - Roles and differences between journalism and communications – Finding the most accurate, credible and timeliest information on science and issues – Essentials of environmental reporting – Discerning uncompromised expert sources – Using human narratives and descriptive storytelling to relate real-world impact – Tapping the databases, records and other tools commonly used by environmental reporters.

UNIT IV CLIMATE ISSUES **9**

The lack of diversity in environmental journalism – “Junk science” – Battling climate denial - Covering GMOs – The problem of doomsday climate reporting – Digital security for journalists and researchers etc.

UNIT V JOURNALISTIC SKILLS **9**

Hands-on journalistic series – Reporting, developing, funding, crafting and publishing environmental stories – Writing diverse stories on environmental history, a wildlife or ocean story, a clam-aquaculture story, a work of nature writing, etc. – A polished, fact-checked, final story with questions answered and edits made from the first draft and at least two added elements such as photos, audio or video clips, graphics, timelines or others to draw people in.

TOTAL: 45 PERIODS

OUTCOMES

- Students will understand the importance of climate issues.
- Students will understand the various aspects of climate change and its effect in society.
- Students will learn to cover the climate change issues.
- Students will understand the need of journalistic skills for covering climate issues.
- Students will learn the various strategies, approaches on covering climate issues in various media.

REFERENCES

1. Lakoff, G., Why it matters how we frame the environment. In Environmental Communication, 2010.
2. Vetlesen, A. J., Nature, technology and environmental crisis. In Bhaskar, R., Næss, P., Høyer, K.G. (eds.), Eco philosophy in a World of Crisis. Critical Realism and the Nordic Contributions. London: Routledge, 2012.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

3. Ytterstad, A., The climate crisis challenges the objectivity ideal in Norwegian journalism. In Ytterstad. A., Norwegian Climate Change Policy – Between Hegemony and Good Sense, Oslo: Unipub, 2012.
4. Anker, Peder, A pioneer country? A history of Norwegian climate politics. In Climatic Change. ISSN 0165-0009. 2016.
5. Klein, N., This Changes Everything - Capitalism vs the Climate. Part 1 and 3. London: Allan Lane, 2014.
6. Stoknes, P.E., What We Think About When We Try Not to Think About Global Warming: Toward a New Psychology of Climate Action. Vermont: Chelsea Green, 2015.

EA5492 DIGITAL PHOTOGRAPHY L T P C
3 0 0 3

OBJECTIVES

- To create opportunities for professional and creative expression through the practice and art of photography.
- To inculcate aesthetic sense involved in creativity.
- To get to know the genres of photography

UNIT I CAMERA 9

Different camera formats, working of an SLR and DSLR and Mirrorless Cameras. Features and functions of SLR and DSLR Cameras. Various camera controls. Anseladams Zone system. Exposure. Image sensors. Different storage formats.

UNIT II LENS AND ELEMENTS OF PHOTOGRAPHY 9

Different type of Lenses - Basic Shots and Camera Angles, Photographic Composition - View point and Camera angle-Eye Level, Low and High, Balance- Aspects of Balancing, Shapes and Lines, Pattern, Volume, Lighting, Texture, Tone, Contrast- and Colour, Framing, various Perspectives.

UNIT III COLOUR AND LIGHTING 9

Colour Theory, Colour Temperature, Electromagnetic spectrum, Lighting Philosophies – Basic styles of Lighting – Properties of Light – Additive and Subtractive Light – Contrast and Lighting Ratios – Direct and Indirect Light – Three point and Five Point Lighting – Light Sources. Light meters and filters

UNIT IV PEOPLE AND PORTRAIT PHOTOGRAPHY 9

Indoor and outdoor lighting techniques for portraits, the Casual Portrait, Environmental Portraits, Group Portraits, Familiar Subjects, Hands and Other Details.

UNIT V GENRES OF PHOTOGRAPHY 9

Basic shooting and Lighting Techniques and Equipments required for different genres of Photography like Black and White, Landscape, Cityscape, Architecture, Advertising, Table top photography Fashion, Food, Automobile, Sports, Travel, Children, Portrait, wild life, Still Life, Event, Silhouette, Festival and Themes.

TOTAL: 45 PERIODS

OUTCOMES

- Students will be able to utilize the principles of good composition in photography.
- Students will be able to develop an individual style in representing the society through photographs.
- Students will have a thorough understanding of how to create visual variety
- Students will understand the foundation principles of design
- Students will gain understanding in Depth of field
- Students will understand the different genres of photography

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES

1. Ansel Adams, The Negative, Bulfinch press, Fourteenth Edition, 2008.
2. BalakrishnaAiyer, Digital Photojournalism, Authors press, 2005
3. Ben long, Complete Digital Photography, Charles River Media, Third Edition, 2005
4. Fil Hunter, Steven Biver, Paul Fuqua, Light - Science & Magic: an Introduction to Photographic Lighting, Focal Press,2007
5. Langford Bilissi,Langford's Advanced Photography, focal press, Seventh Edition, 2008.
6. Scott Kelby, The Digital Photography Book, Peachpit Press, 2009

AC5491 GREEN CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To introduce the basic concept and principles of green chemistry for environmental management.
- To make the students know about green reagents and its importance to the environment
- To acquaint the student with green solvents and its impacts in green chemistry
- To familiarize the synthesis of materials using green methods
- To impart the knowledge on applications of green synthesis technology

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9

History of green chemistry and sustainability- Prevention of waste/by-products – maximum incorporation of reactants in final product-Atom economy – Prevention/minimization of hazardous products – Designing safer chemicals – optimizing reaction conditions.

UNIT II GREEN REAGENTS AND CATALYSTS 9

Choice of starting materials – reagents (Dimethyl carbonate, polymer supported reagents) – catalysts (microencapsulated Lewis acids, zeolites, basic catalysts polymer supported catalysts, introduction to biocatalysts).

UNIT III GREEN SOLVENTS 9

Aqueous phase reactions (Claisen rearrangement, Aldol condensation, wurtz reaction, reduction of carbon carbon double bond, oxidation of amines into nitro compounds – Electrochemical synthesis (synthesis of adiponitrile) - Ionic liquids – reactions in acidic ionic liquids- reactions in neutral ionic liquids (hydrogenations, diels-Alder reactions, Heck reactions, O-alkylation and N-alkylation, methylene insertion reactions.

UNIT IV GREEN SYNTHESES 9

Microwave induced green synthesis (Hoffmann Elimination and Oxidation of alcohols) – Ultra sound assisted green synthesis (Esterification, Saponification and Cannizaro reaction) – Solid state green synthesis (Dehydration of alcohols to alkenes, Grignard reaction)- Solid supported organic synthesis (Synthesis of furans and pyrrole)

UNIT V APPLICATIONS OF GREEN SYNTHESIS 9

Introduction – synthesis of styrene, adipica acid, catechol, 3-Dehydroshikimic acid, methyl methacrylate, urethane. Environmentally benign synthesis of aromatic amines – free radical bromination – synthesis of ibuprofen and paracetamol.

TOTAL: 45 PERIODS

OUTCOMES

- To be familiar with basic concepts of green chemistry and apply to them in various field
- To recognize the catalytic reaction with green reagents and its importance. To identify available green solvents and apply them to various synthesis process
- To recognize the preparations of materials with green process and its application to the environment.
- To gain the knowledge of preparation of various drugs using green synthesis methods
- To be have the skills and technology towards green chemistry and apply in industry.

REFERENCES

1. V.K. Ahluwalia and M. Kidwai, New trends in Green Chemistry, Anamaya Publishers, 2004.
2. V. K. Ahluwalia, Green Chemistry, Narsoa publishers, 2012
3. Bela Torok and Timothy Dransfield ,Green Chemistry, An Inclusive Approach, 1st Edition, Elsevier, 2017.

AC5492 FOOD CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To enable the students to acquire knowledge on the macro and micro constituents of the food
- To know the structure and chemical characteristics of constituents of food.
- To demonstrate the knowledge of food chemistry and applying, the principles and concepts of chemistry as they apply to food systems.
- To familiarize the student with the relationship between water and food.
- To explain the rationale for certain food processes and preservation

UNIT I INTRODUCTION TO FOOD AND ITS PROPERTIES 12

Proteins-Enzymes- Chemistry and structure, kinetics, Maillard reaction. Food carbohydrates: Structural, nutritional and functional aspects. Emulsifiers-role of emulsifiers selection of emulsifier based on hydrophilic and Lipophilic balance (HLB) and its application. Thickeners-definition, chemical structure, gel formation, list of permitted thickeners and food application. Chemical and biochemical changes: changes occur in foods during different processing.

UNIT II PROCESSING AND PRESERVATION 12

Scope and benefits of industrial food preservation. Preservation of foods by chemicals, antibodies, antioxidants, salt and sugar. Principles of food freezing: freezing point of foods Psychrometric chart, Freeze concentration, freeze drying, IQF. Nanotechnology: Principles and application in foods, Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

UNIT III FLAVOURS AND COLOURING AGENTS 9

Chemistry of food flavor, definitions, Flavourmatics /flavouring compounds, flavor retention-off flavours and food taints. Colour -Natural and synthetic food colours, their chemical structure, stability, permitted list of colours, usage levels and food application.

UNIT IV WATER RELATIONS IN FOOD 6

Moisture in food: Structure, properties, Types of water in food and their specific function water activity and stability.

UNIT V FOOD ADDITIVES 6

Definitions, uses and functions of: Acids, Bases, Buffer system, chelating/sequestering agents, Antioxidants, Anti-caking agents, Firming agents. Flour bleating agents and Bread improvers. Anti-microbial agents/ class I & II.

TOTAL: 45 PERIODS

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OUTCOMES

- Will know about the factors governing the food quality and chemical constituents.
- Will be able to name and describe the general chemical structures of the major components of foods and selected minor components
- Will come to know about the techniques involved in food processing and preservation
- Will be acquitted with food additives and their function in preservation
- Will be familiarize with the nature of packed food from industrial processes

REFERENCES

1. Damodaran, S., Parkin, K. L., and Fennema, O.R. (2008) Fennema's Food Chemistry 4th Edition, CRC Press
2. Belitz, H-D., Grosch, W. & Schieberle, P. (2004) Food Chemistry 3rd Ed. (translation of fifth German edition), Springer
3. DeMan, J.M. Principles of Food Chemistry 4rd Ed. Aspen Publishers (2018)
4. Peter C. K. Cheng, Handbook of Food Chemistry, Vol 1, Springer Reference, 2015
5. Jaswinder Kaur and Barry H. Grump Fundamentals of Food Chemistry, Abhizeet Publications, 2010.
6. Harish Kumar Chopra and Parmjit Singh Panesar, Food Chemistry, Narosa Publication, 2010.

AG5491 NATURAL HAZARDS AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

- To teach characteristics of natural hazards.
- To teach mitigation methods for natural hazards.
- To provide knowledge on assessment and management of natural hazards.

UNIT I DISASTER PHENOMENON 9

Disaster threat - characteristics-parameters – mapping aspects for earthquake, landslides, tsunami, cyclones, flood, drought and epidemics.

UNIT II MITIGATION 9

Geological and hydrological hazards - Reduction of hazard proneness – reducing structural vulnerability – changing the functional characteristics of settlement – building code provisions.

UNIT III ASSESSMENT 9

Elements of risk – vulnerability analysis on dam and other infrastructures – risk assessment – plan area – organizational aspects, planning and mapping levels – socio-economic aspects – cost of risk reducing measures.

UNIT IV MANAGEMENT 9

Prevention – preparedness – response – recovery – resource utilization – international assistance – policy and legislation – training – public awareness.

UNIT V CASE STUDIES AND ADVANCED TOOLS 9

Post disaster review – role of remote sensing and GIS –National and state level case studies on various disasters.

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course, the students expected to be able to:

- Gain knowledge on natural hazards and their characteristics
- Have better understanding on geological and hydrological hazards
- Appreciate various mitigation techniques.
- Carryout risk assessment and vulnerability mapping
- Understand the role of remote sensing and GIS in natural hazard risk reduction.

REFERENCES

1. Nick Carter, W. Disaster management, A Disaster manager's Handbook, Publisher: Asian development bank, Manila, 1992.
2. Mitigating natural disasters: Phenomena, effects and options, a Manual for policy makers and planners. Publisher: United Nations, Hew York, 1991.
3. Edward A. Keller, DeVecchio. Natural Disasters: Earth's Processes as Hazards, Disasters and Catastophes, Routledge, 3rd Edition, 2011.
4. Harsh K. Gupta, Disaster Management, Indian National Science Academy, ISBN 8173714568,788173714566, 2006 second Edition, 152 Pages.
5. Ghanshyam Singh and Sandip Bhandari, Disaster Management, Gullybaba Publishing House (P) Ltd; 1st edition (2012), ISBN-13: 978-9381066492.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√	√	√	√	√	√	√	√
CO2	√		√	√	√	√	√	√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√		√	√	√		√	√	√
CO5	√		√	√	√	√	√			√		√

AG5492 OCEAN RESOURCES AND EXPLORATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES

- To understand the Sources of Marine Minerals.
- To understand the various energy resources pertain to marine system
- To understand the importance and economic aspects of marine minerals

UNIT I INTRODUCTION 9

Marine Mineral Resources - sources of Marine Minerals -sources in ocean basins. Formation Processes of Polymetallic Sulfides (PMS) on the Ocean Floor- Plate boundaries and associated mineral and energy occurrences.

UNIT II OCEAN RESOURCES 9

Mineral deposits derived from land sources - Placer Deposits - Lime, Phosphorite and Salt Deposits - Beach Deposits of Continental Margins - rock salt (sodium chloride) - magnesium metal - magnesium compounds and bromine. metalliferous sediments-Seafloor Polymetallic Massive Sulphides - polymetallic manganese nodules. Methane hydrate.

UNIT III ENERGY RESOURCES 9

Wind Energy - Wave Energy - Tidal Energy - Ocean Current Energy - Ocean thermal energy conversion (OTEC) - osmotic power plant-Petroleum resources and radioactive nuclear mineral deposits

UNIT IV OCEAN RESOUCE EXPLORATION AND EXPLOITATION 9

Marine sampling - Water Samplers - Bottom Samplers - Instrumentation

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V OCEAN MINERAL MINING 9

Mining aspects of deep-sea polymetallic sulphides - Manganese Nodules - Methane Hydrates. Sand, Sand Mining & Beach replenishment-Marine maps of Exclusive Economic Zone (EEZ)

TOTAL: 45 PERIODS

OUTCOMES

- Students will understand the various sources of marine minerals.
- Students will able to understand the Mineral deposits derived from land sources.
- Students will learn about the energy resources of marine system.
- Students will learn about various sampling methods and instrumentation.
- Students will able to understand the economic aspects of marine minerals.

REFERENCES

1. H. Kunzendorf, Marine Mineral Exploration, Volume 41, 1st Edition, Elsevier Science, 1986
2. David Spencer Cronan, Handbook of Marine Mineral Deposits, CRC Press, 24-Nov-1999
3. Yves Fouquet , Denis Lacroix , Deep Marine Mineral Resources, 2014th Edition, Springer Dordrecht Heidelberg London New York
4. H. Kunzendorf , Marine Mineral Exploration, ISBN-10: 0444426272, Elsevier Oceanography Series

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√	√	√	√	√	√	√	√
CO2	√		√	√	√	√	√	√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√		√	√	√	√	√		√
CO5	√		√	√	√	√	√		√	√	√	

MC5491 BASIC CRYSTALLOGRAPHY AND CRYSTAL GROWTH L T P C
3 0 0 3

OBJECTIVES

- To introduce the basics of crystal symmetry and crystal structures.
- To provide students with a background to X-ray generation and detection
- To provide instruction on the steps involved in single crystal structure determination
- To teach the concept of powder X-ray diffraction and its applications
- To teach various crystal growth techniques

UNIT I CRYSTAL SYMMETRY AND STRUCTURES 9

Crystalline and non-crystalline materials — symmetry: symmetry operations, symmetry elements - translational symmetries - point groups - space groups – equivalent positions - space lattice - crystal systems – Bravais lattices – crystal directions - crystal planes – Miller indices- interplanar spacing – coordination number– atomic radius – atomic packing factor of SC, BCC, FCC and HCP structures – linear density – planar density – close packed structures.

UNIT II X-RAYS 9

X-rays - generation of X-rays - sealed tube and rotating anode generators – synchrotron radiation – continuous and characteristic X-rays - X-ray absorption – X-ray monochromators – collimation – Soller slits - X-ray detectors (principles only)

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III SINGLE CRYSTAL STRUCTURE DETERMINATION 9

Diffraction by X-rays - Bragg's law – reciprocal lattice and Ewald sphere – atomic scattering factor - intensities of diffracted X-rays -– Single crystal X-ray diffractometers – measurement of intensities – systematic absences – space group determination - factors affecting X-ray intensities – data reduction – solving the structure - phase problem in crystallography – direct methods – refining the structure – results - geometrical parameters.

UNIT IV POWDER X-RAY DIFFRACTION 9

X-ray diffraction by polycrystalline materials - formation of powder diffraction patterns - Debye-Scherrer camera – powder X-ray diffractometer – diffractograms – sample holders – sample preparation – orientation of crystallites – sample rotation – diffraction geometries – indexing of powder pattern – applications of powder diffraction.

UNIT V CRYSTAL GROWTH TECHNIQUES 9

Bridgman technique - Czochralski method - Verneuil technique - zone melting – gel growth – solution growth methods – low and high temperature solution growth methods – vapour growth - epitaxial growth techniques- LPE – MOCVD – MPE.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course the students will

- understand crystal symmetry, crystal planes and simple crystal structures
- gain a knowledge of X-ray generation, absorption, monochromatization and detection
- get a working knowledge of single crystal structure determination
- get some insight into the powder diffraction and its applications
- be able to understand the basics of various crystal growth techniques

REFERENCES

1. Tareen, J.A.K. and Kutty, T.R.N. A Basic course in Crystallography. University Press, 2001.
2. Cullity, B.D. and Stock,S.R. Elements of X-ray Diffraction. Pearson, 2014
3. Stout, G.H. and Jensen, L. X-ray Structure Determination, A Practical Guide. Macmillan : New York, 1989.
4. Woolfson, M.M. An Introduction to X-ray Crystallography. Cambridge University Press, New York, 1997.
5. Bhat, H.L Introduction to Crystal Growth: Principles and Practice. CRC Press, 2014.

MC5492 NONLINEAR SCIENCE L T P C

3 0 0 3

OBJECTIVES

- The students will be introduced to the basics of nonlinear dynamics and its applications.
- The students will learn about the mathematical models needed to study the concepts of fixed points, oscillations, bifurcations and integrability.
- The students will know about the nonlinear dynamical phenomena in chemical systems.
- The students will understand the importance of nonlinear dynamics in biological systems.
- The students will be introduced to the concepts of nonlinear dynamical analysis in geological systems.

UNIT I NONLINEAR DYNAMICS 9

Dynamical systems - linear systems - importance of nonlinearity - nonlinear dynamical systems - Autonomous and non-autonomous systems - phase-space, flows and limit sets . Classification of equilibrium points in planar systems – periodic and chaotic motions - fractals - pattern formation - cellular automata - self-self-organised criticality - networks - stochastic resonance.

UNIT II MATHEMATICAL MODELS 9

First-order differential equations - separation of variables - slope fields - Euler's method - equilibria and phase plane - bifurcations - higher-order equations - trace-determinant plane - harmonic oscillators - equilibrium point analysis - non-autonomous systems and chaos - finite dimensional integrable systems - dispersive systems - solitary waves - solitons - analysis of soliton solutions.

UNIT III CHEMICAL SYSTEMS 9

Chemical oscillations - waves and patterns - transport and external field effects - polymer systems - coupled oscillators - Turing patterns - stirring and mixing effects - Briggs-Rauscher reaction - Belousov-Zhabotinsky reaction - BZ waves - propagating pH front - chemical clocks.

UNIT IV BIOLOGICAL SYSTEMS 9

Biological oscillators - excitable systems - neuronal systems: HH equations - FN equations - physiological control systems - dynamics of bone remodelling - dynamics of nucleic acids:Protein complexes - patterns in biological membranes - cell replication and control - pupil light reflex - dynamical analysis of human tremor - fractals in living organisms.

UNIT V GEOLOGICAL SYSTEMS 9

Computational models of earthquakes - earthquake processes - multi fractals in geosciences - entropy analysis of seismicity - tectonics - spatial distribution of earthquakes - volcanic eruptions - short and long range interactions - RJB model - precursory dynamics - landscape dynamics - dynamics of earth's magnetosphere. Snow avalanches and system model - geomorphology: drainage networks, fractal trees, growth models, diffusion-limited aggregation.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students should able to

- Understand the basics of nonlinear dynamics and its applications.
- Gain knowledge on the concepts of fixed points, oscillations, bifurcations and integrability.
- Appreciate the importance of nonlinear dynamical phenomena in chemical systems.
- Understand the role of nonlinear dynamics in biological systems.
- Apply nonlinear dynamical analysis for geological systems.

REFERENCES

1. M. Lakshmanan and S. Rajasekar. Nonlinear Dynamics: Integrability Chaos and Patterns. Springer-Verlag, 2003
2. M. Lakshmanan and K. Murali. Chaos in Nonlinear Oscillators. World Scientific,Singapore, 1996.
3. S.H.Strogatz. Nonlinear Dynamics and Chaos. CRC Press, 2014.
4. Paul Blanchard, R.L.Devaney and G.R.Hall. Differential Equations. Brooks/Cole, 2012.
5. Irving R.Epstein and J.A. Pojman. An Introduction to Nonlinear Chemical Dynamics. Oxford University Press, 1998.
6. Anne Beuter, Leon Glass, M.C.Mackey and M.S.Titcombe. Nonlinear Dynamics in Physiology and Medicine. Springer, 2003.
7. Donald L. Turcotte. Fractals and Chaos in Geology and Geophysics. Cambridge University Press, 1997.

MT5491 STATISTICAL METHODS L T P C

3 0 0 3

OBJECTIVES

- To organize and describe the data and hence compute the various descriptive measures
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions
- To expose to the basic principles of experimental design and hence carry out the analysis of variance
- To use non parametric methods on data sets which are not from normally distributed population
- To prepare the students to implement the various concepts in statistics using R statistical tool

UNIT I DESCRIPTIVE STATISTICS 9

Frequency distribution - Graphs of frequency distribution - Descriptive Measures - Quartiles and Percentiles - Calculation of sample mean and population mean

UNIT II HYPOTHESIS TESTING 9

Sampling Distributions- Central Limit Theorem - Testing a Statistical Hypothesis - Tests Concerning Means and variances - Independence of Attributes - Goodness of Fit

UNIT IV ANALYSIS OF VARIANCES 9

One way and two way classification - Completely Randomized Design - Randomized Block Design - Latin Square Design

UNIT V NONPARAMETRIC METHODS 9

Sign Test - Wilcoxon's Signed Rank Test - Rank Sum Tests - Tests of Randomness - Kolmogrov Smirnov and Anderson Darling Tests

UNIT V CALCULATIONS USING R 9

Classification and tabulation of data - Graphical representation - Calculation of central tendency and dispersion of data - Implementation of skewness, moments and kurtosis - Hypothesis Testing - Implementation of ANOVA, sign test and rank sum test.

TOTAL: 45 PERIODS

OUTCOMES

- It equips the student to compute mean, variances, quartiles and percentiles for a large set of data points obtained from a series of measurements
- It imparts the knowledge of various test statistics used in hypothesis testing for mean and variances of large and small samples
- It enables the students to compare several means
- It makes the students use sign test and rank test which can be applied to any raw data without the underlying assumptions that the observations are from normal population.
- It equips the students to implement the various concepts learnt using R tool for statistics

REFERENCES

1. Gupta S. C. and Kapoor V. K, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 11th Edition, New Delhi, 2002.
2. John E. Freund ," Mathematical Statistics with Applications", 8th Edition, Pearson Education, New Delhi, 2017.
3. Richard A. Johnson, Irwin Miller and John Freund, "Miller and Freund's Probability and Statistics for Engineers", 8th edition, Pearson Education, New Delhi, 2015.

HS5491 PROFESSIONAL EMAIL COMMUNICATION L T P C
3 0 0 3

UNIT I Email as a medium of professional communication (1 hour)

a. Clear, grammatically correct sentences
b. Clear and coherent paragraphs
c. Polite and professional expression
d. Accurate punctuation

The nature of the e-mail in its present technological state

a. The pros and cons of using email for professional communication

UNIT II Standard email conventions and etiquette

a. Conventions for effective emailing intra and inter workplaces(inclusive of formatting)
b. Interpersonal etiquette to be used in professional emailing
c. Cross- cultural dos and don'ts when using email across borders

UNIT III Understanding email messages accurately (2 hours)

a. Understanding the core message
b. Understanding the writer's intention and expectation accurately
c. Interpreting the style ad tone of the message
d. Reading and understanding messages quickly

UNIT IV Writing clear and contextually appropriate responses (12 hours)

a. Writing appropriate opening and closing sentences
b. Structuring the email logically and coherently
c. Positioning the core message for reader attention and action
d. Writing messages for a range of professional functions such as giving an update, reporting, requesting , clarifying and confirming, giving instructions etc.

UNIT V Using a range of professional styles (10 hours)

a. Maintaining courtesy and professional poise in all messages
b. Being direct or indirect as necessary
c. Being elaborate or brief as necessary
d. Being assertive and decisive when needed

TOTAL: 45 PERIODS

Learning outcome: At the end of the course, the students should

- Understand email as a professional communication medium and as it is used in workplaces today.
- Use standard e-mailing conventions and etiquette used in workplaces internationally.
- Use appropriate style and tone for communicating a variety of professional messages that are generally communicated via e-mail in work and business communication.
- Read and interpret e-mail messages accurately and write contextually appropriate responses.
- Use English accurately while writing emails in generic professional contexts.
- Use punctuation accurately while writing e-mail messages.

Assessment (with individualised feedback for mid-course tests) :

Mid-course Assessment - 1 hour + 1 hour for feedback after evaluation)

Mid-course Assessment - 2 (1 hour + 1 hour for feedback after evaluation)

Final Assessment – 2 hours (inclusive of Email English test)

Classroom teaching methodology: Concept familiarisation will be accompanied with practice in generic professional emailing contexts. Practice tests and individualised feedback will be used feedback.

Material for the course will be teacher generated

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HS5492 **PROJECT REPORT WRITING** **L T P C**
3 0 0 3

OBJECTIVES

The Course aims to,

- Develop the project writing skills of engineering graduates
- Give engineering and technology students practice in writing a project report
- Enhance their awareness on the importance of report writing in the professional context

UNIT I

Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing

UNIT II

Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis

UNIT III

Structure of the Project Report: (Part 1)Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework

UNIT IV

Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography

UNIT V

Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report orally – Techniques

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course students will be able to,

- Write reports successfully
- Analyze issues threadbare and arrive at findings based on the analysis
- Write reports for different purposes

REFERENCE BOOKS

1. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall(2012)
2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012)
3. Daniel Riordan - Technical Report Writing Today (1998)
4. Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.

HS5493 **BASIC PRESENTATION SKILLS** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to,

- Develop public speaking skills among students of engineering and technology
- Enhance the presentation skills of students
- Heighten the awareness related to the fundamentals of presentations

UNIT I

Presentation skills – Characteristics of an effective Oral Presentation – Audience - Context, Content, Speaker Status - Purpose – Modus Operandi – Extempore

UNIT II

Emphasis on syllable stress, pronunciation, intonation, pauses, pace - Preparation for a presentation – Avoiding plagiarism –Ample use of Referencing skills – Efficient ways of Collecting and Collating data (due emphasis on important information)

UNIT III

Impressive introduction – Body language – Use of icebreakers – "Start Proper" for the presentation – Relevant Anecdotes & Jokes - Responding constructively to questions – Time Management – Information sharing

UNIT IV

Impressive introduction – Body language – Use of icebreakers – "Start Proper" for the presentation – Relevant Anecdotes & Jokes - Responding constructively to questions – Time Management – Information sharing

UNIT V

Presentation skills – Guidelines – Group Presentation - Creative approaches to presenting – Technical presentation - Speaking under time constraint – variations in pitch, tone & intonation - Credibility in presentation (Use of authentic data/information) Podium panache – Effective Delivery

Learning Outcomes: At the end of the course, students will be able to,

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Michael Osborn, Susan Osborn, Randall Osborn & Kathleen J Turner, "Public Speaking: Finding Your Voice", 10th Edition, Pearson, 2012.
2. John Hughes & Andrew Mallett, "Successful Presentations DVD & Student's Pack", OUP, Oxford, 2012.
3. Nancy Duarte, "Resonate: Present Visual Stories That Transform Audiences", John Wiley & Sons, New Jersey, 2010.
4. Scott Berkun, "Confessions of a Public Speaker", O'Reilly Media, Inc, Canada, 2010.
5. Barbara Pease & Allan Pease, "The Definitive Book of Body Language", Bantum Books, New York, 2006.
6. Naomi Karten, "Presentation Skills for Technical Professionals: Achieving Excellence (Soft Skills for IT Professionals), IT Governance Publishing, UK, 2010.

AUDIT COURSES (AC)

AX5091	**ENGLISH FOR RESEARCH PAPER WRITING**	**L T P C** **2 0 0 0**

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX5092 DISASTER MANAGEMENT L T P C
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster

CO2: Ability to explaina critical understanding of key concepts in disaster riskreduction and humanitarian response.

CO3: Ability to illustratedisaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describean understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AX5093 **SANSKRIT FOR TECHNICAL KNOWLEDGE** **L T P C**
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS **6**

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES **6**

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS **6**

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE **6**

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING **6**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094 **VALUE EDUCATION** **L T P C**
2 0 0 0

OBJECTIVES

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.
Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV
Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING
1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX5095 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096 PEDAGOGY STUDIES L T P C
2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

AX5097 STRESS MANAGEMENT BY YOGA L T P C 2 0 0 0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do's and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and man kind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.