Effective from January-2022

Faculty of Science **PhD Chemistry**

DEPARTMENT OF CHEMISTRY,

VEER NARMAD SOUTH GUJARAT UNIVERSITY

SURAT -395007

Name of Program	**PhD (Chemistry)**
Abbreviation	**PhD**
Duration	**3 Years**
Eligibility Criteria	**M.Sc. Chemistry**
Objective of Program	1. Develop a deeper understanding of their area of expertise. 2. Conduct and assess research in their area of specialty and adjacent fields by mastering analytical and methodological capabilities. 3. Produce novel research in the area of expertise. 4. Demonstrate the capacity to clearly and effectively convey the findings of their study. 5. Demonstrate an ability to work effectively with other people from various ethnic, educational, and work experience backgrounds. 6. Demonstrate an awareness of and concern for high ethical standards in business research, education, and service. 7. Demonstrate your competence to teach college-level courses in your field of expertise.
Program Outcome	1. Demonstrate a thorough understanding of a substantial body of knowledge with expertise that is at the forefront of an academic discipline or area of professional practice. 2. Demonstrate awareness of the limitations of one's own work and discipline, the complexity of knowledge, and the potential contributions of other interpretations, methods, and disciplines. 3. Awareness of the complexity of knowledge and of the potential contributions of other interpretations, methods, and disciplines. 4. Conceptualize, design and implement advanced level research for the generation of new knowledge, applications, or understanding. 5. Demonstrate personal accountability, initiative, and decision-making in complex situations.

Program Specific Outcomes	1. Following admittance, every researcher may conduct his or her study using appropriate research methodologies and direction. 2. A researcher may finish his Ph.D. research work in a set amount of time (usually three years) and be granted a Doctor of Philosophy degree once his work has been evaluated. 3. This kind of thesis may be classified as a work of intellect. It might also have significant literary significance. 4. Any language or any literature is asses by such a unique research work. 5. It becomes a distinct consequence for every researcher to obtain a Ph.D. degree.
Medium of Instruction	English

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Faculty of Science **PhD Chemistry**

DEPARTMENT OF CHEMISTRY,

VEER NARMAD SOUTH GUJARAT UNIVERSITY

SURAT -395007

Syllabus

Faculty Code: **SCI** Subject (Paper) Code: **CH**

Name of Program**: Ph.D.** Subject: **Chemistry**

Course (Paper) Name & No.: Paper-I: **CH-601 RESEARCH METHODOLOGY**

Course (paper) Unique Code: **PAPER-1 CH-601**

External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	**Core**	**04**	**50**	**50**	**----**	**100**

Course Objectives:	● To understand some basic concepts of research and its methodologies. ● To identify appropriate research topics. ● To identify the overall process of designing a research study.

Paper-I: CH-601

RESEARCH METHODOLOGY

UNIT I **Introduction to Research Methodology** **11 hours**

Objectives of research, Types of research, Significance of research, Research methods versus methodology, Research and the scientific method, Criteria of good research, Problems encountered by researchers in India, Problem selection, project proposal, funding agencies

UNIT II **Literature survey** **11 hours**

Primary sources of journals and patents, Secondary sources, Listing of titles, Abstracts, Compendia and tables of information, Reviews, General treatises, Monographs and treatises on specific areas, Literature search, Information about a specific compound, Science citation index, Box to locate journals.

UNIT III **General Aspects of Scientific Writing** **11 hours**

Type of research articles, why you should publish, where is to be published, choice of journals for publication, components and of manuscript, grammar check, plagiarism issue, submission of the manuscript, review process of manuscript, ethics of authors/reviewers /editor, how to prepare a scientific poster, how to present oral presentation, how to write a proposal to different funding agencies, Researcher's assessment: Impact factors, authors, citations

UNIT IV **Laboratory Safety** **12 hours**

General guidelines. Hygiene, Eye, foot, skin and hand protection, Safety rules, Equipment protection, Respiratory protective equipment, safety equipment, Leaking compressed gas cylinders, electrical safety, Fire extinguishers, Laboratory injuries and treatment, Chemical spills, Mercury and Biohazardous clean up procedure, Accident management, Disposal of chemicals and glassware.

Course Outcomes: Having completed this course, the learner will be able to	
1.	Demonstrate the ability to choose methods appropriate to research aims and objectives. Learn about research methods, their criteria and problems.
2.	To learn about journals and patents. To understand monographs and treatises on specific areas and to grab information about Literature search, citation index and locate journals.

3.	To understand general aspects of research article writing. To learn about publishing, manuscript writing and importance of the author and how the reviewer interprets the article. To know about poster presentation and how to present it.
4.	To learn the importance and significance of laboratory safety and proper regulation of laboratory

Recommended Books:

1. Kothari C. R., *Research Methodology*, New Age International Publishers, New Delhi (2004).
2. Day R. A. and Underwood A.L., *Quantitative analysis*, Prentice Hall (1999).
3. Peters D. G., Hayes J.M. and Hefige G.M., *A brief introduction to Modern chemical analysis*, Saunders(1976).
4. Gopalan R., *Thesis writing*, Vijay Nicole Imprints Private Ltd. (2005).
5. Gopalan R., Subramanian P. S. and Rengarajan K., *Elements of Analytical Chemistry*, Sultan Chand and Sons, New Delhi (2005).

Effective from January-2022

Faculty of Science **PhD Chemistry**

DEPARTMENT OF CHEMISTRY,

VEER NARMAD SOUTH GUJARAT UNIVERSITY

SURAT -395007

Syllabus

Faculty Code: **SCI** Subject (Paper) Code: **CH**

Name of Program**: Ph.D.** Subject: **Chemistry**

Course (Paper) Name & No.: Paper-II: **CH-602 ADVANCED SPECTROSCOPY SEPARATION TECHNIQUES**

Course (paper) Unique Code: **PAPER-2 CH-602**

External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	**Core**	**04**	**50**	**50**	**----**	**100**

Course Objectives:	• To elucidate the UV-visible spectrum and to interpret the IR spectrum having different functional groups and the effect of various factors on IR absorption. • To elucidate the structure of simple and complex organic molecules. • To elucidate the structure of organic molecules using a fragmentation pattern. • To learn the basics of chromatography and to understand principles of instrumental analysis.

Paper-II: CH-602

ADVANCED SPECTROSCOPY AND SEPARATION TECHNIQUES

UNIT I **(A) ULTRAVIOLET AND VISIBLE SPECTROSCOPY** **11 hours**

Various electronic transitions (185-800 nm), Beer-Lambert law, the effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds

(B) INFRARED SPECTROSCOPY

Characteristic vibrational frequencies of alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of Vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies. Interpretation of IR spectra.

UNIT II **NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY** **11 hours**

Complex spin-spin interaction between two, three, four and five nuclei (first-order spectra), virtual coupling. Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Second-order spectra, Simplification of complex spectra-nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique, chemical shift reagents, Carbon-13 NMR Spectroscopy: coupling constants. Interpretation of ^{1}H and ^{13}C-NMR spectra.

UNIT III **MASS SPECTROMETRY** **11 hours**

Factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High-resolution mass spectroscopy. Examples of mass spectral fragmentation of organic compounds with respect of their structure determination.

UNIT IV **CHROMATOGRAPHY** **12 hours**

Principles of chromatography, plate and rate theory. retention time and retention factor, resolution and separation factor; general idea about adsorption, partition and column chromatography, paper and thin-layer chromatography, gas chromatography (GC) and high-performance liquid chromatography

(HPLC) - instrumentation, methodology and applications, UPLC, SFC LC, hyphenated techniques, LC-MS and LC-MS/MS.

Course Outcomes: Having completed this course, the learner will be able to	
1.	Able to interpret the structure of organic compounds from spectra like UV, IR, NMR and Mass.
2.	To understand the familiarize with the basic properties, theory & interpretation of 1H NMR, 13C NMR and 2D NMR spectrometry, to impart knowledge in the theory & principles of spectroscopic techniques for characterization & differentiation of various molecules.
3.	Interpret and evaluate the information contained in the several types of spectra obtained with different types of mass spectrometers. Analyze the validation of the results obtained in the resolution of a problem by mass spectrometry.
4.	Determine appropriate chromatographic technique and approach for analysis. Comprehend the optimization of chromatographic methods.

Recommended Books:

1. Silverstein R. M., Webster F. X., Kiemle D. J., and Bryce D. L., *SpectrometricIdentification of Organic Compounds*. John wileyand sons (2014)..
2. Banwell C. N., and McCash E. M., *Fundamentals of Molecular Spectroscopy* (Vol. 851). New York: McGraw-Hill (1994).
3. Dyer J. R. *Applications of Absorption Spectroscopy of Organic Compounds*. Phi Learning (1965).
4. Pavia D. L., Lampman G. M., Kriz G. S., and Vyvyan J. A., *Introduction to Spectroscopy*, Cengage Learning (2008).
5. Gross J. H. *Mass Spectrometry: A Textbook*, Springer Science and Business Media, 22 (2006).
6. Kalsi P. S. *Spectroscopy of Organic Compounds*, New Age International (2007).
7. Kemp W. *Organic Spectroscopy*, ELBS(1998).
8. Khopkar S. M. *Basic Concepts of Analytical Chemistry*, New Age International (1998).
9. Melinda J.D. *Introduction to Solid NMR Spectroscopy*. Wiley India Pvt Ltd (2010).
10. Mendham J., Denney R. C., Barnes J. D. and Thomas M. J. K. *Vogel's Textbook of Quantitative Chemical Analysis*, Dorling Kindersley (2008).
11. Skoog D. A., West D. M., Holler F. J., & Crouch S. R., *Fundamentals of Analytical Chemistry*,Nelson Education (2013).
12. Willard H. H., Merritt Jr. L. L., Dean J. A., & Settle Jr. F. A., Instrumental Methods of Analysis, 7th edition, CBS Publishers (1988).
13. Holler F. J., Skoog D. A., & Crouch S. R. *Principles of Instrumental Analysis* (6th ed.) Cengage Learning (2007).

14. Danzer K., *Analytical Chemistry: Theoretical and Metrological Fundamentals*, Springer Science & Business Media (2007).
15. Pecsok R. L., Shields L. D., T. Cairns and L.C. Mc William, *Modern Methods of Chemical Analysis*, 2nd Edition, John Wiley, New York (1976).
16. Christian G. D., *Analytical Chemistry*, 6th edition,John Willey and Sons(2003).
17. Bard A. J., Faulkner L. R., Leddy, J., & Zoski C. G. *Electrochemical Methods:Fundamentals and Applications* New York: Wiley(1980).
18. Rouessac F., & Rouessac A. *Chemical Analysis: Modern Instrumentation Methods and Techniques*. John Wiley & Sons (2013).

Effective from January-2022

Faculty of Science **PhD Chemistry**

DEPARTMENT OF CHEMISTRY,

VEER NARMAD SOUTH GUJARAT UNIVERSITY

SURAT -395007

Syllabus

Faculty Code: **SCI** Subject (Paper) Code: **CH**

Name of Program**: Ph.D.** Subject: **Chemistry**

Course (Paper) Name & No.: Elective-I: **CH-603(O) ORGANIC CHEMISTRY**

Course (paper) Unique Code: **ELECTIVE-I CH-603**

External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	**Core**	**04**	**50**	**50**	**----**	**100**

Course Objectives:	● To learn transition metal catalyst based on C-C, C-N coupling reaction, formylation reaction, various acid base-catalyzed condensation reactions and their mechanism. ● To understand the role of chemical reagents in oxidation, reduction, cyclisation and transformation of various organic functional groups, their synthesis and industrial application. ● To learn about pollutants and various methods to determine the air and water pollutants, effluent treatment of sugar, paper & pulp and distilleries. ● To understand unit processes in the synthesis of organic compounds.

Paper-III: ELECTIVE-I

ORGANIC CHEMISTRY

UNIT I **NAME REACTIONS AND NOVEL ORGANIC TRANSFORMATIONS** **12 hours**

Simmons-Smith reaction, Mitsunobu reaction, Corey-Winter reaction, Robinson annulation, Appel reaction, Witting with HWE (Horner-Wadsworth-Emmons modification) reaction, Heck reaction, Henry Reaction, Widman-Stoermer Synthesis, Tiffeneau- Demjanov rearrangement, Hofmann-Martius rearrangement, and their applications**.**

UNIT II **REAGENTS IN ORGANIC SYNTHESIS** **11 hours**

Introduction, preparation, and industrial applications of the following reagents: Luche reagent, Gilman reagent, Wilkinson reagent, Corey Bakshi Shifata reagent, strategies for reactivity umpolung, Trimethylsilyliodide, Prevost reagent, Woodward reagent, Fenton's reagents, Lawsson reagents and Tebbe reagent.

UNIT III **INDUSTRIAL POLLUTION AND ANALYSIS** **11 hours**

Introduction, Aquatic pollution –Pesticide, Industrial and Sewage, Detergents, Oil spills and Oil pollutants. Analytical methods for measuring DO, BOD and COD. Purification and treatment of water. Analytical methods for measuring oxides of N, C, S, O and their effect. Industrial pollution and effluent treatment plants of sugar, drug, pulp & paper industries.

UNIT IV **UNIT PROCESSES IN ORGANIC SYNTHESIS** **11 hours**

Introduction, reagents, mechanism of nitration, sulphonation and sulphation, amination, halogenations and alkylation, industrial important chemicals derived using nitration, sulphonation and sulphation, amination, halogenations and alkylation unit processes.

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics to carry out reactions, nature of the reaction and establish mechanism and monitoring reaction at specified reaction condition
2.	Understand the chemistry involved in oxidation, reduction, transformation, cyclisation etc by employing numerous reactants to appreciate the chemo-selectivity of the

	reagents, synthesis of reagents with respective mechanism and their application in industry. Suggest the use of miscellaneous reagents in organic synthesis.
3.	Learning about aquatic pollution –pesticides, Industrial and Sewage, Detergents, Oil spills and Oil pollutants. Understanding of Analytical methods for measuring DO, BOD and COD oxides of N, C, S, O and their effect. Purification and treatment of water. Industrial pollution and effluent treatment plants of sugar, drug, pulp & paper industries.
4.	To understand unit processes and implementation in industry, determination of various agents in unit process and their synthetic route.

Recommended Books:

1. Corey E.J. and Cheng X.-M., *The Logic of Chemical Synthesis*. John Wiley and Sons (1989).
2. Mundy B. P., Ellerd M. G., and Favaloro Jr. F. G., *Name Reactions and Reagents in Organic Synthesis*. John Wiley and Sons (2005).
3. Li J. J., *Name Reactions: A Collection of Detailed Reaction Mechanism*. Springer-Verlag (2014).
4. Smith M. B., *March's Advanced Organic Chemistry: Reactions, Mechanisms, And Structure*. John Wiley and Sons (2013).
5. Fuhrhop J. H., Penzlin G., and Li G., *Organic Synthesis: Concepts And Methods*. John Wiley and Sons (2003).
6. Davies S. G., *Organotransition Metal Chemistry: Applications to Organic Synthesis: Applications to Organic Synthesis* (Vol. 2), Elsevier (2013).
7. Fifield F.W. and Hairens W.P.J., *Environmental Analytical Chemistry*, 2nd Edition, Black Well Science Ltd. (2000).
8. Vanloon G.W., Duffer S.J., *Environmental Chemistry-A Global Perspective*, Oxford University Press (2000).
9. Baird Colin, *Environmental Chemistry*, Freeman W.H. and Company, New York (1995).
10. De A.K., *Environmental Chemistry*, 4th Edition, New Age International Private Ltd., New Delhi (2000)
11. Warner Peter O., *Analysis of Air Pollutants*, 1st Edition, John Wiley, New York (1996).
12. Shreve's *Chemical Process Industries*, 5th ed., New York: McGraw-Hill (2017).
13. *Riegel's Hand-Book of Industrial Chemistry*, Ed. by Kent James A. (1993).
14. Faith, Keyes, Clark, *Industrial Chemicals*, 4th ed., New York: Willey (1975).
15. Groggins P. H., *Unit Processes in Organic Synthesis*.5th ed., New York: McGraw-Hill (1995).

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Faculty of Science **PhD Chemistry**

DEPARTMENT OF CHEMISTRY,

VEER NARMAD SOUTH GUJARAT UNIVERSITY

SURAT -395007

Syllabus

Faculty Code: **SCI** Subject (Paper) Code: **CH**

Name of Program**: Ph.D.** Subject: **Chemistry**

Course (Paper) Name & No.: Elective-II: **CH-603(P) PHYSICAL CHEMISTRY**

Course (paper) Unique Code: **ELECTIVE-II CH-603 (P)**

External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	**Core**	**04**	**50**	**50**	**----**	**100**

Course Objectives:	1. To learn the statistical thermodynamic approach to chemical kinetics. The factors responsible for the rate of reaction. Thermodynamic concept to understand the rate constant of the reaction 2. To learn about kinetics of control of solution and gas phase reaction. 3. Identify the separation of solid or liquid using phase diagram. 4. Understanding the properties and behavior of Surfactant and Polymers

Paper-III: ELECTIVE-II

PHYSICAL CHEMISTRY

UNIT I THERMODYNAMICS OF GASES AND LIQUIDS 12 hours

Ideal monoatomic gas, Thermodynamic functions Helmholtz free Energy function, pressure, Internal energy, Entropy for mono, diatomic and polyatomic gas, theories of reaction rates, limitations and extension of rate theory, statistical approach to transition-state theory, factors affecting the rate of reaction as per theory, rate of reaction as per Thermodynamic, the effect of Solvent reaction rates, factors determining reaction rates in solution (i) reaction between ions and (ii) ion-dipole

UNIT II MIXING BEHAVIOUR OF LIQUID MIXTURES 11 hours

Properties of Mixtures, method of determination of properties, behaviour of liquid mixture with respect to Raoult's law. The mixing function for ideal and non-ideal solution, excess function for solution. Experimental determination of excess thermodynamic method. Solute solvent interactions, effect of interactions on behaviour of components in mixture, semi empirical equations explaining multi component thermodynamics properties for binary data, theory of liquid mixture.

UNIT III EQUILIBRIUM DIAGRAM OF THREE COMPONENT SYSTEMS 11 hours

Application of reduced phase rule to Two component systems: System with congruent and incongruent M.P., Representation and calculation of composition in three component system, Explanation on phase behaviour of component depending upon miscibility of three components, phase equilibria between two solids and liquid, the phase diagram of multicomponent systems (more than three components)

UNIT IV SURFACE ACTIVE AGENTS AND POLYMERS 11 hours

(A) Theory of surface action; effect and behaviour of surface-active agents on the interfaces, Bulk properties of surfactant solutions and methods of their measurements: micelle properties; measurement of critical micelle concentration; foaming power and foam stability, wetting power, emulsifying power, stability of dispersion and detergency.

(B) Introduction, transition temperatures such as T_g, Tc, Tm, solubility parameter, solution properties, temperature, good/ bad solvent, Behaviour of Polymers, Special polymers like block copolymers, Polymer colloids, Polymer

Microgels and Biomedicals Polymers.

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learning Ideal monoatomic gas, Thermodynamic functions Helmholtz free Energy function, pressure, Internal energy, Understanding the concept of entropy, theories of reaction rates, limitations and extension of rate theory, statistical approach to transition-state theory, factors, rate of reaction, the effect of Solvent.
2.	Understanding properties of Mixtures, method of determination. Learning Raoult's law. The mixing function for ideal and non-ideal solution, excess function for solution. Experimental determination of excess thermodynamic method. To know about Solute solvent interactions, effect of interactions, semi empirical equations and theory of liquid mixture.
3.	To learn application of reduced phase rule. Representation and calculation of composition in three component system, Knowing about phase behavior of component, phase equilibria between two solids and liquid, the phase diagram of multicomponent systems.
4.	Learning the theory of surface action, effect and behaviour, properties of surfactant solutions and methods of their measurements: micelle properties. Measurement of critical micelle concentration; foaming power and foam stability, wetting power, emulsifying power, stability of dispersion and detergency. Understanding transition temperatures, solubility parameters, solution properties, temperature, good/ bad solvent and about polymers.

Recommended Books:

1. Chemical kinetics by K. J. Laidler
2. Advanced Physical Chemistry by Puri Sharma
3. Physical Chemistry by Atkins and Paula
4. Chemical kinetics by S.K.Jain Chemical Kinetics by Gurdeep Raj
5. Chemical Kinetics & Dynamics by J.I. Steinfeld, J.S. Francisco & W.L.Hase. Printice Hall)
6. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre, Pearson
7. Phase equilibria by Mats Hillert
8. Biochemistry by C.B.Powar and G.R. Chatwal
9. Advanced physical chemistry by Gurtu & Gurtu
10. Molecular Thermodynamics of Fluid Phase Equilibria by J.M.Prausnitz, R.N. Lichtenthaler, E.G. Azevedo
11. Thermodynamic Properties of Nonelectrolyte Solutions By William Acree, Acadamic Press
12. The manufacture of soaps other detergents and glycerin Edited by Edgar Woollatt
13. Synthetic detergent Edited by Milwidsky

14. Bailey's Industrial Oil and Fat Products Vol-1 Fourth Edition, Edited by Daniel Swern
15. Soaps & detergent Edited by K.S. Parasuram
16. Synthetic Detergents Edited by Davidson
17. BIS – IS: 4955-1978; Specification for Synthetic Detergent Powders for household use
18. Gemini Surfactants: Synthesis interfacial and Application 8. Handbook of Detergent; Part A, B, C, D
19. Raw Materials for Industrial Polymers by H Ulrich, Hanser Publication1989.
20. Principles of Polymer Science, by Bahadur and Sastry, Narosa Publishing House 2002.
21. Polymer Science by Gowarikar, Johan Wiley and Sons 1986.
22. Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
23. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.
24. Petrochemicals The Rise of an Industry by Peter H. Spitz, Johan Wiley and sons 1988.
25. Polymer Chemistry by Malcolm P. Stevens, Oxford University Press, Inc, 1990.
26. Handbook of polymer Testing Roger Brown, Marcel Dekker Inc, 1999.
27. Instrumental Methods by Dyer.
28. Developments in Polymer Characterization 1-5 by J. V. Dawkins

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Faculty of Science **PhD Chemistry**

DEPARTMENT OF CHEMISTRY,

VEER NARMAD SOUTH GUJARAT UNIVERSITY

SURAT -395007

Syllabus

Faculty Code: **SCI** Subject (Paper) Code: **CH**

Name of Program**: Ph.D.** Subject: **Chemistry**

Course (Paper) Name & No.: Elective-III: **CH-603(I) INORGANIC CHEMISTRY**

Course (paper) Unique Code: **ELECTIVE-III CH-603 (I)**

External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	**Core**	**04**	**50**	**50**	**----**	**100**

Course Objectives:	1. Understand the concept of green chemistry with its application. 2. Learn the basics of alternative sources of energy sonochemistry and microwaves. 3. To Gain knowledge homogeneous catalysis, biocatalysis and photocatalysis reaction. 4. Awareness of Mossbauer spectroscopy.

Paper-III: ELECTIVE-III

INORGANIC CHEMISTRY

UNIT I GREEN CHEMISTRY **12 hours**

Green Solvents:

(a) Water as a green Solvent for Organic Reactions: C-C and C-N bond formation in water,

Condensation reactions, Electrophilic substitution reactions, Reduction reaction, the Oxidation reaction

(b) Ionic Liquid as a solvent: Reaction in acidic ionic liquids, Reaction in neutral ionic liquids, Hydrogenation, Diels-Alder reaction, Heck reaction

UNIT II ALTERNATIVE SOURCES OF ENERGY: **11 hours**

(a) Ultrasonic Reactions: Esterification, Saponification, Hydrolysis, Substitution reaction, Alkylation, Coupling reactions

(b) Microwave-assisted Reactions in organic solvents and Solid-phase reactions

UNIT III CATALYSIS **11 hours**

(a) Homogeneous Catalysis: Hydrogenation of Alkenes, Hydrocarbonylation of Olefins, Activation of C-H bond, Oxidative-Addition reaction, Reductive-Elimination reaction, Insertion and Deinsertion reaction

(b) Biocatalysis

(c) Photocatalysis

UNIT IV MOSSBAUER SPECTROSCOPY **11 hours**

A basic principle, Spectral parameters and spectrum display, Interpretation of Isomer shift, Application of the technique to the studies of bonding and structure of Fe^{+2} and Fe^{+3} compounds, Sn^{+2} and Sn^{+4} compounds and detection of oxidation states. FAB and electron spray, mass spectrometry of metal complexes.

Course Outcomes: Having completed this course, the learner will be able to	
1.	To understand about green chemistry, green solvents and green reactions. To learn about ionic liquids and its characteristics.

2.	Learning about alternative sources of energy such as Ultrasonic Reactions: Esterification, Saponification, Hydrolysis, Substitution reaction, Alkylation, Coupling reactions, solid-phase and microwave-assisted reaction.
3.	Understanding about biocatalysis, photocatalysis and Homogeneous Catalysis: Hydrogenation of alkenes, hydrocarbonylation of olefins, activation of C-H bond, oxidative-addition reaction, reductive-elimination reaction, Insertion and desertion reaction
4.	Learning basic principle, spectral analysis, interpretation of Mossbauer spectroscopy. Understanding about the application of the technique to the studies of bonding and structure of Fe and compounds and detection of oxidation states. FAB and electron spray, mass spectrometry of metal complexes.

Recommended Books:

1. Instrumental Methods and Chemical Analysis-Galen Ewing 5th Ed., McGraw-Hill Publishing Company Ltd., 1985.
2. Instrumental Methods of Chemical Analysis B.R.Sharma, Goel Publishing House, Meerut.
3. Organometallic Compounds, Indrajeet Kumar, Pragati Prakashan.
4. Green Chemistry, K.R.Desai, Bhavnaben D. Mistry, Tarulata N. Chhowala and K.K.Ojha, Himalaya Publishing House.
5. New Trends in Green Chemistry 2nd Edition, V.KAhluvalia and M.Kidwai, Annammaya Publishers, New Delhi.
6. Green Chemistry, Theory and Practice, Paul T.Anastas and J.C.Warney, Oxford University Press 2000, New York, U.S.A