

Scheme of studies for M. Sc. Chemistry (Semester wise) for 2008 Session and onwards

Summary:

M. Sc Chemistry program comprises of 4 semesters with 66 credit hours.

1st Semester:

No. of Credits = 18 Credits

Course Code	Title of the Course	Credits
CHEM-501	Basic Mathematics for Chemists	Th.+ Pr. 2(2-0)
CHEM-511	Analytical Chemistry	4(3-1)
CHEM-551	Inorganic Chemistry-I	4(3-1)
CHEM-561	Organic Chemistry-I	4(3-1)
CHEM-571	Physical Chemistry-I	4(3-1)
Total		18

2nd Semester

No. of Credits = 18 Credits

Course Code	Title of the Course	Credits
CHEM-502	Computer Applications in Chemistry	Th.+ Pr. 2(2-0)
CHEM-521	Biochemistry	4(3-1)
CHEM-553	Inorganic Chemistry-II	4(3-1)
CHEM-563	Organic Chemistry-II	4(3-1)
CHEM-573	Physical Chemistry-II	4(3-1)
Total		18

3rd SEMESTER

Every student will be offered two compulsory theory courses of five credits (3 and 2) in Semester III. Moreover at the beginning of 3rd Semester every student shall opt one field of specialization (11 credits). Some of the students will be offered research on the basis of merit while others will be offered a theory course (3 + 1 Credit) from field other than specialization in lieu of research.

List of compulsory courses

Course Code	Title of the Course	Credits
CHEM-601	Forensic Chemistry	2(2-0)
CHEM-602	Industrial Chemistry	3(3-0)

With Research

Two theory courses (compulsory) of (2+3) credits	Credit Th + Pr
One theory course of specialization (Major)	5 (5-0)
One theory course of specialization (Minor)	3(3-0)
Research	4 (3-1)
	<u>4 (4-0)</u>
Total	16

Fields of Specializations

Every student shall opt any one of the following specializations.

- i. Analytical Chemistry
- ii. Biochemistry
- iii. Inorganic chemistry
- iv. Organic chemistry
- v. Physical chemistry

i) Analytical Chemistry

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-614	Advanced Spectroscopy – I (Minor)	4(3-1)
CHEM-615	Advanced Chromatographic Techniques (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-616 Instrumental Methods of Analysis

3(3-0)

ii) Biochemistry

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-623	Metabolism and Bio- Energetics (Minor)	4(3-1)
CHEM-624	Microbiology and Industrial fermentation (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-622 Enzymes and Nutrition**3(3-0)****iii) Inorganic Chemistry**

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-653	Stereochemistry & Periodicity, Nuclear chemistry (Minor)	4(3-1)
CHEM-654	Organometallic & Bio-inorganic Chemistry (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

CHEM-655 Inorganic Polymers & Chemical Forces**3(3-0)****iv) Organic Chemistry**

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-663	Reaction Mechanism, (Major)	3(3-0)
CHEM-664	Spectroscopic Methods in Organic Chemistry (Minor)	4(3-1)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

CHEM-665 Organometallics**3(3-0)****v) Physical Chemistry**

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-673	Surface Phenomena (Minor).	4(3-1)
CHEM-674	Molecular Spectroscopy (Major).	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

CHEM-675 Statistical and Quantum Mechanics**3(3-0)**

Without Research

	Credits
	Th + Pr
Two theory courses (compulsory) of 05 credits	5 (5-0)
One theory course of specialization (Major)	3 (3-0)
One theory course of specialization (Minor)	4(3-1)
One theory course (Minor) from field other than specialization	<u>4(3-1)</u>
Total	16

Fields of Specializations

Every student shall opt any one of the following specializations.

- vi. Analytical Chemistry
- vii. Biochemistry
- viii. Inorganic chemistry
- ix. Organic chemistry
- x. Physical chemistry

ii) Analytical Chemistry

Course Code	Title of Course	Credits
CHEM-614	Advanced Spectroscopy – I (Minor)	4(3-1)
CHEM-615	Advanced Chromatographic Techniques (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

CHEM-616 Instrumental Methods of Analysis **3(3-0)**

ii) Biochemistry

Course Code	Title of Course	Credits
CHEM-623	Metabolism and Bio- Energetics (Minor)	4(3-1)
CHEM-624	Microbiology and Industrial fermentation (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

CHEM-622 Enzymes and Nutrition **3(3-0)**

iii) Inorganic Chemistry

Course Code	Title of Course	Credits
CHEM-653	Stereochemistry & Periodicity, Nuclear chemistry (Minor)	4(3-1)
CHEM-654	Organometallic & Bio-inorganic Chemistry (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

CHEM-655 Inorganic Polymers & Chemical Forces 3(3-0)

iv) Organic Chemistry

Course Code	Title of Course	Credits
CHEM-663	Reaction Mechanism, (Major)	3(3-0)
CHEM-664	Spectroscopic Methods in Organic Chemistry (Minor)	4(3-1)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

CHEM-665 Organometallics 3(3-0)

v) Physical Chemistry

Course Code	Title of Course	Credits
CHEM-673	Surface Phenomena (Minor).	4(3-1)
CHEM-674	Molecular Spectroscopy (Major).	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

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CHEM-675 Statistical and Quantum Mechanics 3(3-0)

4th SEMESTER

Every student will be offered one compulsory theory course of three credits in Semester IV. Moreover the scheme of studies on behalf of III semester will be carried over to semester IV accordingly.

Compulsory course

Course Code	Title of the Course	Credits
CHEM-603	Environmental Chemistry	3(3-0)

With Research

Research	Credits
	Th + Pr
Research	4(4-0)
One theory course (compulsory)	3(3-0)
One theory course of specialization (Major)	3(3-0)
One theory course of specialization (Minor)	<u>4(3-1)</u>
Total	14

Specialization (Total 11 Credits)

Field of specialization will remain same as opted in semester 3rd.

i) Analytical Chemistry

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-617	Advanced Spectroscopy – II (Minor)	4(3-1)
CHEM-618	FTIR and Raman Spectroscopy (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member.

CHEM-619 Instrumental Methods of Analysis-II 3(3-0)

ii) Biochemistry

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-627	Chemotherapy & Immunology (Major)	3(3-0)
CHEM-628	Molecular Biology & Physical Techniques (Minor)	4(3-1)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-626 Endocrine System 3(3-0)

iii) Inorganic Chemistry

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-656	Homogeneous Catalysis by Transition Metal Complexes (Minor)	4(3-1)
CHEM-657	Inorganic Reaction Mechanisms (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-658 Physical Methods in Inorganic Chemistry 3(3-0)

iv) Organic Chemistry

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-668	Chemistry of Natural Products (Minor)	4(3-1)
CHEM-669	Organic Synthesis (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-667 Chemistry of Protective Groups & Reactive Intermediates 3(3-0)

v) Physical Chemistry

Course Code	Title of Course	Credits
CHEM-600	Research	4(4-0)
CHEM-677	Advanced Approaches of Homogeneous and Heterogeneous Kinetics (Minor)	4(3-1)
CHEM-678	Polymers and Photochemistry (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-679 Elementary Group Theory 3(3-0)

without Research

	Credits Th + Pr
One theory course (compulsory)	3(3-0)
One theory course of specialization (Major)	3(3-0)
One theory course of specialization (Minor)	4(3-1)
One theory course (Minor) from field other than specialization	4(3-1)
Total	14

Specialization (Total 11 Credits)

Field of specialization will remain same as opted in semester 3rd.

i) Analytical Chemistry

Course Code	Title of Course	Credits
CHEM-617	Advanced Spectroscopy – II (Minor)	4(3-1)
CHEM-618	FTIR and Raman Spectroscopy (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-619 Instrumental Methods of Analysis-II **3(3-0)**

ii) Biochemistry

Course Code	Title of Course	Credits
CHEM-627	Chemotherapy & Immunology (Major)	3(3-0)
CHEM-628	Molecular Biology & Physical Techniques (Minor)	4(3-1)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-626 Endocrine System 03

iii) Inorganic Chemistry

Course Code	Title of Course	Credits
CHEM-656	Homogeneous Catalysis by Transition Metal Complexes (Minor)	4(3-1)
CHEM-657	Inorganic Reaction Mechanisms (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-658 Physical Methods in Inorganic Chemistry 3(3-0)

iv) Organic Chemistry

Course Code	Title of Course	Credits
CHEM-668	Chemistry of Natural Products (Minor)	4(3-1)
CHEM-669	Organic Synthesis (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-667 Chemistry of Protective Groups & Reactive Intermediates 3(3-0)

v) Physical Chemistry

Course Code	Title of Course	Credits
CHEM-677	Advanced Approaches of Homogeneous and Heterogeneous Kinetics (Minor)	4(3-1)
CHEM-678	Polymers and Photochemistry (Major)	3(3-0)

The following major course may also be substituted with the 3 credits Course (Major) subject to the interest & availability of the faculty member

CHEM-679 Elementary Group Theory 3(3-0)

Note: Order of the courses in semesters may be changed depending upon the available resources.

Details of M. Sc Courses (Chemistry)

SEMESTER SYSTEM (Session 2008 & Onwards)

MSc Courses for 1st Semester

CHEM – 501 Basic Mathematics for Chemist (Cr. 02)

Introduction: Review of basic algebra, Graphs and their significance in chemistry. Trigonometric, Logarithmic and exponential functions. Differentiation, partial differentiation, differential equations and their use in chemical problems. Concept of maxima and minima. Integration, Determinants and Matrices, their properties and use in chemical problems. Solutions of linear equations (simple, determinant and matrices methods), operator theory, The eigen value problem and curve fitting.

Recommended Books

1. Paul M. "Maths for Chemistry" Edition 1st, Oxford University Press, (2006).
2. Ghram D. "Mathematics in Chemistry" Edition 1st, (1996)
3. Tebutt P., "Basic Mathematics for Chemists" 2nd Edition. (1998).

CHEM – 511 Analytical Chemistry – I (Cr.03)

Introduction to Analytical Chemistry, Sampling; Types of samples, Techniques/ Steps involved in sample preparation, Drying and ignition, Weighing, Analytical balance, its construction working volumetric glassware, Errors in measurements, Calibration of glassware, Steps involved in chemical analysis, System for units of measurements and their inter conversion, Chemical concentration and preparation of solutions, Calibration and calibration curves(construction and interpretation), Standard addition and internal standard methods, Statistical treatment of analytical data; Precision, accuracy and types of errors, Sample, Population, Mean, Average, Median, Range, Standard Deviation, Variance, Significant figures, Chemical Equilibrium and its types.

Analytical Chemistry Lab – I (Cr. 1)

1. Calibration of glass ware (Pipette, Burette, Flask) used for volumetric Analysis
2. Use of Analytical balance and calculation of standard deviation
3. Use of pH meter for plotting acid - base titration curve and assay of commercial caustic soda
4. Plotting of first differential curve for titration of acetic acid and commercial soda
5. Measurement of solubility products of sparingly soluble salts
6. Determination of HCl by titrating with NaOH and plotting of a titration curve.
7. Packing of chromatographic column and separation of mixture of dyes.
8. Separation of various components of plant extract by column chromatography.

9. Separation of mixture of dyes by Radial chromatography.
10. Separation of mixture of Amino acids by paper chromatography
11. Coating of TLC plates and separation of mixture of dyes.
12. Separation of mixture of Amino acids by TLC.

Recommended Books

1. D.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holt Reinhart Inc, London
2. G.D.Christian, Analytical Chemistry, John Wiley & Sons
3. D.C. Harris , Quantitative Chemical Analysis, Freeman, N. Y.

CHEM – 551 Inorganic Chemistry – I (Cr.03)

- i) Chemistry of Lanthanides and Actinides:
Structure, occurrence and preparation, Separation and electronic configuration, oxidation states, spectral and magnetic properties, Complex formation, Applications and uses of elements and their compounds.
- ii) Chemistry of Coordination Compounds:
Introduction of d – block elements, Nomenclature, Werner 's theory, Valence bond theory, Crystal field and Ligand field theory, Molecular orbital theory, Jhan-Teller Theorem, Magnetic properties, the spectrochemical series and color of metal complexes, Isomerism and Stereochemistry of coordination compounds, Geometry of complexes having coordination number 2 to 6, Applications of coordination compounds in chemistry, life and industry.
- iii) Non – aqueous Solvents:
Introduction, classification of solvents, Types of reactions in non-aqueous solvents, effect of physical and chemical properties of solvents, study of reactions in liq. NH₃, liq. SO₂, liq. HF and liq. BrF₃, Reactions in molten salt system.

Inorganic Chemistry Lab – I (Cr. 1)

1. Qualitative Analysis of inorganic mixture comprising of six radicals by micro and semimicro techniques.
2. Estimation of Halide ions (Cl⁻, Br⁻, I⁻) by adsorption indicator
3. Complexometric titrations using EDTA
 - a. Ni
 - b. Ca (II) and Mg (II) in a mixture
 - c. Mg (II), Mn (II) and Zn (II) in a mixture.

Recommended Books

1. Cotton, F. A. and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition, John Wiley, (1988).
2. Greenwood, N.N. and A. Easns Shaw, Chemistry of the Elements, 2nd Edition, Pergaman (1984).
3. Joly, W.L., Principles of Inorganic Chemistry, McGraw Hill, (1985). 5. Sharpe, A.G., Inorganic Chemistry, 2nd Edition, John Wiley, (1987).

4. de Lavis, R., Principles of Quantitative Chemical Analysis, 1st Edition, WCB/McGraw Hill, (1997).
5. Harris, D. C., Quantitative Chemical Analysis, 4th Edition, W.H. Freeman, (1995).

CHEM – 561 Organic Chemistry – I (Cr.03)

i) **Basic concepts**

Nomenclature of aliphatic, alicyclic, aromatic, heterocyclic organic compounds, concept of aromaticity.

ii) **Stereochemistry of organic compounds**

Conformational Isomerism in Acyclic Compounds, Cyclobutane, Cyclopentane, Cyclohexane, Mono-substituted, Di-substituted Cyclohexanes and condensed rings.

Geometrical Isomerism: E/Z Nomenclature, Cis/Trans & Syn/Anti Nomenclature, Determination of configuration.

Optical Isomerism: Chirality and Symmetry. Optical isomerism of Compounds upto three Asymmetric Centers, Relative and Absolute configuration, R/S nomenclature, Racemization, Resolution of racemic mixture, Optical isomerism in biphenyls, allenes and spiro compounds, Asymmetric Synthesis, Stereospecificity and Stereoselectivity.

iii) **Structure and Reactivity**

The effect of structure & medium and steric effects on the strength of acids and bases and on acid-base equilibria. Resonance and inductive effects on acidity and basicity. Linear free energy relationships.

iv) **Introduction to reactive intermediates**

Structure, methods of generation, reactions and synthetic applications of carbenes, nitrenes and arynes.

Organic Chemistry Lab. – I (Cr.01)

Separation & Identification of two and three component mixture of organic compounds by physical and chemical methods.

Recommended Books

1. Streitwieser, A., C. Heathcock and E. M. Kosower, *Introduction to Organic Chemistry*, Macmillan, New York.
2. Pine, S. H., *Organic Chemistry*, McGraw-Hill, New York.
3. Morrison, R. T. and R. N. Boyd, *Organic Chemistry*, Allyn & Bacon, London.
4. Kemp, W., *Organic Spectroscopy*, Macmillan, London.
5. Solomons, G. "Organic Chemistry" Edition 7th, McGraw-Hill, New York

i) Chemical Thermodynamics

Review of first law of thermodynamics. Second law of thermodynamics and its applications. Clausius inequality. Nernst heat theorem and its applications. Third law of thermodynamics and determination of absolute entropy. Entropy of mixing. Partial molal quantities.

ii) Kinetic theory of gases

Maxwell's law of distribution of velocities and derivation of average velocity, most probable velocity and root mean square velocity from the law. Significance of Maxwell's law. Derivation of Maxwell's distribution for kinetic energy. Barometric formula, effect of altitude, temperature and molecular mass on vertical distribution of particles.

iii) Chemical Kinetics

Concept of order of reaction. Kinetics of third order reactions with different concentration and molecular identity. Kinetics of opposing, reversible, consecutive and parallel reactions. Kinetics of thermally excited chain reactions. Theories of reactions.

Physical chemistry lab – I (Cr – 1)

1. Determination of specific and molar rotations of optically active substance in solution polarimetrically.
2. Percentage by refractometer.
3. Verification of Beer–Lambert's law, and determination of unknown concentration of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ solution by colorimeter.
4. Determination of distribution coefficient of I_2 between H_2O and CCl_4 .
5. Preparation of buffer solution and measurement of exact pH – Value by pH meter.

Recommended Books

1. Atkins P.W., "Physical Chemistry" (6th Ed). ELBS Oxford University Press (1998).
2. Alberty R. A. & Silvey., "Physical Chemistry" (7th Ed). John Wiley and Sons (1992).
3. Barrow G. M., "Physical Chemistry" (5th Ed). McGraw Hill, Inc., (1998).
4. Castellan G. W., "Physical Chemistry" (3rd Ed). Norasa Publishing House.
5. Gurdeep R. "Advanced Physical Chemistry" (3rd Ed). Krishna Prakashan Media (P) Ltd. (2008)

MSc Courses for 2nd Semester

CHEM– 502 Computer Applications in Chemistry (Cr.02)

Introduction to computers, Programming, Computer aided numerical methods, Data handling, Curve fitting, Errors, Graphical display of data, Molecular modeling, simulation and animation. World Wide Web and Chemical Databases on internet, Techniques of information search, Microsoft Office (MS Word, MS Excel, MS Powerpoint), ChemsSketch/Chemdraw.

Recommended Books

1. David C. Young, *Computational Chemistry*, John Wiley & Sons, (2001)
2. Ramesh K., *Computers and Their Applications to Chemistry*, Alpha Science International, (2005).
3. Arora, K., *Computer Applications in Chemistry*, Anmol Publications PVT. LTD. (2004)
4. Sherry W. K., Sherry K. *Microsoft Office 2007 Simplified*, John Wiley & Sons, (2007)
5. *ChemSketch 5.0 User's Guide*, Advanced Chemistry Development, (2001)

CHEM – 521 Biochemistry – I (Cr.03)

History and Scope of Biochemistry. Origin and nature of biomolecules.

Carbohydrates: Definition and Classification, Monosaccharides: Pyranose and Furanose ring structures. Stereoisomerism and Optical isomerism. Disaccharides; Structures, Polysaccharides, starch, Glycogen and Cellulose. Modified Carbohydrates, Glycoproteins and Glycolipids

Proteins: Amino acids, classification and properties. Stereochemistry, Primary, Secondary, Tertiary and Quaternary structures Biological functions of proteins and peptides, Protein folding and Stability.

Enzymes: Chemical Nature, Nomenclature and Classification. Enzyme activity. Coenzymes and immobilized enzymes, Specificity of Enzymes, Enzyme Inhibition. Regulation of Enzyme activity.

Lipids: Structures and classification of Fatty Acids, essential and non-essential fatty acids, Phospholipids, Fats and oils; Hydrogenation, Oxidation and Rancidity, Beta-oxidation of fatty acids, Lipid Bilayer, Lipid Mobility.

Nucleic Acids: Purines and pyrimidines, nucleosides and nucleotides, Structural and functional differences between DNA and RNA. Types of DNA and RNA, their functions in biological systems. Central Dogma and its significance. Fundamentals of DNA Replication, Transcription and Translation.

Vitamins: Introduction, classification, chemistry and biological significances of vitamins A, B, C, D, E and K.

Biochemistry Lab – I (Cr.01)

1. Safety Lab Practices
2. Standard Buffer preparation and use of pH meter.
3. Operation and use of micropipettes

4. Qualitative Tests for carbohydrates (Mono-, Di-, and polysaccharides, Pentoses and Hexsoses).
5. Quantitative Determination of Reducing Sugars by using Calorimetric Method (Spectrometric).
6. Enzymatic Hydrolysis of Glycogen and Starch.
7. Phenyl Hydrazine Test for Reducing Sugars (Osazone Test).
8. Effect of Alaklies on Sugars.
9. Qualitative tests for fats, Sterols and Phospholipids
10. Saponification Tests and Iodine Values of Fat.
11. Isolation of DNA by from Plants and Animal Tissues
12. Qualitative tests for Amino Acids.
13. Estimation of protein by Kjeldahl, Lowery methods.
14. Separation of Amino Acids using Paper Chromatography and Thin Layer Chromatography (TLC).
15. Determination of Ash Contents of Food.
16. Determination of Percentage Moisture Contents of Dry Mass in Food
17. Determination of Ascorbic acid in Lemon Juice.
18. Use of Online available Protein Databases.
19. Determination of Secondary structure of Proteins using online available software.

Recommended Books

1. Lehninger, A. L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet, *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Murray, R. K., P. A. Mayes, D. K. Granner and V. W. Rodwell, *Harper's Biochemistry*, Appleton and Lange(2000).
4. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co.(1999).
5. Stryer, L. *Biochemistry*, Freeman & Co.(1994).
6. Bryce, C. F. A., *Microcomputers in Biochemistry: A practical approach*, Oxford University Press.

CHEM – 553 Inorganic Chemistry – II (Cr.03)

- i) Bonding Models for Non-transition elements:
VSEPR model followed by VB Theory for determination of geometries of molecules and ions containing sigma bond as well as pi-bonds, Band theory of metallic bonding (Conductors, Insulators and Semiconductors), Bonding in electron deficient compounds, Hydrogen bonding.
- ii) pi – Acceptor Ligands:
Transition metal carbonyls (Mononuclear, Binuclear, Polynuclear), The eighteen electron rule as applied to metal carbonyls, Evaluation of structures based on spectroscopic evidence, Chemistry of metal carbonyls. Applications of metal carbonyls and their derivatives to catalysis and organic synthesis.
- iii) Organic Reagents used in Inorganic Analysis:
Types of reagents, their specific nature and methods of applications with specific examples, Complexometric titrations involving various reagents

(EDTA etc), Chelates and chelate effect, Role of organic reagents in different analytical techniques.

Inorganic Chemistry Lab – II (Cr. 1)

1. Gravimetric Estimations
 - a. Barium ions
 - b. Oxalate ions
2. Redox titrations
 - a. Cu (II) by Potassium iodate
 - b. Fe (II) by Ceric sulphate
3. Preparation of four Inorganic compounds in pure state using different techniques of synthesis
 - a. *tris* – Etylenediamine Ni(II) chloride dihydrate
 - b. Pot. Trioxalatoaluminate (III)
 - c. Ammonium Ni(II) sulphate
 - d. Hexa aquochromium (III) chloride

Recommended Books

1. Greenwood, N.N. and A. Easnshaw, Chemistry of the Elements, 2nd Edition, Pergaman (1984).
2. Joly, W.L., Principles of Inorganic Chemistry, McGraw Hill, (1985).
3. de Lavis, R., Principles of Quantitative Chemical Analysis, 1st Edition, WCB/McGraw Hill, (1997).
4. Harris, D. C., Quantitative Chemical Analysis, 4th Edition, W.H. Freeman, (1995).
5. Huheey, J.E, 'Inorganic Chemistry', Harper and Row, (Latest Edition)
6. Kotz, J. C. and P. Treichel, Chemistry and Chemical Reactivity, 4th Edition, Saunders College Publishing, (1999).
7. Cotton, F. A. and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition, John Wiley, (1988).

CHEM – 563

Organic Chemistry – II (Cr.03)

- i) Reaction mechanism I
Introduction to reaction mechanism, Methods of determination of reaction mechanism, Comprehensive study on the mechanism of different types of substitution, addition and elimination reactions with emphasis on their determination.
- ii) Oxidation and Reduction
Oxidation
Oxidation of saturated hydrocarbons, olefinic double bonds, aromatic rings, systems containing oxygen such as alcohols, aldehydes, ketones and dicarbonyl compounds, oxidative decarboxylation of acids. Oxidation of systems containing nitrogen such as amines, hydrazines and hydrazones.

Reduction

Reduction of cycloalkanes, alkenes, conjugated olefins, alkynes and aromatic rings. Hydrogenolysis, reduction of benzylic and allylic systems, aldehydes and ketones. alcohols, pinacols, epoxides, acids and their derivatives. Reduction of systems containing nitrogen such as imines, oximes and nitro compounds.

iii) Active Methylene Compounds

Alkylation, arylation and acylation of active methylene compounds. Acid and base catalysed aldol condensations. Conditions, mechanism and synthetic applications of the following reactions, Claisen reaction, Claisen – Schmidt reaction, Knoevenagel reaction, Perkin reaction, Reformatsky reaction, Stobbes condensation, Darzen's glycidic ester synthesis, Mannich reaction and Wittig reaction.

Organic Chemistry Lab – II (Cr. 1)

Estimation of phenol & acetone, amino groups, synthesis of azodyes, iodobenzene, iodoform, sulphanilic acid, cinnamic acid, benzil & benzilic acid, ethyl benzene.

Recommended Books

1. March, J., *Advanced Organic Chemistry*, Wiley, New York.
2. Pine, S. H., *Organic Chemistry*, McGraw-Hill, New York.
3. Gould, E. S., *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart & Winston, New York.
4. House, H. O., *Modern Synthetic Reactions*, Benjamin, California.

CHEM – 573 Physical Chemistry – II (Cr.03)

i) Atomic and molecular structure

Schrodinger's wave equation. Postulates of quantum theory. Operators, Eigen value, Eigen function, orthogonality and normalized wave functions. Motion of particle in three dimensional box and idea of degeneracy. Mathematical treatment of rigid rotator and calculation of bond length of simple molecule.

ii) Statistical thermodynamics

Stirling approximation. Probability. Statistical treatment of entropy. The Boltzman distribution law and partition function. Physical significance of partition function. Separation of partition function. Partition function and thermodynamics functions live internal energy and entropy. Translational, rotational, vibrational and electronic partition function and their comparison.

iii) Electrochemistry

Concept of conductance of electrolytes. Debye–Huckle equation and limiting law. Ionic strength, weak electrolytes and Debye–Huckle theory. Activity and activity coefficients of electrolytic solutions. Determination of activities.

Concentration cells. Determination of e.m.f. of concentration cells with and without transference. Fuel cells and hydrocarbon fuel cells.

Physical Chemistry Lab – II (Cr.01)

1. Determination of pKa and Ka value of a weak acid.
2. Molecular mass determination of non-electrolyte solute by cryoscopic method.
3. Determination of number of associated molecule of Benzoic acid in Benzene and to determine the Distribution coefficient of Benzoic acid between H₂O and Benzene.
4. Determination of unknown concentrations of KMnO₄ and K₂Cr₂O₇ solution spectrophotometrically.
5. Determination of percentage purity of an optically active compound.

Recommended Books

1. Atkins P.W., "Physical Chemistry" (6th Ed). ELBS Oxford University Press (1998).
2. Alberty R. A. & Silvey., "Physical Chemistry" (7th Ed). John Wiley and Sons (1992).
3. Barrow G. M., "Physical Chemistry" (5th Ed). McGraw Hill, Inc., (1998).
4. Castellan G. W., "Physical Chemistry" (3rd Ed). Norasa Publishing House.
5. Gurdeep R. "Advanced Physical Chemistry" (3rd Ed). Krishna Prakashan Media (P) Ltd. (2008).

MSc Courses for 3rd Semester

a) Compulsory Papers (Total 05 credits)

CHEM – 601 Forensic Chemistry (Cr.02)

This subject will integrate the concept and techniques developed in chemistry, physiology and biochemistry and apply them to the pharmacology and detection of drugs and toxins.

Most important topics in forensic science are fingerprinting, forensic serology, hair and fiber analysis, explosive residues, glass comparisons, drug analysis, bullet and cartridge analysis, DNA analysis, Forensic botany and forensic toxicology.

Recommended Books

1. Bell, Suzanne, *Forensic Chemistry*, 1st Edition, 2006, Prentice Hall,
2. Jackson, Andrew R. W. and Julie M. Jackson, *Forensic Science*, 2004 1st Edition Prentice Hall
3. Khan, Javed, Kennedy, Thomas J., Christian, Jr., Donnell, Basic Principles of Forensic Chemistry 2009, Human Press
4. W.G. Eckert, Introduction to Forensic Sciences, Second Edition, Elsevier, New York, 1992.
5. N.E. Genge, The Science of Crime Scene Investigation: The Forensic Casebook, Ballentine Books, New York 2002.

CHEM – 602 Industrial Chemistry (Cr.03)

Chemical processes i.e. unit operations, unit process, Chemical process control and instrumentation, Safety; Hazards such as fire or toxic materials. Research and development, Important modern industries, their chemistry and technology, like pharmaceutical, polymer, paper, petroleum, oil, fats and waxes, water conditioning, flavors and food additives, sugar and starch, steel, soap and detergent etc.

Recommended Books

1. Eckenfelder, W.W., Industrial Water Pollution control, McGraw Hill Book Co. New York, 2000.
2. Durney, L. J. , Graham's Electroplating Engineering Handbook, CBS Publishers and Distributors, New Delhi, 1997.
3. Witcoff, H.A. and B.J. Reuben, Industrial Organic Chemicals, (Latest Edition) John Wiley and Sons Inc. New York.
4. Kent, J.A. Riegel's Handbook of Industrial Chemistry, CBS Publishers and Distributors, New Delhi, 1997.
5. Kovaces, M. Pollution Control and conservation, Ellis Harwood Ltd., Chichester, 1985.
6. McGhee, T. J., Water Supply and Sewerage, McGraw Hill Book Co. New York, 1991.
7. Chattopadhyay, A., Unit Operations in Chemical Engineering, Khanna Publishers, New Delhi-6, 1993.

8. Smith, R., Chemical Process Design, McGraw Hill Book Co. New York, 1995.
9. Moor, W.R., An Introduction to Polymer Chemistry, London Press, London.
10. Guez, R., Principles of Polymer Systems, McGraw Hill Book Co. New York.
11. Crompton, T.R., Analytical Instrumentation for the water industry, Butterworth, Heinmann Ltd., Oxford, 1991.
12. SIRI Board of Consultants and Engineers, Handbook of Industrial Chemicals, Small Industries Research Institute, New Delhi, 1995.
13. Sirivastawa, A.K., Small, Medium and Large Scale Industries, Small Industries Research Institute, New Delhi, 1996.

b) Specialization (Total 11 credits)

i) ANALYTICAL CHEMISTRY

CHEM – 614 Advanced Spectroscopy – I (Cr.03)

Atomic Spectrometry: Atomic Absorption and Flame Emission Spectrometry, instrumentation and applications, Emission Spectrometry with plasma and electrical discharge sources, UV/Visible Spectrophotometry: basic principle, instrumentation and applications.

Analytical Chemistry Lab. III (Cr.01)

1. Measurement of λ_{\max} and calculation of Molar absorptivity of potassium permagnate.
2. Plotting of calibration graph and measurement of unknown sample concentration.
3. Use of standard addition method in Spectrophotometry.
4. Determination of iron (II) using 1,10-phenanthroline method.
5. Determination of iron (III) using thiocyanate method involving solvent extraction.
6. Determination of phosphate by Spectrophotometry using molybdenum blue method.
7. Determination of Sodium in tap water sample by using Flame photometer.
8. Determination of Potassium in tap water sample by using Flame photometer.
9. Determination of Calcium in chalk sample by using Flame photometer.
10. Determination of Calcium in drinking water by EDTA.
11. Identification of free salicylic acid in aspirin by using TLC.
12. Determination of Methylene blue value of activated charcoal.
13. Determination of iron in tap water by AAS.
14. Determination of copper content in milk samples by AAS.

Books Recommended

1. D.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holt Reinhart Inc, London
2. G.D.Christian, Analytical Chemistry, John Wiley & Sons
3. D.C. Harris , Quantitative Chemical Analysis, Freeman, N. Y.

4. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.

CHEM – 615 Advanced Chromatographic Techniques (Cr.03)

Gas – Liquid chromatography, concepts of theoretical plates, Van – deemter equation, High–performance liquid chromatography, instrumentation and applications of these techniques

Books Recommended

1. D.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holt Reinhart Inc, London
2. G.D.Christian, Analytical Chemistry, John Wiley & Sons
3. D.C. Harris , Quantitative Chemical Analysis, Freeman, N. Y.
4. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.

CHEM – 616 Instrumental Methods of Analysis (Cr.03)

Potentiometry: Nernst equation, reference electrodes, Ion - selective electrodes, Glass electrodes for pH measurements, Potentiometric titrations.
Fluorescence and Phosphorescence spectrometry: Atomic and Molecular Fluorescence, basic principles and applications, Structural factors, measurements, comparison of Luminescence and UV – Visible absorption methods.

Books Recommended

1. D.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holt Reinhart Inc, London
2. G.D.Christian, Analytical Chemistry, John Wiley & Sons
3. D.C. Harris , Quantitative Chemical Analysis, Freeman, N. Y.
4. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.

ii) BIOCHEMISTRY

CHEM – 622 Enzymes and Nutrition (Cr.03)

i) Enzyme Structure and Functions

Chemical nature, nomenclature and classification of enzymes, Cofactors, effect of different factors on enzyme activity, Kinetics Studies of substrate reactions. (MICHAELIS- MENTEN EQUATION and LINEWEAVER-BURKE PLOT) Quantitative assay of enzyme activity, substrate specificity, Enzyme substrate interactions and nature of the active site, Models Of enzyme substrate complex Mechanism of enzyme action with specific reference to Chymotrypsin and nuclease, Inhibition, Competitive, uncompetitive, non competitive and irreversible inhibition, Regulatory enzymes; Allosteric enzymes, Multi-enzyme systems, Zymogens, Isoenzymes Non-Protein Biocatalysis Ribosome's, (RNA as Enzyme), Enzymatic

control of Metabolic pathways, Therapeutic uses of Enzyme and Immobilized enzymes.

ii) Nutrition

Classification of Food, Source of Nutrients, Respiration, Caloric value of food, Calorimetry, Respiratory Quotient, Basal metabolic rate (BMR) and General Factor, chemical composition, functions, deficiency symptoms and requirements of Nutrients and their biological values, Balanced diet, Role of nutrition in growth, development and Chronic disease.

Recommended Books

1. Lehninger, A. L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet, *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Murray, R. K., P. A. Mayes, D. K. Granner and V. W. Rodwell, *Harper's Biochemistry*, Appleton and Lange (2000).
4. Robert, *Harper's Biochemistry*, 25th Edition. (2000).
5. West, *Text Book of Biochemistry* 4th Edition. (2000).
6. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co. (1999).
7. Stryer, L. *Biochemistry*, Freeman & Co. (1994).

CHEM– 623 Metabolism and Bioenergetics (Cr.03)

Methods of metabolism study, Biological oxidation – reduction including respiratory carriers, Cell Bioenergetics, ATP cycle, Oxidative phosphorylation, Energy metabolism including caloric value of foods, Calorimetry, RQ and BMR. Anabolism and Catabolism), Metabolism of Carbohydrates, Lipid Metabolism, Metabolism of Proteins and Amino acids. Carbohydrates Biosynthesis in Plants & Bacteria and conversion of Amino acids to specialized products.

Biochemistry Lab. III (Cr.01)

Molecular Lab Handling, Biological pH and Buffering System and electrodes, Techniques for the sample preparation, CBP. (Dialysis, Ultracentrifugation Lyophilization) Glycation, Biosensors, Cell Fractionation, Planar Chromatography, (Paper and Thin-Layer) Ion Exchanger Chromatography, Amino acid Analyzers, HPLC and FPLC, Perfusion Chromatography, Gel Exclusion Chromatography, Column, and Affinity Chromatography ELISA, RIA and Centrifugation in Biological Research.

Recommended Books

1. Lehninger, A. L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet, *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co. (1999).
4. Stryer, L. *Biochemistry*, Freeman & Co. (1994).

5. Dawis, B. D., R. Dulbecco, H. N. Eisen and H. S. Ginsbery, *Microbiology*, Harper & Row.

CHEM – 624 Microbiology & Industrial Fermentations (Cr.03)

1. Scope of Microbiology and fermentation, General morphology and cytology of microorganisms, Microscopic Examination of Microorganism. Classification and methods of isolation of microorganisms, General effects of environments on microorganisms, nutrition of microorganisms. Growth (Normal growth Cycle and Continuous Culture) and Reproduction, Pure culture Study.

2. Introduction to industrial microbiology; Research Methodology Bioenergetic of microorganism for the industries purpose, oxygen transfer, Industrial Uses of Bacteria, Molds, Yeast and viruses Application of chemostate and turbidostat, Microbial production of Alcohol, Citric acid and Acetic acid with mechanism; Antibiotic, enzyme production, Fermented Foods Vinegar production, Amino Acid, Petroleum Microbiology and Deterioration of Materials. (Paper, Textile and Cordage, Painted Surface) and Analytical Microbiology.

Recommended Books

1. Lehninger, A. L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet, *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co. (1999).
4. Stryer, L. *Biochemistry*, Freeman & Co. (1994).
5. Dawis, B. D., R. Dulbecco, H. N. Eisen and H. S. Ginsbery, *Microbiology*, Harper & Row.

iii) INORGANIC CHEMISTRY

CHEM – 653 Stereochemistry & Periodicity, Nuclear chemistry Cr.03

a) Concepts of Stereochemistry and Periodicity (Periodic Properties)
Introduction, VSEPR model, Hybridization, three center bonds, Molecular Orbital correlation diagrams.

First and Second row anomalies, the use of d-orbitals by non-metals, Reactivity and d-orbital participation, The use of p-orbitals in pi-bonding, Periodic anomalies of non-metals and post transition metals.

b) **Nuclear Chemistry**

Introduction, classification of Nuclides, Radioactivity and radioactive series, Artificial radioactivity, units of radioactivity, Determination of Half-life, Nuclear Fission and Fusion reactions, Applications of radio isotopes as tracers.

Inorganic Chemistry Lab. III (Cr.01)

1. Use of some organic reagents for the estimation of various elements
 - a) 8-Hydroxyquinoline Al (III) and Fe (III)
 - b) Nitron (NO_3^{-1})
 - c) Salicyladoxine Ni (II) in presence of Cu (II)
 - d) Anthranilic Acid Co (II) and Zn (II)
 - e) Pyrogallol Bi^{3+}
2.
 - a) Chromatographic Techniques - Column, Thin layer and Paper chromatographic techniques for the qualitative separation of inorganic compounds
 - b) Applications of Solvent extraction and ion exchange techniques
3. Synthesis of following Inorganic compounds / Complexes in a pure state and determine their state of purity
 - a. $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}$
 - b. $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
 - c. $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}$
 - d. $[\text{Co}(\text{en})_3]\text{Cl}_3$

Recommended Books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, 2001
2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., "Basic Inorganic Chemistry", 3rd Ed., Wiley, New York, 1995.
3. Atkins, P. and Jones, L., "Chemicals Principles" Freeman & Company, 2002.
4. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.
5. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary
6. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.

CHEM – 654 Organometallic & Bio-inorganic Chemistry(Cr.03)

a) Organo metallic Chemistry

Introduction, Compounds of transition metals, Single, double and triple bonds to carbon, (compound types, Acyls, Alkylidene complexes and alkylidyne complexes), delocalized hydrocarbon systems, (alkene, olefins, allyl and Butadienes), Alkyne complexes, Cyclic π complexes (four, five and six member rings), Applications of organometallic compounds in synthetic chemistry and industry.

b) Bio-Inorganic chemistry:

Essential elements, Biochemistry of iron (iron storage and transport), Haemoglobin and myoglobins, Cytochromes, other natural oxygen carrier, Biochemistry of other metals (Zn, Cu, Co, Cr, Ni, and V), Metal based drugs.

Recommended Books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, 2001
2. Garry L. Miessler, Donald A. Tarr, "Inorganic Chemistry" 3rd Edition, Pearson Education, Inc. (2004).
3. Keith F. Purcell and John C. Kotz, "An Introduction to Inorganic Chemistry" Saunder, College, Philadelphia (1980).
4. Jordan, R. B., Reaction Mechanisms of Inorganic and Organometallic Systems, 2nd Edition, Oxford University Press, (1998).
5. Angelici, R. J., Synthesis and Technique in Inorganic Chemistry, 1st Edition, University Science Books, (1986).

CHEM – 655 Inorganic Polymers & Chemical Forces (Cr.03)

a) Inorganic Polymers:

1. Molecular species (polymeric Sulphur nitrogen compounds, Borazines, Phosphazines, Boranes, Carboranes, and Silicones)
2. Polyionic species (Isopoly and heteropoly anions of transition elements, polysilicates, and polyphosphates)
3. Metal cluster compounds

b) Chemical Forces:

Internuclear distances and atomic radii, types of chemical forces, Hydrogen bond, Bonding in Clathrates, urea adducts, effects of Chemical forces.

Books Recommended

1. Jordan, R. B., Reaction Mechanisms of Inorganic and Organometallic Systems, 2nd Edition, Oxford University Press, (1998).
2. Angelici, R. J., Synthesis and Technique in Inorganic Chemistry, 1st Edition, University Science Books, (1986).
3. Garry L. Miessler, Donald A. Tarr, "Inorganic Chemistry" 3rd Edition, Pearson Education, Inc. (2004).
4. Keith F. Purcell and John C. Kotz, "An Introduction to Inorganic Chemistry" Saunder, College, Philadelphia (1980).
5. Huheey, J. E., Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, 2001.

iv) ORGANIC CHEMISTRY

CHEM: 663 Reaction Mechanism

Molecular Rearrangements.

Classification of molecular rearrangements. Mechanism of intramolecular 1, 2 – shifts involving migration of a group from carbon to carbon, carbon to nitrogen and carbon to oxygen. Mechanism and examples of Wagner – Meerwein, Pinacol – Pinacolone, Benzidine-Benzillic acid, Favorski, Wolf, Beckmann, Hofmann, Curtius, Lossen, Schmidt, Baeyer – Villiger, Dakin and Fries rearrangements.

Pericyclic Reactions

Introduction, Hoffman theory, Fukii theory, Mobius Huckle theory of electrocyclic reactions, cycloaddition reactions, Pericyclic reactions involving 2, 4, 6 π electrons, sigmatropic rearrangements.

Free radicals

Generation, Detection and Reactions, Application of free radical in industry. Role of free radicals in nature and environment.

Recommended Books

1. March, J., *Advanced Organic Chemistry*, Wiley, New York.
2. Gould, E. S., *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart & Winston, New York.
3. Morrison, R. T. and R. N. Boyd, *Organic Chemistry*, Allyn & Bacon, London.
4. House, H. O., *Modern Synthetic Reactions*, Benjamin, California.

CHEM – 664 Spectroscopic Methods in Organic Chemistry (Cr.03)

UV/VIS Spectroscopy: Basic principle, instrumentation & sample handling, Woodward Fieser rule for conjugated dienes and α,β -unsaturated carbonyl systems. Absorption by aromatic compounds. Applications of UV-Visible spectroscopy

IR Spectroscopy: Basic Principle, Instrumentation and sample handling, Interpretation of IR spectra, Applications of IR spectroscopy.

Mass Spectrometry: Basic Principle, Instrumentation, Modes of fragmentation of various organic molecules, Determination of molecular mass, molecular formula and molecular structure, Interpretation of Mass spectrum.

NMR Spectroscopy: Basic Principle, Spin flipping, Spin relaxation, The Chemical shift, Instrumentation and Sample handling, Spin-spin splitting and coupling constant, Interpretation of NMR spectra.

Structure elucidation of organic compounds by joint applications of IR, UV, NMR spectroscopy and Mass spectrometry.

Organic Chemistry Lab III (Cr.01)

1. Experimental techniques e.g. distillation, solvent extraction, chromatography etc.
2. Multi-step synthesis of some organic compounds
3. Estimation of glucose and number of acetyl groups

Recommended Books

1. Williams, D. and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, McGraw-Hill, New York.
2. Younas, M., *Organic Spectroscopy*, A. H. Publisher, Lahore.
3. Silverstein, R. M., G. C. Bassler and T. C. Morrill, *Spectrometric Identification of Organic Compounds*, Wiley, New York.
4. Kemp, W., *Organic Spectroscopy*, Macmillan, London.

CHEM – 665 Organometallics (Cr.03)

Preparation and uses of organoLi, organoMg(Grignard's reagent), organoSn, organoCu, organoZn and organoPd in synthetic organic chemistry with special focus on stereochemical outcome. Brief introduction of organoB, organoSi and organoS chemistry.

Recommended Books

1. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry" Edition 1st, Oxford University Press, 2001.
2. Huheey, J.E, 'Inorganic Chemistry', Harper and Row, (Latest Edition)
3. Garry L. Miessler, Donald A. Tarr, "Inorganic Chemistry" 3rd Edition, Pearson Education, Inc. (2004).
4. Keith F. Purcell and John C. Kotz, "An Introduction to Inorganic Chemistry" Saunder, College, Philadelphia (1980).

v) PHYSICAL CHEMISTRY**CHEM – 673 Surface Phenomena (Cr.03)**

Surface tension, adsorption isotherms, Freundlich, Langmuir and BET isotherms. Adsorption at liquid surface, surfactants, micellization. Methods of preparation of gels and emulsions. Classification structure of gels. Thixotropy. Precipitation in gels. Liesegang rings. Emulsifiers. Properties of emulsions. Breaking of emulsions. Orientation theory. Emulsification and wetting. Significance. Sols and their preparation, properties of suspensions optical properties of sols. Determination of particle size. Kinetic properties of sols. Sedimentations of suspensions, electrical properties of sols, electrophoresis and electroosmosis. Stability of suspensions. Precipitation of sols. Molecular weight determination of macromolecules. The cause of semi-permeability. Mechanism of osmotic pressure. Determination of the molecular weight by osmometry.

Physical Chemistry Lab. III (Cr.01)

1. Determination of heat of solution of a substance by solubility method.
2. Determination of empirical formula of Ferric-salicylic acid complex colorimetrically.
3. Determination of order of reaction and the rate constant of a given reaction.
4. Verification of Freundlich isotherm for organic acids.
5. To prepare As_2S_3 sol.
6. Determination of activity coefficients by measuring electromotive force.
7. Determination of Molar extinction coefficient.

Recommended Books

1. Kaufman E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company.(1966).
2. Aktin P.W., "Elementary Physical Chemistry" 2nd Edition (1998).
3. Scott S. K. , "Begining Mathematics for Physical Chemistry" Oxford University Press (1996).
4. Tebutt P., "Basic Mathematics for Chemists" 2nd Edition. (1998).
5. Gurdeep R. "Advanced Physical Chemistry" (3rd Ed). Krishna Prakashan Media (P) Ltd. (2008)

CHEM – 674

Molecular Spectroscopy (Cr.03)

Molecular Spectroscopy

Classification of spectroscopy. Rotational spectra of rigid linear molecules and determination of bond lengths. The stark-effect. Harmonic and anharmonic oscillator models for the energy of a diatomic molecule. Types of vibrational modes. Interpretation of IR spectra of simple molecules. Fermi resonance, applications and sampling techniques. Types of electronic transition. H – atom spectrum, energies of atomic orbital, electronic angular momentum and the fine structure. Idea of Raman scattering, Rayleigh scattering and molecular polarizability. Rotational Raman spectra of linear molecules. Symmetric top molecules and spherical top molecules vibrational Raman spectra. Nuclear magnetic resonance spectroscopy.

Recommended Books

1. Castellan G. W., "Physical Chemistry" (3rd Ed).Norasa Publishing House.
2. Fried V., U. Bluiks, H.F. and Hameka, "Physical Chemistry". MacMillan Publishing Company, Inc.
3. Laidler K.J. & J.H. Meiser., "Physical Chemistry".Benjamin/Cummings Publishing Company, Inc.(1998).
4. Kaufman E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company.(1966).
5. Colin N. Banwell and Elaine M. McCash " Fundamentals of Molecular Spectroscopy, Edition 4th, The Bath Press Avon, (1994).
6. Gurdeep R. "Advanced Physical Chemistry" (3rd Ed). Krishna Prakashan Media (P) Ltd. (2008)

CHEM – 675 Statistical and Quantum Mechanics (Cr.03)

Statistical and Quantum Mechanics:

Statistical ensembles, probability. Description of various systems, concept of states, accessible states and distribution. Maxwell's Boltzmann's statistics (MBS) of the systems of independent particles. Applications of partition functions of two chemical equilibrium and chemical kinetics. Bose-Einstein and Fermi-Dirac statistics (BES and FDS).

Operators and their properties, angular momentum, central field problem, Hydrogen like atoms, approximate methods, perturbation method and variation principle. Valence bond theory (VBT) and Molecular Orbital theory (MOT).

Recommended Books

1. Atkins P.W., "Physical Chemistry" (6th Ed). ELBS Oxford University Press (1998).
2. Alberty R. A. & Silvey., "Physical Chemistry" (7th Ed). John Wiley and Sons (1992).
3. Laidler K.J. & J.H. Meiser., "Physical Chemistry". Benjamin/Cummings Publishing Company, Inc.(1998).
4. Kaufman E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company.(1966).
5. Aktin P.W., "Elementary Physical Chemistry" 2nd Edition (1998).
6. Scott S. K. , "Begining Mathematics for Physical Chemistry" Oxford University Press (1996).
7. Gurdeep R. "Advanced Physical Chemistry" (3rd Ed). Krishna Prakashan Media (P) Ltd. (2008)

MSc Courses for 4th Semester

a) Compulsory (Cr. 03)

CHEM – 603 Environmental Chemistry (Cr.03)

The Human Environment, The litho, bio and hydrosphere, The nature and composition of natural waters, Water pollution, Chemistry of soil, Composition of the atmosphere, Oxides of carbon, sulphur and nitrogen in air pollution, Atmospheric Monitoring, Instrumental methods of environmental chemistry. Ozone demolition, Acid rain, Green House Effect

Recommended Books

1. A. Kumar, Environmental Chemistry, Wiley Eastern, New Delhi.
2. J. W. Moore & E.M. Moore, Environmental Chemistry, Academic Press, New York.
3. S. K. Banerji, Environmental Chemistry, Prentice Hall, Delhi.
4. S. K. Banerji, Environmental Chemistry, Tata Publisher, Delhi.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.
6. Neil, P.O. Environmental Chemistry, Chapmann, London.
7. Baird, C. Environmental Chemistry, Free man, New York.

b) Specialization (Cr. 11)

i) ANALYTICAL CHEMISTRY

CHEM – 617 Advance Spectroscopy –II (Cr.03)

Mass Spectroscopy: Principle of Mass spectroscopy, Instrumentation in details, Quantitative and Qualitative application in analytical chemistry. X-rays Spectroscopy: Nature and production of X-rays, X-rays absorption, X-rays emission, Instrumentation, X-rays fluorescence analysis, Diffraction studies single crystal analysis

Recommended Books

1. D.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holt Reinhart Inc, London
2. G.D.Christian, Analytical Chemistry, John Wiley & Sons
3. D.C. Harris , Quantitative Chemical Analysis, Freeman, N. Y.
4. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.

CHEM – 618 FTIR & Raman Spectroscopy (Cr.03)

Origin of Molecular spectra, Origin of infrared and Raman spectra, Normal coordinate and normal vibrations, Symmetry of normal vibration and selection rules, selection rule for infrared and Raman spectra, Metal isotope spectroscopy,

vibrational spectra in gaseous phase and inert gas matrices, comparison of Raman with Infrared spectroscopy. Quantitative/Qualitative analysis, Instrumental detail and their use as analytical tool.

Analytical Chemistry Lab. (Cr.01)

1. Verification of deviations from Beer-Lambert's law.
2. Determination of chloride content in drinking water samples bymercury(II) thiocyanate spectrophotometric method.
3. Determination of copper in various food samples by diethyldithiocarbamate spectrophotometric method.
4. Determination of aspirin in pharmaceutical preparation and caffeine in tea and coffee by U.V Visible Spectrophotometry involving extraction.
5. Analysis of analgesic by HPLC.
6. Quantitative and qualitative analysis of different fruit juices for vitamin C by HPLC.
7. Estimation of Sodium and Potassium in biological fluids by flame photometry.
8. Determination of calcium in milk samples by flame photometry.
9. Determination of Magnesium in tap water, food, leaves etc by AAS.
10. Determination of manganese content in tea leaves by AAS.
11. Determination of sulphate and phosphate in commercial samples by complexometric titrations using EDTA.
12. Determination of iron in pharmaceutical samples by redox titration.
13. Determination of Sodium bicarbonate contents in baking Soda powder by conductometric titration with HCl.

Recommended Books

1. D.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holt Reinhart Inc, London
2. G.D.Christian, Analytical Chemistry, John Wiley & Sons
3. D.C. Harris , Quantitative Chemical Analysis, Freeman, N. Y.
4. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.

CHEM – 619 Instrumental Methods of Analysis - II (Cr.03)

Nuclear Magnetic Resonance: Nuclear emission Alpha particles, Beta particles, Gamma – rays and neutron, Nuclear reaction; Radiochemical decay and activity, Necessary instrumentation including sources, accelators and detectors. Thermal method of Analysis: TGA, Differential thermal analysis (DTA) and differential scanning Calorimetry (DSC), Pyrolysis and thermometric titration, type of measurements and applications of these techniques.

Recommended Books

1. D.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holt Reinhart Inc, London

2. G.D.Christian, Analytical Chemistry, John Wiley & Sons
3. D.C. Harris , Quantitative Chemical Analysis, Freeman, N. Y.
4. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.

ii) BIOCHEMISTRY

CHEM – 626 Endocrine systems (Cr.03)

- i) Endocrine System – Introduction, Chemical nature of Hormones, common characteristics, mode of action, chemistry, metabolism and biological functions of Pituitary, Adrenal, Thyroid, Parathyroid, Pancreatic and gonadal hormones.
- ii) Biochemistry and body fluids – Composition and function of Blood, blood plasma, Blood proteins, Red blood cells, Haemoglobin, White blood cells, Platelets, Blood coagulation and blood pressure, Antibodies, Antigens and blood groups. Composition of Urine, Extra- cellular fluid like cerebrospinal fluid, Lymph, sweat, tears, Synovial fluid and interstitial fluid.

Recommended Books

1. Lehninger, A. L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet,. *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co.(1999).
4. Stryer, L. *Biochemistry*, Freeman & Co.(1994).
5. Dawis, B. D., R. Dulbecco, H. N. Eisen and H. S. Ginsberg, *Microbiology*, Harper & Row.

CHEM – 627 Chemotherapy and Immunology (Cr.03)

I): Chemotherapeutic Agents and Chemotherapy, Historical Highlight of chemotherapy, Characteristic of Antibodies that Qualify them as Chemotherapeutic agents, Antibiotic and their mode of action. Antifungal, Antiviral and Antitumor Antibiotic Microbiological Assay of antibiotic , antipyretics, analgesics, antimalarials, sulpha drugs and antibiotics with special reference to penicillin mechanisms of drug resistance. Non-medical uses of Antibiotic.

ii) Principles of immunology, antigens, antibodies, characteristics of antigens and antibody reaction, allergy and hypersensitivity, The complement System, Blood groups (A, B, O, MNO and Rh factor). Acquired immunity and Immunodeficiencies.

Recommended Books

1. Lehninger, A. L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet,. *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co.(1999).
4. Stryer, L. *Biochemistry*, Freeman & Co.(1994).

5. Dawis, B. D., R. Dulbecco, H. N. Eisen and H. S. Ginsbery, *Microbiology*, Harper & Row.

CHEM – 628 Molecular Biology & Physical Techniques (Cr.03)

i) Molecular dogma, Biosynthesis of RNA and DNA nucleosides, DNA polymerases, nucleosides catabolism, DNA as a genetic material, replication, Transcription, Translation Genetic coding, Gene and mutation units, Structure of Chromation and its functions, Gene activation, Virus replication and its protein regulation.

ii) Spectrophotometer Electrophoresis, centrifugation, Electron microscopy, PCR, DNA sequencer X-ray diffraction, Spectroscopy as applied to biological compounds etc, Use of isotopes in biochemistry.

Biochemistry Lab. (Cr.01)

Methods for the isolation of DNA and RNA, (Blood serum and plant Samples) Electrophoresis (Verticals and Horizontal), Pulsed Field Gel Electrophoresis, Capillary Electrophoresis, Immunoelectrophoresis, PCR , DNA Sequencer, Primer Designer, Southern, Northern Western blotting technique, Electrophoresis of plasma proteins, polyacrylamide gel electrophoresis. Agarose electrophoresis of DNA and RNA. . Dialysis ultra filtration and lyophilization.

Recommended Books

1. Lehninger, A. L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet,. *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co.(1999).
4. Stryer, L. *Biochemistry*, Freeman & Co.(1994).
5. Dawis, B. D., R. Dulbecco, H. N. Eisen and H. S. Ginsbery, *Microbiology*, Harper & Row.

INORGANIC CHEMISTRY

CHEM – 656 (Cr.03)

Homogeneous Catalysis by Transition metal complexes

- a) Homogeneous Catalysis by Transition metal complexes
- i) Reaction of CO and Hydrogen (Hydroformylation, Reductive Carbonylation, Reduction of CO by hydrogen, Synthesis gas and the water gas shift reaction)
- ii) Carbonylation reaction (Synthesis of methanol and methyl acetate, Adipic ester, other Carbonylation reactions, Decarbonylation reactions)
- iii) Catalytic addition of molecules to C – C multiple bonds (Homogeneous hydrogenation, Hydrocylation and Hydrocylation)

Inorganic Chemistry Lab. IV (Cr.01)

Instrumental Methods of Analysis

- a) Conductometry

1. Titration of Strong acid and Weak acid with a Strong base
2. Precipitation Titration involving AgNO_3 and KCl
3. Determination of Dissociation Constant (K_a) for Acetic Acid

b) Spectrophotometry (Colorimetry)

1. Microdetermination of Cr (III) by diphenylcarbazide
2. Determination of Fe (II) by 1:10 - Phenanthroline
3. Determination of Nitrites
4. Determination of Fe (III) by 8 - hydroxyquinoline

c) Potentiometry

1. Determination of K_1 , K_2 , and K_3 for H_3PO_4
2. Determination of Chloride in the presence of Iodide and evaluation of K_{sp} of AgI and AgCl
3. Determination of Co (II)
4. Determination of Fe (II)

Recommended Books

1. Jordan, R. B., Reaction Mechanisms of Inorganic and Organometallic Systems, 2nd Edition, Oxford University Press, (1998).
2. Kotz, J. C. and P. Treichel, Chemistry and Chemical Reactivity, 4th Edition, Saunders College Publishing, (1999).
3. Angelici, R. J., Synthesis and Technique in Inorganic Chemistry, 1st Edition, University Science Books, (1986).
4. Garry L. Miessler, Donald A. Tarr, "Inorganic Chemistry" 3rd Edition, Pearson Education, Inc. (2004).
5. Keith F. Purcell and John C. Kotz, "An Introduction to Inorganic Chemistry" Saunder, College, Philadelphia (1980).

CHEM – 657

Inorganic Reactions Mechanism (Cr.03)

a) Kinetics and Mechanisms of Inorganic Reactions

Rate law, Stationary State approximation, Inert and labile complexes, Substitution reaction

i) Octahedral Complexes (Acid hydrolysis, Acid catalysed equation, Anation reactions, Base hydrolysis, Attack on ligands, Steric effects of inert ligand)

ii) Square planar Complexes (Nucleophilic reactivity, Trans effect, Cis effect, effect of leaving group, Mechanism of substituting Racimization reactions. Electron transfer processes (outer and inner sphere reactions).

b) Oxidative Addition and Reductive Elimination

Oxidative Addition, One electron oxidative addition, Addition of Oxygen, Addition of bimetallic species, Hydrogen addition, HX addition, Organic halides, Reductive Elimination.

Recommended Books

6. Jordan, R. B., Reaction Mechanisms of Inorganic and Organometallic Systems, 2nd Edition, Oxford University Press, (1998).

- Kotz, J. C. and P. Treichel, *Chemistry and Chemical Reactivity*, 4th Edition, Saunders College Publishing, (1999).
- Garry L. Miessler, Donald A. Tarr, “*Inorganic Chemistry*” 3rd Edition, Pearson Education, Inc. (2004).
- Keith F. Purcell and John C. Kotz, “*An Introduction to Inorganic Chemistry*” Saunder, College, Philadelphia (1980).

CHEM – 658 Physical Methods in Inorganic Chemistry (Cr.03)

Thermogravimetric Analysis, Thermogravimetry (TG), Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC), Separation Methods (Solvent Extraction, Column, TLC and Ion Exchange Chromatography), Potentiometry, Conductometry.

Recommended Books

- Huheey, J. E., Keiter, E. A. and Keiter, R. L., “*Inorganic Chemistry: Principles of Structure and Reactivity*”, 4th Ed., Harper and Row, New York, 2001
- Jordan, R. B., *Reaction Mechanisms of Inorganic and Organometallic Systems*, 2nd Edition, Oxford University Press, (1998).
- Kotz, J. C. and P. Treichel, *Chemistry and Chemical Reactivity*, 4th Edition, Saunders College Publishing, (1999).
- Angelici, R. J., *Synthesis and Technique in Inorganic Chemistry*, 1st Edition, University Science Books, (1986).

iv) ORGANIC CHEMISTRY

CHEM – 667 Chemistry of Protective Groups and Reactive Intermediates

All important protective groups of different organic functional groups involved in organic synthesis including alcohol, amines, carboxylic acid, etc. Structure eneration and reaction of reactive intermediate including carbenes, nitrenes, arynes and free radicals.

Recommended Books

- Finar, I. L., *Organic Chemistry*, Vol-II, Longman, London.
- March, J., *Advanced Organic Chemistry*, Wiley, New York.
- Hendrickson, Cram, and Hammond “*Organic Chemistry*”
- Pine, S. H., *Organic Chemistry*, McGraw-Hill, New York.
- Gould, E. S., *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart & Winston, New York.

CHEM – 668 Chemistry of Natural products (Cr.03)

Introduction to natural products, classification, isolation, biosynthesis and structure elucidation of steriods, terpenoids alkaloids, carotenes, vitamins and flavonoids.

Organic Chemistry Lab. IV (Cr.01)

- Multistep synthesis of different types of organic compounds.

- Purification of the products by chromatographic and other techniques.
2. Isolation and purification of some natural products.
 3. Conformation of the products by different techniques e.g. elemental analysis, spectroscopy etc.

Recommended Books

1. Finar, I. L., *Natural Product Chemistry*, Vol-I, Longman, London.
2. Streitwieser, A., C. Heathcock and E. M. Kosower, *Introduction to Organic Chemistry*, Macmillan, New York.
3. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry" Edition 1st, Oxford University Press, 2001.

CHEM – 669 Organic synthesis (Cr.03)

Introduction to retrosynthesis. Retrosynthetic analysis, Functional group inter-conversion (FG1), C – C, C – N and C – O bond formation. Applications to the synthesis of various target molecules.

Difunctionalized compounds. Role of crown ethers and quaternary ammonium salts in organic synthesis. Protective groups. Recent trends in organic synthesis.

Recommended Books

1. Warren, *Organic Synthesis*, McGraw-Hill, New York.
2. March, J., *Advanced Organic Chemistry*, Wiley, New York.
3. Pine, S. H., *Organic Chemistry*, McGraw-Hill, New York.
4. Gould, E. S., *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart & Winston, New York.
5. Morrison, R. T. and Boyd, N. *Organic Chemistry*, Allyn & Bacon, London.

v) PHYSICAL CHEMISTRY(Cr.03)

CHEM – 677 Advanced approach of homogeneous and heterogeneous kinetics 03

Liquids and gaseous systems of inorganic and organic reactions. Single systems, double systems. Study of reactions on solid surfaces. Single reacting gas, retardation by reaction products, Two reacting gases, retardation by reactants, adsorption-heterogeneous reaction, Reactions in solution, Influence of solvents involving ions, primary and secondary salt effect on kinetics of the reactions. Comparison between homogeneous and heterogeneous kinetics.

Physical Chemistry Lab. (Cr.01)

1. Determination of equilibrium constant of reversible reaction $I_2 + I^- \rightleftharpoons I_3^-$ and to evaluate ΔG^0 .
2. Determination of molecular mass of polymer by viscosity method.
3. Determination of flocculation value of electrolytes and to verify Hardy-Schultz rule.
4. Determination of activation energy of a chemical reaction.

5. Study of variation of conductance of solution of weak and strong electrolytes with concentration (a) pure solvents (b) binary mixture of solvents
6. Determination of heat of solution of a substance from solubility measurements and to determine thermodynamic quantities like ΔG^0 , ΔH^0 , ΔS^0 of the solution.
7. Potentiometric titration

Recommended Books

1. Atkins P.W., "Physical Chemistry" (6th Ed).ELBS Oxford University Press (1998).
2. Alberty R. A. & Silvey., "Physical Chemistry" (7th Ed). John Wiley and Sons (1992).
3. Barrow G. M., "Physical Chemistry" (5th Ed). McGraw Hill, Inc., (1998).
4. Castellan G. W., "Physical Chemistry" (3rd Ed).Norasa Publishing House.
5. Fried V., U. Bluiks, H.F. and Hameka, "Physical Chemistry". MacMillan Publishing Company, Inc.
6. Laidler K.J. & J.H. Meiser., "Physical Chemistry".Benjamin/Cummings Publishing Company, Inc.(1998).
7. Kaufman E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company.(1966).
8. Aktin P.W., "Elementary Physical Chemistry" 2nd Edition (1998).
9. Scott S. K. ,"Begining Mathematics for Physical Chemistry" Oxford University Press (1996).
10. Tebutt P., "Basic Mathematics for Chemists" 2nd Edition. (1998).
11. Gurdeep R. "Advanced Physical Chemistry" (3rd Ed). Krishna Prakashan Media (P) Ltd. (2008)

CHEM – 678

Polymers and photochemistry (Cr.03)

Classification of polymers. Kinetics of condensation, addition and co-polymerisation reactions. Molecular mass determination by different methods laws of photochemistry. Quantum efficiency and its determination. Photochemical reactions. Photosensitised reactions. Phosphorescence, fluorescence, chemiluminiscence, Lasers.

Recommended Books

1. Atkins P.W., "Physical Chemistry" (6th Ed).ELBS Oxford University Press (1998).
2. Alberty R. A. & Silvey., "Physical Chemistry" (7th Ed). John Wiley and Sons (1992).
3. Castellan G. W., "Physical Chemistry" (3rd Ed).Norasa Publishing House.
4. Fried V., U. Bluiks, H.F. and Hameka, "Physical Chemistry". MacMillan Publishing Company, Inc.
5. Laidler K.J. & J.H. Meiser., "Physical Chemistry".Benjamin/Cummings Publishing Company, Inc.(1998).

6. Kaufman E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company.(1966).
7. Aktin P.W., "Elementary Physical Chemistry" 2nd Edition (1998).
8. Scott S. K. ,"Begining Mathematics for Physical Chemistry" Oxford University Press (1996).
9. Gurdeep R. "Advanced Physical Chemistry" (3rd Ed). Krishna Prakashan Media (P) Ltd. (2008)

CHEM – 679 Elementry Group Theory (Cr.03)

Symmetry, Symmetry elements and operations, Point groups, Group representation and Character table, Reducible and irreducible representation, Application of Group theory to Valence bond, Molecular orbital, Crystal field theories and IR spectra.

Recommended Books

1. Atkins P.W., "Physical Chemistry" (6th Ed).ELBS Oxford University Press (1998).
2. Alberty R. A. & Silvey., "Physical Chemistry" (7th Ed). John Wiley and Sons (1992).
3. Barrow G. M., "Physical Chemistry" (5th Ed). McGraw Hill, Inc., (1998).
4. Castellan G. W., "Physical Chemistry" (3rd Ed).Norasa Publishing House.
5. Fried V., U. Bluiks, H.F. and Hameka, "Physical Chemistry". MacMillan Publishing Company, Inc.
6. Laidler K.J. & J.H. Meiser., "Physical Chemistry".Benjamin/Cummings Publishing Company, Inc.(1998).
7. Kaufman E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company.(1966).
8. Aktin P.W., "Elementary Physical Chemistry" 2nd Edition (1998).
9. Scott S. K. ,"Begining Mathematics for Physical Chemistry" Oxford University Press (1996).