

**POST GRADUATE DEPARTMENT OF CHEMISTRY,
BERHAMPUR UNIVERSITY**

**M. Phil. Syllabus
2017**

Semester-I

<u>Paper No.</u>	<u>Subject</u>	<u>Marks</u>	<u>Credits</u>	<u>Time</u>
CC-1	Research Methodology	100	04	3 h
CC-2	Spectroscopic Techniques in Chemistry	100	04	3 h
CC-3	Seminar Presentations	100	04	
CE-1	Inorganic Chemistry	100	04	3 h
CE-2	Physical Chemistry	100	04	3 h
CE-3	Organic Chemistry	100	04	3 h

Semester-II

CC-4	Review of Research Progress	100	04	3 h
	Dissertation	300	12	

CC - Chemistry Core

CE – Chemistry Elective

N. B. The students of M. Phil. Chemistry have to take one of the elective papers out of three (CE-1, 2 and 3) in 1st semester.

CC-1: Research Methodology

Chapter I

Meaning and objectives of Research, Types of Research, Significance of Research, Research Methods vs methodology, Scientific method vs Arbitrary Method, Criteria of good research, Research Design: (meaning of research design, need of research design, basic principle of research design, good design, different designs).

Chapter II

Means and methods of scientific research, Organization of scientific research, Literature : Search for existing literature, Review the literature selected, Develop a theoretical and conceptual framework, writing up the review. Scientific paper: How to prepare Title, Abstract, Introduction, Results, Discussion and References.

Chapter III

Chi-square Test: Applications, Steps Involved in Applying Chi-square Test, Alternative Formula, Conversion, important characteristic and limitation. Analysis of Variance and Covariance: Principle, Technical, Setting and coding.

Chapter IV

Application of Computer in Research: Document preparation, EXCEL, Power Point Presentation. Numerical analysis. Figure Plotting: Figure insertions in documents. Use of Internet in Research, Websites, search Engines, E-journal and E-Library, INFLIBNET. Usage of packages (e.g. ORIGIN; EXCEL) for data analysis. Curve Fitting: Linear and Non-linear fitting of data.

References:

1. Computers and Their Applications to Chemistry, Ramesh Kumari (2002), Alpha Science international Ltd. UK
2. How to write and publish a scientific paper, Day RA (1992), Cambridge University press. London
3. Research Methodology: Methods and Techniques, Kothari, C.R.(2008), Second Edition. New Age International Publishers, New Delhi.
4. Research Methodology From Philosophy of Science to Research Design, Volume 3, Alexander M. Novikov and Dmitry A. Novikov, CRC Press, Taylor & Francis Group 2013.
5. Design and Analysis of Experiments by Montgomery, Douglas C.

6. Management Research Methodology; Integration of Principles, Methods and Techniques by Krishnaswamy, K.N., Sivakumar, AppaIyer and Mathiranjana M.
7. Research Methodology- A Step-By-Step Guide for Beginners by Ranjit Kumar.
8. Research Methods by Trochim, William M.K.

CC-2: Spectroscopic Techniques in Chemistry

Chapter I

Isolation and purification of organic and inorganic compounds (solids and liquids) with special emphasis on chromatographic techniques: TLC, column chromatography and HPLC. Drying and dehydrating agents.

Chapter II

Elucidation of organic and inorganic compounds by UV-Visible and infrared spectroscopy.

Chapter III

Elucidation of organic and inorganic compounds by NMR spectroscopy (^1H , ^{13}C , ^{15}N , ^{31}P -nuclei, 2-D) and mass spectrometry (HRMS, LCMS, MALDI).

Chapter IV

Elucidation of organic and inorganic compounds by Thermo Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), X-ray diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS), Electronic Paramagnetic Resonance (EPR), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Fluorescence Spectroscopy.

Books suggested:

1. A textbook of Quantitative Inorganic Analysis, A.I. Vogel, ELBS, London.
2. Dynamics of Chromatography- Part I; J.C. Gidding; Dekker, New York.
3. Vogel's textbook of Practical Organic Chemistry, B.S. Furness et al. Longman Group.
4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, Wiley, New York.
5. Spectrometric Methods in Organic Chemistry, D.H. Williams and I. Fleming, Tata McGraw Hill Education.
6. Organic Spectroscopy, William Kemp, John Wiley.
7. Applications of Spectroscopy Techniques in Organic Chemistry, P. S. Kalsi, New Age International

CE-1: Inorganic Chemistry

Chapter – I

Review of Chemical Bonding: The Schrodinger equation and its application to simple systems, Quantum mechanical concept of the chemical bonding, Resonance and hybridisation, The M. O. Method and its application to diatomic and triatomic molecules

Chapter – II

Inorganic Chains, Rings, Cages and Clusters: Catenation, Heterocatenation, Silicate minerals, Intercalation; Borazine, Phosphazenes; Boranes, Carboranes, Metallaboranes, Metallacarboranes; Carbonyl clusters, Halide type clusters.

Chapter – III

Solids: Ionic solids, Lattice energy, Ionic radii, Conductors, Insulators and Semiconductors, Defects in solids, Solid state reactions, The band and zone theories of metals, Spinel and other magnetic materials.

Chapter – IV

Organometallic Chemistry: 18-Electron rule, Metal carbonyl complexes, Nitrosyl complexes, Dinitrogen complexes, Metal alkyls, carbenes, carbynes and carbides; Nonaromatic alkene and alkyne complexes, Metallocenes, Organometallic compounds in catalysis

Books suggested:

1. Inorganic Chemistry, J. E. Huheey, E. A. Keiter, R. L. Keiter, Pearson Education.
2. Inorganic Chemistry, Missler and Tarr, Prentice Hall
3. Organometallic Chemistry: A Unified Approach (2nd edn.), R. C. Mehrotra & A. Singh, New Age International.

CE-2: Physical Chemistry

Chapter – I

(a) **Transition State Theory:** Potential energy surface, Partition function for translation, rotation and vibration, Derivation of rate equation, Comparison of collision and transition state theories, Transition coefficient, Thermodynamic treatment of reaction rate, Interpretation of entropies of activation.

(b) **Quantum Chemistry:** Wave and quantum concept: Operation concepts in quantum chemistry, Wave mechanics of simple systems with constant potential energy and variable potential energy.

Chapter – II

(a) **Reaction in Solution:** Kinetic in solution, Solvent effect, Ionization of neutral molecules, Kinetics of ionization, Reaction between ions and neutral molecules, Ionic strength and secondary salt effect, Dipolar aprotic solvents.

(b) Parallel first order reactions, Two parallel first order reactions all of the same order, Parallel first order and second order reactions, Radioactive series and radioactive steady state, General first order series and parallel reactions, Competitive consecutive reactions, Consecutive parallel second order reaction, Equilibrium from kinetic point of view.

Chapter – III

The study of rapid reactions, Diffusion controlled reactions, Methods for studying rapid reactions, Quenching of fluorescence, Polarography and diffusion – coupled methods, Magnetic resonance method, Relaxation method, Flash photolysis.

Chapter – IV

Group Theory: Application of group theory, SALC, Huckel theory for conjugated systems, Butadiene, cyclopropenyl system, Benzene, Naphthalene, Calculation of bond order and stabilisation energy, Application of group theory for construction of molecular orbitals.

Books suggested:

1. Symmetry and Spectroscopy of Molecules, K. Veera Reddy, New Age International, Delhi
2. Quantum Chemistry, 5th edition (2000), I.N. Levine, Pearson Educ. Inc., New Delhi.
3. Introductory Quantum Chemistry, 4th edition, A.K. Chandra, Tata McGraw Hill, New Delhi.
4. Introduction to Quantum Mechanics with Applications to Chemistry (1935), L. Pauling and E. B. Wilson, McGraw Hill, New York.
5. Quantum Chemistry, R. K. Prasad, Wiley.
6. Chemical Applications of Group Theory, F.A. Cotton, Wiley.
7. Chemical Kinetics, Third Edition (1987), K. J. Laidler, Harper & Row, New York.

8. Kinetics and Mechanism of Chemical Transformations (1993), J. Raja Ram and J.C. Kuriacose, MacMillan Indian Ltd., New Delhi.

CE-3: Organic Chemistry

Chapter – I

Organic Spectroscopy and Stereochemistry: Elucidation of organic compounds by UV, IR, NMR Spectroscopy and Mass Spectrometry. Application of Circular Dichroism (CD) and Optical rotatory dispersion (ORD).

Chapter – II

Retrosynthetic Analysis: Synthons and synthetic equivalents and planning good Synthesis of Organic Compounds.

Chapter – III

Reagents in Organic Synthesis: Woodward reagent, Dithianes, Lithium diisopropylamide (LDA), Prevost reagent, Diazomethane, 1,3-Dicyclohexylcarbodiimide (DCC), Crown ether complex, Polymer supported reagents, DDQ, PCC, AIBN.

Chapter – IV

a) **Synthesis of Some Important Natural Products:** Paracetamol, Propanolol, AZT, Elgerin, Imatiniv, Chopidogrel.

Books suggested:

1. Organic chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford University Press.
2. Advanced Organic Chemistry: Reactions, Mechanism and Structure (McGraw-Hill), J. March. John Wiley and Sons.
3. Stereochemistry of Organic Compounds, Ernest L. Eliel, Samuel H. Wilen, Wiley.
4. Organic Synthesis, The Disconnection Approach, S. Warren, Wiley.
5. Organic Chemistry, Volume 2: Stereochemistry and the Chemistry Natural Products, I. L. Finar, Pearson Education India.