Programme Outcomes

B. Sc.

After the completion of graduation, students will be able to acquire the following attributes.

PO-1. Acquire knowledge of fundamentals, models, basic scientific principles and methods.

PO-2. Solve the problem and also think methodically, independently and draw a logical conclusion.

PO-3. - Able to use proper communication skills for successful interaction in personal and public life.

PO-4. Able to undertake projects/tasks, plan and implement effectively.

PO-5. To inculcate the scientific temperament in the students and outside the scientific community.

PO-6. Use modern techniques, decent equipment and software used in different fields of science

PO-7. To explain nomenclature, stereochemistry, structures, reactivity,and mechanism of the chemical reactions.

PO-8. Apply ethical principles and appreciate the importance of ethical practices in professional life and uphold human dignity.

PO-9. Able to undertake activities informed by social values (such as social equity), social issues and cultural diversity.

PO -10. Able to analyse problems scientifically and find the solutions

Course Outcomes

Department of Chemistry

After completion of this course students should be able to:

B. Sc. I Semester I

DSC-3A- Chemistry paper I (Inorganic Chemistry)

CO-1. Explain the Bohr's theory of hydrogen atom and its limitations, Wave particle duality, Heisenberg uncertainty principle, Quantum numbers and their significance, Shapes of s, p and d atomic orbitals.
CO-2. Describe a) Aufbau's principle b) Hunds rule of maximum multiplicity c) Pauli's exclusion principle.
CO-3. Predict the Periodicity of the elements.
CO-4. Relate the Chemical Bonding and Molecular structure.
CO-5. Discuss Valence bond theory (VBT).
CO-6. Compare the Molecular orbital theory (MOT) and Valence bond theory (VBT).

DSC-4A- Chemistry paper II (Organic Chemistry)

CO-7.Desribe Curved arrow notations, Cleavage of Bonds: Homolysis and Heterolysis. Organic molecular species: Nucleophiles and electrophiles. Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation effect
CO-8. Explain Reactive Intermediates: Generation, Structure, Stability and Reactions of Carbocations, Carbanions and carbon free radicals.
CO-9.Predict the Nomenclature of stereoisomers: D and L, erythro and threo, R and S, E and Z.
CO-10. Discuss the Aromaticity concept and predict the Aromatic, Non aromatic, Antiaromatic, Pseudoaromatic compounds.
CO-11. Relate the Cycloalkanes, cycloalkanes and alkadienes.
CO-12.Describe a) Photohalogenation b) Catalytic halogenations c) Catalytic hydrogenation d) Effect of heat e) Reaction with hydrogen halide.

B.Sc. I Semester II
DSC-4B-Chemistry Paper IV (Analytical Chemistry)

CO-13.Expalin Analytical processes (Qualitative and Quantitative), Methods of analysis (Only classification), Sampling of solids, liquids and gases, Errors, types of errors.
CO-14. Discuss the Basic Principle of Chromatography, Basic terms, Classification of Chromatography.

CO-15.Comparison of paper chromatography and TLC
CO-16.Outline of titrimetric Analysis such as Strong acid-strong base, Strong acid-weak base, Strong base-weak acid, Complexometric titrations.
CO-17. Use and Applications Water Analysis.
CO-18. Explain the Analysis of Fertilizers.

CHEMISTRY-DSC 3B: Chemistry Paper-III
(Physical Chemistry)

CO-19.Expalin the First law of thermodynamics, Statements of second law of thermodynamics, Carnot's cycle and its efficiency, Statement of Third Law of thermodynamics
CO.20.Solve the Problem based on thermodynamics
CO-21.Discuss the Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.
CO-22. Compare between ΔG and ΔGo, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.
CO-23. Relate Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Ideal and Non ideal gases.
CO-24. Illustrate Deviation of real gases from ideal behavior, compressibility factor, causes of deviation. Van der Waals equation of state for real gases.
CO-25. Find the Derivation of Zero order reaction, First order reaction, Pseudo-unimolecular reactions, second order reaction.

B.Sc. Part II (CBCS)
Sem III
Paper No. DSC- C3 - Chemistry paper no. V (Physical Chemistry)

CO-26. Discuss Types of conductors, Conductivity, Equivalent and Molar conductivity and their variation with dilution for weak and strong electrolytes in aqueous solution
CO-27. Illustrate the conductance by using Wheatstone bridge. Kolharausch law of independent migration of ions and its applications such as Ionic mobility, determination of degree of ionization of weak electrolyte, solubility and solubility products.
CO-28. Describe all Physical Properties of Liquids and Third order reactions,derivation of rate constant.
CO-29. Explain the Adsorption as a surface phenomenon, Definition of adsorption, adsorbent, adsorbate, absorbent. Factors affecting adsorption, Types of adsorption
CO-30. Compare between physical and chemical adsorption, Adsorption isotherms: Freundlich adsorption isotherm, Langmuir adsorption isotherm.
CO-31. Outline of Types of Nuclear radiation, properties of α, β and γ radiations, Detection and measurement of nuclear radiations by Scintillation and Geiger muller counter methods.

Paper No. DSC-C4- Chemistry paper No. VI
(Industrial Chemistry)

CO-32.Explain the Basic Concepts in Industrial Chemistry
CO-33.Compare between classical chemistry and industrial chemistry.
CO-34.Find the Normality, Equivalent weight, Molality, Molecular weight,Molarity, Molarity of mixed solution.
CO-35.Describe the method of Size reduction- Principle,Jaw crusher,ball mill ,Size Enlargement –Principle,Pellet mill,tumbling agglomerates .
CO-36.Discuss the Theory of Corrosion and Elecroplating.
CO-37. Use and Manufacturing Paper Industry and Soaps and Detergent

B.Sc. Part II (CBCS)
Sem. IV
Paper No. DSC-D3- Chemistry paper no. VII (Industrial Chemistry)

CO-38.Describe the concept in Co-ordination chemistry
CO-39.Compare between double salt and complex salt
CO-40.Find the IUPAC nomenclature of coordination compounds
CO-41.Explain the Chelation, classification and its applications.
CO-42.Outline of P- Block elements and its characteristics.
CO-43. Discuss the Characteristics of d-block elements with special reference to
i) Electronic structure ii) Oxidation states, stability of oxidation states of Fe with respective to Latimer diagram iii) Magnetic character iv) Colored ions v) Complex formation.
CO-44. Find the Application of complex formation

Paper No. DSC- D4 - Chemistry paper no. VIII
(Organic Chemistry)

CO-45.Explain the reaction and methods of Preparation of Carboxylic acids and their derivatives.
CO-46.Describe the Classification, Nomenclature, structure, Methods of preparation and reactions of Amines and Diazonium Salts.
CO-47.Compare the reducing and non-reducing sugars.
CO-48.Discuss the Classification of carbohydrates.
CO-49.Relate the Reactivity of Carbonyl group and categorize its reactions.
CO-50.Outline of Representation of conformations of ethane by using Saw- Horse, Fischer (dotted line wedge) and Newmann's projection formulae and ethane and n-butane by Newmann's Projection formula.

B. Sc III Chemistry

After completion of these course students should be able to;

Paper XI PhysicalChemistry

CO 51 - Describe Heisenberg Uncertainty Principle, concept of energy operator, particle in one dimensional box.

Co 52 - Define Quantum theory, explain Schrodinger wave equation, emf measurement and its application.

CO 53 – Analyse electromagnetic spectrum, Raman Spectra compare and contrast rotational spectra, vibrational spectra, vibrational Raman spectra and rotational Raman spectra of diatomic molecule.

CO 54 – Write Photochemical Law's, reactions and various Photochemical Phenomena.

CO 55– Classify solutions, relation vapour pressure temperature relations.

CO-56.Compare between electrodes and cells.

Paper IX Inorganic Chemistry

CO-57. Find the meaning of various terms involved in Acids and Bases.
CO-58.Describes the shapes of d-orbitals.
CO-59. Discuss the Applications of Semiconductor and Superconductors.
CO-60.Predict the mechanism involved in Organometallic Chemistry.
CO-61.Expalin the homogenous catalysis and heterogeneous catalysis.
CO-62.Predict the degeneracy of d-orbitals.

Paper X Organic Chemistry

CO-63. Describe the principle of UV Spectroscopy.
CO-64. Impart the concept of vibrational Transitional region of IR Spectrum.
CO-65. Illustrate the Structure of Unknown Organic compounds.
CO-66. Compare between UV and NMR.
CO-67.Explain the principle of mass spectroscopy.
CO -68.Solve the problem based on UV, NMR and IR.

Paper XII Analytical Chemistry

CO-69. Explain the Precipitation Techniques.
CO-70. Discuss the applications of organic precipitants.
CO-71. Explain the Principle of flame photometry.
CO-72. Design the experimental set up for flame photometry.
CO-73. Describe the theory of Colorimetry and spectrophotometry.
CO-74. Identify the concept of Quality control.
CO-75.Categarised the different functional group based on Chromatography.

B. Sc III Chemistry

Paper XIII Inorganic Chemistry

CO 75 – Explain SN 1 and SN 2 reactions for inert and labile complexes.
Co 76 – Describe the Thermodynamic and Kinetic aspects of metal complexes.
CO 77 –Discuss the Nuclear reactions and energetic of nuclear reactions.
CO 78 – Use of Thorium, Uranium and Plutonium in atomic energy.
CO 79 – Compare between lanthanide and actinides.
CO80- Predict Biological role of alkali and alkaline earth metal ions with special referenc to Na+, K+ and Ca2+.

Paper No. XIV Organic Chemistry

CO-81. Use and application Lithium aluminium hydride LiAlH4, Raney Nickel,Osmium tetraoxide,Selenium dioxide (SeO2),Dicyclohexyl Carbodiimide (DCC), Diazomethane.
CO-82. Explain the Diels -Alder reaction,Meerwein –Pondorff-Verley reduction,Hofmann rearrangement,Wittig reaction,Wagner- Meerwein rearrangement,Baeyer Villiger oxidation.
CO-83. Discuss the Retrosynthesis of different Molecules.
CO-84. Describe Electrophilic addition to >C=C< and −C≡C− bonds.
CO-85.Solve the problem based on addition reaction.
CO-86.Inpart the concept of Anti-Markovnikoff's addition.
CO-87. Explain Synthesis and uses of ethambutal, phenobarbitone, isoniazide, benzocaine, Chloramphenicol, paludrine.
CO-88.Outline the biogenesis of Alkaloids,Terpenoids.

Chemistry Paper No. XV (Physical Chemistry)

CO-89. Discuss Gibbs phase rule, Phase diagram, true and metastable equilibria.
CO-90. Compare one component systems and two component systems.
CO-91. Describe the concept of Thermodynamics and its applications
CO-92. Explain the different State of solid, Laws of crystallography, Weiss indices and Miller indices.
CO-93. Solve the Numerical problems based on Derivation of Bragg's equation.
CO-94.Predict the Simultaneous reactions such as Opposing reaction, Side reaction,Consecutive reactions,Chain reaction, Explosive reaction.

Paper No. XVI (Industrial Chemistry)

CO-95. Discuss Manufacture of cane sugar in India: Extraction of juice, Clarification, Concentration, crystallization, centrifugation and other details of industrial process.
CO-96. Explain the Manufacture of Industrial Heavy Chemicals.
CO-97. Describe the use, Classification and applications of Synthetic Polymers.
CO-98. Categarised the different term involved in nanotechnology.
CO-99. Impart the role of Petroleum industry and eco-friendly fuels.
CO-100. Identify the concept of Nanotechnology.

Name of Programme: M.Sc. Analytical Chemistry

Course Outcomes:-

Part-I Semester-I		
CH-1.1	**(Inorganic Chemistry – I)**	**CO1**: Students will be able to explain the basic chemistry of transition metals and its compounds, spectroscopic characteristics of such compounds, nomenclature, reactions and applications. **CO2:** Students will obtain knowledge about Preparation, structure, physical and chemical properties of metal carbonyls of transition metals. **CO3**: Students will be able to understand the all aspects of synthesis, bonding, structure and reactivity of organometallic compounds and their applications in homogenous catalysis. **CO4**: Student will be able determine the stability of the complexes and will be able to explain the nuclearstability and reactions.
CH-1.2	**(Organic Chemistry – I)**	**CO1**: Students will able to differentiate between various organic reactive intermediates. **CO2**: Students can recognize, classify, explain, and apply fundamental organic reactions. **CO3**: Students will have ability to distinguish between different kinds of isomers. **CO4**: Course will develop interest in writing and finding mechanisms of new reactions.
CH-1.3	**(Physical Chemistry – I)**	**CO1**: Students will be able to understand basic principles of thermodynamics and statistical mechanics **CO2**: Able to learn advanced topics like quantumstatistics and molecular dynamic simulation methods. **CO3**: Develop abilities to understand how to estimate and analyze the physicochemical properties of condensed and gas phase materials. **CO4**: Able to utilize spectral data to estimate molecular thermodynamic properties through partition function calculations. **CO5**: Understand properties of detergents and colloidal materials **CO6**: Learns the principles and techniques to understand gas and liquid adsorptions on solid surfaces **CO7**: Can learn spectral techniques to study surface adsorption phenomena. **CO8**: Learn principles and techniques for estimation of average molecular weight of a polymer or biological macromolecules

		CO9: Develop abilities to characterize polymers through understanding theories of virial coefficients, concepts of glass transition temperatures, etc.
CH.1.4	**(Analytical Chemistry-I)**	**CO1**: Students would acquire the knowledge about the fundamentals of Analytical Chemistry including the sampling, sample pretreatment, basic techniques, methods and data handling, processing and statistical analysis of the same. **CO2**: Students would acquire the knowledge and understand the scope of Analytical Chemistry spanning various fields. The students will learn fundamentals of qualitative analysis using conventional techniques **CO3**: Students will learn the chromatographic techniques, choice of chromatographic techniques and tuning of the chromatographic technique as per the need based on the samples to deal with, learn electroanalytical techniques and computation chemistry which would groom them for alternative analytical strategies which form one of the important components of analytical chemistry. **CO4**: Students will learn about referring to the standard reference books and infer information from the same. Analytical case study problems would be discussed to familiarize with the scope and advantagesof Analytical Chemistry.
PCH-1.2	**Practical – I**	**CO1**: Ability in professional sampling and sample treatment before actual analysis CO2: Ability to treat and evaluate the results of analysis **CO3**: Understanding and capability of performing basic chemical processes in a chemical laboratory CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes) **CO4**: Students can be able to prepare various concentration solutions like molar, normal, ppm, etc. **CO5**: Determine the rate constants of various first order and second order reactions **CO6**: Determine the redox potential of a system, relative strength of acid etc using potentiometer, conductometer
		Part-I Semester-II
CH-2.1	**(Inorganic Chemistry–II)**	**CO1**: Students will get the knowledge of the basic chemistry of non-transition elements and their compounds, synthesis and structural features, and applications. **CO2**: To be able to explain the structures of inorganic compounds based on different theories. Student will understand the chemistry of various types of solvents. **CO3**: Be well versed with the knowledge about the chemistry of Lanthanides and Actinides with respect to occurrence, separation, compounds and applications.

		CO4: To understand the three dimensional structures of solid-state materials of industrial importance and to get the knowledge of bio-inorganic Chemistry.
CH-2.2	**(Organic Chemistry – II)**	**CO1:** Illustration of modern synthetic methods and applications of reagents. **CO2:** Provide knowledge of different organometallic compounds and various coupling reactions. **CO3:** Understand principle and applications of protection and deprotection of various functional groups. **CO4:** It will elaborate to understand the concept of chemoselectivity, regioselectivity and enantioselectivity.
CH2.3	**(Physical Chemistry – II)**	**CO1:** Students will learn basics of quantum mechanics. **CO2:** Knowledge of the course will form the basis or essential requirement for the course "Advanced Quantum Chemistry" **CO3:** Able to understand selection rules and to predict the electronic spectra of conjugated organic molecules. CO4: Able to study photochemical and photophysical phenomena **CO5:** Capable of qualitative and quantitative analysis of various ingredients from industrial, food and pharma samples using techniques of emission spectroscopy. **CO6:** Capable of understand the electrochemical aspects of materials, ionic processes and electrochemical sensors, battery materials and characterizations etc. **CO7:** Able to study electrokinetic effects and their applications in the field of protein separation, characterization etc. **CO8**: Understanding the molecular dynamics through kinetic studies. Applications to explore reaction pathways, protein-ligand binding rates, etc. will help to understand life governing processes.
CH.2.4:	**(Analytical Chemistry-II)**	**CO1:** Students will acquire the knowledge of spectroscopic tools/instruments used in chemical analysis and interpretation of the data. The scope and limitations of the spectroscopic tools would be discussed so that the students learn about the type of samples which could be analyzed by these tools offering choices among the spectroscopic tools. **CO2:** Students will learn about the simple and advanced instruments used for analysis like NMR, MS, AAS, ICP and thermal analysis (TGA, DTA, DSC etc.) techniques spanning wide variety of samples to be considered for analysis. **CO3**: Students will learn about the instrumentation, sample preparation and handling of sample, analysis and data interpretation and structural elucidation. **CO4:** Learning about different instruments will give them idea about appropriate choice of the instrument for analysis

		based on the source and type of analyte(s) in the sample under consideration.
PCH-2.1	**(Practical – II)**	**CO1**: Students developed for precise sample solution preparation and sample treatment before actual analysis. **CO2**: Students can be able to perform the calculations and error analysis **CO3:** Develop understanding of basic chemical processes and deciding methods of analysis. **CO4:** Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, high end thermometers, refractometer, pH meter etc.) **CO5:** Students can be able to prepare various concentration solutions like molar, normal, ppm, etc. **CO6**: Determine the unknown concentration and thermodynamic parameters using conductometer CO7: Student will explore how to estimate order of reaction and the catalysis **CO8**: students can estimate refractive index and molecular weights of species. **CO9:** Students can understand the estimation of equilibrium properties like redox potential, phase diagram etc
	Part-II , Semester-III	
ACH-3.1	**(Advanced Analytical Techniques)**	**CO1**: Develop knowledge of fundamental, instrumentation and working of state of art instrumental analytical techniques, effective use and choice of technique, written and/or oral communication of the concepts of analytical chemistry which will be useful as analytical chemist and R&D. **CO2**: Acquire knowledge of mass spectrometry, type of MS, ionization types and specific practical applications of MS. **CO3**: Acquire knowledge of basics of nanochemistry, nanomaterials and nanotechnology and application orientated synthesis and characterization of nanomaterials. **CO4**: This course gives wide understanding about theinstrumental analytical techniques (SEM, TEM, EDS, STM, AFM, Raman, XFS, ESR, XPS, AES, SIMS etc.)employed for qualitative and quantitative analysis for contemporary research.
ACH-3.2	**(Organic Analytical Chemistry)**	**CO 1**: Students will gain knowledge of the instruments used at the interface of Analytical-Organic chemistry useful for R&D and structural elucidation using UV-Visible, IR, 1H & 13C NMR, Mass spectrometry data and interpretation of the same. **CO 2**: Students will acquire knowledge about the drug, their classification, sources of impurities (chemical, atmospheric and microbial contamination) in pharmaceutical raw materials and analysis of the same.

		CO 3: Students will gain knowledge about the conventional and advanced analytical approaches for analysis of drug, vitamin, body fluids and clinical samples. **CO 4**: Students will have an idea of commonly used pesticides and their analysis and also about forensic science and forensic sample analysis.
ACH- 3.3	**(Electroanalytical Techniques in Chemical Analysis)**	**CO1:** Fundamental knowledge of electrochemistry, electrodes, types of electrodes, its construction will lay foundation for the course. **CO2:** Students will gain knowledge and skill in electroanalytical techniques like cyclic voltammetry and its types, polarography, coulometry and dynamic light scattering technique for qualitative and quantitative analysis. **CO3:** Students will be familiar with the advanced electrodes used for chemical analysis, liquid-liquid membrane electrodes, enzymes and gas electrodes. **CO4:** Students will learn about electrophoretic techniques, advances in electrophoresis techniques and its analytical applications.
ACH-3. 4	**(A) (Environmental Chemical Analysis and Control)**	**CO1:** Students will acquire knowledge about sampling, criteria of good sampling, handling, preservation and storage of the samples, pretreatment and post treatment of samples. **CO2:** Students will acquire knowledge of conditions and strategies required during sampling and electrochemical and spectral methods for analysis of environmental samples. **CO3:** Students will learn about the air and water pollution, sources of pollution, typical parameters and properties (physical, chemical and biological) to be measured in air and water pollution with relevance to specific case studies. **CO4:** Students will be acquainted with organic pollutants and their analysis with special reference to pesticide analysis.
ACHP – III	**Practical -III**	**CO1**: In-depth training on laboratory solution preparations on all concentration scales **CO2:** Training on laboratory safety and lab ethics in scientific work **CO3:** Training on planning, design and execution of experiments **CO4**: Training on uncertainty estimations for experimentally measured and derived properties of solutions **CO5:** Training on scientific literature search, defining the objective of the work, research skills, data representation in tabular and graphical form etc.

		CO6: Training on experimental verification of fundamental theories, comparison of data with literature and scientific discussion on any deviation of data from expected theoretical values or reported literature. **CO7**: Developing analytical skills **CO8:** Training on qualitative and quantitative
		Part-II semester-IV
ACH 4.1	**(Modern Separation Method in Analysis)**	**CO1:** Students will learn about modern separation and chromatographic used for analysis of different type of samples. **CO2:** The student will understand instrumentation and mechanism of various separation techniques. **CO3**: Student will acquire knowledge regarding various choice of instrument and detectors to be used for analysis depending on the sample and matrix. **CO4**: Student will learn fundamentals of extractive chromatography, types of extraction techniques, advances in extraction methods and their hyphenations with chromatography leading to addressing challenging problems in analytical chemistry.
ACH-4.2	**(Organic Industrial Analysis)**	**CO1:** Acquire knowledge of handling and investigating the characteristics of the oils, fats, detergents and soap samples and analysis of the same providing opportunity in cosmetic, pharmaceuticals, dyes and polymers industries. **CO2:** Student will gain knowledge and importance of food quality, probe for food adulteration and adulterants, food preservative, food flavors and analysis of their components. **CO3**: Students will also gain knowledge about the animal food stuff and the additives added in the animal food stuff as antibiotics, dietary supplements and growth promoting drugs, preservatives etc. and analysis of the same. **CO4:** Student will learn about the analysis of cosmetics, face powder, hair dyes and hair care products, types of cosmetics, precautionary measures and composition of the cosmetics and specific roles of the ingredients. Will acquire knowledge about the paints, pigmentsand petroleum products, composition and analysis of the same using conventional and instrumental techniques.
ACH- 4.3	**(Advanced Methods in Chemical Analysis)**	**CO1**: Students will be skilled in the techniques like fluorescence, phosphorescence, types of quenching, FRET and applications of the same in Analytical Chemistry and for addressingresearch problems. **CO2**: Students will gain knowledge of the kinetic methods of analysis supporting the analysis and data procured in research.

		CO3: The students will acquire the knowledge of advanced method of chemical analysis XPS, XRF, fluorescence and phosphorescence spectroscopy which will bebeneficial in research. **CO4:** Students will acquire knowledge of identifying types of plastic and will also beable to and determination of metallic impurities in plastics
ACH-4.4	**Applied Analytical Chemistry**	**CO1:** The students will acquire knowledge the principles and through knowledge of scientific techniques of Spectrochemical methods of analysis, analysis of soil and fertilizers **CO2:** The students will be acquainted with understand the analysis of TNT, RDX, Lead azide, EDNA and explosives. **CO3:** Students will also gain the knowledge of the spectrochemical methods of analysis. **CO4**: The students will acquire knowledge of analysis of metals, alloys, minerals and ores commonly used in the industry.
ACHP –IV	**Practical-IV**	**CO1:** The students will acquire hands on training for conducting the representative experiments for the analysis of wide variety of samples of inorganic, organic and physical approaches by qualitative and quantitative analysis. Demonstrate professional and ethical attitude to serve the society **CO2:** Students will have knowledge of safety signs on container of chemicals, safety in handling of chemicals, MSDS sheets, learn sample preparation and characterization for confirming the purity.

M.Sc. Inorganic Chemistry Course Outcomes

Part-I Semester-I		
CH-1.1	**(Inorganic Chemistry – I)**	**1. CO1:** Students will be able to explain the basic chemistry of transition metals and its compounds, spectroscopic characteristics of such compounds, nomenclature, reactions and applications. **CO2:** Students will obtain knowledge about Preparation, structure, physical and chemical properties of metal carbonyls of transition metals. **CO3:** Students will be able to understand the all aspects of synthesis, bonding, structure and reactivity of organometallic compounds and their applications in homogenous catalysis. CO4: Student will be able determine the stability of the complexes and will be able to explain the nuclear stability and reactions
CH-1.2	**(Organic Chemistry – I)**	**CO1:** Students will able to differentiate between various organic reactive intermediates. **CO2:** Students can recognize, classify, explain, and apply fundamental organic reactions. **CO3:** Students will have ability to distinguish between different kinds of isomers. **CO4:** Course will develop interest in writing and finding mechanisms of new reactions.
CH-1.3	**(Physical Chemistry – I)**	**CO1:** Students will be able to understand basic principles of thermodynamics and statistical mechanics **CO2:** Able to learn advanced topics like quantum statistics and molecular dynamic simulation methods. **CO3:** Develop abilities to understand how to estimate and analyze the physicochemical properties of condensed and gas phase materials. **CO4:** Able to utilize spectral data to estimate molecular thermodynamic properties through partition function calculations. **CO5:** Understand properties of detergents and colloidal materials **CO6:** Learns the principles and techniques to understand gas and liquid adsorptions on solid surfaces **CO7:** Can learn spectral techniques to study surface adsorption phenomena. **CO8:** Learn principles and techniques for estimation of average molecular weight of a polymer or biological macromolecules. **CO9:** Develop abilities to characterize polymers through understanding theories of virial coefficients, concepts of glass transition temperatures, etc.
CH.1.4:	**Analytical Chemistry-I**	**CO1:** Students would acquire the knowledge about the fundamentals of Analytical Chemistry including the sampling, sample pretreatment, basic techniques, methods and data handling, processing and statistical analysis of the same. **CO2:** Students would acquire the knowledge and understand the scope of Analytical Chemistry spanning various fields. The students will learn fundamentals of qualitative analysis using conventional techniques

		CO3: Students will learn the chromatographic techniques, choice of chromatographic techniques and tuning of the chromatographic technique as per the need based on the samples to deal with, learn electroanalytical techniques and computation chemistry which would groom them for alternative analytical strategies which form one of the important components of analytical chemistry. **CO4:** Students will learn about referring to the standard reference books and infer information from the same. Analytical case study problems would be discussed to familiarize with the scope and advantages of Analytical Chemistry
PCH-1.1	**Practical**	**CO1:** Ability in professional sampling and sample treatment before actual analysis **CO2:** Ability to treat and evaluate the results of analysis **CO3:** Understanding and capability of performing basic chemical processes in a chemical laboratory **CO4:** Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes) **CO5:** Students can be able to prepare various concentration solutions like molar, normal, ppm, etc. **CO6:** Determine the rate constants of various first order and second order reactions **CO7**: Determine the redox potential of a system, relative strength of acid etc using potentiometer, conductometer **CO8:** Know the formation of alloys like Brass, Bronze, phase diagram for binary and ternary systems studied in details like a composition, critical temperature, etc **CO9:** Validity of Freundlich adsorption isotherms to remove toxic material such as dye, acetic acid, and other industrial effluents
Part-I Semester-II		
CH-2.1	**(Inorganic Chemistry – II)**	**CO1:** Students will get the knowledge of the basic chemistry of non-transition elements and their compounds, synthesis and structural features, and applications. **CO2:** To be able to explain the structures of inorganic compounds based on different theories. Student will understand the chemistry of various types of solvents. **CO3:** Be well versed with the knowledge about the chemistry of Lanthanides and Actinides with respect to occurrence, separation, compounds and applications. **CO4:** To understand the three-dimensional structures of solid-state materials of industrial importance and to get the knowledge of bio-inorganic Chemistry.
CH-2.2	**(Organic Chemistry – II)**	**CO1**: Illustration of modern synthetic methods and applications of reagents**.** **CO2:** Provide knowledge of different organometallic compounds and various coupling reactions. **CO3:** Understand principle and applications of protection and deprotection of various functional groups.

		CO4: It will elaborate to understand the concept of chemo selectivity, regioselectivity and enantioselectivity.
CH2.3	**(Physical Chemistry – II)**	**CO1:** Students will learn basics of quantum mechanics. **CO2:** Knowledge of the course will form the basis or essential requirement for the course "Advanced Quantum Chemistry" **CO3:** Able to understand selection rules and to predict the electronic spectra of conjugated organic molecules. **CO4:** Able to study photochemical and photophysical phenomena **CO5:** Capable of qualitative and quantitative analysis of various ingredients from industrial, food and pharma samples using techniques of emission spectroscopy. **CO6:** Capable of understand the electrochemical aspects of materials, ionic processes and electrochemical sensors, battery materials and characterizations etc. **CO7:** Able to study electrokinetic effects and their applications in the field of protein separation, characterization etc. **CO8:** Understanding the molecular dynamics through kinetic studies. Applications to explore reaction pathways, protein-ligand binding rates, etc. will help to understand life governing processes.
CH.2.4:	**Analytical Chemistry-II**	**CO1:** Students will acquire the knowledge of spectroscopic tools/instruments used in chemical analysis and interpretation of the data. The scope and limitations of the spectroscopic tools would be discussed so that the students learn about the type of samples which could be analyzed by these tools offering choices among the spectroscopic tools. **CO2:** Students will learn about the simple and advanced instruments used for analysis like NMR, MS, AAS, ICP and thermal analysis (TGA, DTA, DSC etc.) techniques spanning wide variety of samples to be considered for analysis. **CO3**: Students will learn about the instrumentation, sample preparation and handling of sample, analysis and data interpretation and structural elucidation. **CO4:** Learning about different instruments will give them idea about appropriate choice of the instrument for analysis based on the source and type of analyte(s) in the sample under consideration.
PCH-2.1 And PCH-2.2	**Practical**	**CO1**: Students developed for precise sample solution preparation and sample treatment before actual analysis. **CO2**: Students can be able to perform the calculations and error analysis **CO3:** Develop understanding of basic chemical processes and deciding methods of analysis. **CO4:** Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, high end thermometers, refractometer, pH meter etc.) **CO5:** Students can be able to prepare various

		concentration solutions like molar, normal, ppm, etc. **CO6:** Determine the unknown concentration and thermodynamic parameters using conductometer **CO7:** Student will explore how to estimate order of reaction and the catalysis **CO8:** students can estimate refractive index and molecular weights of species. **CO9:** Students can understand the estimation of equilibrium properties like redox potential, phase diagram etc
Part-II Semester-III		
PCH-3.1	**(Inorganic Chemical Spectroscopy**	**CO1:** At the end the student should be able to: Recognize symmetry elements in a molecule; State the point group a molecule belongs to; Combine matrices and set up matrix for transformations and acquisition of a theoretical support which underlies much of spectroscopy. **CO2:** Able to describe molecular vibration with the interaction of matter with light, Explain the basic concepts in IR and Raman Spectroscopy, Examines IR and Raman spectroscopy and molecular structure determination by the simple molecules. **CO3:** Students will be able to identify, describe and explain the function of the several components of a mass spectrometer and predict the fragmentation patterns expected. **CO4:** The ability to investigate and determine the local structure of typical elements in inorganic compounds and able to explain the surface composition and chemical nature of the surface elements.
ICH-3.2	**(Coordination Chemistry – I)**	**CO1**: To be able to describe and explain the bonding in d-metal complexes using crystal field and ligand field theories and calculate the crystal field stabilization energy and its role in stabilizing the complexes. **CO2:** At the end of the course students should be able to interpret simple electronic spectra and predict both position and intensity based on Orgel/Tanabe-Sugano diagrams and explain the spectroscopic properties of transition metal complexes. **CO3:** Students should be able to estimate the spin-only magnetic moment for given complex and predict the nature of magnetic properties. **CO4:** Students will be able to explain the reactivity and stabilities of ternary complexes and their reactions.
ICH- 3.3	**(Nuclear Chemistry)**	**CO1:** Students will be able to different modes of radioactive decay and also theories of radioactive decay. **CO2:** Students will be able to explain the nuclear structure and stability using various models. **CO3:** Students will get basic knowledge of nuclear reactions, mechanism and energy calculations.

		CO4: At the end students should be able to describe the fundamentals of nuclear reactors, isotopic chemistry, and the applications of radioactivity.
ICH3. 4	**(A) (Organometallic and Bioinorganic Chemistry)**	**CO1:** After successful completion of the course the students should be able to explain the synthesis, structure, bonding, properties and reactivity of Alkyls and Aryls of Transition Metals. **CO2:** After successful completion of the course the students should be able to explain the synthesis, structure, bonding, properties and reactivity of Compounds of Transition Metal – Carbon with Multiple bonds. **CO3:** Students should be able to describe the role of metals in medicines, deficiency disorders of metals and use of platinum, gold and lithium compounds in the treatment of cancer, arthritis and psycho drugs, respectively. **CO4:** At the end of the course student should be able to explain the natural proteins that carry dioxygen in various animals, the role of myoglobin and hemoglobin in carrying dioxygen in mammals and other non-heme proteins for oxygen uptake.
ICH-3.4 (B)	**(Selected Topics in Inorganic Chemistry)**	**CO1:** Students will learn about the basic principles of catalysis. **CO2:** Students will get knowledge about the coordination polymers. **CO3:** After completion of the course students will be able to learn about the non-conventional sources of energy. CO4: Students will be able to understand the supra-molecular chemistry and the principles of it.
ICHP – III	**Practical-III**	**CO1:** Ability in professional sampling and sample treatment before actual analysis **CO2:** Ability to treat and evaluate the results of analysis **CO3:** Understanding and capability of performing basic chemical processes in a chemical laboratory **CO4:** Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes) **CO5:** Ability in professional sampling and sample treatment before actual analysis **CO6:** Ability to treat and evaluate the results of analysis **CO7:** Understanding and capability of performing basic chemical processes in a chemical laboratory **CO8:** Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes) COs – POs& PSOs mapping
Part-II semester-IV		
ICH4.1	**(Instrumental Techniques)**	**CO1:** Students will obtain knowledge of the working principles involved for selective analytical methods and the fundamental basics of the instrumentation including electronic spectroscopy and diffraction techniques.

		CO2: Students will understand the advanced methods involved in determination of the quality and quantity of chemical substances in given compounds. **CO3:** At the end of the course students will learn the interpretation of the experimental data obtained using various techniques and instruments for laboratory analysis carried out for quality assurance. **CO4:** Students will be able to demonstrate the use of complementary analytical techniques to define the system/materials more precisely. To know the recent advancements in the instrumental methods of temperature programmed analysis.
ICH-4.2	**(Coordination Chemistry-II)**	**CO1:** After successful completion of the course students will be able to familiar with various reactions of transition metal complexes and will be able to predict the mechanism involved using direct and indirect evidences. **CO2:** At the end students will be able to explain the cis-effect, trans-effect, and mechanism of electron transfer reactions. **CO3**: Students will be able to explain the photochemistry of transition metal complexes. **CO4**: Students will be able to describe the industrial applications of transition metals as catalysts.
ICH-4.3	**(Chemistry of Inorganic Materials)**	**CO1**: At the end of the course students should be able to explain the bonding and structures of the solid-state materials. **CO2:** After completion of this course students will be able to explain the various defects present in the solid-state materials and their impact on electronic and structural properties of the same. **CO3**: Students will be able to explain the various synthesis methods and advanced instrumentation tools used for characterization of nano-materials. CO4: At the end students will be able to explain the optical, magnetic and structural properties of the nanomaterials and will be able to explain their applications in various industrial fields such as electronic devices, Energy generation and storage, Automobiles, Sports and toys, Textile Industries, Cosmetics Production, etc. COs – POs& PSOs mapping matrix (1- low, 2-medium, 3-high, 0-No correlation)
ICH-4.4	**(A) (Energy and Environmental Chemistry)**	**CO1:** At the end, students will be able to: Learn basic concepts of solid waste management, beginning from source generation to waste disposal. **CO2:** Students should be able to-Characterize the solid waste in terms of hazardous waste components; impact of waste management on health and environment; understand steps towards solid waste management-waste reduction at source, materials and resource

		recovery/recycling, treatment and disposal techniques. **CO3:** After completion of the course student will be able to explain the advanced energy conversion devices such as Fuel cells, and the various techniques involves in the production of Hydrogen (future fuel). **CO4:** Students will be able to demonstrate the reactions involved in the advanced energy storage devices, can predict the theoretical energy storage capacities of such devices, understand the chemistry of various batteries.
ICHP – IV	**Practical-IV**	**CO1:** Ability in professional sampling and sample treatment before actual analysis **CO2:** Ability to treat and evaluate the results of analysis **CO3:** Understanding and capability of performing basic chemical processes in a chemical laboratory **CO4:** Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes) **CO5:** Ability in professional sampling and sample treatment before actual analysis **CO6:** Ability to treat and evaluate the results of analysis **CO7:** Understanding and capability of performing basic chemical processes in a chemical laboratory **CO8:** Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes).

Name of Programme: M.Sc. Organic Chemistry

Course Outcomes:-

Part-I Semester-I		
CH-1.1	**(Inorganic Chemistry – I)**	**CO1**: Students will be able to explain the basic chemistry of transition metals and its compounds,spectroscopic characteristics of such compounds, nomenclature, reactions and applications. **CO2:** Students will obtain knowledge about Preparation, structure, physical and chemical properties of metal carbonyls of transition metals. **CO3**: Students will be able to understand the all aspects of synthesis, bonding, structure and reactivity of organometallic compounds and their applications inhomogenous catalysis. **CO4**: Student will be able determine the stability of the complexes and will be able to explain the nuclearstability and reactions.
CH-1.2	**(Organic Chemistry – I)**	**CO1**: Students will able to differentiate between various organic reactive intermediates. **CO2**: Students can recognize, classify, explain, and apply fundamental organic reactions. **CO3**: Students will have ability to distinguish between different kinds of isomers. **CO4**: Course will develop interest in writing and finding mechanisms of new reactions.
CH-1.3	**(Physical Chemistry – I)**	**CO1**: Students will be able to understand basic principles of thermodynamics and statistical mechanics **CO2**: Able to learn advanced topics like quantumstatistics and molecular dynamic simulation methods. **CO3**: Develop abilities to understand how to estimate and analyze the physicochemical properties of condensed and gas phase materials. **CO4**: Able to utilize spectral data to estimate molecular thermodynamic properties through partition function calculations. **CO5**: Understand properties of detergents and colloidal materials

		CO6: Learns the principles and techniques to understand gas and liquid adsorptions on solid surfaces **CO7**: Can learn spectral techniques to study surface adsorption phenomena. **CO8**: Learn principles and techniques for estimation of average molecular weight of a polymer or biological macromolecules **CO9**: Develop abilities to characterize polymers through understanding theories of virial coefficients, concepts of glass transition temperatures, etc.
CH.1.4	**(Analytical Chemistry-I)**	**CO1**: Students would acquire the knowledge about the fundamentals of Analytical Chemistry including the sampling, sample pretreatment, basic techniques, methods and data handling, processing and statistical analysis of the same. **CO2**: Students would acquire the knowledge and understand the scope of Analytical Chemistry spanning various fields. The students will learn fundamentals of qualitative analysis using conventional techniques **CO3**: Students will learn the chromatographic techniques, choice of chromatographic techniques and tuning of the chromatographic technique as per the need based on the samples to deal with, learn electroanalytical techniques and computation chemistry which would groom them for alternative analytical strategies which form one of the important components of analytical chemistry. **CO4**: Students will learn about referring to the standard reference books and infer information from the same. Analytical case study problems would be discussed to familiarize with the scope and advantagesof Analytical Chemistry.
PCH-I	**Practical – I**	**CO1**: Ability in professional sampling and sample treatment before actual analysis CO2: Ability to treat and evaluate the results of analysis **CO3**: Understanding and capability of performing basic chemical processes in a chemical laboratory CO4: Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes) **CO4**: Students can be able to prepare various concentration solutions like molar, normal, ppm, etc. **CO5**: Determine the rate constants of various first order and second order reactions **CO6**: Determine the redox potential of a system, relative strength of acid etc using potentiometer, conductometer
Part-I Semester-II		

CH-2.1	**(Inorganic Chemistry– II)**	**CO1**: Students will get the knowledge of the basic chemistry of non-transition elements and their compounds, synthesis and structural features, and applications. **CO2**: To be able to explain the structures of inorganic compounds based on different theories. Student will understand the chemistry of various types of solvents. **CO3**: Be well versed with the knowledge about the chemistry of Lanthanides and Actinides with respect to occurrence, separation, compounds and applications. **CO4**: To understand the three dimensional structures of solid-state materials of industrial importance and to get the knowledge of bio-inorganic Chemistry.
CH-2.2	**(Organic Chemistry – II)**	**CO1:** Illustration of modern synthetic methods and applications of reagents. **CO2:** Provide knowledge of different organometallic compounds and various coupling reactions. **CO3:** Understand principle and applications of protection and deprotection of various functional groups. **CO4:** It will elaborate to understand the concept of chemoselectivity, regioselectivity and enantioselectivity.
CH2.3	**(Physical Chemistry – II)**	**CO1:** Students will learn basics of quantum mechanics. **CO2:** Knowledge of the course will form the basis or essential requirement for the course "Advanced Quantum Chemistry" **CO3:** Able to understand selection rules and to predict the electronic spectra of conjugated organic molecules. CO4: Able to study photochemical and photophysical phenomena **CO5:** Capable of qualitative and quantitative analysis of various ingredients from industrial, food and pharma samples using techniques of emission spectroscopy. **CO6:** Capable of understand the electrochemical aspects of materials, ionic processes and electrochemical sensors, battery materials and characterizations etc. **CO7:** Able to study electrokinetic effects and their applications in the field of protein separation, characterization etc. **CO8**: Understanding the molecular dynamics through kinetic studies. Applications to explore reaction pathways, protein-ligand binding rates, etc. will help to understand life governing processes.

CH.2.4:	**(Analytical Chemistry-II)**	**CO1:** Students will acquire the knowledge of spectroscopic tools/instruments used in chemical analysis and interpretation of the data. The scope and limitations of the spectroscopic tools would be discussed so that the students learn about the type of samples which could be analyzed by these tools offering choices among the spectroscopic tools. **CO2:** Students will learn about the simple and advanced instruments used for analysis like NMR, MS, AAS, ICP and thermal analysis (TGA, DTA, DSC etc.) techniques spanning wide variety of samples to be considered for analysis. **CO3**: Students will learn about the instrumentation, sample preparation and handling of sample, analysis and data interpretation and structural elucidation. **CO4:** Learning about different instruments will give them idea about appropriate choice of the instrument for analysis based on the source and type of analyte(s) in the sample under consideration.
PCH-II	**(Practical – II)**	**CO1**: Students developed for precise sample solution preparation and sample treatment before actual analysis. **CO2**: Students can be able to perform the calculations and error analysis **CO3:** Develop understanding of basic chemical processes and deciding methods of analysis. **CO4:** Capability of performing measurements on basic analytical instruments (photometers, spectrometers, chromatographs, high end thermometers, refractometer, pH meter etc.) **CO5:** Students can be able to prepare various concentration solutions like molar, normal, ppm, etc. **CO6**: Determine the unknown concentration and thermodynamic parameters using conductometer CO7: Student will explore how to estimate order of reaction and the catalysis **CO8**: students can estimate refractive index and molecular weights of species. **CO9:** Students can understand the estimation of equilibrium properties like redox potential, phase diagram etc.
Part-II, Semester-III		

OCH-3.1	**(Organic Reaction Mechanism)**	**CO1:** Develop an ability to use effective written and/or oral communication through the application of organic chemistry concepts. **CO2:** Gives a basic understanding of how organic chemistry impacts the natural and technological environments. **CO3:** This course gives wide understanding about the organic reaction mechanism. **CO4**: This course will give an idea about pericyclic reactions.
OCH-3.2	**(Advanced Spectroscopic Methods)**	**CO1:** Students will able to different stretching and bending vibrational modes in IR spectroscopy and can apply their knowledge in interpretation of functional groups. **CO2:** Understand mass spectral fragmentation techniques with respect to structure determination. **CO3:** Understand how to interpret nuclear magnetic resonance spectrum from values of chemical shift. **CO4:** Students will have an idea of Beer Lamberts law and its applications.
OCH-3.3	**(Advanced Synthetic Methods)**	**CO1:** The applications of the reagents help students in designing multistep organic synthesis. **CO2:** They can utilize advanced techniques like microwaves, ionic liquids, ultrasound etc during their higher studies. **CO3:** Knowledge of retro-synthetic analysis helps for the study and design of a new reaction. **CO4:** Students will have an ability to develop eco-friendly methods for organic transformations
OCH-3.4	**(A) (Drugs and Heterocycles)**	**CO1**: Able to correlate structure activity relationship of bioactive compounds **CO2**: Give idea of different classes of drugs for

		particular diseases **CO3**: Utilize their knowledge in synthesis of various bioactive heterocycles. **CO4**: Able to recognize reactivity and applications of three, four, five, six and seven-member heterocycles.
OCHP – III	**Practical-III**	**CO1:** Separate and analyze the different component mixtures of simple organic compounds **CO2:** Students will able to purify organic compounds employing different techniques. **CO3:** Independently perform synthesis of simple organic compounds. **CO4:** Independently perform synthesis of simple organic compounds. **CO5:** Separate and analyze the different component mixtures of simple organic compounds **CO6:** Students will able to purify organic compounds employing different techniques. **CO7:** Students will have good experimental skills for qualitative and quantitative analysis. **CO8**:Independently perform synthesis of simple organic compounds.

Part-II semester-IV

OCH: 4.1	**4.1 (Theoretical Organic Chemistry)**	**CO1:** Students will apply principles of green chemistry in organic synthesis **CO2:** Students will able to identify aromatic compounds. **CO3:** Students will get an idea of calculation of delocalization energy of organic compounds. CO4: Students will acquire knowledge of kinetic and thermodynamic controlled reactions.
OCH-4.2	**(Stereochemistry)**	**CO1:** The study of stereochemical aspects of organic molecules gives very important tool in assigning the properties of bioactive molecules. **CO2:** Students will have sound knowledge about conformations of acyclic and cyclic compounds. **CO3:** Students will have sound expertise in designing of new bioactive molecules with specific stereochemical properties. **CO4:** Students will have an idea of applications of chiral reagents in asymmetric synthesis.
OCH-4.3	**(Chemistry of Natural Products)**	**CO1:** Gain knowledge about classification of natural products and their stereochemistry. **CO2:** Illustrate the principles of biosynthesis, green synthesis, stereoselective transformations and its physiological role in human body. **CO3:** Understand structure and synthesis of various harmones. **CO4:** Able to understand vitamin deficiency and importance of different vitamins in human health.
OCH-4.4 (A)	**(Applied Organic Chemistry)**	**CO1:** This knowledge helps to get placement to the students in agrochemicals, cosmetic, pharmaceuticals, dyes, polymers industries **CO2:** Students will have knowledge of cosmetics, perfumes and food flavours in day to day life. **CO3:** Knowledge of unit processing will be useful for automation industries.

		CO4: Students will get an idea of synthesis of pesticides and their applications in agriculture.
OCHP – IV	**Practical-IV**	**CO1**: To demonstrate professional and ethical attitude with enormous responsibility to serve the society **CO2:** Students will have knowledge of safety signs on container of chemicals, safety in handling of chemicals, MSDS sheets. **CO3:** Students will have ability to synthesize commercial products. **CO4**: Based on the experience of project work, students will have ability to start their R & D laboratory. **CO5**: To demonstrate professional and ethical attitude with enormous responsibility to serve the society **CO6:** Students will have knowledge of safety signs on container of chemicals, safety in handling of chemicals, MSDS sheets. **CO7:** Students will have ability to synthesize commercial products. **CO8:** Based on the experience of project work, students will have ability to start their R & D laboratory.

CO-86: Write the program of numerical methods and predict the output

B.Sc.-III (Sem-V)

DSE-E9-Mathematical Analysis

CO-87: Find the upper and lower Darboux's sums, Riemann integration and find the integrationof a bounded function on closed and bounded intervals.

CO-88: Discuss the idea about Riemann integrability and Riemann integration.
CO-89: Restate the necessary and sufficient condition for Riemann Integrability and explain it.
CO-90: Illustrates theorems on algebra and properties of Riemann integrable functions.
CO-91: Identify Improper integral of first kind and improper integral of second kind.
CO-92: Select proper convergence test to check convergence of given improper integrals.
CO-93: Examine convergence of an improper integral by choosing proper test.
CO-94: Find Fourier series of periodic functions.

DSE-E10-Abstract Algebra

CO-95: Tell definitions of basic concept of ring and identify examples of ring.
CO-96: Define an integral domain, field and illustrates the theorems on it.

CO-97: Restate necessary and sufficient condition of a ring to be a subring.

CO-98: Develop Quotient ring and discuss theorems on it.

CO-99: Illustrate theorems on Homomorphism of ring and Isomorphism theorems.

CO-100: Explain ideals of a ring, prime ideals and maximal ideals and related results.

CO-101: Discuss imbedding of rings.

CO-102: Describe polynomial rings, Euclidean domain, PID and UFD.
CO-103: Construct permutation group s_3 and dihedral groupD_4.

DSE-E11-Optimization Techniques

CO-104: Construct real word problems as linear programming models and describe thetheoretical working of graphical methods.

CO-105: Define optimal solution and feasible solution.
CO-106: Analyze whether the given problem has optimal solution or feasible solution.
CO-107: Use suitable methods to solve optimization problems.
CO-108: Discuss solution methods including graphs and linear programming to analyze andsolve the two-person, zero-sum game.

CO-109: Identify and select procedure for solving various sequencing, assignment,transportation problem.

DSE-E12-Integral Transform CO-110: Define Laplace transform and inverse Laplace transforms.

CO-111: Find the Laplace and inverse Laplace transform of standard functions.
CO-112: Illustrates standard results for finding Laplace and inverse Laplace transforms.
CO-113: Discuss various methods to find Laplace and inverse Laplace transforms.
CO-114: Evaluate the Laplace transforms and inverse Laplace transform of various functions byusing proper method.

CO-115: Tell definitions of finite Fourier transform and infinite Fourier transform.
CO-116: Recall the relation between Laplace transform and Fourier transform.