Dr. N.G.P. ARTS AND SCIENCE COLLEGE (Autonomous)

REGULATIONS 2025-26 for Post Graduate Programme
(Outcome Based Education model with Choice Based Credit System)

M.Sc. Degree

(For the students admitted during the academic year 2025-26 and onwards)

Programme: M.Sc. Chemistry

Eligibility

A pass in B.Sc. Chemistry as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent there to by the Academic Council subject to such conditions as may be prescribed there to are permitted to appear and qualify for the **Master of Science (CHEMISTRY)** Degree Examination of this College after a course study of two academic years.

Programme Educational Objectives

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To build the firm foundation in the fundamentals and correlate the application with the current developments in chemistry.
2. To get sufficient expertise in the operational knowledge and laboratory skills in all major fields of chemistry.
3. To emphasize on integrating various disciplines of Science and encourage for interdisciplinary approach.
4. To acquire problem solving capacity, interpretation of results with the use of sophisticated instruments and devises new preparation techniques.
5. To motivate the students to prepare for competitive examinations, job carriers and get trained for industrial entrepreneurship.

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	Make use of knowledge in the major fields of Chemistry which would make them to analyze the significant role played in the field of energy, materials, health sector and environment.
PO2	Select the appropriate modern scientific instruments, to plan and execute in laboratory.
PO3	Interpret the Knowledge and skills to develop independent writing reports and to execute the ideas.
PO4	Take part in research- based knowledge in interdisciplinary approach including design of experiments, analysis and interpretation of data for provide better solution in emerging issues.
PO5	Utilize the knowledge for social, economic, and environmental challenges globally and formulate for life-long learning in the broadest context of technological change.

Guidelines for Programmes offering for Semesters:

Subjects	No. of Papers	Credit	Semester No.
Core (Credits 2, 3, 4, 5)	17	70	I to IV
Extra Disciplinary Course (EDC)	1	4	II
Discipline Specific Elective (DSE)	4	4 x 4 = 16	I to IV
Internship (IT)	1	2	III
TOTAL CREDITS		**92**	

PG Curriculum

Programme Name -M. Sc Chemistry

A.Y: 2025-26

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
First Semester												
25CEP1CA	Core -I	Organic Reaction Mechanism	4	1	-	5	60	3	25	75	100	4
25CEP1CB	Core -II	Coordination Chemistry	4	1	-	5	60	3	25	75	100	4
25CEP1CC	Core -III	Thermodynamics and Kinetics	4	1	-	5	60	3	25	75	100	4
25CEP1CD	Core -IV	Analytical Chemistry	4	1	-	5	60	3	25	75	100	4
25CEP1CP	Core Practical -I	Organic Chemistry	-	-	6	6	72	6	40	60	100	3
25CEP1DA	DSE-I	Polymer Chemistry	4	-	-	4	48	3	25	75	100	4
25CEP1DB		Industrial Chemistry										
25CEP1DC		Green Chemistry										
Total			**20**	**4**	**6**	**30**	**360**				**600**	**23**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Second Semester												
25CEP2CA	Core -V	Stereochemistry and Pericyclic Reactions	4	1	-	5	60	3	25	75	100	4
25CEP2CB	Core -VI	Bio-Inorganic Chemistry	4	-	-	4	48	3	25	75	100	4
25CEP2CC	Core -VII	Molecular Spectroscopy	4	1	-	5	60	3	25	75	100	4
25CEP2CP	Core Practical -II	Inorganic Chemistry	-	-	8	8	96	6	40	60	100	4
25BCP2EA	EDC	Drug Biochemistry	4	-	-	4	48	3	25	75	100	4
25CEP2DA		Cosmetic Chemistry										
25CEP2DB	DSE - II	Electrochemistry	4	-	-	4	48	3	25	75	100	4
25CEP2DC		Organic Reactions and Reagents										
		Total	**20**	**2**	**8**	**30**	**360**				**600**	**24**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Third Semester												
25CEP3CA	Core -VIII	Chemistry of Natural Products	4	1	-	5	60	3	25	75	100	4
25CEP3CB	Core -IX	Inorganic Chemistry	4	1	-	5	60	3	25	75	100	4
25CEP3CC	Core -X	Quantum Chemistry and Group Theory	4	1	-	5	60	3	25	75	100	4
25CEP3CD	Core -XI	Analytical Spectroscopy	4	1	-	5	60	3	25	75	100	4
25CEP3CP	Core Practical – III	Physical Chemistry	-	-	6	6	72	6	40	60	100	3
25CEP3CT	IT	Internship							40	60	100	2
25CEP3DA	DSE - III	Dye and Textile Chemistry	4	-	-	4	48	3	25	75	100	4
25CEP3DB		Nanomaterials and Nanotechnology										
25CEP3DC		Bio-Organic Chemistry										
Total			**20**	**4**	**6**	**30**	**360**				**700**	**25**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Fourth Semester												
25CEP4CA	Core-XII	Synthetic Organic Chemistry	4	1	-	5	60	3	25	75	100	4
25CEP4CB	Core-XIII	Statistical Thermodynamics and Computational Chemistry	4	1	-	5	60	3	25	75	100	4
25CEP4CV	Core-XIV	Project and Viva voce	-	-	16	16	192	-	80	120	200	8
25CEP4DA	DSE - IV	Environmental Chemistry	4	-	-	4	48	3	25	75	100	4
25CEP4DB		Catalysis										
25CEP4DC		Medicinal Chemistry										
		Total	**12**	**2**	**16**	**30**	**360**				**500**	**20**
			***Grand Total**								**2400**	**92**

Theory : CIA 25: ESE 75
Practical/ IT : CIA 40: ESE 60
Project : CIA 80: ESE 120

***Total Credits does not exceed 92 credits**

DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I-IV

Semester I (Elective I)

List of Elective Courses

S.No.	Course Code	Name of the Course
1	25CEP1DA	Polymer Chemistry
2	25CEP1DB	Industrial Chemistry
3	25CEP1DC	Green Chemistry

Semester II (Elective II)

List of Elective Courses

S.No.	Course Code	Name of the Course
1	25CEP2DA	Cosmetic chemistry
2	25CEP2DB	Electrochemistry
3	25CEP2DC	Organic Reactions and Reagents

Semester III (Elective III)

List of Elective Courses

S.No.	Course Code	Name of the Course
1	25CEP3DA	Dye and Textile Chemistry
2	25CEP3DB	Nanomaterials and Nanotechnology
3	25CEP3DC	Bio-Organic Chemistry

Semester IV (Elective IV)

List of Elective Courses

S.No.	Course Code	Name of the Course
1	25CEP4DA	Environmental Chemistry
2	25CEP4DB	Catalysis
3	25CEP4DC	Medicinal Chemistry

EXTRA CREDIT COURSES

The following are the courses offered under self-study to earn extra credits:

Semester III

S.No.	Course Code	Course Name
1	25CEPSSA	Research Methodology
2	25CEPSSB	Forensic Chemistry and Crime Investigation

Semester – I CORE: ORGANIC REACTION MECHANISM							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25CEP1CA	ORGANIC REACTION MECHANISM	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The basic principles of acids and bases, electronic effects and aromaticity of organic compounds • The mechanism involving in the various aliphatic, aromatic electrophilic and nucleophilic substitution reactions • The basic knowledge about addition, elimination reactions involved in multiple bonds.
Prerequisite	Knowledge on Organic Chemistry

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Apply the electronic effects in organic chemistry, stability of organic compounds.	K3
CO2	Utilize various methods to determine the reaction mechanisms.	K3
CO3	Summarize reaction mechanisms of nucleophilic substitution reactions	K3
CO4	Illustrate the reaction mechanisms of electrophilic substitution reactions.	K4
CO5	Compare the addition and elimination reactions.	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓			✓	✓
CO2		✓	✓		
CO3	✓	✓		✓	
CO4			✓		
CO5	✓	✓	✓	✓	✓

25CEP1CA | ORGANIC REACTION MECHANISM

Syllabus

Unit	Content	Hrs	Resources
I	**Electronic Effects and Aromaticity** Electron displacement – Inductive and field effect – Delocalized bonds – Rules of resonance - Steric inhibition of resonance - Steric enhancement of resonance – Hyperconjugation – Hydrogen bonding. Aromaticity: Aromatic systems with 2,6 and 10 electrons - Alternant and non-alternant hydrocarbons, systems of more than 10 electrons – Annulenes - Azulenes - Ferrocene and Syndones - Concept of homo aromaticity.	12	Text Book
II	**Methods of Determining Reaction Mechanism** Thermodynamic and kinetic requirements of reactions: Types of mechanism - Thermodynamic and kinetic control – Methods of determination of reaction mechanism – Determination of the presence of intermediate – Isolation - Detection - Trapping – Cross over experiments – Isotopic labeling – Isotopic effect – Kinetic evidence. Curtin Hammett principle - Hammett equation – Hammond postulates - Limitations and deviations – Taft equation	12	Text Book
III	**Aliphatic & Aromatic Nucleophilic Substitution Reactions** S_N1, S_N2, S_Ni and neighboring group participation - Kinetics - Effect of structure, solvent, leaving and entering group and Stereochemistry. Claisen and Dieckmann condensation. Mechanism of aromatic nucleophilic substitution - S_N^{Ar} and Benzyne mechanism - Chichibabin reaction - Cine substitution	12	Text Book
IV	**Aliphatic & Aromatic Electrophilic Substitution Reactions** S_E1 and S_E2 reactions - Mechanisms and reactivity - Ketoenol tautomerism - Halogenation of carbonyl compounds - Stork enamine reaction - Aromatic electrophilic substitution - Orientation and mechanism - Nitration - Halogenation and - Friedel-Crafts alkylation - Friedel Crafts acylation - Vilsmeyer-Haack reaction - Bischler Napieralski reaction.	12	Text Book

V	**Addition and Elimination Reaction** Addition to C-C and C-O multiple bonds – Electrophilic - Nucleophilic and free- radical additions - Birch reduction - Michael addition - Diels-Alder reaction - Meerwein – Pondorf reduction - Stobbe condensation. Elimination reactions - E_1 and E_2 mechanism - Orientation - Hofmann and Saytzeff rules - Elimination versus substitution - Hofmann degradation and Cope eliminatio.	12	Text Book
	Total	**60**	

Text book	1.	Michael B. Smith, 2015, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7^{th} Edition, Willey & USA.
	2.	Morrison R.N. Boyd R.N. and Bhattacharjee, 2010, "Organic Chemistry", 7^{th} Edition, Pearson Education &UK.
Reference Books	1.	Bansal R.K., 2012, "Organic Chemistry Reaction mechanisms."7^{th} Edition, New Age International Private Ltd & New Delhi.
	2.	Lowry and Richardson, 1997, "Mechanism and theory in organic chemistry", 3^{rd} Edition. Pearson Publishers & UK.
	3.	Clayden J, Greeves N and Warren S, 2014, "Organic Chemistry" 2^{nd} Edition, Oxford University Press & UK.
	4.	Nasipuri D, 2018, "Stereochemistry of Organic Compounds: Principles and Applications", 3^{rd} Edition, New Age International Publishers & New Delhi.

Journal and Magazines	https://www.sciencedirect.com/topics/chemistry/michael-addition
E-Resources and Website	https://archive.nptel.ac.in/courses/104/101/104101115/

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/Case Study

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester – I CORE: COORDINATION CHEMISTRY							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	25CEP1CB	COORDINATION CHEMISTRY	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The basic principles of coordination chemistry • The mechanism involving in coordination complexes • The basic knowledge about structure and bonding in metal carbonyls.
Prerequisite	Knowledge on Coordination Chemistry

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Interpret the various theories of coordination compounds, MO diagrams of complexes.	K3
CO2	Outline the various types of reaction mechanism of coordination complexes.	K3
CO3	Compare the various symmetries and geometries of coordination complexes	K3
CO4	Examine the structure and bonding of metal carbonyls.	K4
CO5	Analyse the importance of electronic spectroscopy.	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓				✓
CO2		✓	✓		
CO3	✓	✓		✓	✓
CO4			✓		✓
CO5	✓	✓		✓	✓

25CEP1CB	COORDINATION CHEMISTRY

Syllabus

Unit	Content	Hrs	Resources
I	**Theories of coordination compounds** Valence bond and Crystal field theory - Splitting of d orbitals in ligand field and different symmetries - Crystal Field Stabilization Energy - Factors affecting the magnitude of 10 Dq - Evidence for crystal field stabilization – Spectrochemical series - Site selection in spinels - Tetragonal distortion from octahedral symmetry - Jahn-Teller distortion – Nephelauxetic effect – Molecular orbital theory - Octahedral – Tetrahedral and square planar complexes - pi bonding and molecular orbital theory.	12	Text Book
II	**Reaction mechanism in coordination complexes** Theories of trans effect - The rate law for nucleophilic substitution reaction and mechanism of square planar complexes - Kinetics and substitution reaction mechanism of octahedral complexes. Ligand field effects and reaction rates - Reaction rates influenced by acid and bases – Racemization and isomerization - Mechanism of redox reaction – Outer sphere mechanism - Inner sphere mechanism	12	Text Book
III	**Structure of coordination complexes** Complexes with coordination number two, three, four, five six, seven and eight - Site preference in trigonal bipyramidal and square pyramidal complexes - Isomerism in five coordinate complexes - Distortion from perfect octahedral symmetry - Trigonal prism - Geometrical isomerism in octahedral complexes.	12	Text Book
IV	**Structure and bonding in metal carbonyls** Metal carbonyl complexes - Classification- synthesis - Structure and properties - 18 electron and EAN rule – Nature of M-CO bonding - Binding mode of CO and IR spectra of metal carbonyls - Metal carbonyl hydrides -Metal nitrosyl complexes.	12	Text Book

V	**Electronic spectra and magnetism** Microstates, terms and energy levels for d^1 – d^9 ions in cubic and square fields - Selection rules - Band intensities and band widths - Energy level diagrams of Orgel and Tanabe – Sugano - spectra of V^{3+} and Ni^{2+} - Calculation of 10Dq and magnetic moment for V^{3+} (oct) and Ni^{2+} (oct) complexes - Charge transfer spectra - Change in magnetic properties of complexes in terms of spin orbit coupling - Temperature independent paramagnetism.	12	Text Book
	Total	**60**	

Text book	1.	Huheey. J.E, Keiter. E.A and Keiter. R.L, 2006, "Inorganic Chemistry, Principles of Structure and Reactivity", 1st Edition, Pearson Education & UK..
	2.	Cotton. F.A, Wilkinson. G, Murillo. C.A and Bochmann. M, 1999, "Advanced Inorganic Chemistry", 6th Edition, A Wiley - Interscience Publications, John Wiley and Sons & USA.
Reference Books	1.	J.D. Lee, 2022 "Concise Inorganic Chemistry 5th Edition, Oxford University Press & UK.
	2.	Gurdeep Raj, 2014, "Advanced Inorganic Chemistry", 12th Edition, Geol Publishing House & New Delhi
	3.	Shriver. D. F, Weller. M.T, Overton. T, Rourke. J and Armstrong. F.A, 2014, "Inorganic Chemistry", 6th Edition, New York, W.H. Freeman and Company & USA.
	4.	Stephen J Lippard, 2005, "Principles of Bioinorganic Chemistry", 2nd Edition, Panima publishing corporation & New Delhi.

Journal and Magazines	https://www.tandfonline.com/journals/gcoo20
E-Resources and Website	https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Inorganic- Chemistry-Volume-1/ATOICV1-8-3-Orgel-and Tanabe-Sugano-Diagrams-for- Transition-Metal-Complexes-d1-d9-States.pdf

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/Case Study

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester – I CORE: THERMODYNAMICS AND KINETICS							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25CEP1CC	THERMODYNAMICS AND KINETICS	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The Fundamentals of equilibrium and non- equilibrium thermodynamics • The chemical equilibrium and catalysis • The application-oriented knowledge about electrochemistry.
Prerequisite	Knowledge on Basic of Thermodynamics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Analyse the concepts of equilibrium thermodynamics.	K4
CO2	Understand the concepts of non-equilibrium thermodynamics.	K3
CO3	Analyze the concepts and functions of electrochemical reactions	K4
CO4	Interpret the knowledge about chemical kinetics in molecular reactions.	K4
CO5	Apply concept involved in catalysis and adsorption.	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2		✓			✓
CO3	✓			✓	
CO4			✓		
CO5	✓	✓		✓	✓

25CEP1CC	THERMODYNAMICS AND KINETICS

Syllabus

Unit	Content	Hrs	Resources
I	**Equilibrium thermodynamics** Gibbs - Helmholtz equation - Maxwell relations - Third law and its limitations - Thermodynamics of systems of variable compositions - Partial molar quantities and their determination- Chemical potential - Gibbs-Duhem equation - Gibbs- Duhem-Margules equation - Fugacity - Determination of fugacity of gases by graphical method and from equations of state – Variation of fugacity with temperature - Fugacity (or activity) coefficient.	12	Text Book
II	**Non-equilibrium thermodynamics** Phenomenological laws and Onsager Reciprocal relations - Conservation of mass and energy in closed and open system- Entropy production in heat flow and chemical reactions - Entropy production and entropy flow in open systems - Principles of microscopic reversibility - Onsager's theory - Validity and its verification	12	Text Book
III	**Electrochemistry** Activity - Mean ion activity and mean activity coefficient of electrolytes in solution - Debye-Huckel theory and limiting law - Debye-Hückel-Onsager equation verification and limitations. The electrical double layer - Structure and models (Helmholtz, Guoy-Chapman and Stern) - Kinetics of electrode processes - Current-potential curve - Butler Volmer relation and its approximations - Tafel equation - Charge transfer resistance	12	Text Book
IV	**Chemical Kinetics – I** Theories of reaction rates – Collision - transition State - Lindemann - Hinshelwood - Rice – Ramsperger – Kassel theory (RRK), Rice–Ramsperger – Kassel–Marcus (RRKM) theory - Slater treatments - Fast reaction kinetics – Stopped flow method - Chemical relaxation method.	12	Text Book
V	**Chemical Kinetics - II** Homogenous catalysis - Hammett acid-base catalysis - Acidity function - Enzyme catalysis – Michaelis – Menton kinetics - Lineweaver Burk plot – Influence of pH and temperature on enzyme catalysis Heterogeneous catalysts - Adsorption and free energy relation	12	Text Book

	at interfaces - Gibbs adsorption isotherm - Adsorption isotherms (Langmuir and BET) - Measurement of surface area - Kinetics of heterogeneous catalysis (Langmuir Hinshelwood mechanism and Eley-Rideal mechanism).		
	Total	**60**	

Text book	1.	Atkins. P and Julio de Paula, 2014, "Physical Chemistry" 10th Edition, Oxford University Press & UK.
	2.	Glasstone. S, 2008, "Thermodynamics for Chemists", 11th Edition, Ewp Publishers & USA.
Reference Books	1.	Grow. D.R, 1994, "Principles and applications of electrochemistry", 4th Edition, CRC Press publishers & UK.
	2.	Laidler. K.J, 2003, "Chemical Kinetics", 3rd Edition. Pearson Education Publishers & India
	3.	Bockris. J.O.M and Reddy A. K. N, 1998, "Modern Electrochemistry", 4th Edition, Plenum Press & US.
	4.	Adamson. A.W, 1982, "Physical chemistry Surfaces", 4th Edition, Wiley-Blackwell, USA.

Journal and Magazines	https://link.springer.com/journal/10800
E-Resources and Website	https://archive.nptel.ac.in/courses/104/101/104101128/

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/Case Study

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester – I CORE: ANALYTICAL CHEMISTRY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25CEP1CD	ANALYTICAL CHEMISTRY	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The nature of errors and their types • Various techniques involved in chromatography • Thermo analytical, Radiochemical, Fluorescence and electroanalytical techniques.
Prerequisite	Knowledge on Analytical Chemistry

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Identify the nature of errors and their analysis.	K3
CO2	Apply the various methods of chromatographic techniques.	K3
CO3	Examine the Spectrophotometry, XRD and Fluorescence Spectroscopy.	K3
CO4	Explain the basic analysis of Thermal methods of analysis.	K4
CO5	Analyse the various electroanalytical techniques.	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2		✓			✓
CO3	✓				✓
CO4		✓	✓	✓	
CO5	✓		✓	✓	✓

25CEP1CD | ANALYTICAL CHEMISTRY

Syllabus

Unit	Content	Hrs	Resources
I	**Data and error analysis** Types of errors (accuracy, precision, significant figures) – Frequency distributions (Binomial, Poisson and normal). Describing data - Population and sample - Mean – Variance and standard deviation. Way of quoting uncertainty – Robust estimators - Repeatability and reproducibility of measurements. Hypothesis testing - Levels of confidence and significance - Analysis of residuals.	12	Text Book
II	**Chromatography** Principles, instrumentation and uses of ion exchange - Paper - Thin-layer and column chromatography –High Performance Thin Layer Chromatography (HPTLC) - High Performance Liquid Chromatography (HPLC) – Gas Chromatography and Mass Spectroscopy (GC-MS) - Gas Chromatography and Field Ionization Detector (GC-FID), Gas Chromatography and Electron Capture Detector (GC-ECD) and Gas Chromatography and Pulsed Flame Photometric Detector (GC-PFPD).	12	Text Book
III	**Spectrophotometry, XRD and fluorescence spectroscopy** Principles, instrumentation and applications of Atomic Absorption Spectrophotometry (AAS) - Flame Emission Spectroscopy (FES) and Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) - Single crystal and powder XRD (X-ray diffraction) - Fluorescence spectroscopy.	12	Text Book
IV	**Thermal methods of analysis** Principles - Instrumentations and applications of thermogravimetry analysis (TGA) - Differential Thermal Analysis (DTA) - TGA and DTA of $CaC_2O_4.H_2O$ (Calcium oxalate monohydrate), $CuSO_4.5H_2O$ (Copper Sulphate Penta hydrate), $CaCO_3$ (Calcium carbonate) - Differential Scanning Calorimetry (DSC) - Poly lactic acid (PLA)	12	Text Book
V	**Electroanalytical techniques** Electrochemical sensors - Ion-sensitive electrodes – Glass membrane - Solid - liquid membrane - Gas sensor. Principles and instrumentations of polarography - Cyclic voltammetry - Amperometric titrations	12	Text Book
	Total	**60**	

Text book	1.	Skoog and West, 2014, "Instrumental methods of analysis" 6th Edition, Cengage Publishers & USA.
	2.	Sharma B.K, 2011, "Instrumental methods of chemical analysis", 1st Edition, Krishna Prakashan Media pvt. Ltd & New Delhi
Reference Books	1.	Willard H.W, Merrit. L.I, Dean. J.J.A and Settle. F.A, 2004, "Instrumental methods of analysis". 7th Edition, CBS Publishers & New Delhi.
	2.	Srivastava.V.K and Srivastava. K.K, 1985, "Introduction to Chromatography," 2nd Edition, Holden Day & New York
	3.	Hibbert. D.B and Gooding. J.J, 2006, "Data Analysis for Chemistry", 1st Edition, Oxford University Press & UK.
	4.	Bard. A. J and Faulkner. L. R, 2001, "Electrochemical Methods-Fundamentals and Applications", 2nd Edition, John Wiley & Sons, USA.

Journal and Magazines	https://www.jscimedcentral.com/journal-info/JSM-Spectroscopy-and-Chromatography
E-Resources and Website	http://www.issp.ac.ru/ebooks/books/open/XRay_Spectroscopy.pdf

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/Case Study

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester – I CORE PRACTICAL: ORGANIC CHEMISTRY							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	25CEP1CP	ORGANIC CHEMISTRY	CORE		-	72	3

Preamble	This course has been designed for students to learn and understand • The method of analysis to identify common functional groups • The practice to estimate phenol and aniline • The laboratory skill to perform organic compound preparation
Prerequisite	Knowledge on type of organic functional groups

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Evaluate the methodology to separate organic mixture	K4
CO2	Analyze special elements present in the organic compound	K3
CO3	Identify the functional groups present in the organic compound	K3
CO4	Estimate the number of organic molecules present in the solution metals present in the mixture	K4
CO5	Demonstrate the preparation of organic compounds	K3

Mapping with Program Outcomes:					
Cos / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓		✓	✓	
CO3	✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓
CO5	✓			✓	

25CEP1CP	ORGANIC CHEMISTRY

S.No	List of Experiments
1	Analysis of organic mixture -I
2	Analysis of organic mixture -II
3	Analysis of organic mixture -III
4	Analysis of organic mixture -IV
5	Analysis of organic mixture -V
6	Estimation of Phenol
7	Estimation of Aniline
8	Estimation of Glucose
9	Preparation of Acetylsalicylic acid from methyl salicylate
10	Preparation of Benzilic acid from benzoin (rearrangement)
11	Preparation of Benzanilide from benzophenone (rearrangement)
12	Preparation of p-Bromoacetanilide from aniline

Texk Books	1.	N.S.Gnanaprakasam and Ramamurthy.G,1998, "Organic Chemistry-Lab Manual",S.Viswanathan Co. Pvt. Ltd & Chennai.
	2.	B.S.Furniss, Brain.S, Hannaford A.J, and Antony.J, 2016, "Vogel's Text book of Practical Organic Chemistry", 5th Edition, ELBS/Longman & UK.

Learning Method	Demonstration/ Hands on Experiments

Focus of the Course	Skill Development/ Employability

Semester – I DSE: POLYMER CHEMISTRY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25CEP1DA	POLYMER CHEMISTRY	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The significance of polymers • Polymer structure, properties and characteristics • Polymer processing techniques and its applications.
Prerequisite	Knowledge on Polymer Chemistry

Course Outcomes (COs)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Summarize the mechanism of polymerization process.	K3
CO2	Categorize the different polymerization techniques.	K4
CO3	Analyze the various characteristics of polymers	K4
CO4	Examine the structure, properties and fabrication techniques.	K4
CO5	Categorise the commercial polymers and applications.	K5

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1		✓	✓	✓	✓
CO2		✓			
CO3	✓	✓		✓	
CO4			✓		
CO5	✓	✓		✓	✓

25CEP1DA	POLYMER CHEMISTRY

Syllabus

Unit	Content	Hrs	Resources
I	**Chemistry of polymers** Addition and Condensation polymers - Mechanism (free radical, ionic, Zeigler-Natta polymerization) – Kinetics of polymerization – Kinetic chain length –Factors affecting chain polymerization - Inhibition and retardation – Carother's equation. Difference between polymers and plastics-Compounding of plastics - Fillers, plasticizers, colourants, auto oxidants, fire retardants and thermal stabilizers.	10	Text Book
II	**Polymerization techniques and types** Polymerization Techniques (bulk, solution, suspension, emulsion, melt, interfacial solid-gas phase condensation). Types of copolymerization – Free radical - Ionic – Polycondensation – Copolymer equation – Significance – Monomer and radical reactivity – Q-e scheme - Determination of monomer reactivity ratio – Mayo-Lewis and Fineman Ross methods – Block and graft copolymerization – Methods of preparation and mechanism	10	Text Book
III	**Polymer characteristics and characterization** Types of degradation – Thermal- Mechanical - Photodegradations - The concept of number average and weight average molecular weight methods. Separation of polymers – Precipitation and analytical methods – Determination of molecular weights – Osmotic pressure - Viscosity - Ultra centrifugation. Analysis and testing of polymers - Spectroscopic methods, x-ray diffraction study	10	Text Book
IV	**Polymer properties and fabrication** Morphology and order in crystalline polymers – Configuration of polymer chain – Tacticity (Mono and disubstituted polyethylene, polypropylene, polybutadiene). Significance of stereoregularity - Polymer structure and physical properties – Crystalline melting point (Tm) – Melting points of homogeneous series – Effect of chain flexibility and heat of fusion - The glass transition temperature (Tg) Relationship between Tm and Tg - Fabrications of polymers – Moulding, casting and spinning	9	Text Book

V	**Commercial polymers and applications** Preparation, properties and applications of polyethylene - Polyvinyl chloride - Polyamides - Polyesters - Polymethylmethacrylate - Polystyrene - Polycarbonates - Phenolic resins and epoxy resins. Types and applications of conducting polymers and biopolymers. Liquid crystalline polymers	9	Text Book
	Total	**48**	

Text book	1.	Gowariker. V.R and Viswanathan. N.V, 2019, "Polymer science", 3rd Edition, New Age International Publishers & New Delhi.
	2.	Bhatnagar, M.S. 2004, "A Textbook of Polymers: Chemistry and Technology of Polymers. Processing and Applications", Vol. II. 1st Edition, S Chand, New Delhi..
Reference Books	1.	Manas Chanda, 2013, "Introduction to Polymer Science and Chemistry", 2nd Edition, CRC Press & USA..
	2.	Goel R. Fried, 2003, "Polymer science and technology", 2nd Edition, Prentice Hall & New Jersey
	3.	George Odian,2007, "Principles of polymerization", 4th Edition, Wiley India Pvt. Ltd & New Delhi..
	4.	Billmeyer. F.W, 2007, "Text book of Polymer science", 3rd Edition, Wiley India Pvt.Ltd & New Delhi..

Journal and Magazines	Polymer Chemistry, Journal of Polymer Science
E-Resources and Website	https://nitsri.ac.in/Department/Chemical%20Engineering/M3__Polymer_Technology.pdf

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester – I DSE: INDUSTRIAL CHEMISTRY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25CEP1DB	INDUSTRIAL CHEMISTRY	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The properties and manufacture of glass products • The coating techniques • The classification and properties of alloys
Prerequisite	Knowledge on industrial chemistry

Course Outcomes (COs)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Summarize the properties and preparation of glass products.	K3
CO2	Utilize the coating process of paint and pigments.	K3
CO3	Illustrate the various types and properties of alloying Materials.	K3
CO4	Analyse the types and manufacturing process of fertilizer.	K4
CO5	Develop the various types and manufacturing process of cement and ceramics.	K3

Mapping with Program Outcomes:

Cos / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2		✓	✓		
CO3	✓	✓		✓	✓
CO4			✓		
CO5	✓	✓		✓	✓

25CEP1DB	INDUSTRIAL CHEMISTRY

Syllabus

Unit	Content	Hrs	Resources
I	**Silicon industries** Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass - Composition and properties of the glasses - Soda lime – Lead - Armoured - Safety - Borosilicate - Fluorosilicate – Coloured - Photosensitive. Chemistry of refractories and Abrasives.	10	Text Book
II	**Surface coatings** Objective of coating surfaces - Preliminary treatment of surface - Classification of surface coatings - Paints and pigments - Formulation and composition of Oil paint, Vehicle, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents - Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint). Wax polishing-Water and Oil paints - Metallic coatings (electrolytic and electroless). Metal spraying and anodizing	10	Text Book
III	**Alloys** Classification of alloys (ferrous and non-ferrous) -Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization and dephosphorization, Surface treatment, argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels	10	Text Book
IV	**Fertilizer** Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, polyphosphate, superphosphate, and triple super phosphate. Compound and mixed fertilizers - Potassium chloride - Potassium sulphate	10	Text Book
V	**Ceramics and cements** Ceramics: clays and feldspar-Manufacture of ceramics and their types - High technology ceramics and their applications - Superconducting and semiconducting oxides - Fullerenes - Carbon nanotubes and carbon fibre. Cements: Classification of cement - Ingredients and their role - Manufacture of cement and the setting process- Quick setting cements	8	Text Book
	Total	**48**	

Text book	1.	Sharma.B .K , 2003 ,"Industrial Chemistry", 22nd edition, Goel Publishing House & Meerut
	2.	White. H.L, 1986, "Introduction to Industrial Chemistry", 1st edition, A Wiley Interscience Publication & USA.
Reference Books	1.	Pawar. R.A, Gugale. G.S, Nagawade. A.V, Gadave. K.M, 2017, "A Book of Industrial Chemistry", 1st edition, NiraliPrakashan Publishers & Pune.
	2.	Alan Heaton, 1996, "An Introduction to Industrial chemistry", 3rd edition, Chapman & Hall Publishers & UK
	3.	Uppal. M.M, 2001, "Textbook of Engineering Chemistry", 6th Edition, Khanna Publishers & New Delhi.
	4.	Jain and Jain, 2017," Engineering Chemistry", 17th edition, Dhanpat Rai & Sons&New Delhi

Journal and Magazines	https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCH1604.pdf
E-Resources and Website	https://www.scribd.com/document/491788610/Metal-and-Metal-Alloys-Notes#

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester – I DSE: GREEN CHEMISTRY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25CEP1DC	GREEN CHEMISTRY	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The basics of green chemistry • The advantages of green synthetic methods of organic compounds • The reactions and applications of green chemistry
Prerequisite	Knowledge on green chemistry

Course Outcomes (COs)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Gain knowledge on green chemistry principles.	K3
CO2	Understand various methods of Green synthetic routes.	K3
CO3	Develop the basic knowledge of the various green reactions.	K3
CO4	Compare Aqueous phase, Solid state and PTC reactions.	K4
CO5	Analyze the Photochemical, Microwave, Sonication and Ionic liquid reactions.	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓			✓	✓
CO2		✓	✓		
CO3	✓	✓		✓	
CO4	✓		✓		✓
CO5	✓	✓		✓	✓

25CEP1DC	GREEN CHEMISTRY

Syllabus

Unit	Content	Hrs	Resources
I	**Principles of green chemistry** Twelve principles of green chemistry - Explanation. Planning a green synthesis - Percentage atom utilization – Evaluating type of reaction involved - Selection of appropriate solvent – Reagent - Protecting groups - Use of catalyst – Energy requirement.	10	Text Book
II	**Green synthesis** Adipic acid - Catechol - Disodiumiminodiacetate - Hoffmann elimination - Benzoic acid from methyl benzoate - Toluene - Diels-Alder reaction- Decarboxylation - Safe marine antifoulant	10	Text Book
III	**Green reactions** Mechanism and application of Acyloin condensation – Aldol condensation – Arndt-Eistert-synthesis – Baeyer Villiger oxidation - Baker Venkatraman Rearrangement -Barbier reaction - Barton reaction - Baylis-Hillman Reaction - Backmann rearrangement - Benzil-Benzilic rearrangement Biginelli reaction	10	Text Book
IV	**Aqueous phase, solid state and PTC reactions** Aqueous phase reaction - Hydrolysis of methyl salicylate – Chalcone - p-ethoxy acetanilide- p-acetamido phenol - Vanillidene acetone. SFE (Super Critical Fluid Extraction) - Liquid CO_2 in green synthesis. Solid state - Diphenyl carbinol - Phenyl benzoate - Azomethines. PTC (Phase Transfer Catalyst) reaction – Phenylisocyanide- Diphenyl-7 Hydroxycoumarin.	10	Text Book
V	**Photochemical, microwave, sonication and ionic liquid reactions** Photochemical reactions - Benzopinacol, trans Azobenzene to cis-azobenzene, trans stilbene to cis-stilbene. Microwave reactions-3-methyl-1-phenyl-5-pyrazolone, copper phthalocyanine. Sonication reaction – Butyraldehyde. Ionic liquid reactions-1-Acetyl Naphthalene – Green hydrogen Products and Green ammonia	8	Text Book
	Total	**48**	

Text book	1.	Ahluwalia. V. K. 2011, "Green Chemistry-Greener Alternatives to synthetic alternatives to synthetic organic transformations", 1st edition, Narora Publishing House & New Delhi.
	2.	Ahluwalia V. K, 2019, "Green Chemistry", 3rd edition, Ane Books India & NewDelhi.
Reference Books	1.	Asim. K. Das and Madhua. Das, 2012, "Environmental Chemistry with Green Chemistry" , Books and Allied Pvt. Ltd &New Delhi.
	2.	Rashmi S, Srivastava M.M, 2009. "Green Chemistry" 4th edition, NarosaPublishing House & New Delhi
	3.	Indu Tucker Sidhwani, Rakesh K. Sharma, 2020," An Introductory Text on Green Chemistry: For Undergraduate Students", 1st edition, Wiley & Sons & Germany.
	4.	Kumar V, 2010, "An Introduction to Green Chemistry", 2nd edition, Vishal Publishing Co & New Delhi

Journal and Magazines	https://simons.hec.utah.edu/papers/BOOK2_C7.PDF
E-Resources and Website	https://www.uou.ac.in/sites/default/files/slm/MSCCH-604.pdf

Learning Method	Chalk and Talk/ Assignment/Seminar/ Group Discussion

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations