

**COURSES OF STUDY**  
**FOR**  
**THE M. Phil EXAMINATION IN CHEMISTRY**  
**UNDER SEMESTER SYSTEM**  
(Effective From 01-01-2018)



**P.G. DEPARTMENT OF CHEMISTRY**  
**GANGADHAR MEHER UNIVERSITY, SAMBALPUR**  
**ODISHA**

**P.G. Department of Chemistry, G.M. University**  
**M. Phil Syllabus**

The M. Phil Course in Chemistry spans a period of one academic year beginning from 1<sup>st</sup> January to 31<sup>st</sup> December comprising of two semesters with the following course structure. In Semester-I, each theory paper (CH611, CH612 and CH613) carries 100 marks out of which 20 marks are for internal assessment examination except for the paper CH614 i.e. the Teaching Assignment, which does not have internal examination. There will be one internal assessment examinations for each theory paper. There will be no internal examination in Semester-II. The duration of an examination for each theory is 3 hours. The pattern of teaching and examination in M. Phil classes is displayed in the Table given below for 2018 batch.

Semester	Paper Code	Nomenclature	Maximum Marks	Credit
Semester - I	CH-611	Recent Trends in Chemistry	100 (80 + 20)	04
	CH-612	Research Methodology - I	100 (80 + 20)	04
	CH-613	Research Methodology - II	100 (80 + 20)	04
	CH-614	Teaching Assignment	100	04
	<b>Total in Semester - I</b>			<b>400</b>
Semester - II	CH-621	Dissertation	200 (Written - 150 Presentation - 25 Viva Voce - 25)	8
<b>Complete Course</b>			<b>600</b>	<b>24</b>

**SEMESTER - I****Recent Trends in Chemistry****CH-611****Full Marks: 100 (4 Cr)****Unit: I Nanomaterials-I****(1Cr: 10-12 lectures)**

Definition, Types of nanostructures, Properties and Applications:

One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties, application as ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application, nanocatalysis, basic principle.

Synthesis and preparation of Nanomaterials and Synthetic Techniques:

Synthesis of bulk nanostructured materials - Sol Gel processing- bulk and nano composite materials - Grinding - high energy ball milling – injection moulding - extrusion - melt quenching and annealing, Self assembly-Self Assembled Monolayers (SAM) - Vapour Liquid Solid (VLS) approach - Chemical Vapour Deposition (CVD) - Langmuir-Blodgett (LB) films - Spin coating - Templated self assembly Electrochemical approaches: Thin films -Epitaxy -Lithography.

**Unit: II Nanomaterials-II****(1Cr: 10-12 lectures)**

Carbon nanostructures:

Synthesis, separation and characterization of Fullerene and its derivatives, applications, toxicity. Carbon nanotube (CNT), structure, synthesis and functionalization of CNT, electronic, vibrational, mechanical and optical properties of CNT, applications. Graphene, structure, synthesis and functionalization of Graphene, Graphene composites, electronic applications of Graphene, Graphene Oxide. The environmental effects of carbon based nanomaterials.

Nanosensors:

Introduction to sensors. Characteristics and terminology - static and dynamic characteristics. Micro and nano-sensors, Fundamentals of sensors, micro fluids, Packaging and characterization of sensors, Sensors for aerospace and defense, Organic and inorganic nanosensors, Biosensors: Magnetic Nanoparticles for Imaging and Therapy, Clinical diagnostics, generation of biosensors, Nanomaterial based biosensors, Biosensors based on nucleotides and DNA, Electron transfer of biomolecules, Photodetectors, Nanophotonics, Nanoelectronic Devices, Biosensors,

**Unit:III Supramolecular Chemistry****(1Cr: 10-12 lectures)**

Concepts of Supramolecular Chemistry: Definition, Nature of supramolecular interactions, Host-guest interaction, Molecular recognition, Types of recognition.

Cation-binding Hosts: Concepts, Cation receptors, Synthesis and structure of crown ethers, lariat ethers, podands, cryptands, spherands, calixarenes, Selectivity of cation complexation, Macrocyclic and template effects.

Anion-binding Hosts: Concepts, Anion host design, Anion receptors, Shape and selectivity, Cation hosts to anion hosts, pH effect.

Neutral receptors: Clathrates, cavitands, cyclodextrins, cyclophanes.

Self-assembly molecules: Design, synthesis and properties of the molecules, Self

assembling by H-bonding, Metal-ligand interactions and other weak interactions, metallomacrocycles, catenanes, rotaxanes, helicates and knots.

Applications of Supramolecular Chemistry: Rational Design, molecular electronic devices, molecular wires, molecular rectifiers, molecular switches, molecular logic. cyclodextrins as enzyme mimics, ion channel mimics, supramolecular reactivity and catalysis.

**Unit: IV Homogeneous Catalysis (1Cr: 10-12 lectures)**

Catalysis: Terminology in catalysis, TO(Turnover),TON( Turnover number), TOF(Turnover frequency), Sequences involved in a catalysed reaction, Other terms used in catalysis, enantioselectivity, stereoselectivity, chemoselectivity, regioselectivity, Asymmetric synthesis using a catalyst.

Hydroformylation: Importance, Cobalt catalyst for hydroformylation, Phosphine modified cobalt catalysis, Rhodium-Phosphine catalyst, Factors affecting n/iso ratio of hydroformylation product, Enantioselective hydroformylation.

Methanol Carbonylation and Olefin Oxidation: Monsanto process of conversion of methanol to acetic acid, Celanese process using LiI modified Rhodium catalyst, Tennessee Eastman acetic anhydride process using Rhodium catalyst, British Petroleum's Cativa Process using Iridium catalyst, The Wacker Process of oxidation of ethylene using Palladium catalyst.

Ube's oxalate process using Palladium catalyst, Carbamate synthesis using catalysts of Platinum group metals, Propionic acid synthesis using Ruthenium catalyst

**References:**

1. Chemistry of nanomaterials : Synthesis, properties and applications - CNR Rao et.al.
2. Nanoparticles: From theory to applications, Wiley Weinheim , 2004 - G. Schmidt,.
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830-831, Cambridge University Press.
4. Processing & properties of structural nanomaterials - Leon L. Shaw
5. Environmental Chemistry for a Sustainable World, Volume 1: Nanotechnology and Health Risk Editors: Lichtfouse, Schwarzbauer, Robert
6. Advances in Nanotechnology and the Environment, CRC Press, Taylor and Francis Group - Juyoung Kim
7. Chemical Sensors and Biosensors, Wiley; New York, Chichester, 2002 - Brian R Eggins.
8. Biosensors: A Practical Approach, Oxford University Press, 2004 - J. Cooper & C. Tass,
9. Nanomaterials for Biosensors, Wiley - VCH, 2007 - Cs. Kumar
10. The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH Verlag GmbH&Co, Weinheim, 2004 - C.N.R.Rao, A.Muller, A.K.Cheetham (Eds)
11. Nanostructures and Nanomaterials: Synthesis, properties and applications, Imperial College Press, 2004 - G.Cao
12. Handbook of nanoscience, Engg. and Technology, CRC Press, 2002 - W. Gaddand, D. Brenner, S. Lysherski and G. J. Infrate (Eds)
13. Physical properties of Carbon Nanotube-R Satio
14. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell
15. Nanotubes and Nanowires, RCS Publishing - CNR Rao and A Govindaraj
16. Nanoscale materials -Liz Marzan and Kamat
17. Carbon Nanomaterials for Environmental and Biological Applications, Bergmann and Machado. Springer.

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19. Supramolecular Chemistry- Concepts and Perspectives, Wiley-VCH, 1995 - J. M. Lehn
20. Supramolecular Chemistry, Oxford University Press, 1999 - P. D. Beer, P. A. Gale, D. K. Smith
21. Molecular Self-assembly, Organic Versus Inorganic Approaches, Springer, 2000 - M. Fujita
22. Core Concepts in Supramolecular Chemistry and Nanochemistry, John Wiley & Sons, 2007 - Jonathan W. Steed, David R. Turner, Karl J. Wallace,
23. Basic Organometallic Chemistry, Concept, Synthesis and Applications, Universities Press- B. D. Gupta and A. J. Elias
24. Applied Homogeneous Catalysis, Wiley VCH, Weinheim, 2002- B. Cornils, W. A. Hermann
25. Homogeneous Catalysis, John Wiley, 2002 – S. Bhaduri and D. Mukesh
26. Recent Achievements, Trends and Prospects in Homogeneous Catalysis, F. J. Waller, Journal of Molecular Catalysis, 31 (1985) 123 - 136

## Research Methodology-I

**CH-612**

**Full Marks: 100 (4 Cr)**

**Unit: I Scope of Research and Ethics**

**(1 Cr: 8-10 lectures)**

Introduction and Scope, Research problem: Identification, Selection, Formulation of research objectives

Research design: Components, Types and Importance

Research ethics, Institutional ethics committee

Plagiarism - Pitfall

**Unit: II Technical Writing**

**(1 Cr: 8-10 lectures)**

Types of technical documents: Full length research paper, Short/Brief communications, Letters to editor, Book chapter, Review, Conference report, Project proposal

Components of a full length research paper: Title/Topic statement, Abstract/key words, Aims and objectives, Hypothesis building, Rationale of the paper, Work plan, Materials and methodology, Results and discussion, Key issues and arguments, Acknowledgement, Conflict of interest statement, bibliography, Technical Resumes & Cover Letters

Components of a research proposal: Project summary, Key words, Origin of the proposal, Major Objectives, Methodology, Instrument facility available in the PI's department, Overview of status of Research and Development in the subject, Importance of the proposed project in the context of current status, Bibliography

**Unit: III Scientometrics**

**(1 Cr: 10-12 lectures)**

How to cite and how to do referencing

Literature search technique: using SCOPUS, Google Scholar, PUBMED, Web of Science, Indian Citation Index, and RG

Styles of referencing: APA, MLA, Oxford, Harvard, Chicago

Annotated bibliography

Tools for citing and referencing: Grammarly, Endnote etc

**Unit: IV Presentation and Communication skills**

**(1 Cr: 10-12 lectures)**

Tables, Figures and Pictures using Excel

PowerPoint slide preparation

Preparation of Posters

Electronic submission of manuscripts

Communication skills, oral and poster

## Research Methodology-II

**CH-613**

**Full Marks: 100 (4 Cr)**

**Unit: I IPR and Cyber Law**

**(1 Cr: 8-10 lectures)**

Patents  
 Patent laws, process of patenting a research finding  
 Intellectual property (IP), Intellectual property right (IPR)  
 Copyright, Trademarks, GI  
 Cyber laws  
 COPE

**Unit: II Quantitative Data Analyses**

**(1 Cr: 10-12 lectures)**

Types of data, Data collection - Methods and Tools  
 Hypothesis testing  
 Normal and Binomial distributions and their property  
 Tests of significance: Student *t*-test, *F*-test, *Chi-square* test  
 Correlation and Regression  
 ANOVA – One-way and Two-way, Multiple-range test

**Unit: III Computer Fundamentals**

**(1 Cr: 10-12 lectures)**

Introduction to MS-Office software: MS-Word (Track change)  
 MS-Excel  
 MS-Power Point  
 MS-Access

Features for Statistical data analysis using computers and software, Microsoft Excel Data Analysis ToolPak, SPSS

**Unit: IV Advanced Tools & Techniques in Chemistry**

**(1 Cr: 8-10 lectures)**

Principle of measurement of Magnetic susceptibility using Gouy Balance  
 Kjeldal's method of estimation of Nitrogen in a sample  
 UV-Visible Spectrophotometry  
 IR Spectrophotometry  
 NMR Spectroscopy  
 Mass Spectrophotometry  
 ESR spectroscopy  
 Polarography

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3. Inside Microsoft Office Professional - Cassel P *et al.*
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5. Microsoft 2007: Introductory Concepts and Techniques - Shelly GB, Vermaat ME, Cashman TJ
6. Statistical Methods - Snedecor GW & Cochran WG
7. Computers: Concepts & Uses - Sumner M
8. How Computers Work - White R
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10. Cyber Law - Kumar Anupa P

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13. Biostatistical Analysis - Zar JH
14. Research Methodology - R Panneerselvam
15. Research Methodology: Methods & techniques, 2008 - CR Kothari
16. Analytical chemistry - AI Vogel
17. Instrumental methods of analysis - BK Sharma
18. Instrumentation - Chatwal and Chatwal
19. Instrumentation - Upadhyaya and Upadhyaya

**CH-614** **Teaching Assignment** **Full Marks: 100 (4 Cr)**

**SEMESTER-II**

**Dissertation**

**CH-621** **Full Marks: 200 (8 Cr)**

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