

Syllabus of 2-Year M.Sc. in Chemistry

**Based on National Curriculum and Credit
Framework for Undergraduate Programme
With effect from 2026-27**

SEMESTER I-IV



**Kazi Nazrul University
Asansol, West Bengal**

**SEMESTER – VII**

COURSE TYPE: MAJOR

COURSE NAME: Inorganic Chemistry General - I

COURSE CODE: MSCCEMMC701

Course Type: MAJOR	Course Details: MC-1			L-T-P: 3-0-4	
Credit: 5 3 (Theory) + 2 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

On completion of this course, the students will be able to understand:

Learning objectives:

1. Concept of analytical chemistry including error, precision, random error standard deviation.
2. Learn to draw straight line using least square method.
3. Understanding of different instrumental methods such as electroanalytical method, thermal methods for separation of elements.

Syllabus:**Theory****Unit I: Introduction to Analytical Chemistry (05 Lectures)**

Errors in chemical analysis: accuracy, precision; determinate, indeterminate, systematic and random errors; source, effect and detection of systematic errors; distribution of random errors; standard deviation of calculated results - sum or difference, product or quotient, logarithm or antilogarithm; significant figures; rounding and expressing results of chemical computations; least square method for calibration plots.

Unit II: Separation Techniques (17 Lectures)

Classification, principle and efficiency of the techniques. Mechanism of separation: adsorption, partition & ion exchange; Chromatography: mathematical relations of capacity, selectivity factor; distribution constant and retention time; chromatogram; elution in column chromatography: band broadening and column efficiency; column resolution; qualitative and quantitative aspects of chromatographic methods of analysis using LC, GC, TLC, HPLC (Normal and reverse phase); size-exclusion chromatography; Ion chromatography and capillary electrophoresis: principles, methods and applications. Solvent extraction, distribution ratio, principle of solvent extraction, extraction equilibrium and effect of pH; application in analytical chemistry.



Unit III: Electroanalytical Methods (18 Lectures)

Fundamentals, electrochemical cell, reference and indicator electrodes, supporting electrolyte, electrolytic process, Dropping Mercury Electrode (DME), Ilkovic equation, DC and AC polarography, Cyclic Voltammetry (CV), Cottrell equation, amperometric, conductometric and coulometric titration.

Unit IV: Thermal Analysis (05 Lectures)

Different methods of analysis: TGA, DTA, DSC; thermogram, applications; thermal stability of covalent and non-covalent bonds, thermal degradation, different types of titrations and their applications.

Practical

1. Ion-exchanger
2. Solvent extraction
3. Ore / Alloy analysis.

Recommended Books:

1. R. L. Dutta and G. S. De, Inorganic Chemistry, Pt – I, 7th Edn, 2013, The New Book Stall, 2013.
2. R. Sarkar, General and Inorganic Chemistry, Pt- I, II, 2nd Edn, Books & Allied (P) Ltd, 2009.
3. A. K. Das, Fundamental Concepts of Inorganic Chemistry, (Vol. 1-3), 2nd Edn, CBS Publisher, 2012.
4. A. K. Das, Fundamental Concepts of Inorganic Chemistry, (Vol. 4-7), CBS Publisher, 2014.
5. D. F. Shriver, P. W. Atkins and C. H. Langford, Inorganic Chemistry, Oxford University Press, New York, 1990.
6. D. A. Skoog, D. M. West, F. J. Holler & S. R. Crouch, Fundamentals of Analytical Chemistry, Thomson, 8th Edition.
7. Douglas, D. McDaniel and J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn, John Wiley and Sons, Inc., New York, 2001.
8. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4th Edn, Pearson Education, India, 2006.



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9. R. P. Budhiraja, Separation Chemistry, New Age International (P) Ltd, New Delhi.
10. N. N. Greenwood and A. Earnshaw, Chemistry of the Elements, 2nd Edn, Elsevier, India, 2005.
11. C. E. Meloan, Techniques in Analytical Chemistry, John Wiley & Sons.
12. F. A. Cotton, G. Wilkinson, C. M. Murillo and M. Bochmann, Advanced Inorganic Chemistry, 6th Edn, John Wiley and Sons, Inc., New York, 1999.
13. A. G. Sharpe, Inorganic Chemistry, 3rd Edn, Pearson Education, New delhi, 2004.
14. D. Banerjea, Inorganic Chemistry: A Modern Treatise, Asian Books Private Ltd, 2012.
15. A. I. Vogel, A Text Book of Quantitative Inorganic Analysis, 3rd Edn, Longmans, 1961.
16. M. Kolthoff, P. J. Elving and E. B. Sandell, Treatise on Analytical Chemistry, Pt-I, II, III, The Interscience Encyclopedia, Inc., New York. 1959.
17. G. D. Christia, P. K. Dasgupta & K. A. Schug, Analytical Chemistry, Wiley, 7th Edition.



Syllabus of 2-Year MSc in Chemistry

COURSE TYPE: MAJOR

COURSE NAME: Organic Chemistry General - I

COURSE CODE: MSCCEMMC702

Course Type: MAJOR	Course Details: MC-2			L-T-P: 3-0-4	
Credit: 5 3 (Theory) + 2 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

On completion of this course, the students will be able to understand:

Learning objectives:

1. Understanding of retrosynthesis for different types of reaction.
2. Synthesis, nomenclature and reactions of different types of heterocyclic compounds.
3. Concepts of polynuclear hydrocarbons.
4. Understanding of preparation of Amino acids and their reactions.

Syllabus:

Theory

Unit I: Retrosynthesis (15 lectures)

Features of organic synthesis, *Retrosynthetic analysis*: disconnections; concept of synthons and synthetic equivalents, donor and acceptor synthons; illogical electrophiles and nucleophiles, natural reactivity and *umpolung*; synthesis involving *umpolung* strategy, latent polarity in bifunctional compounds: consonant and dissonant polarity; interconversion and addition of functional groups (FGI and FGA); functional group removal (FGA); C-C disconnections and synthesis: one-group and two-group (1,2- to 1,5-dioxygenated compounds), reconnection (1,6-dicarbonyl. Synthesis involving enolates and enamines with special reference to diethyl malonate and ethyl acetoacetate; Robinson annelation; synthesis through protection of functional groups (alcohol, amine, carbonyl, acid) Strategy of ring synthesis: thermodynamic and kinetic factors; synthesis of large rings, application of high dilution technique. concept and examples of cascade reaction.

Unit II: Heterocycles (16 lectures)

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom;

Saturated heterocycles: Synthetic approaches, reactivity of oxiranes, aziridines, oxaziridines, diaziridine and diazirines, oxitanes, azatidanes and thietanes



Five-membered aromatic heterocyclic compounds: Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), and Thiophene.

Six-membered aromatic heterocyclic compounds: General synthetic approaches, properties and reaction of Pyridine and its derivative

Five membered aromatic heterocyclic compounds: Synthetic approach of indole (Fischer indole synthesis and Madelung synthesis), quinoline and isoquinoline, (Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction) properties and reactions.

Unit III: Polynuclear hydrocarbon (5 lectures)

Reactions of naphthalene, phenanthrene and anthracene; Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene.

Unit-IV: Amino acids (9 lectures)

Classification, physical properties, concept of isoelectric point and its determination, electrophoresis, synthesis with mechanistic details: Strecker, Gabriel, acetamido malonic ester, azlactone, Bücherer hydantoin, chemical properties (with mechanism): ninhydrin reaction, Dakin-West reaction; resolution of racemic amino acids; Estimation of amino acids by Sorensen formol titration.

Practical

Separation (chemical) of binary mixtures of solid-solid/liquid-solid/liquid-liquid organic samples and identification of individual components

Recommended Books:

1. J. March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th Edn., John Wiley, New York, 1999.
2. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part A and Part B, 4th Edn., Plenum Press, New York, 2001.
3. P. G. M. Wuts and T. W. Greene, Greene's Protective Groups in Organic Synthesis, 4th Edn, Wiley-VCH, 2006.
4. S. Warren and P. Wyatt, Organic Synthesis: The Disconnection Approach, 2nd Edn, Wiley-VCH, 2008.



5. E. J. Corey and X.-M. Chelg, *The Logic of Organic Synthesis*, John Wiley & Sons, 1995.
6. T.L. Gilchrist and R.C. Storr, *Organic Reactions and Orbital Symmetry*, 2ndEdn., Cambridge University Press, 1979.
7. R. K. Bansal, *Heterocyclic Chemistry: Syntheses, Reactions and Mechanisms*, Wiley Eastern Limited, New Delhi, 1999.
8. T. L. Gilchrist, *Heterocyclic Chemistry*, Pearson Education, 2008.
9. T. Eicher, S. Hauptmann and A. Speicher, *The Chemistry of Heterocycles*, Wiley-VCH, 2012.
10. G. Brahmachari, *Green Synthetic Approaches for Biologically Relevant Heterocycles*, Elsevier, 2014.
11. A. I. Meyers, *Heterocycles in Synthesis*, John Wiley & Sons, 1974.
12. A.R. Katritzky, *Comprehensive Heterocyclic Chemistry*, Elsevier Book series.
13. G. Brahmachari, *Green Synthetic Approaches for Biologically Relevant Heterocycles*, Elsevier, 2014.
14. T. H. Lowry and K.C. Richardson, *Mechanism and Theory in Organic Chemistry*, 3rd Edn., Harper and Row, New York, 1998.
15. H. Neurath, *The Proteins: Composition, Structure and Function*, Vols. 1-5, Academic Press, New York, 1963.
16. J. Clayden, N. Greeves, S. Warren and P. Wothers, *Organic Chemistry*, Oxford University Press, Oxford, 2001.
17. W. Caruthers, *Modern Methods of Organic Synthesis*, 3rdEdn., Low Price Edition, Cambridge University Press, 1996.
18. H. O. House, *Modern Synthetic Reactions*, 2ndEdn., Benjamin, 1971.
19. R. O. C. Norman and J. M. Coxon: *Principle of organic synthesis*
20. S. Warren, *Organic Synthesis: The Disconnection Approach*, 1stEdn, Wiley, 2012.



Syllabus of 2-Year MSc in Chemistry

COURSE TYPE: MAJOR

COURSE NAME: Organic Chemistry General - II

COURSE CODE: MSCCEMMC703

Course Type: MAJOR	Course Details: MC-3		L-T-P: 3-0-4		
Credit: 5 3 (Theory) + 2 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

On completion of this course, the students will be able to understand:

Learning objectives:

- 1. Understanding of some organic name reactions.*
 - 2. Concepts of mechanism, stereochemistry, regioselectivity of Pericyclic reactions.*
 - 3. Study of chemistry of functional groups of natural products.*
 - 4. Concept of drug design (physicochemical principles) and basis of drug design, quantitative description, physicochemical approach of drug molecules.*
 - 5. Thermodynamic approach of drug design and drug delivery in biological systems.*
- Reaction mechanism of substitution, elimination and addition reaction*

Syllabus:

Theory

Unit I: Organic name reactions (10 lectures)

Baeyer-Villiger oxidation; Barton reaction; Beckmann rearrangement; Birch reduction; Claisen rearrangement; Favorskii reaction; Fries rearrangement; Heck reaction; Mannich reaction; McMurry reaction; Michael addition; Perkin reaction; Sharpless asymmetric epoxidation; Stille coupling; Strecker reaction; Suzuki coupling; Wittig reaction; Yamaguchi esterification

Unit II: Introduction to Pericyclic Reactions (10 lectures)

Mechanism, stereochemistry, regioselectivity in case of

Electrocyclic reactions: FMO approach involving 4π - and 6π -electrons (thermal & photochemical) and corresponding cyclo-reversion reactions, Woodward-Hofmann selection rules and stereochemistry of electrocyclic reaction

Cycloaddition reactions: FMO approach, selection rules and stereochemistry of cycloaddition. Diels-Alder reaction, Alder ene reaction, photochemical [2+2] cycloadditions.



Unit-III: Chemistry of natural products: Chemistry and function (15 lectures)

Chemistry and function of some major groups of natural products such as terpenoids (*monoterpenoids*: geraniol, alpha-pinene, camphor, menthol, carvone; *sesquiterpenoids*: farnesol, zingiberine, caryophyllene, santonin; *diterpenoids*: abietic acid, taxol; *triterpenoids*: beta-amyrane, oleanolic acid, ursolic acid), alkaloids (papaverine, emitene, morphine, quinine, nicotine, ephedrine) and carbohydrates (monosaccharides and disaccharides); concepts on biosynthetic pathways (*mevalonic acid*, *geranyl pyrophosphate*, *shikimic acid*) for natural products

Unit-IV: Medicinal chemistry (10 lectures)

Concept of drug design (physiochemical principles and basis of drug design, quantitative description, physicochemical approach of drug molecules, different methods of drug design, Free Wilson method and its application to extra thermodynamic approach); pharmacodynamic and pharmacokinetic (drug absorption, distribution, metabolism and excretion) aspects; drug targets (enzymes, receptors, nucleic acids); membranes and receptors (drug transport mechanism and absorption processes, prodrugs and bioactivation, receptor theories and receptor models, drug receptor interactions); concept on lead compounds and lead modifications; pharmacophore; structure-activity relationship (SAR); clinical trials; bioavailability; computer-aided drug design (*de novo* design), docking procedures and molecular modelling; discussion with suitable examples of choice.

Practical

Chromatography

1. Determination of R_f values and identification of organic compounds (amino acids/dye/Sugars) by thin layer chromatography (TLC)
2. Determination of R_f values and identification of organic compounds (2/3 sugars) by Paper chromatography

Recommended Books:

1. J. March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th Edn., John Wiley, New York, 1999.
2. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part A and Part B, 4th Edn., Plenum Press, New York, 2001.
3. T. L. Gilchrist and C. W. Rees, Carbenes, Nitrenes and Arynes, Nelson, New York, 1973.



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4. T. H. Lowry and K.C. Richardson, Mechanism and Theory in Organic Chemistry, 3rd Edn., Harper and Row, New York, 1998.
5. H. Neurath, The Proteins: Composition, Structure and Function, Vols. 1-5, Academic Press, New York, 1963.
6. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press, Oxford, 2001.
7. W. Caruthers, Modern Methods of Organic Synthesis, 3rd Edn., Low Price Edition, Cambridge University Press, 1996.
8. P. Sykes, A Guide to Mechanism in Organic Chemistry.
9. R. T. Morrison and R. N. Boyd: Organic Chemistry
10. R. O. C. Norman and J. M. Coxon: Principle of organic synthesis
11. L. Finar, Organic Chemistry, Vol I, 6th Edn., Addison Wesley Longmann, London, 1998.
12. S. Warren, Organic Synthesis: The Disconnection Approach, 1stEdn, Wiley, 2012.
13. T.L. Gilchrist and R.C. Storr, Organic Reactions and Orbital Symmetry, 2nd Edn., Cambridge University Press, 1979.
14. R. B. Woodward and R. Hoffman, The Conservation of Orbital Symmetry, Academic Press, 1970.
15. S. Sankararaman, Pericyclic Reactions – A Textbook, Wiley-VCH Verlag, 2005.
16. I. Fleming, Pericyclic Reactions, Oxford University Press, 1996.
17. X.-T. Liang and W.-S. Fang, Medicinal Chemistry of Bioactive Natural Products, John Wiley & Sons, 2006.
18. S. K. Talapatra and B. Talapatra, Chemistry of Plant Natural Products, Springer, 2012.
19. S. V. Bhat, B. A. Nagasampagi and M. Sivakumar, Chemistry of Natural Products, Narosa Publishing House, New Delhi, 2005.
20. K. Chatterjee and E. J. Topol, Cardiac Drugs, 1 edition, Jaypee Brothers Medical Pub., 2013.
21. W. H. Frishman and D. A. Sica, Cardiovascular Pharmacotherapeutics - 3rd Edition, CardioText, 2011.
22. Atta-ur-Rahman and M.I. Choudhary, Frontiers in Cardiovascular Drug Discovery, Bentham Publications, 2010.



Syllabus of 2-Year MSc in Chemistry

COURSE TYPE: MAJOR

COURSE NAME: Physical Chemistry General - I

COURSE CODE: MSCCEMMC704

Course Type: MAJOR	Course Details: MC-4			L-T-P: 3-0-4	
Credit: 5 3 (Theory) + 2 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

On completion of this course, the students will be able to understand:

Learning objectives:

1. Concepts of electrical properties of molecules and different types of intermolecular forces.
2. Understanding of Photophysical and photochemical process.
3. Basic concepts of polymers, their classifications, nomenclature and molecular weight determination.
4. Concepts of partition functions.
5. Adsorption – theory and significance.
6. Langmuir, Freundlich – adsorption isotherms, significance.
7. Understand the colloids and different types of electrokinetic phenomena, concept of micelles.

Syllabus:

Theory

Unit-I: Electric & Magnetic Properties of atoms & Molecules (7 lectures)

Electrical properties of molecules, polarizability, induced and orientation polarization, Debye and Clausius-Mossotti equations (without derivation) and their applications, Origin and types of intermolecular forces, different types of potential and their diagrams.

Unit-II: Photochemistry (8 lectures)

Primary photophysical processes, potential energy diagram, Franck-Condon principle and vibrational structure of electronic spectra, bond dissociation, decay of excited state by radiative and nonradiative paths, fluorescence and phosphorescence, Jablonsky diagram. laws of photochemistry, quantum yield, photochemical equilibrium, photosensitized reactions, kinetics of HI decomposition.



Unit-III: Chemistry of Polymers (8 lectures)

Basic Concepts, classification, nomenclature, molecular weights, molecular weight distribution Methods for determination of Molecular weights, viscosity molecular weight, intrinsic viscosity, mark-Houwink relationships, Glass transition temperature, Polymerization reaction, kinetics of free radical and condensation polymer. Graft polymerization.

Unit-IV: Statistical Thermodynamics (10 lectures)

Motivation for study, Entropy and Probability, Stirling approximations, Maxwell-Boltzmann Distribution, concept of partition functions, translational, rotational, vibrational and electronic partition functions, Thermodynamic properties in terms of partition functions, Equilibrium constant.

Unit-V: Surface Chemistry (12 lectures)

Special feature of interfaces, physical and chemical adsorptions, Langmuir and Freundlich adsorption isotherms, surface excess and Gibbs adsorption isotherms, heterogeneous catalysis (single reactant), Electrical double layers, zeta potential, overvoltage, Stern double layer (qualitative idea), Tyndall effect, electrokinetic phenomena (qualitative idea), colloids and electrolytes, micelle and reverse micelle, critical micelle constant (CMC)

Practical

1. Kinetics of charge transfer complex (Naphthalene-I₂)
2. Determination of CMC by measuring molar conductance with gradual addition of concentrated surfactant solution in water Conductometrically.
3. Determination of Ionisation constant of dibasic/tribasic acid using pH meter.

Recommended Books:

1. G. W. Castellan, Physical Chemistry, Narosa Publishing House, Calcutta, 1995.
2. Ira N. Levine, Physical Chemistry, PHI Learning Pvt. Ltd.
3. R. A. Alberty and R. J. Silbey, Physical Chemistry, John Wiley and Sons, Inc., New York, 1995.
4. S. Glasstone, Text Book of Physical Chemistry, Macmillan and Company Ltd., London, 1951.
5. T. Engel and P. Reid, Physical Chemistry, Pearson Education, New Delhi, 2006.



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6. D. A. McQuarrie and J. D. Simon, Physical Chemistry: A Molecular Approach, Viva Books Private Limited.
7. P. C. Rakshit (Revised by S.C. Rakshit), Physical Chemistry, Sarat Book Distributors, Kolkata.
8. P. W. Atkins & Julio De Paula, Physical Chemistry, Eighth Edition, Oxford University Press, Oxford
9. P. W. Atkins & Julio De Paula, Elements of Physical Chemistry, Fifth Edition, Oxford University Press, Oxford
10. R.G. Mortimer, Physical Chemistry, Third Edition, Elsevier Academic Press.
11. P. Monk, Physical Chemistry Understanding our Chemical World, John Wiley & Sons Ltd.
12. K.L. Kapoor, A Text Book of Physical Chemistry (Vol. 1 – 5), Macmillan India Limited, New Delhi.
13. P. A. Cox, The Electronic Structure & Chemistry of Solids, Oxford University Press, Oxford, 1987.
14. S. Pahari, Physical Chemistry (Vol. 1 & 2), New Central Book Agency (P) Ltd.
15. Berry, Rice & Ross, Physical Chemistry, Oxford University Press.
16. W. J. Moore, Physical Chemistry, Longman Green and Co. Ltd., 1953.
17. Pahari and Pahari, Problems on Physical Chemistry, New Central Book Agency (P) Ltd.
18. K. K. Rohatgi-Mukherjee, Fundamentals of Photochemistry, New Age International Pvt. Ltd., 2021.
19. A. Ghoshal, Numerical Problems on Physical Chemistry, Books and Allied (P) Ltd.
20. J. C. Ghosh, Experiments in Physical Chemistry, Bharati Bhawan Publishers and Distributors, Patna, 1994
21. S. K. Maity and N. K. Ghosh, Physical Chemistry Practical, New Central Book Agency (P) Ltd.
22. A. K. Nad, B. Mahapatra & A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007.
23. S. Ghosh, M Das Sarma, D Majumdar & S Manna, Chemistry in Laboratory, Santra Publication, 2019.



Syllabus of 2-Year MSc in Chemistry

COURSE TYPE: MINOR

COURSE NAME: ADVANCED PHYSICAL CHEMISTRY

COURSE CODE: MSCCEMMN701

Course Type: MINOR	Course Details: MNC1			L-T-P: 4-1-0	
Credit: 5 5 (Theory) + 0 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	30	-	70

On completion of this course, the students will be able to understand:

Learning objectives:

1. Understanding of Photophysical and photochemical process.
2. Concept of supramolecular chemistry, their landscape, building blocks, orbitals.
3. Understand the collision theory and transition state theory for any reaction.
4. Concepts of different kind of catalysis.

Syllabus:

Theory

Unit I: Photochemistry (10 lectures)

Absorption, Lambert-Beer's law, photochemical laws, primary photophysical processes, potential energy diagram, Franck-Condon principle, fluorescence and phosphorescence, Jablonsky diagram.

Unit II: Supramolecular Chemistry (20 lectures)

Concept and language, scientific/technological landscape, building block, atomic and molecular valences, supramolecular orbitals, pallet of non-covalent forces and their harnessing towards crystal engineering, structure directed supramolecular arrays, crystal synthesis, deliberate isolation of different functional materials

Unit III: Chemical Kinetics – II (15 lectures)

Collision theory of bimolecular reactions, unimolecular reactions, Lindemann theory, transition state theory, free energy and entropy of activation, pressure-dependence of rate constant, primary kinetic salt effect. Homogeneous catalysis, with reference to acid base and enzyme catalyses, heterogeneous catalysis.

Practical

Verification of Lambert Beers' law.



Recommended Books:

1. G. W. Castellan, Physical Chemistry, Narosa Publishing House, Calcutta, 1995.
2. Ira N. Levine, Physical Chemistry, PHI Learning Pvt. Ltd.
3. R. A. Alberty and R. J. Silbey, Physical Chemistry, John Wiley and Sons, Inc., New York, 1995.
4. K. K. Rohatgi-Mukherjee, Fundamentals of Photochemistry, New Age International Pvt. Ltd., 2021.
5. T. Engel and P. Reid, Physical Chemistry, Pearson Education, New Delhi, 2006.
6. D. A. McQuarrie and J. D. Simon, Physical Chemistry: A Molecular Approach, Viva Books Private Limited.
7. K. J. Laidler, Chemical Kinetics, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1988.
8. P. C. Rakshit (Revised by S.C. Rakshit), Physical Chemistry, Sarat Book Distributors, Kolkata.
9. P. W. Atkins & Julio De Paula, Physical Chemistry, Eighth Edition, Oxford University Press, Oxford
10. P. W. Atkins & Julio De Paula, Elements of Physical Chemistry, Fifth Edition, Oxford University Press, Oxford
11. K.L. Kapoor, A Text Book of Physical Chemistry (Vol. 1 – 5), Macmillan India Limited, New Delhi.
12. S. Pahari, Physical Chemistry (Vol. 1 & 2), New Central Book Agency (P) Ltd.
13. Berry, Rice & Ross, Physical Chemistry, Oxford University Press.
14. W. J. Moore, Physical Chemistry, Longman Green and Co. Ltd., 1953.
15. Pahari and Pahari, Problems on Physical Chemistry, New Central Book Agency (P) Ltd.
16. A. Ghoshal, Numerical Problems on Physical Chemistry, Books and Allied (P) Ltd.
17. F. Vogtle, Supramolecular Chemistry: An Introduction, Wiley, Chichester, 1991.
18. B. Dietrich, P. Viout and J. -M. Lehn, Macrocyclic Chemistry – Aspects of Organic and Inorganic Supramolecular Chemistry, VCH, Weinheim, 1993.
19. J. -M. Lehn, Supramolecular Chemistry: Concepts and Perspectives, VCH, Weinheim, 1995.
20. S. K. Maity and N. K. Ghosh, Physical Chemistry Practical, New Central Book Agency (P) Ltd.
21. A. K. Nad, B. Mahapatra & A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007.



SEMESTER – II

COURSE TYPE: MAJOR

COURSE NAME: Advanced General Chemistry-I

COURSE CODE: MSCCEMMC801

Course Type: MAJOR	Course Details: MC-5			L-T-P: 3-0-4	
Credit: 5 3 (Theory) + 2 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

On completion of this course, the students will be able to understand:

Learning objectives:

- 1. To inspire the students about the chemistry which is good for human health and environment.*
- 2. To make students aware of how chemical processes can be designed, developed and run in a sustainable way.*
- 3. To acquire the knowledge of the twelve principles of green chemistry and how to apply in green synthesis.*
- 4. To make students aware about the benefits of using green chemistry.*
- 5. Knowledge of synthesis of nanomaterials.*
- 6. Concepts of some special types of nanomaterials.*
- 7. Characterisations of nanomaterials by using different instrumental techniques.*
- 8. Concepts of Photoelectron spectroscopy and CD/ORD Spectroscopy.*

Syllabus:

Theory

Unit I: Green Chemistry:(10 Lectures)

Sustainable development, twelve principles of green chemistry and implementations, atom economy, environmental E-factor, role of catalysts, microwave and ultrasound irradiation in green synthesis, traditional and alternative commercial syntheses of ibuprofen, paracetamol, adipic acid and maleic acid etc, green chemistry in action developing foam, whitening agent, detergent builders, green insecticides, biosynthesis of synthetic chemical, photochemical reactions in atmosphere, photochemical smog and stratospheric ozone depletion; chemicals from renewable feedstock.

Unit II: Nano chemistry (12 Lectures)

Basics of nanoscience, nanotechnology and nanoparticles; Preparation of nano particles, top down and bottom-up approach; electrochemical, chemical, photochemical and biochemical



synthesis of nano particles. Characterization techniques, Properties of nano particles, variation of properties with size; Applications of nano particles. Synthesis and properties of carbon nanotubes; Organic conductors, liquid crystals.

Unit III: Photoelectron spectroscopy (11 Lectures)

ESCA, UPS, Auger, XRF and EXFAS; spectroscopic and other tools in structure elucidation.

Unit IV: CD/ORD Spectroscopy and AES, AAS (12 Lectures)

Methods, molecular dissymmetry and chiroptical properties, Cotton effect, Faraday effect in magnetic circular dichroism (MCD) and application.

Practical

Synthesis and characterization of Nanomaterials.

Analysis of waste water (pH, BOD, COD, turbidity, viscosity, conductance).

Recommended Books:

1. S. Warren, Organic Synthesis: The Disconnection Approach, 1st Edn, Wiley, 2012.
2. A. K. Das, Environmental with Green Chemistry, Books & Allied (P) Ltd, 2004.
3. Ahluwalia, Green Chemistry Environmentally Benign Reactions, Ane Books-New Delhi, 2012.
4. G. Cao, Nanostructures & Nanomaterials, Synthesis, Properties & Applications, Imperial College Press, London, 2004.
5. L. Cademartiri and G. A. Ozin, Concepts of Nanochemistry, Wiley-VCH, Weinheim, 2009.
6. D. W. Turner, C. Baker and C. R. Bundle, Molecular Photoelectron Spectroscopy, Wiley Interscience, New York, 1970.
7. J. H. D Eland, Photoelectron Spectra, Butterworth, London, 1984.
8. T. L. Barr, Modern ESCA: the Principles and Practice of X-ray Photoelectron Spectroscopy, CRC Press, Boca Raton, FL, 1994.
9. G.A. Ozin, A. C. Arsenault and L. Cademartiri, Nanochemistry: A Chemical approach to Nanomaterials, Royal Society of Chemistry, London, 2009.



Syllabus of 2-Year MSc in Chemistry

COURSE TYPE: MAJOR

COURSE NAME: Advanced Inorganic Chemistry-I

COURSE CODE: MSCCEMMC802

Course Type: MAJOR	Course Details: MC-6		L-T-P: 3-0-4		
Credit: 5 3 (Theory) + 2 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

On completion of this course, the students will be able to understand:

Learning objectives:

- 1. Coordination compounds – Crystal field theory, and some preliminary idea about Ligand Field Theory.*
- 2. Concept of Jahn-Teller Distortion and application.*
- 3. Explanation about the origin of colour of complexes.*
- 4. Concepts of magnetic properties of the complexes.*
- 5. Understanding of reaction mechanism.*
- 6. Concepts of mechanism of different types of inorganic reaction.*
- 7. Understanding of Molecular magnetism.*

Syllabus:

Unit I: Coordination chemistry – stereochemistry, bonding and structure (12 lectures)

Preamble, Orgel/Tanabe-Sugano diagram, ligand symmetry orbital, molecular orbital, Angular overlap model, spectral features, Nephelauxetic effect, Racah parameter, Franck Condon principle, vibronic coupling, band broadening, spin-orbit coupling, spin-forbidden transition, intensity stealing, magnetic properties, cooperative, anomalous and subnormal magnetic moments, lowering of symmetry, electronic, steric and Jahn-Teller effects on energy levels, conformation of chelator/congregator/macrocyclic, structural equilibrium and implication.

Unit II: Inorganic reaction mechanism II (10 lectures)

Preamble, factors affecting the rate of a chemical reaction, analysis of rate data, complex rate laws, kinetically indistinguishable schemes, nucleophilicity and rate scales: Edward scale, nPt scale, Gutmann donor number, Drago E & C scale, trans- and cis- effects, water exchange rates, proton ambiguity, mechanistic simulation; associative, dissociative, interchange, nucleophilic,



electrophilic, insertion pathways; Hammett relation, application of LFER in chemical kinetics.

Unit III: Molecular magnetism I (08 lectures)

Classification of magnetic materials, van Vleck equation and its application, Curie-Weiss law and its implication, Lande interval rule, microstates, multiplet, multiplet width, hole formalism, zero-field splitting, spin-orbit coupling, quenching of orbital contribution, Fermi contact and pseudo-contact shifts, chemical shift reagent.

Practical

Synthesis and characterization of Schiff base ligands and their complexes.

Recommended Books:

1. R. L. Dutta and G. S. De, Inorganic Chemistry, Pt – I, 7th Edn, 2013, The New Book Stall, 2013.
2. R. Sarkar, General and Inorganic Chemistry, Pt- I, II, 2ndEdn, Books & Allied (P) Ltd, 2009.
3. A. K. Das, Fundamental Concepts of Inorganic Chemistry, (Vol. 1-3), 2ndEdn, CBS Publisher, 2012.
4. A. K. Das, Fundamental Concepts of Inorganic Chemistry, (Vol. 4-7), CBS Publisher, 2014.
5. D. F. Shriver, P. W. Atkins and C. H. Langford, Inorganic Chemistry, Oxford University Press, New York, 1990.
6. Douglas, D. McDaniel and J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn, John Wiley and Sons, Inc., New York, 2001.
7. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4th Edn, Pearson Education, India, 2006.
8. N. N. Greenwood and A. Earnshaw, Chemistry of the Elements, 2nd Edn, Elsevier, India, 2005.
9. J. D. Lee, Concise Inorganic Chemistry, 5thEdn, Oxford University Press, 1999.
10. F. A. Cotton, G. Wilkinson, C. M. Murillo and M. Bochmann, Advanced Inorganic Chemistry, 6th Edn, John Wiley and Sons, Inc., New York, 1999.



Syllabus of 2-Year MSc in Chemistry

11. R. B. Jordan, Reaction Mechanisms of Inorganic and Organometallic Systems, Oxford University Press, 1998.
12. S. Asperger, Chemical Kinetics and Inorganic Reaction Mechanisms, 2nd Edn, Springer, London, 2012.
13. F. Basolo and R. G. Pearson, Mechanism of Inorganic Reactions, 2nd Edn, Wiley, New York, 1967.
14. D. Katakis and G. Gordon, Mechanisms of Inorganic Reactions, John Wiley & Sons, New York, 1987.
15. R. G. Wilkinns, Kinetics and Mechanism of Reactions of Transition Metal Complexes, 2nd Edn, VCH, Weinheim, 1991.
16. I. Vogel, A Text Book of Quantitative Inorganic Analysis, 3rd Edn, Longmans, 1961.
17. C. J. F. Böttcher, Theory of Electric Polarisation, Vols 1 and 2, Elsevier Scientific Publishing Co, New York, 1973.
18. D. W. Davies, The Electric and Magnetic Properties of Molecules.



Syllabus of 2-Year MSc in Chemistry

COURSE TYPE: MAJOR

COURSE NAME: Advanced Organic Chemistry-I

COURSE CODE: MSCCEMMC803

Course Type: MAJOR	Course Details: MC-7			L-T-P: 3-0-4	
Credit: 5 3 (Theory) + 2 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

On completion of this course, the students will be able to understand:

Learning objectives:

1. *Knowledge of stereoselective and stereospecific reactions.*
2. *Concepts of stereochemical aspects of some organic reactions.*
3. *Understanding of asymmetric synthesis and asymmetric induction.*
4. *Stereochemistry of some reaction.*
5. *Knowledge of conformation and reactivity for alicyclic compounds.*
6. *Knowledge of stereochemical change of substitution, elimination and NGP reactions.*
7. *Application of UV-VIS, IR, NMR, MASS Spectroscopy for organic molecules.*

Syllabus:

Theory

Unit I: Dynamic Stereochemistry (15 lectures)

A) General Introduction

Regioselective, regio specific and chemoselective reactions; stereo-selectivity and stereospecificity; Stereoselective reactions: Classification, terminology and principles; Curtin-Hammett principle and Wenstein-Eliel equations; conformation, reactivity & mechanism (*viz.* acyclic and cyclic system focusing on nucleophilic substitution reaction, formation and cleavage of epoxide ring, addition reactions to double bonds, elimination reactions, pyrolytic *syn*-elimination, oxidation of cyclohexanols, *etc.*); elementary idea about asymmetric synthesis

B) Synthetic Approach

Asymmetric synthesis and Asymmetric Induction; Diastereo selective synthesis: Asymmetric synthesis with chiral substrates, Cram's rule – its application and deviation, Felkin-Anh Model Prelog's rule, Enantio Selective synthesis.



C) Stereochemical Aspects of a few Organic Reactions

Polar addition reactions to alkene, Prevost and Woodward Hydroxylation, Hydroxylation by OsO_4 followed by reductive cleavage, Catalytic reductions of alkenes and alkynes, Nucleophilic substitution on saturated carbon, E_1 and E_2 reaction, stereoconvergent Elimination, stereochemical aspects of a few Molecular rearrangement – Pinacol rearrangement, Beckmann rearrangement, Claisen rearrangement and Cope rearrangement.

D) Alicyclic system

Conformation and Reactivity in cyclohexanes; Steric effect and stereoelectronic effect; Neighbouring group effects, effects of conformation on rearrangement and transannular reactions in alicyclic system; Diastereo selection in cyclic system. Reactions of cyclohexane derivatives; Hydrolysis of ester of cyclohexane carboxylic acids, Esterification Reaction of cyclohexane carboxylic acids, S_N^1 , S_N^2 , E_1 , E_2 , NGP, reactions. Hydride reduction of cyclohexanones to cyclohexanols, oxidation of cyclohexanols with Chromic acid, Merged substitution – elimination reaction, Reaction of 2-Aminocyclohexanol by Nitrous acid, Pinacol-pinacolone rearrangement in cyclohexanediols.

Unit II: Spectroscopy (15 lectures)

A) UV Spectroscopy

Introduction to absorption and emission spectroscopy, Types of electronic transitions, Effect of solvent polarity on electronic transitions, Chromophores and Auxochromes, Absorption and Intensity shift; Bathochromic and Hypsochromic shifts, Hyperchromic and Hypochromic shifts. Application of Fieser-Woodward Rules for calculation of λ_{max} for Conjugated dienes and α , β – unsaturated carbonyls, Distinction between cis and trans isomers.

B) IR Spectroscopy

Fundamental and non-fundamental molecular vibrations, IR absorption positions of O, N and S containing functional groups, Effect of H-bonding, conjugation, resonance and ring size on IR absorptions, Fingerprint region and its significance, application in functional group analysis.

C) NMR Spectroscopy

Basic principles of PMR Spectroscopy, nuclear shielding and deshielding phenomenon, chemical shift and factors influencing it, Spin-Spin coupling and coupling constant, Anisotropic effect. Interpretation of PMR spectra of simple organic compounds such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate and toluene.

Carbon-13 NMR spectroscopy - general considerations; chemical shift values (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon); coupling constant; Two



Dimensional NMR Spectroscopy - COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.

D) Mass Spectrometry

Elementary idea and fragmentation rule in characterization of organic compounds.

E) Combined spectral applications

Applications of all the spectroscopic techniques (UV, FT-IR, NMR and Mass) in a combined manner to solve structural problems of unknown organic compounds.

Practical

1. Chromatographic separation

Column chromatographic separation of mixture of organic compounds

2. Identification of Simple organic compound by IR and NMR (spectra to be provided)

Aliphatic system-

Diethyl fumarate; Mesityl oxide; Pent-1-yn-3-ol; ethanol, 2-butene, 1-butene, acetaldehyde

Mono substituted aromatic system-

Benzylacetate; Toluene, phenol, benzoic acid, benzaldehyde, ethyl benzene, nitro benzene, N-methylaniline

Disubstituted aromatic system-

4-Bromoacetanilide; 2-Bromo-4'-methylacetophenone; 2-Methoxyacetophenone; 4-Aminobenzoic acid; Salicylamide; 2-Hydroxyacetophenone; 1,3-Dinitrobenzene; trans-4-Nitrocinnamaldehyde; 4-Nitrobenzaldehyde; 4-Methylacetanilide; 2-Hydroxybenzaldehyde; 4-Nitroaniline; 3-Nitrobenzaldehyde; 2-Methoxybenzaldehyde; Methyl 4-hydroxybenzoate; Methyl 3-hydroxybenzoate; 3-Aminobenzoic acid; Ethyl 3-aminobenzoate; Ethyl 4-aminobenzoate; 3-nitroanisole; 3-Methylacetanilide.

Trisubstituted aromatic system-

Vanillin; 2-Hydroxy-3-nitrobenzaldehyde; 2,3-Dimethylbenzonitrile; 3-Ethoxy-4-hydroxybenzaldehyde; 5-Methyl-2-nitroanisole, 1,3,5-trimethyl benzene.

Recommended Books:

1. E.L. Eliel, S.H. Wilen and L.N. Mander, Stereochemistry of Organic Compounds, John Wiley & Sons, New York, 1994.
2. S. Sengupta, Basic Stereochemistry of Organic Molecules, 2009.
3. D. Nasipuri, Stereochemistry of Organic Compounds, 2nd Edn., Wiley Eastern, New Delhi, 1993.



4. E.L. Eliel, N.L. Allinger, S. J. Angyal and G.A Morrison, Conformational Analysis, John Wiley & Sons, Inc., 1967.
5. J. Eames and J. Peach, Stereochemistry at a Glance, Blackwell Science, 2003.
6. K. Mislow and W. A. Benjamin, Introduction to Stereochemistry New York, 1965.
7. B. Testa, Principles of Organic Stereochemistry, Marcel Dekker, New York, 1979.
8. E. Juaristi, Stereochemistry & Conformational Analysis, John Wiley & Sons, Inc., 1991.
9. M. Nogradi, Stereochemistry: Concepts and Applications, Pergamon Press, New York, 1981.
10. William Kemp, Organic Spectroscopy, 3rd Edn., Macmillan Press Ltd., 1991.
11. D. L. Pavia, G. M. Lampman and G.S. Kriz, Introduction to Spectroscopy, 3rd Edn., Harcourt, Inc., 2001.
12. R. M. Silverstein, G. C. Bassler and T. C. Morrill, Spectroscopic Identification of Organic Compounds, 5th Edn., John Wiley & Sons, Inc., 1991.
13. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 5th Edn., Tata McGraw-Hill Edition, New Delhi, 2004.
14. J. March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th Edn., John Wiley, New York, 1999.
15. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part A and Part B, 4th Edn., Plenum Press, New York, 2001.
16. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press, Oxford, 2001.
17. I. Fleming, Frontier Orbitals and Organic Chemical Reactions, John Wiley, 1980.
18. W. Caruthers, Modern Methods of Organic Synthesis, 3rd Edn., Low Price Edition, Cambridge University Press, 1996.
19. H. O. House, Modern Synthetic Reactions, 2nd Edn., Benjamin, 1971.
20. R. O. C. Norman and J. M. Coxon: Principle of organic synthesis
21. S. Warren, Organic Synthesis: The Disconnection Approach, 1st Edn, Wiley, 2012.



Syllabus of 2-Year MSc in Chemistry

COURSE TYPE: MAJOR

COURSE NAME: Advanced Physical Chemistry-I

COURSE CODE: MSCCEMMC804

Course Type: MAJOR	Course Details: MC-8			L-T-P: 3-0-4	
Credit: 5 3 (Theory) + 2 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

On completion of this course, the students will be able to understand:

Learning objectives:

1. *Understanding the symmetry and group theory. Reducible, irreducible representations.*
2. *Concepts of Great Orthogonality Theorem and its application.*
3. *Understanding of Raman spectroscopy and application.*
4. *Concepts of Transition State Theory, Potential energy diagram, Hammett's acidity function.*
5. *Quantum mechanical approach of rotational and vibrational motion of particles.*
6. *Understanding of partial molar quantities, excess functions, activity coefficients.*

Syllabus:

Theory

Unit I: Symmetry and Group Theory (12 lectures)

Concept of symmetry, symmetry elements and symmetry operations, optical activity, concept of groups, point symmetry groups, class, group multiplication tables, matrix representation, equivalent and reducible representations, irreducible representations, great orthogonality theorems statement (without derivation) and interpretation, proof of its corollaries, character table and its construction, number of times an irreducible representation occurs in a reducible one; the reduction of reducible representations, notation of irreducible representations.

Unit II: Advanced Molecular Spectroscopy – II (4 lectures)

Raman spectroscopy: Classical and quantum theories of Raman Effect; Pure rotational, Vibrational and vibrational-rotational Raman spectra; Selection rules; Mutual exclusion principle, Resonance Raman; Surface Enhanced Raman Scattering (SERS).



Unit III: Chemical Kinetics- III (5 lectures)

Transition state theory, potential energy surfaces, concept of imaginary frequency, thermodynamic treatment of reaction rates, energy of activation, volume of activation, reactions in solutions, diffusion and activation-controlled reactions, influence of solvent dielectric constant and ionic strength on reaction rates, linear free energy relationship, effect of substituents, Hammett's and Taft's constants, Hammett's acidity functions, Oscillatory reactions.

Unit IV Quantum Chemistry – III (4 lectures)

Free particle system – position, momentum, energy and uncertainty relation, motion of three dimensions, degeneracy, potential barrier, Vibrational motion of a particle, classical mechanical treatment, Rotational motion of a particle – Schrodinger equation and wave function.

Unit V: Solutions Thermodynamics and Electrochemistry (5 lectures)

Partial molar quantities, significance and the determination of partial molar quantities, Thermodynamics of ideal and non-ideal binary solutions, excess functions and their determination, Activity coefficients, Experimental determination of activity coefficients of electrolytes and non-electrolytes,

Practical

1. Study of kinetics of $K_2S_2O_8 + KI$ reaction by spectroscopic method.
2. Determination of solubility product of $AgCl$ by potentiometric titration of $AgNO_3$ solution against standard KCl solution
3. Determination of CMC of a surfactant measuring optical density of a probe.
4. Determination of ground state acidity constant (pK) of a suitable organic molecule (e.g. Picric acid) measuring optical density.

Recommended Books:

1. G. W. Castellan, Physical Chemistry, Narosa Publishing House, Calcutta, 1995.
2. Ira N. Levine, Physical Chemistry, PHI Learning Pvt. Ltd.
3. R. A. Alberty and R. J. Silbey, Physical Chemistry, John Wiley and Sons, Inc., New York, 1995.
4. S. C. Rakshit, Molecular Symmetry Group and Chemistry, The New Book Stall, Kolkata, 1988.



Syllabus of 2-Year MSc in Chemistry

5. D. M. Bishop, Group Theory and Chemistry, Oxford University Press, Oxford, 1993.
6. A. Vincent, Molecular Symmetry and Group Theory, John Wiley & Sons, New York, 1998.
7. F. A. Cotton, Chemical Applications of Group Theory, 3rd Edn, John Wiley & Sons, New York, 1999.
8. T. Engel and P. Reid, Physical Chemistry, Pearson Education, New Delhi, 2006.
9. D. A. McQuarrie and J. D. Simon, Physical Chemistry: A Molecular Approach, Viva Books Private Limited.
10. P. C. Rakshit (Revised by S.C. Rakshit), Physical Chemistry, Sarat Book Distributors, Kolkata.
11. F. L. Pilar, Elementary Quantum Chemistry, Tata McGraw-Hill, New Delhi, 1990.
12. K. J. Laidler, Chemical Kinetics, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1988.
13. P. W. Atkins & Julio De Paula, Physical Chemistry, Eighth Edition, Oxford University Press, Oxford
14. P. W. Atkins & Julio De Paula, Elements of Physical Chemistry, Fifth Edition, Oxford University Press, Oxford
15. R.G. Mortimer, Physical Chemistry, Third Edition, Elsevier Academic Press.
16. P. Monk, Physical Chemistry Understanding our Chemical World, John Wiley & Sons Ltd.
17. K.L. Kapoor, A Text Book of Physical Chemistry (Vol. 1 – 5), Macmillan India Limited, New Delhi.
18. S. Pahari, Physical Chemistry (Vol. 1 & 2), New Central Book Agency (P) Ltd.
19. Berry, Rice & Ross, Physical Chemistry, Oxford University Press.
20. W. J. Moore, Physical Chemistry, Longman Green and Co. Ltd., 1953.
21. Pahari and Pahari, Problems on Physical Chemistry, New Central Book Agency (P) Ltd.
22. Ghoshal, Numerical Problems on Physical Chemistry, Books and Allied (P) Ltd.
23. J. C. Ghosh, Experiments in Physical Chemistry, Bharati Bhawan Publishers and Distributors, Patna, 1994
24. S. K. Maity and N. K. Ghosh, Physical Chemistry Practical, New Central Book Agency (P) Ltd.
25. A. K. Nad, B. Mahapatra & A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007.
26. S. Ghosh, M Das Sarma, D Majumdar & S Manna, Chemistry in Laboratory, Santra Publication, 2019.



Syllabus of 2-Year MSc in Chemistry

COURSE TYPE: MINOR

COURSE NAME: ADVANCED INORGANIC & ORGANIC CHEMISTRY

COURSE CODE: MSCCEMMN801

Course Type: MINOR	Course Details: MNC-2		L-T-P: 4-1-0		
Credit: 5 5 (Theory) + 0 (Practical)	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	30	-	70

On completion of this course, the students will be able to understand:

Learning objectives:

- 1. Students acquire knowledge of role of metal ions in our biological systems and mechanisms of action of drugs in our body system.*
- 2. Basic knowledge of analytical chemistry.*
- 3. Concept of extraction and purification process of compounds.*
- 4. Knowledge of different chromatography techniques.*
- 5. To make students aware of how chemical processes can be designed, developed and run in a sustainable way.*
- 6. To acquire the knowledge of the twelve principles of green chemistry and how to apply in green synthesis.*
- 7. Understanding of heterocyclic compounds and polynuclear compounds.*
- 8. Concepts of drug and pharmaceuticals.*

Syllabus:

Theory

Unit I: Basic Analytical Chemistry (8 lectures)

- General principle: Accuracy and precision in analysis, types of errors, data analysis and curve fitting (linear $Y = mX + C$ type), numerical problems, mean, mode and variant.
- Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc., column chromatography, ion-exchange chromatography, etc., determination of ion exchange capacity of anion /cation exchange resin.

Unit II: Bioinorganic Chemistry (Elementary concept) (7 lectures)

Elements of life: essential and beneficial elements, major, trace and ultratrace elements. Role of metal ions (specially Na^+ , K^+ , Mg^{2+} , Ca^{2+} , $\text{Fe}^{3+/2+}$, $\text{Cu}^{2+/+}$ and Zn^{2+}) in biological systems. toxic



metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal dependent diseases.

Unit III: Basic Principles of Green Chemistry (7 lectures)

Tools of green chemistry including the use of alternative feed stocks or starting materials, reagents, solvents, target molecules, and catalysts (homogeneous, heterogeneous and biocatalysis), green chemistry as the alternative chemistry for protection of environment.

Unit IV: Heterocycles (10 lectures)

Structures of furan, pyrrole, thiophene, Pyridine, Pyrimidine, Pyrimidine derivatives like uracil, thymine and cytosine, purine, purine derivatives like adenine, guanine & uric acid; Reactivity and basicity comparison between pyrrole and pyridine.

Unit V: Polynuclear Hydrocarbons (5 lectures)

Preparations, Properties and Reactions of naphthalene, phenanthrene and anthracene

Unit VI: Drugs and Pharmaceuticals (8 lectures)

Drug discovery, design and development; Concept on lead compounds and lead modifications; pharmacophore, Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen); antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Practical

Organic preparation:

1. Condensation: preparation of phthalimide
2. Nitration: acetanilide
3. Hydrolysis: hydrolysis of amides/Esters

Calculate percentage yield, based upon isolated yield (crude) and theoretical yield.

Recommended Books:

1. S. Warren, Organic Synthesis: The Disconnection Approach, 1st Edn, Wiley, 2012.
2. Ahluwalia, Green Chemistry Environmentally Benign Reactions, Ane Books-New Delhi, 2012.
3. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, University Science Books, Mill Valley, CA, 1993.
4. A. K. Das, Environmental with Green Chemistry, Books & Allied (P) Ltd, 2004
5. W. Kaim and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, Wiley, New York, 1994.



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6. I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine, Bioinorganic Chemistry, Viva Books Pvt. Ltd., New Delhi, 1998.
7. D. A. Skoog, D. M. West, F. J. Holler & S. R. Crouch, Fundamentals of Analytical Chemistry, Thomson, 8th Edition.
8. A. I. Vogel, A Text Book of Quantitative Inorganic Analysis, 3rd Edn, Longmans, 1961.
9. M. Kolthoff, P. J. Elving and E. B. Sandell, Treatise on Analytical Chemistry, Pt-I, II, III, The Interscience Encyclopedia, Inc., New York. 1959.
10. G. D. Christia, P. K. Dasgupta & K. A. Schug, Analytical Chemistry, Wiley, 7th Edition.
11. G. Thomas, Fundamentals of Medicinal Chemistry, 5th Edn, Oxford University Press, 2013.
12. R. B. Silverman, The Organic Chemistry of Drug Design and Drug Action, 3rd Edn, Academic Press, 2014.
13. M. P. S. Ishar and A Faruk, Syntheses of Organic Medicinal Compounds, Alpha Science, 2006.
14. D. R. Budman, A. H. Calvert and E. K. Rowinsky, Handbook of Anticancer Drug Development, Lippincott Williams & Wilkins, Philadelphia, PA, USA, 2003.
15. E. Garrett-Meyer, Principles of Anticancer Drug Development, Springer, 2010.