**Instructions**

*Please follow the scheme of studies of relevant prospectus strictly.

*Course Code and Course Title should be carefully noted.

*Prospectus are available in soft form at university website.

*For any clash of scheme of studies in prospectus and outlines, please contact the Focal person (Department of Chemistry)

Dr. Matloob Ahmad

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**M.Sc Chemistry**

**Semester 1**

**CHM-551**  
**Physical Chemistry-I**  
4(3-1)

**Kinetic Theory of Gases**

**Chemical Thermodynamics**
Relation of entropy and energy with equilibrium constant and their dependence on temperature. Clausius-Clapeyron equation. Chemical potential. Partial molar quantities.

**Chemical Kinetics**

**CHM-551 - Practicals**
- Equilibrium constant of the KI + I₂ = KI₃ reaction
- Kinetics of saponification of ethyl acetate
- Acid catalyzed hydrolysis of sucrose
- Study of the adsorption isotherms of acetic acid charcoal system
- Study of the charge transfer complex formation between iodine and benzene
- Determination of activation energy for the acid catalyzed hydrolysis of ethyl acetate
- Determination of partial molar volumes
- Determination of partition coefficient of a substance in two immiscible liquids.
Books Recommended:


Acids and Bases
Concepts of acids and bases; scale of acidity and basicity; pKa values; predicting acids/basis reactions from pKa values; the effect of structure on the strengths of acids and bases, field effects, resonance effects, steric effects, hydrogen bonding effects and hybridization effects, the effect of the medium on the strengths of acids and bases; the Hammett and Tafts equations, applications and limitations.

Stereochemistry
Introduction; optical isomerism; optical activity, chirality, symmetry elements and optical inactivity, relative and absolute configuration, R, S notation, methods of determining configuration. Racemic mixtures and their resolution, asymmetric synthesis, optical activity in biphenyls, alkenes and spiro compounds, stereospecific and stereoselective reactions; Geometrical isomerism. Determination of configuration of geometrical isomers, Z, E, conventions cis-and trans- isomerism in cyclic systems; Conformational isomerism conformational analysis of monosubstituted cyclohexanes, disubstituted cyclohexanes and decalin systems.

Oxidation Reduction Reactions:
a) Oxidation: Introduction. Oxidation of saturated, olefinic and aromatic compounds. System containing oxygen and nitrogen compounds.

Purification Techniques: Fractional distillation, fractional distillation under reduced pressure and fractional crystallization

Mixture Analysis: Analysis of two component mixture.
Books Recommended:


CHM-555 Inorganic Chemistry-I 4(3-1)

1. **BONDING MODELS FOR NON TRANSITION ELEMENTS**
   (a) Covalent bond. VSEPR model followed by VBT for prediction of geometries of molecules and ions containing sigma bonds as well as pi bonds. MOT for homonuclear and heteronuclear diatomic molecules.
   (b) Metallic bond. Band theory to describe conductors, insulators and semiconductors.
   (c) 3 center 4 electrons bond, 3 center 2 electrons bond, bent bond, H bonding.

2. **CHEMISTRY OF COORDINATION COMPOUNDS**

3. **LANTHANIDES AND ACTINIDEES**
   Historical survey, occurrence, separation and preparation. Oxidation states, magnetic properties of Lanthanides and Actinides. Lanthanides contraction. Applications and uses of elements and their compounds.

**CHM-555 Pracicals**

1. Separation of cations by paper chromatography: (Pb^{2+},Cd^{2+},Cu^{2+},Co^{2+},Ni^{2+},Ag^{+})
2. Preparation And Characterisation Of Complex Compounds:
   (i) Sodium Cobaltinitrate (ii)Potassium trioxalato aluminate (iii) Ammonium Nicke (ii) Sulphate (iv) Hexa aqua Chromium (III) chloride.
3. Complexometric Titration (Any four) Cu^{2+} / Ni^{2+};Ca^{2+} /Ba^{2+};Au^{2+} /Pb^{2+};Cd^{2+} /Zn^{2+};Ni^{2+} /Mg^{2+};Ca^{2+} /Zn^{2+}

**Books Recommended:**

CHM-557    Environmental Chemistry 3(3-0)


Recommended Books:


CHM-559    Analytical Chemistry-I 3(3-0)

Chemical Analysis and Data Handling
Accuracy of analytical processes such as sampling, weighing, volume measurements, precipitation, washing, filtration and ignition. Recent developments in the sampling techniques, statistical analysis; random and systematic errors, rounding off the data, arithmetic mean, median, mode, standard deviation, relative standard deviation, student t-test, F-test etc., quality control and quality assurance constructing and interpreting quality control and quality assurance constructing and interpreting quality control plots. The use of computer in data handling.

Ionic Equilibria in Solutions
Activity and activity coefficients, Hydrogen ion activity and pH for weak acids and bases, Determination of pKa and pKb value, common ion effect and its industrial applications. Buffer its composition and mechanism and buffer capacity. Stability and
formation constants of complexes, methods for their determination.

**Separation Techniques**
Solvent extraction Principle, factors affecting the extraction systems, Distribution la, coefficient and ratio, multiple batch extraction, practical applications in chemical analysis.
Chromatographic methods General theory of chromatography, classification of chromatographic methods, column, paper, thin-layer, and ion-exchange chromatography and their applications.

**Books Recommended:**


**CHM-561  Biochemistry-I  3(3-0)**

Introduction to biochemistry, scope of biochemistry, living systems, evolution and rise of living systems, important elements of living systems including carbon, nitrogen, phosphorus, hydrogen etc. foundations of biochemistry, the physical, cellular, chemical, genetic and evolutionary foundations of life, nature of organic matter, isomerism, general reactions of different functional groups, biologically important organic compounds, carbohydrates, proteins, lipids and nucleic acids

**Books Recommended:**


**Semester 2**

**CHM-552  Physical Chemistry-II  4(3-1)**

**Electrochemistry**
Theory of metallic conduction, electrode potential, electrochemical cell, electrolysis and related issues, liquid junction potential electron transfer reactions, rate of charge transfer

**Quantum Chemistry and Spectroscopy**

Eigen functions and eigenvalues, Schrödinger wave equation and its applications, Hamiltonian operator, Simple harmonic oscillator. Rigid rator, vibrator, Quantum numbers.

**Symmetry Elements**


**CHM-552 **

**Practicals**

- Determination of molecular weight of a polymer by viscosity method
- Precipitation value of electrolytes
- Measurement of IR spectra of simple compound and their interpretation
- Measurement of cyclic voltammogram of an organic compound and its interpretation
- Determination of dipole moment of an organic liquid
- Determination of percentage composition of KMnO₄ / K₂Cr₂O₇ in a given solution by spectroscopy.
- Stoichiometry of a complex in solution by jobs method
- Evaluation of pKa value of indicator by spectrometric method

**Books Recommended:**


**CHM-554**

**Organic Chemistry-II**

4(3-1)

**Aliphatic nucleophilic substitution and Elimination reactions**

Aliphatic nucleophilic substitution reactions Mechanisms and study of SN1, SN2, SN1,
SN2, mechanism; neighbouring group participation
intra molecular displacement by neighbouring oxygen, nitrogen, sulphur and halogen; The effects of the substrate
structure, entering group, leaving group and reaction medium on the mechanisms and rates of substitution reactions.

Elimination Reactions
Mechanisms study of E1, E1cB and E2 mechanisms; attacking base, leaving group and the reaction medium on the rates and mechanisms of elimination reactions; competition between elimination and substitution reactions.

**Aromatic Substitution reactions**
Electrophilic substitution Aromaticity; mechanisms of substitution; orientation sulfonation, Friedel-Crafts reactions, diazo-coupling, formylation and carboxylation.
Nucleophilic substitution
Mechanisms Study of SNAr, SN1 and benzyne mechanisms; The effects of substrate structure, leaving group and the attacking nucleophile on the rates of substitution reactions.

**Named Organic Reactions**
Cannizzaro reaction, Perkin reaction, Michael reaction, Claisen-Schmidt reaction, Darzens Glycidic Ester reaction, Stobbe reaction, Mannich reaction, Wittig reaction, Ene reaction and Reformatsky reaction, Diels-Alder reaction.

**CHM-554 Practical**
Organic Synthesis at least four experiments involving two step synthesis
Estimation of Amide and Carboxyl groups, Phenol and other functional groups.
Determination of Saponification value and acid value in oil.

**Books Recommended:**

1. **Chemistry of Non-Aqueous Solvents:**
   Classification of solvents. Type of reactions in non-aqueous solvents. Physical and chemical properties of solvents. Study of reactions in liquid NH₃, HF, SO₂, BrF₃, CH₃COOH and HCN. Reactions in molten salt system.
2. **Pi-Acceptor Ligands:**
3. **Kinetics and mechanism of inorganic reactions:**

**CHM- 556**

**Practicals**

1. **Estimation Of Anions (Any four)**
   Chloride/Phosphate; Chloride/Nitrate; Bromide/Nitrate; Iodide/Nitrate; Borate/ Acetate; Oxalate/ Chloride; Sulphate/Phosphate
2. **KIO₃ Titrations (Any two)**
3. **Gravimetric Estimations:**
   Estimations of Ba²⁺ ; Oxalate ions.

**Books Recommended:**

**CHM-558**

**Analytical Chemistry II** 3(3-0)

Properties of Light and its interaction with matter, relation between frequency, velocity and wave number, Lambert-Beer’s Law and its limitations, Single and double beam
spectrophotometers, sources of light (lamp and lasers), monochromators, photomultiplier tubes, detectors, diode array and charged coupled devices, applications of UV-Vis spectrophotometer in natural product research, pharmaceutical industry, separation process, enzyme essay study, clinical studies, microbiology. Applications of IR, NMR and Mass spectrophotometer in research & development and quality control process.

**Reference Books:**


**CHM-560 Biochemistry-II 3(3-0)**

**Physical aspects of Biochemistry**


**Digestion Absorption and Utilization:**

Carbohydrates, Lipids proteins nucleic acids, vitamins, minerals.

**Enzymes**


**Books Recommended:**


**CHM-562 Introductory Spectroscopy 2(2-0)**

**Spectroscopy:**

Introduction to principle, instrumentation and application of Electronic (UV / Visible) Atomic (Emission /Absorption), Molecular (Infrared) and Nuclear Magnetic Spectroscopy.
Recommended Books:


Semester 3

Specialization in Organic Chemistry

CHM-651 Spectroscopic Organic Techniques 3(3 – 0)

(a) Introduction

(b) Ultraviolet/Visible Spectroscopy:

(c) Infrared Spectroscopy:
Introduction, Vibrational modes and absorption frequencies, Hooks Law, Instrumentation and sample handling, Interpretation of Infrared spectra, Characteristic absorptions frequencies of some common functional groups, Applications of Infrared spectroscopy.

(d) Nuclear Magnetic Resonance:
Introduction, Spin flipping Nuclear Precession and absorption of electromagnetic radiation, Spin relaxation, The Chemical shift and integration curve, Molecular structure and chemical shifts, Instrumentation and Sample handling, Spin splitting and coupling constants. Interpretation of NMR spectra.

(e) Mass spectrometry:
Introduction, Basic Principle, Instrumentation (theory and operation) The mass spectrum, Modes of Fragmentation of various organic molecules. Applications of mass spectrometry determination of molecular weight, molecular formula and molecular
structure. Interpretation of mass spectra.

**Recommended Books:**


**CHM-653 Rearrangements and Pericyclic Reactions  3(3 – 0)**


**Pericyclic Reactions**

Conrotatory and Disrotatory motion of orbital, electrocyclic reactions, thermal cyclization, Photochemical cyclization, Hofman rule, Fukui Theory of Frontier orbitals. Introduction to cycloaddition reactions. Suprafacial and Antanafacial addition woodward Hofman Rule. Frontier theory and mobius huckle theory for (2 + 2) and (2 + 4) thermal and photochemical cycloaddition reaction.

**Recommended Books:**

Alkolids
Introduction, occurrence, function of Alkolids in plants, Classification, Nomenclature, Pharmaceutical Applications, Isolation, Qualitative Test and General Properties, General Method of Structure Determination. Morphines, Nicotine, Quinine.

Drugs
Introduction, Sources, Route of administration, Metabolites and mechanism of drug action. Sulfonamide, Antipyretics, Analagasic, Barbiturates, Antibiotics, their general synthesis and structure activity relationship.

Recommended Books:


Synthesis of Organic Compounds:
Students must be informed of MSDS of all compounds used in experiments.
The experiments may be arranged as per choice/requirement of instructor but should be designed from following categories;
Various experiments involving the development of amide, ester and ether linkages.
Experiments involving oxidation and reduction of organic compounds.
Synthesis of various dyes.

Recommended Books:


Specialization in Analytical Chemistry
**CHM-659**  **Electroanalytical Techniques**  **3(3-0)**

**Introduction**: Electrochemistry, Electrochemical cells, Standard cell potential, Indicator electrode, Reference electrodes, Classification of electro analytical methods, Bulk method, Interfacial methods, static methods, dynamic methods

**Potentiometric method of analysis**: Potentiometric measurements, Indicator electrodes, Metallic indicator electrode, Membrane indicator electrode, working of potentiometer and its application including pH measurements, ion selective electrode systems, ion exchange membrane electrode, solid state membrane electrodes and bio-membrane electrodes, potentiometric titrations.

**Coulometry and Electrogravimetry**: Basic electrochemistry, principle, instrumentation of coulometry, principle, instrumentation of electrogravimetry, consequences of electrogravimetry, Ohmic drop, activation over potential, concentration and gas polarization, basic difference and merits/demerits of coulometry and electrogravimetry.

**Reference Books**:

**CHM-661**  **Advanced Separation Techniques**  **3(3-0)**

**Chromatography**: Classification of chromatographic techniques, chromatographic processes, rate theory of chromatography, Van-Deemter equation and its significance in evaluating column efficiency.

**Gas Liquid Chromatography**: General principle, sample preparation/derivatization, separation process and instrumental aspects and its applications.

**High Performance Liquid Chromatography**: General principle, sample preparation, separation process (normal phase and reverse phase separation), instrumentation, method development and applications.

**Capillary Electrophoresis (CE)**: Introduction of Electrophoresis, Theory and principle of CE, mobility, electro-osmotic flow separation by CE, instrumentation, modes of operation, applications.

**Reference Books**:

CHM-663 Atomic Spectroscopy

Atomic Absorption Spectrophotometry:
principle of atomic absorption spectrophotometry, concentration dependence of absorption, quantitative methodology, instrumentation for atomic absorption spectrophotometry, radiation sources, atomizers, flames, graphite furnaces and electrochemical atomizers, wavelength selectors, detectors, handling background absorption, interferences in atomic absorption spectrophotometry, sample handling in atomic absorption spectrophotometry, preparation of the sample, use of organic solvents, microwave, digestion, sample introduction methods, applications of atomic absorption spectrophotometry.

Atomic Emission Spectrophotometry:
introduction, principle of atomic emission spectrometry, atomic emission spectrometry using plasma sources, plasma and its characteristics, inductively plasma, direct current plasma, microwave induced plasma, choice of argon as plasma gas, instrumentation for ICP-MS.

Atomic Fluorescence Spectrometry:
Origin of atomic fluorescence, atomic fluorescence spectrum, types of atomic fluorescence transitions, principle of atomic fluorescence spectrometry, fluorescence intensity and analyte concentration, instrumentation for atomic fluorescence spectrometry, applications of atomic absorption spectrophotometry, interferences, merits and limitations.

Reference Books:

CHM-665 Analytical Chemistry Practicals

Practicals
The experiments may be set making use of the following instruments depending upon their availability, special experiments may also be designed for which a specimen list of instruments is given below. For the innovative designing of experiments, the journal of chemical education may be consulted.

INSTRUMENTS
UV/Visible spectrophotometers
Flame photometers
pH-meters
Conductivity bridge
Gas chromatography
HPLC chromatography
Electro gravimetric apparatus
Atomic absorption spectrophotometer
Infrared spectrophotometers

Experiments
Determination of iron in soil by spectrophotometry.
Spectrophotometric determination of molybdate ion.
Separation of dyes using column/paper/thin layer chromatography.
Separation of sugars using paper chromatography.
Separation of amino acids using paper/thin layer chromatography.
Separation of hydrocarbons using GC/HPLC.
Determination of iron in food products spectrophotometrically.
Determination of phosphate content in commercial fertilizers by spectrophotometry.
Determination of nickel in vegetable ghee by spectrophotometry involving solvent extraction.
Identification and spectrophotometric determination of aspirin, phenacetine and caffeine in pharmaceutical samples.
IR analysis and identification of human body stones
Mass spectrometry of mineral oil samples.
To determine pKa values for the given samples of weak acids by potentiometric method.
To determine the quality parameters i.e. pH, conductance and concentration of anions and cations.
To determine Ni (II) in steel using DMG reagent by spectrophotometric method.
To determine vitamin-C concentration in the given samples.
To determine calcium and zinc in milk by atomic absorption spectrophotometer.
To determine lead in sewage sludge by atomic absorption spectrophotometer.
To determine Mn and Cr in stainless steel spectrophotometrically.
To record and characterization of IR spectra of at least 1 organic compounds.

Specialization in Physical Chemistry
CHM-675       Kinetics of Complex Reactions       3(3-0)

Chemical Reactions
Advanced theories of unimolecular reactions, Chain and non chain complex reactions, Fast reactions, Experimental techniques for measurement of fast reaction kinetics, Kinetics of catalyzed reactions

Photochemical reactions
Introduction, Photochemical reactions, photochemical reactions in gas phase and in solutions, quantum yields, flash photolysis, photochemical reaction kinetics

Interfacial Phenomena
Solid surfaces, Gas solid interfaces, thermodynamics of adsorption, adsorption at liquid surfaces, organized molecular assemblies, colloids and surfactants, liquid interfaces, surface tension and adsorption from solutions,

Recommended Books:


CHM-677       Nuclear and Radiation Chemistry       3(3-0)

Nuclear Chemistry
Introduction to Nuclear chemistry, Nuclear systematic, sources of nuclear instability, nuclear energetics , nuclear fission and fusion

Nuclear Techniques

Radiation Chemistry

Recommended Books:

ChM-683 Material Chemistry 3(3-0)

Physical Chemistry of Macromolecules
Introduction, molecular forces and chemical bonding in macromolecules, configurations and conformation of polymer chains, theories of polymer solutions, spectroscopic analysis, thermal analysis, polymer reheloey

Solid State
Introduction, attractive forces, properties of solids, crystal structure, crystal defects, crystallography, theories of bonding, packing of atoms in metals.

Modern Materials
Composite materials, superconductors, conducting polymers, biopolymers, Bullet proof polymers, edible plastics, smart materials, nano particles.

Recommended Books:

5. Joel R. Fried “Polymer Science and Technology” Prentice Hall PTR. 1995, USA.

CHM-685 Physical Chemistry Practicals 2(0 –2)

1. Sugar analysis and inversion studies by polarimetry
2. Verify Beer’s Lambert’s Law for the given solution.
3. Investigate the kinetics of hydrolysis of ethyl acetate in the presence of hydrochloric acid at room temperature and determination of order of reaction.
4. Interpretation of IR and NMR spectra
5. Determination of molecular weight of given sample of polymer viscometrically
6. Thermal analysis of given polymer sample with the help of available established
7. Surface characteristics of given polymer sample with the help of available established literature
8. Waste water treatment using chemicals
9. Waste water treatment using advanced oxidation process
10. Study of isotherms and experiments of surface chemistry
11. Preparation of colloidal solution and determination of precipitation value of colloidal solution by using monovalent, bivalent and trivalent cations
12. Determination of apparent molar volume of different sample solutions
13. Calculation of partial molar volume by graphical method
14. Kinetic study of enzyme catalyzed reactions

**Specialization in Inorganic chemistry**

**CHM-687** Main Group Organometallic and Organic Reagents 3(3 - 0)

**Main Group Organometallic Reagents**
Introduction, Preparation, classes of nucleophilic organometallic reagents organo-Li, S, Sc, Si, B, Sn, Sb and Zn in organic synthesis, control side reaction (Enolization vs. nucleophilic addition, substitution vs. elimination, selectively among functional groups via organometallic reagents

**Organic reagents in inorganic Analysis**
Type of reagents, their specific nature and methods of applications with specific examples, Complexometric and gravimetric methods involving various reagents, chelates and chelate effect.

**Recommended Books:**


**CHM-689** Spectroscopic Methods of Analysis 3(3-0)

Recommended Books:

CHM-691 Organo-Transition Metal Compounds 3(3-0)

Introduction, Cluster Compounds: Nomenclature and Structural Patterns, Metal Carbonyl Type Clusters, Anionic, Hydrido, Larger and Superlarge Carbonyl Clusters, Non-Carbonyl Clusters, Heteroatom in Clusters, Electron Counting Rules (TEC, Wades, Capping). Metal to Carbon Single, Double and Triple bonds; Acyls, Alkylidene and Alkalidyne Complexes, Bonding to Olefins, Polyolefins, Allyl, Alkyne and Arene Complexes.

Recommended Books

CHM-693 Inorganic Chemistry Practicals 2(0-2)

1. Conductometry
   - Titration of strong acid and weak acid with a strong base.
   - Precipitation titration involving AgNO₃ and KCl.
2. Potentiometry
   - Determination of K₁, K₂ and K₃ for H₃PO₄
   - Determination of chloride in the presence of iodide and evaluation of AgI and AgCl
3. Spectrophotometry
   - Micro determination of Cr(III) by Di-phenylcarbazide.
   - Determination of Fe (II) by 1-10Phenanthrolne.
   - 8-Hydroxyquinoline Al (III) and Fe (III)
   - Salicylaldoxime: Ni (II) in the presence of Cu (II)
   - Anthranilic acid: Co (II) and Zn (II)

5. Inorganic Synthesis:
   Preparation of at least six inorganic compounds/complexes in a pure state and determination of their state of purity.

**Semester 4**

**Specialization in Analytical Chemistry**

CHM-652 Thermal Methods of Analysis 3(3-0)

**Thermal Analysis:**
Introduction, classification and principles of thermal analysis, thermograms, instrumentations, applications and limitations of thermal analysis.

**Thermogravimetric Analysis (TGA) and Derivative Thermal analysis (DTA):**
Introduction and principle of thermogravimetric analysis and derivative thermal analysis, its instrumentation, applications, data interpretations, limitations.

**Differential Thermal Analysis (DTA):**
Introduction and principle of differential thermal analysis, its instrumentation, applications, data interpretations, limitations.

**Differential Scanning Calorimetry (DSC):**
Introduction and principle of differential scanning calorimetry, its instrumentation, applications, data interpretations, limitations.

**Differential Photo-Calorimetry (DPC):**
Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

**Evolved Gas Analysis (EGA):**
Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

**Thermo-mechanical Analysis (TMA):**
Introduction and principle of thermo-mechanical analysis, its instrumentation, applications, data interpretations, limitations.

**Dynamic Mechanical Analysis (DMA):**
Introduction and principle of dynamic mechanical analysis, its instrumentation, data interpretations, applications.

**Di-electric Thermal Analysis (DETA):**
Introduction and principle of di-electric thermal analysis, its instrumentation, data interpretations, applications.

Reference Books:

CHM-654 Nuclear Analytical Techniques 3(3-0)
Introduction to Nuclear sciences, Radioactive decay, Production of nuclear radiation, Interaction of radiation with matter, Radio-analytical techniques, Radiation detection and measurement instruments, Role of radiotracers in development of modern nuclear analytical techniques, Applications of radio-tracers in medical, environment, agriculture and industrial.

Reference Books:

CHM-656 Luminescence Spectrophotometry 3(3-0)
Introduction, origin of fluorescence and phosphorescence spectra, Jablonski diagram, activation, deactivation, fluorescence spectrum, fluorescent and phosphorescent species,
photoluminescence and structure, factors affecting fluorescence and phosphorescence, fluorescence quenching, quantum yield, instrumentation for fluorescence measurement, sources, wavelength selectors, sampling, detectors, read out devices, instrumentation for phosphorescence measurement, sampling, recording procedure, application of fluorescence and phosphorescence.

Reference Books:

CHM-658 Food and Drug Analysis 3(3-0)
Course Contents:
Introduction to food analysis, food gradients and nutritional values, sampling of food, general methods of analysis. Analysis of milk, butter, wheat flour, meat, beverages, tea, coca, honey and soft drinks.

Pharmaceuticals:
Classification of drugs, test for analysis of different pharmaceuticals, introduction to US and British pharmacopeia.

Forensics:
History and scope of forensic science, forensic ethics, forensic toxicology. Classification and analysis of narcotics & dangerous drugs, examination of crime scene evidences, fingerprinting, skeletal material to provide scientific opinion for legal.

Reference Books:

CHM- 680 Standard Methods and Quality Assurance 3(3– 0)

COURSE OBJECTIVES
The objectives of this course are to:
- Introduce students to the concept and benefits of quality assurance/quality control in the manufacturing industries
- Expose students to the process of conducting quality control of products in chemical and allied industries
- Expose students to the causes and effects of industrial and laboratory hazards and accidents
• Educate them on prevention and control of industrial and laboratory accidents

CONTENTS

Method development and validation: Selection of analytical methods for problem solving, Optimizing the experimental procedures, Single operator characteristics, Blind analysis of standard samples, Ruggedness testing, Equivalency testing, Sensitivity of instruments, Limits of detection and Signal-to-noise ratio.

Quality Control: Introduction and concept of quality control and quality assurance, Development of quality standards in industries, Quality control chart, Quality control in some industries, General safety practices, Good laboratory practices


Automation in analytical methods: Automatic, automated and smart instruments and their applications with special emphasis on clinical, industrial and quality control aspects

Books Recommended:


CHM-670/Analytical Chemistry Practicals 2(0-2)

Practicals
The experiments may be set making use of the following instruments depending upon their. Availability, special experiments may also be designed for which a specimen list of instruments is Given below. For the innovative designing of experiments the Journal of Chemical Education may be consulted.

INSTRUMENTS
Atomic absorption spectrophotometer
Infrared spectrophotometers
GCMS
HPLC
UV/Visible spectrophotometers
Flame photometers
pH-meters
Conductivity bridge
Thin Layer Chromatography
Electro gravimetric apparatus
Experiments
Potentiometric determination of Fluoride in drinking water.
Spectrophotometric determination of Iron in soil.
Determination of pH of Hair Shampoos.
IR analysis and identification of human body stones
Ultraviolet Spectrophotometric determination of Aspirin and Caffeine in pharmaceutical samples.
Determination of iron in foods products spectrophotometrically.
Determination of Calcium by Atomic Absorption Spectrophotometry.
Determination of Mercury in Laboratory Air using Atomic Absorption Spectrophotometry.
Flame Emission Spectrometric determination of Sodium.
Qualitative and Quantitative Analysis of Fruit juices for Vitamin C using HPLC.
Enzymatic determination of Glucose in Blood.
Separation of dyes using column/paper/thin layer chromatography.
Separation of sugars using paper chromatography.
Separation of amino acids using paper/thin layer chromatography.
Identification of fingerprints by chemical test.
Analysis of Analgesics using HPLC.
Determination of phosphate content in commercial fertilizers by spectrophotometry.
Determination of nickel in vegetable ghee by spectrophotometry involving solvent extraction.
Mass spectrometry of mineral oil samples.
To determine calcium and zinc in milk by atomic absorption spectrophotometer.
Test for analysis of drugs.
To determine lead in sewage sludge by atomic absorption spectrophotometer.
Identification of fingerprints by powder test.
To record and characterization of IR spectra of at least 1organic compounds.
Gas Chromatographic analysis of drugs and poison.
Analysis of milk, beverages and meat.

Reference Books:
1. Yolanda Picó, Chemical Analysis of Food: Techniques and Applications
2. Leo M. L. Nollet. Handbook of Food Analysis: Physical characterization and

Specialization in Organic Chemistry

CHM–660 Organic Polymers 3(3 – 0)

Introduction to polymer chemistry. Step-growth polymerization, free radical addition
polymerization, ionic polymerization; stereochemistry polymers; polymerization using
Moleculars weight determination. Structure property relation. Reactions of synthetic polymers; polymers degradation and stability with special emphasis on thermal and photo-degradation.

**Recommended Books:**


**CHM–662 Reactive Intermediates and Photochemistry 3(3–0)**


**Photochemistry:**


**Recommended Books:**


**CHM – 664 Disconnection Approach 3(3–0)**

**The Disconnection Approach**


**Recommended Books:**

CHM – 666 Organic Catalyst and Catalysis 3(3–0)

Homogeneous and heterogeneous catalysis, Acid Catalysis, Base Catalysis, Metal ion catalysis, Hydrogenation, Asymmetric hydrogenation, Hydroboration and Hydrocyanation of olefins, Transformation of alkenes and alkynes i.e. polymerization, metathesis, dimerization and oligomerization and olefin isomerization, oxidation of olefins using catalysts, Metal complexes and Quaternary ammonium compounds in organic synthesis.

Recommended Books:

CHM-672 Advanced Organic Chemistry Practicals -II 2(0-2)

The experiments may be arranged as per choice/requirement of instructor but should be designed from following categories;

Synthesis of the organic compounds involving multi step synthesis using various synthetic methods. Synthesis of five or six membered heterocyclic compounds. Synthesis of targeted molecules; Anthranilic Acid. Benzilic acid, p-nitro aniline, Phenacetin and Acridon.

Recommended Books:

Specialization in Inorganic Chemistry

CHM-676  X-ray Spectroscopy  3(3-0)

Introduction, Lattice and unit cell, geometry of crystals, crystal systems, primitive and non primitive cells, Lattice direction and planes crystal shapes Dimensional relationship, Braggs equation, reciprocal lattice, experimental methods of single & multicrystal (power) analysis, diffraction and diffractometer, identification and applications.

Recommended Books:


CHM-678  Homogenous Catalysis  3(3-0)

Reaction of CO and hydrogen, Hydroformylation, reductive carbonylation, reduction of CO by hydrogen, synthesis of water gas and shift reactions. Carbonylation reaction, Synthesis of methanol and methyl acetate, adipic ester, other carbonylation and decarbonylation reactions. Catalytic addition of molecules to C-C multiple bonds, Homogeneous hydrogenation, and hydrocylation and hydrocynation.

Recommended Books:


CHM-684  Radio Nuclear Chemistry  3(3-0)

Fundamentals and applied aspects of Radio activity and nuclear chemistry. Trans-Uranium elements; Natural and artificial radioactivity, methods for isotope production, nuclear reactions; mass spectrograph, Astam mass spectrograph, The structure of the nucleus; nuclear stability and radioactive decay; Types, characteristics and detection of radio active Particles; laws of radioactive decay; the interaction of radiation with matter
including radiological health hazards; Processing of the nuclear materials. Accelerators of charged particles Applications of radioisotopes.

Recommended Books:

1. F. Landler, Kennedy, Miller, “Nuclear and Radiochemistry”, 2\textsuperscript{nd} Ed, John Wiley and Sons, Inc. (1964).

CHM-686 Magneto Chemistry 3(3-0)

Theory of magnetism, diamagnetism, paramagnetism, ferro-, ferri- and antiferromagnetism, magnetic susceptibility, magnetic moments, Faraday’s & Gouy’s methods, orbital contribution to magnetic moment, Russell-Sanders coupling scheme, derivation of term symbols of for \(^1p^1\) - \(^6p^6\) and \(^1d^1\) - \(^10d^{10}\) systems, pigeon holes diagram, effect of temperature on magnetic properties of complexes. Magnetic moment of lanthanides.

Recommended Books:


CHM- 668 Advanced Inorganic Practicals 2(0-2)

Preparation of at least six compounds/organometallic compounds and characterization by IR and UV spectrophotometer to the subject of availability of facilities. Spectroscopic determination of some metal ions, Estimation of different metals in food, tap water and brass etc. By atomic absorption spectrometer/flame photometer/UV/Visible spectrophotometer, subject to the availability of facilities.

Recommended books:

Specialization in Physical Chemistry

CHM-688 Group Theory and Solutions 3(3-0)

Advanced Group Theory
Group Algebra. Point groups. Classes Symmetry, The character table and representation, Group theory application in chemistry

Solution Chemistry
Physicochemical characteristics of solvents. Solute-solvent interaction, salvation of ions, preferential salvation. Thermodynamic methods for study of solutions

Biophysical Chemistry
Principles of biophysical chemistry; thermodynamic aspect of simple molecules, macro molecules, lipids and biological membranes; nucleic acids and proteins; enzyme kinetics and catalysis; experimental techniques

Recommended Books:

CHM-690 Quantum and Statistical Mechanics 3(3-0)

Statistical Mechanics

Quantum Chemistry

Theoretical and Computational Chemistry

Recommended Books:

CHM-692 Advanced Spectroscopy 3(3-0)

Molecular Spectroscopy
Electromagnetic radiations, interactions of electromagnetic radiations with matter, microwave, infrared and Raman spectroscopy of polyatomic molecules, vibrational-rotational spectra.

Nuclear Magnetic Resonance
Principles of magnetic resonance. Nuclear magnetic resonance (NMR) spectroscopy. Coupling phenomenon in simple (AXn) and complex systems. Relaxation mechanisms and their applications. Dynamic NMR. Applications in structure elucidation.

Electron Spin Resonance
Electron spin resonance spectroscopy (ESR). Principles and applications to solids and solutions.

Recommended Books:
2. G. M. Barrow, “Introduction to Molecular Spectroscopy,” 2nd Ed, McGraw-Hill,
New York, USA (1962).


4.

CHM-694 Electrochemical Aspects of Solutions 3(3-0)

Electrochemistry of Solution
Introduction to solution and its units, Conductance and resistance, Fugacity, activity, activity coefficient, colligative properties of electrolytes, ionic mobility, cell constant, ionic strength

Kinetics of Electrode Process
Theories of electrolytes, interfacial phenomena, electrode kinetics, mechanism of electrode reactions, Butler Volmer equation, cyclic voltametry and its applications

Electrochemistry of Colloidal Solution
Colloids, classification, preparation of colloidal solution, peptisation, coagulation, flocculation, peptisation, Dialysis, Electrophoresis, Zeta potential, Solutions of Surfactants.

Recommended Books:

CHM-674 Advanced Physical Chemistry Practicals 2(0-2)

NB: At least eight experiments should be performed from following list subjected to availability of apparatus and chemicals.
1. Determination of Equivalent and molar conductance of aqueous and non-aqueous solutions of different electrolytes.
2. Determination of partial molar volumes and excess molar volumes for binary and ternary systems.
3. Purification of the given commercial solvent using pertinent methods of separation (distillation, fractional distillation, reflux).
4. Verification of Ostwald’s Dilution law.
5. Verification of Debye-Huckel Limiting law.
6. Determination of heat of solutions of selected compounds by solubility methods in aqueous and non-aqueous media.
7. Determination of critical micelle concentration of selected surfactants in aqueous and non-aqueous media by surface tension and conductivity.
8. Determination of free energy of micellization of selected surfactants in aqueous and non-aqueous media by surface tension and conductivity.
10. Determination of degree of dissociation of weak electrolytes.
11. Determination of pKa values of acids.
12. Determination of pKa values of indicators.
13. Preparation of buffers of required pH values.

Books recommended: