GC UNIVERSITY, FAISALABAD

Scheme of Studies

Master of Philosophy in Chemistry

04 Semester / 2 years Degree Program
for the year 2015 & onward

Department of Chemistry
## Scheme of Studies of M.Phil Chemistry

### Semester 1 & 2

#### Inorganic Chemistry

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CHM-701</td>
<td>Solid State Chemistry</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-702</td>
<td>Photochemical Reactions of Transition Metals</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-703</td>
<td>Applied Transition Metal Catalytic Chemistry</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-704</td>
<td>Chemistry of Organometallic Compounds</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-705</td>
<td>Inorganic Electronic Spectroscopy</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-706</td>
<td>Kinetics and Mechanism of Inorganic Reactions</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-707</td>
<td>Bio-Inorganic Chemistry</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-708</td>
<td>Nano Chemistry</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-709</td>
<td>Applied Spectroscopy</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-710</td>
<td>Extractive Metallurgy</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-712</td>
<td>Metal Based Drugs</td>
<td>3(3-0)</td>
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#### Organic Chemistry

<table>
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<tr>
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<tbody>
<tr>
<td>CHM-751</td>
<td>Modern Trends in Organic Synthesis</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-752</td>
<td>Advanced Stereochemistry</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-753</td>
<td>Physio-organic Chemistry and Reaction Mechanism</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-754</td>
<td>Advanced Heterocycles I</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-755</td>
<td>Chemistry of Glycosides</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-756</td>
<td>Biosynthesis of Natural Products</td>
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<tr>
<td>CHM-757</td>
<td>Advanced Nuclear Magnetic Resonance</td>
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<tr>
<td>CHM-759</td>
<td>Symmetry Controlled Reactions</td>
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<td>CHM-760</td>
<td>Classics in Total Synthesis</td>
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<tr>
<td>CHM-761</td>
<td>Role of Protective Groups in Organic Synthesis</td>
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<tr>
<td>CHM-762</td>
<td>Advanced Heterocycles II</td>
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#### Analytical Chemistry

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<tr>
<td>CHM-731</td>
<td>Laser and Luminescence Spectroscopy</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-732</td>
<td>Environmental Analysis</td>
<td>3(3–0)</td>
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<tr>
<td>CHM-733</td>
<td>Radiopharmaceuticals and Quality Control</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-734</td>
<td>Techniques for Surface Analysis</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-735</td>
<td>Polymer Characterization by Hyphenated Techniques</td>
<td>3(3–0)</td>
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<tr>
<td>CHM-736</td>
<td>Advanced Emission Spectroscopy</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-738</td>
<td>Chromatographic Techniques</td>
<td>3(3–0)</td>
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<tr>
<td>CHM-739</td>
<td>Research Methodology</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-740</td>
<td>Chemoinformatics</td>
<td>3(3-0)</td>
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#### Physical Chemistry

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<tr>
<td>CHM-781</td>
<td>Physical Chemistry of High Polymers</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-782</td>
<td>Complex Extension of Quantum Chemistry</td>
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<tr>
<td>CHM-783</td>
<td>Electrode Processes</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-784</td>
<td>Magnetic Spin Dynamics</td>
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<td>CHM-785</td>
<td>Molecular Spectroscopy</td>
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<td>CHM-786</td>
<td>Photochemistry</td>
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<td>CHM-787</td>
<td>Solution Chemistry</td>
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<td>CHM-788</td>
<td>Colloids and Surfactants</td>
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<tr>
<td>CHM-789</td>
<td>Theoretical and Computational Chemistry</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-790</td>
<td>Physical Chemistry of Biomolecules</td>
<td>3(3 – 0)</td>
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<td>CHM-791</td>
<td>Heterogeneous Catalysis</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-792</td>
<td>Modern Aspects of Chemical Kinetics</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-793</td>
<td>Environmental Chemistry and Energy Conversions</td>
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### Semester 3 & 4

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<td>CHM-728</td>
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<tr>
<td>CHM-729</td>
<td>Seminar (Research)</td>
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<tr>
<td>CHM-730</td>
<td>Thesis</td>
<td>6(6 – 0)</td>
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M. PHIL CHEMISTRY

INORGANIC CHEMISTRY

CHM-701    Solid State Chemistry  3(3-0)

Classification of bonds and crystals, The effect of radius ratio and charge on crystals, Application of the isoelectronic principle, Ordered solids including interstitial compounds, Alloys, Superclustures and Storage batteries, Amorphous solids (Glass and Polymers)

Recommended Books:


CHM-702    Photochemical Reactions of Transition Metals  3(3-0)

Introduction, Basic Photochemical processes, Photosubstitution reactions, Photoredox reactions, Reactivity of CTTM and CTTL excited states, Ligand photoreactions, Scavenging of reaction intermediates, Photoreaction and solar energy conversion, Photochemistry techniques.

Recommended Books:


CHM-703    Applied Transition Metal Catalytic Chemistry  3(3-0)

Ziegler-Natta and Wacker catalyst, polymerization and Oligomerization of ethylene, propylene, olefins, cyclic olefins and alkynes, Fischer-Tropsch process, Oxidation reaction, synthesis of acrylates and related derivative.

Recommended Books:

CHM-704 Chemistry of Organometallic Compounds  3(3-0)

Nature of metal-carbon bond in organometallic compounds, transition metal organometallic complexes, naturally occurring organometallic compounds, fundamental process in reactions of organotransition metal complexes like insertion and extrusion of CO, SO\textsubscript{2}, NO, olefins and diffracton, Experimental techniques in organometallics (techniques using Schlenk glassware, chemical analysis, IR Raman, photoelectronic, Mossbauer and NMR spectroscopy, X-ray and neutron diffraction)

Recommanded Books:


CHM-705 Inorganic Electronic Spectroscopy  3(3-0)

Introduction, Term symbols, Russel Sanders coupling scheme, Development of correlation and Tanabe-sugano diagram, Ligand field spectra of octahedral complexes, Absorption spectra of coordination compounds, Band assignments and interpretation of absorption spectra of complexes, Charge transfer spectra, Spectra of low symmetry complexes, Magneto chemistry.

Recommanded Books:

**CHM-706  Kinetics and Mechanisms of Inorganic Reactions  3(3-0)**


**Recommended Books:**


**CHM-707  Bio-Inorganic Chemistry  3(3-0)**

Development and importance of bio-inorganic chemistry. Introduction to metals of biological importance. Function of metals in enzyme catalysis. Oxygen carriers; nitrogen fixation; vitamin B6 and B12. Importance of metals and nonmetals in biological systems. Metal ions and chelating agents for medicinal purposes.

**Recommended Books:**

CHM-708 Nano Chemistry 3(3-0)


Recommended Books:


CHM-709 Applied Spectroscopy 3(3-0)


Recommended Books:

Extractive Metallurgy (CHM-710) 3(3-0)

Introduction; Pyrometallurgy, Hydrometallurgy, Biohydrometallurgy, Leaching of Au, Ag, Pt, Pd, Rh, Ce, In, Cu, Zn, Fe from minerals; General Principle, Leaching from oxides, leaching of sulfides, leaching of phosphate, leaching of silicates, Leaching of Secondary resources; slags, smelter dusts, Ashes, electronic wastes, Treatment of leach liquor; Crystallization, Adsorption, ionic precipitation, ionic flotation and precipitate flotation, solvent extraction

Recommended Books:


Metal Based Drugs (CHM-712) 3(3-0)

Introduction, Strategic considerations, Radiodiagnostic, Biopharmaceutical properties of drugs substances, Pharmacologic Activity, Drug Design, DRUG/Receptor Interactions, Drugs Resistance and Metabolism, Lithium and Mental Health, Gold and Rheumatoid Arthritis, Platinum ammine halides, Metallocenes and their halides: Ti, V, Fe, Gold and other metal phosphines, other main group and transition-metal compounds, cis-platin, carboplatin, platinum anti cancer drugs, technetium radiopharmaceuticals, gadolinium MRI contrast agents, auranofin, Mechanism of action studies, Dose-Limiting problems: toxicology,

Recommended Books:

Analytical Chemistry

CHM-731   Laser and Luminescence Spectroscopy   3(3-0)


Atomic and molecular fluorescence spectroscopy basic principle and instrumentation, structural factors, instrumentation for fluorescence and Phosphorescence Measurement, Room temperature Phosphorescence, Comparison of Luminescence and UV-Visible Absorption Methods.

Books recommended:

CHM-732   Environmental Analysis   3(3-0)


Recommended Books:
**CHM- 733  Radiopharmaceuticals and Quality Control  3(3-0)**

Introduction; Structure of atom and nucleus; Radioactive decay; Unit of radioactivity; Cyclotron-produced radionuclides; Reactor-produced radionuclides; Instruments for radiation detection and measurement; Specific activity; Radionuclide generators; Radiopharmaceuticals; Formulation of radiopharmaceuticals for different organs; Characteristics of specific radiopharmaceuticals; Diagnostic uses of radiopharmaceuticals in nuclear medicine; Therapeutic uses of radiopharmaceuticals in nuclear medicine; Quality Control of Radiopharmaceuticals; Nuclear pharmacy.

**Books Recommended:**


**CHM-734  Techniques for surface analysis  3(3-0)**


**Books Recommended:**

**CHM-735  Polymer Characterization by Hyphenated Techniques**  
3(3-0) 

**Books Recommended:**  

**CHM-736  Advanced Emission Spectroscopy**  
3(3-0) 

**Recommended Books:**  

**CHM-738  Chromatographic Techniques**  
3(3-0) 

**Recommended Books:**  
Scheme of Studies of M.Phil Chemistry

CHM- 739  Research Methodology  3(3-0)

Research Methodology


Recommended Books:
2. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers’Distributors

CHM-740  CHEMOINFORMATICS  3(3-0)

Recommended Books

2) Andrew R. Leach, V.J. Gillet; An Introduction to Chemoinformatics 2007 Published by Springer, Netherlands.
3) Johann Gasteiger and Thomas Engel; Chemoinformatics: A Textbook. 2003 Wiley-VCH Verlag GmbH & Co. KGaA.
4) Eduardo A. Castro and A. K. Haghi; Advanced Methods and Applications in Chemoinformatics: Research Progress and New Applications 2012 by IGI Global.
5) Jürgen Bajorath; Chemoinformatics Concepts, Methods, and Tools for Drug Discovery 2004 Humana Press Inc. Totowa, New Jersey
6) Jean-Loup Faulon, Andreas Bender Handbook of Chemoinformatics Algorithms 2010 Chapman & Hall/CRC Boca Raton, FL
7) Roberto Todeschini and Viviana Consonni Molecular Descriptors for Chemoinformatics 2009 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
ORGANIC CHEMISTRY

CHM-751 Modern Trends in Organic Synthesis 3(3-0)

Introduction to retro synthesis and disconnection approach, synthesis of aromatic compounds. One and two group C-X disconnections. Donor and acceptor synthesis and concepts of Umpulung. C-C disconnections and disfunctionalized compounds compounds. Devising synthetic schemes for unknown molecules and some natural products.

Books Recommended:

CHM-752 ADVANCED STEREOCHEMISTRY 3(3-0)

Prostereoisomerism, Concept of Re and Si face, Homotopic, Enantiotopic and Diastereotopic ligands and faces, Stereoselectivity and Stereospecificity, Configuration and conformation of cyclic molecules, Stereochemistry and conformational analysis of cyclohexane system, six- membered sp2-hybridized cyclic systems and six membered saturated heterocycles. Stereochemistry and conformational effects in small, common and medium rings. Bicyclic and polycyclic fused rings systems. Bridged rings and stereochemical restrictions. Chiroptical properties, Optical Rotatory Dispersion and Circular Dichroism.

Books Recommended:
CHM-753  Physico-Organic Chemistry and Reaction Mechanism  3(3-0)

Chemical reactions and energy changed; qualitative aspects of collision. Transition state theories, rates and equilibria; tracer techniques, trapping of intermediates. Interpretation of kinetic data. Correlation of structure with reactivity.; Linear free energy relationship, stereochemical and spectroscopic evidences. Study of reaction mechanism of some recent reactions.

Books Recommended:


CHM-754  Advanced Heterocycles I  3(3-0)

Three membered heterocycles:

Nomenclature, Physical properties, Synthesis, Chemical reactions and medicinal importance of Aziridine, Oxirane, Thiirane, Diazirine, Oxaziridine, Dioxirane.

Four membered heterocycles:

Nomenclature, Physical properties, Chemical reactions and medicinal importance of Azetidine, Oxetan, Thietane, Diazetidine, Dioxetane, Dithietane

Seven membered heterocycles

Nomenclature, Physical properties, Chemical reactions and medicinal importance of Azepane, Oxepane, Thiepane, Thiazepene

Recommended Books:

CHM-755 Chemistry of Glycosides 3(3-0)
Glycosides of flavonoids, coumarins and saponinsIsolatins, detection and chromatographic separation; acid, alkaline and enzymatic hydrolysis to aglycones; identification of sugar residue. Spectroscopic determination of aglycone and glycoside structures. Derivatization, structural elucidation and biological importance of glycosides.

Books Recommended:

CHM-756 Biosynthesis of Natural Products 3(3-0)
Introduction to biosynthesis. Biosynthesis of fatty acids, polyketides, isoprenoids, amino acids and alkaloids, Metabolites from shikimic acid (ArC1 ARC2 and ARC3 metabolites) and of mixed biosynthetic origin (metabolites derived from acetate and mevalonate.)

Books Recommended:

CHM-757 ADVANCED NUCLEAR MAGNETIC RESONANCE 3(3-0)
Theoretical principles. Chemical shift and spin coupling in $^1$H and $^{13}$C nuclei, factors affecting chemical shift and spin coupling in different spin systems. DEPT, INEPT, SINEPT, Homonuclear 2D NMR techniques COSY, NOESY, INADEQUATE, TOCSY, ROESY, 2D J-resolved spectroscopy, Heteronuclear 2D techniques HMQC, HMBC, DOSY, Structure elucidation by using NMR techniques.

Books Recommended:
CHM-759  Symmetry Controlled Reactions  3(3-0)

Huckel moleculars orbital-and perturbation orbital theories; Frontier orbitals (HOMO-LUMO) concept; orbital symmetry; alternate and non-alternate hydrocarbons, Huckel and Mobious systems. Classes of peicyclic reactions: electrocyclic, cycloaddition, sigmatropic and chelotropic reactions and their interpretation through (a) orbital symmetry conservation (b) frontier orbital treatment and (c) Huckel-Mobious approach Applications to organic synthesis.

Books Recommended:


CHM-760  Classics in Total Synthesis  3(3-0)

Basic Concepts, Retro synthesis, Multistep total Synthesis of natural products, Pencillins, Prostaglandins, Estrone, Menthol, Quinine, Ajmaline.

Books Recommended:


CHM 761  Role of Protecting Groups in Organic Synthesis  3(3-0)

Introduction
(i) Protection of Carboxylic Acid Group
By ester formation, By diazotization, By salt formation, by reaction with SOCl₂ by hydroxamic acid etc.
(ii) Protection of Hydroxyl Group
Both for alcoholic and phenolic by ether formation, by ester formation by acetal and ketal formation
(iii) **Protection of Carbonyl Group**  
By Acylation  
By phthaloyl group and their related deprotecting Groups.  

(iv) **Protection of Amine Group**  
By acetal and ketal formation.  
By hydrazone formation.

**Books Recommended:**


**CHM-762 Advanced Heterocycles II 3(3-0)**

**Five membered heterocycles:**

Nomenclature, Physical properties, Synthesis, Chemical reactions and medicinal importance of Pyrrole, Thiophene, Furan, Indole, Benzo[b]Thiophene, Benzo[b]furan, Isoindole, Benzo[c]Thiophene, Isobenzofuran, 1,3-azoles, (Imidazole, Thiazole, Oxazole), 1,2-azoles (pyrazole, Isothiazole & Isoxazole) and their Derivatives

**Six membered heterocycles:**

Nomenclature, Physical properties, Synthesis, Chemical reactions and medicinal importance of Pyridine, Quinoline, Isoquinoline, Pyryliums, 2- and 4-Pyriones, Benzopyryliums, Benzopyrans, Diazines (Pyridazine, Pyrimidine & Pyrazine) and their derivatives

**Recommended Books:**

PHYSICAL CHEMISTRY

CHM-781  Physical Chemistry of High Polymers  3(3-0)

Molecular forces and chemical bonding in polymers, configuration and conformation of polymer chains, theories of polymer solutions; phase separation and fractionation, plasticization, molecular size measurement, spectroscopic analysis, thermal analysis, morphology and order in crystalline polymers, polymer rheology, electrical and magnetic properties of polymers.

Recommended Books:


CHM-782  Complex Extension of Quantum Chemistry  3(3-0)

Revision of basic quantum (Historic background, Uncertainty principle, Time-dependent/Time-independent Schrödinger equation, Probability, complex number, Particle in one dimensional box, Tunneling, Operators) Particle in three dimensional box, Requirements of an acceptable wave function, The Harmonic oscillator (one-dimensional harmonic oscillator, Vibration of molecules, Numerical solution of one-dimensional Schrödinger equation), Angular momentum, The Hydrogen atom , Theorems of quantum mechanics (Hermitian operator, Parity, Matrices), The Variation Method (Variation theorem, Determinants, Linear variation methods), Perturbation Theory (Non-degenerate perturbation theory, Perturbation treatment of the Helium atom ground state, perturbation theory for a degenerate energy level).

Recommended Books:

**Scheme of Studies of M.Phil Chemistry**

**CHM-783  Electrode Processes  3(3-0)**

Theories of electron transfer reactions, electron transfer process, electroanalytical techniques, methods for studying homogeneous and heterogeneous electron transfer reactions. semiconductor electrochemistry. Industrial electrochemistry. Electro-chemical energy conversion systems.

**Recommended Books:**

**CHM-784  Magnetic Spin Dynamics  3(3-0)**

Revision of basic magnetic spin dynamics (Classical, quantum and spin angular momentum, nuclear spin and nuclear Zeeman splitting, quadruple nuclei with integer and half integer spin, magnetism, macroscopic and microscopic magnetism, simple pulse sequence, in homogeneous broadening, chemical shift, heteronuclear decoupling). The NMR spectrometer(the magnet, transmitter section, the duplexer, the probe, the receiver section, overview of radiofrequency section, Pulse gradient section), Fourier transform NMR (heteronuclear experiments, Arrayed experiments, two dimensional spectroscopy, three dimensional spectroscopy), mathematical techniques, Quantum mechanics (functions, operators, eigen functions, eigen values, eigen vectors, diagonalization, exponential operators)

**Recommended Books:**

**CHM-785  Molecular Spectroscopy  3(3-0)**

Microwave, infrared and Raman Spectroscopy. Normal coordinate analysis. Electronic spectra of diatomic and simple polyatomic molecules. Molecular symmetry, group theory and applications in chemistry. Applications of spectroscopy in structural chemistry

**Recommended Books:**
**Scheme of Studies of M.Phil Chemistry**

**CHM-786  Photochemistry  3(3-0)**

Principle of photochemistry. Sources of radiation, actinometry (both physical and chemical), primary and secondary photochemical processes, quantum yields, experimental techniques, photolytic studies of aqueous and non-aqueous systems, effects of radiation on solids. Kinetics, mechanism, energetics of photochemical reactions.

**Recommended Books:**

**CHM-787  Solution Chemistry  3(3-0)**


**Recommended Books:**

**CHM-788  Colloids and Surfactants  3(3-0)**


**Recommended Books:**
CHM-789  Theoretical and Computational Chemistry  3(3-0)


Recommended Books:


CHM-790  Physical Chemistry of Biomolecules  3(3-0)


Recommended Books:

CHM-791  Heterogeneous Catalysis  3(3-0)

Introduction to catalysis, Classification of catalytic systems, classification of solid catalysts, adsorption of molecules at the solid surfaces, adsorption isotherms, surface area and porosity, adsorbed states of molecules on metal surfaces, potential energy curves for adsorption, descriptive chemistry of chemisorptions on metals, quantitative aspect of chemisorptions on metals, sorption on oxide surfaces, the band theory of solids, adsorption on insulator oxides, kinetics of heterogeneous reactions, mass transport limitation of catalyzed reactions. Catalysis in energy conversion and in the production of hydrocarbon feed stock, Oxidation catalysis: The Petrochemical Industry, Catalysis in the inorganic chemical industry, Catalysis in Atmospheric Pollution Control

Recommended books:

CHM-792  Modern Aspects of Chemical Kinetics  3(3-0)


Books Recommended:
CHM-793  Environmental Chemistry and Energy Conversions  3(3-0)


Books Recommended:


THE END