BERHAMPUR UNIVERSITY

Syllabus

(M. Phil. & Pre-Ph. D.)

P. G. Department of Chemistry

Berhampur University

Berhampur-760007(Odisha)

2020-21

M. Phil. &Pre-Ph. D. Syllabus.
(Effective from 2020-21)

Semester-I: (Total No. of Core papers: 03, Elective papers: 01)

Course Number	Course Name	Credit	Exam Hr	Marks	Total
CHEM MPC1	Research Methodology	4	1 (mid sem) 3 (End sem)	20 (mid sem) 80 (End sem)	100
CHEM MPC2	Spectroscopic Techniques in Chemistry	4	1 (mid sem) 3 (End sem)	20 (mid sem) 80 (End sem)	100
CHEM MPC3	Presentation of a review report (based on 05 important published research articles of reputed journals)	2		50	100
	Publication and Research Ethics	2		50	
CHEM MPE1	Inorganic Chemistry	4	1 (mid sem) 3 (End sem)	20 (mid sem) 80 (End sem)	100
CHEM MPE2	Physical Chemistry				
CHEM MPE3	Organic Chemistry				

Semester-II: (Total No. of Core papers: 02, Elective papers: Nil)

Course Number	Course Name	Credit	Exam Hr	Marks	Total
CHEM MPC4	Review of Research Progress	4		100	100
CHEM MPD1	Dissertation	12		300	300

Code: CHEM: Chemistry, C: Core, E: Elective, D: Dissertation

NB: Pre-Ph. D. students have to register for 16 credits

M. Phil. students have to register for 32 credits

Both M. Phil & Pre-PhD students have to take one elective papers out of three (CHEM MPE1, CHEM MPE2 & CHEM MPE3) in 1st semester.

SEMESTER-I

Course No. CHEM MPC1 **Course Name: Research Methodology**

Semester: I Credits: 4 (core)

Course Coordinator: Dr. B. K. Garnaik, Phone: 9777107130, Email: bama_61@rediffmail.com
Dr. S. N. Sahoo, Phone: 9437480321, Email: sns.chem@buodisha.edu.in
Dr. G. Phaomei, Phone: 9861235845, Email: gp.chem@buodisha.edu.in
Dr. L. D. Rout, Phone: 8658959639, Email: ldr.chem@buodisha.edu.in
Dr. B. B. Parida, Phone: 7752057108, Email: bbp.chem@buodisha.edu.in

Objectives and learning outcome:

This course focuses on the basics of science and ethics, research integrity and publication ethics. Indexing and citation databases, research metrics.

Ability to systematically solve research problems learns how to plan research work. Learning method, scientific tools, search engines and techniques relevant to solve research problem.

Unit-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). **(12 Hrs)**

Unit-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. **(12 Hrs)**

Unit-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. **(12 Hrs)**

Unit-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.

(12 Hrs)

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 Mathiranjan M.
7. Research Methodology- A Step-By-Step Guide for Beginners by Ranjit Kumar.
8. Research Methods by Trochim, William M.K.

Course No. CHEM MPC2 Course Name: **Spectroscopic Techniques in Chemistry**

Semester: I Credits: 4 (core)
Pre-requisites: Basic understanding of M. Sc. level Spectroscopy, analytical chemistry etc.

Course Coordinator: Dr. L. D. Rout, Phone : 8658959639, Email: ldr.chem@buodisha.edu.in
Dr. B. B. Parida, Phone : 7752057108, Email: bbp.chem@buodisha.edu.in

Objective and learning outcome: The students/scholars will be able to solve structural identification of organic/inorganic compounds through various spectroscopic and other techniques (UV-Visible, IR, NMR, Mass, EPR, XRD, XPS, DTA, TGA, electron microscopy etc).

Unit-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. **(12 Hrs)**

Unit-II

Structural identification and Elucidation of organic and inorganic compounds by UV-Visible and infrared spectroscopy. **(12 Hrs)**

Unit-III

Elucidation of organic and inorganic compounds by NMR spectroscopy (^{1}H, ^{13}C, ^{15}N, ^{31}P-nuclei, 2-D) and mass spectrometry (HRMS, LCMS, MALDI). **(12 Hrs)**

Unit-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.

(12 Hrs)

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. Furhen ey. 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.

Course No. CHEM MPC3 Course Name: **Seminar Presentation**

Semester: I Credits: 4 (core)
Pre-requisites: As per concerned supervisor

Course Coordinator: Head and concerned faculty members of the department.

Objectives:

To learn literature survey, writing project report.
To improve communication skill delivering presentation in audience.

Course No. CHEM MPE1 Course Name: Inorganic Chemistry

Semester: I Credits: 4 (Elective)
Pre-requisites: Basic understanding of M. Sc. level Inorganic, Organometallic chemistry

Course Coordinator: Dr. S. N. Sahoo, Phone : 9437480321, Email: sns.chem@buodisha.edu.in

Objective and learning outcome: The students/scholars will learn solving research problems in various aspects of chemical bonding, cage & cluster compounds, solid state crystal lattice, semiconductors and organometallics applications in their research.

Unit- 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.

(12 Hrs)

Unit-II

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

(12 Hrs)

Unit-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, Spinels and other magnetic materials.

(12 Hrs)

Unit-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.

(12 Hrs)

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 Ed.), R. C. Mehrotra & A. Singh, New Age International.

Course No. CHEM MPE2 Course Name: **Physical Chemistry**

Semester: I Credits: 4 (Elective)
Pre-requisites: Basic understanding of M. Sc. level Physical chemistry.

Course Coordinator: Dr. G. Phaomei, Phone : 9861235845, Email: gp.chem@buodisha.edu.in

Unit-I:

(a) **Transition State Theory:** Potential energy surface, Partition function for translation, rotation and vibration, Derivation of rate equation, Comparision 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.

(12 Hrs)

Unit-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.

(12 Hrs)

Unit-III:

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

(12 Hrs)

Unit-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.

(12 Hrs)

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.

Course No. CHEM MPE3 Course Name: **Organic Chemistry**

Semester: I Credits: 4 (Elective)
Pre-requisites: Basic understanding of M. Sc. level advance Organic Chemistry.

Course Coordinator: Dr. L. D. Rout, Phone : 8658959639, Email: ldr.chem@buodisha.edu.in
Dr. B. B. Parida, Phone : 7752057108, Email: bbp.chem@buodisha.edu.in

Objective and learning outcome: The students/scholars will learn various techniques, methods of solving research problems using spectroscopy, retrosynthesis, synthetic application of very useful organic reagents organic synthesis. Several natural products of medicinal importance are included for a glimpse how natural products play very important role as medicinal-drug candidates.

Unit-I:

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

(12 Hrs)

Unit-II:

Retrosynthetic Analysis: Synthons and synthetic equivalents and planning good Synthesis of Organic Compounds and their application in retrosynthesis of various compounds.

(12 Hrs)

Unit-III:

Reagents in Organic Synthesis: Woodward reagent, Prevost reagent, 1,3-Dithianes, Lithium diisopropylamide (LDA), Diazomethane, Dicyclohexylcarbodiimide (DCC), Crown ether complex, Polymer supported reagents, DDQ, n-Bu_3SnH-AIBN, Corey-Fuch, Ohira-Bestmann, Simon-Smith (CH_2I_2-Zn/Cu), Kulin-Kuvich clopropanation, Peterson Olefination, Petasis reagent (Petasis olefination), Horner Wittig, Grubbs catalyst, CBS catalyst, Yamaguchhi esterification.

(14 Hrs)

Unit-IV:

a) **Synthesis of Some Important Natural Products:**

Introduction to natural products, their importance in biological applications. synthesis and biological activities of Paracetamol, Aspirin, Propanolol, AZT, Elgerin, Imatiniv, Chopidogrel, Remdesvir, Favipiravir.

(10 Hrs)

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.
6. Name reactions and Reagents in Organic Synthesis 2nd Ed, Bradford P Munday, Michael G. Ellerd and Frank G. Favaloro, Jr. Wiley Interscience.

SEMESTER -II

Course Objectives: This paper is designed to give the students/scholars an exposure to the methodology in preparation of their dissertation.
Learning Outcomes: Students/scholars after completion of the course will be acquainted with presentation and discussion of scientific thoughts and work along with development of understandings and skills.

Course Number	Course Name	Credit
CHEM MPC4	Review of Research Progress	4
CHEM MPD1	Dissertation	12

Specializations: As per the concerned supervisor.

CHEM MPC4: The students/scholars have to present the review of research progress in the department.

CHEM MPD1: Consists of dissertation work, presentation and viva-voce.