

SYLLABUS
FOR
Ph. D COURSE WORK IN CHEMISTRY
UNDER SEMESTER SYSTEM
(Effective From 01-01-2018)



P.G. DEPARTMENT OF CHEMISTRY
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P.G. Department of Chemistry, G.M. University
Syllabus for Ph. D Course work

The Ph.D Course work in Chemistry spans a period of six months beginning from 1st January to 31st July comprising of one semester with the following course structure. Each theory paper i.e CH 711, CH712 and Ch713 carries 100 marks out of which 20 marks are for internal assessment examination. There will be one internal assessment examinations for each theory paper. The duration of an examination for each theory examination is 3 hours. The paper CH714 carries 200 marks which does not have internal examination. The pattern of teaching and examination involved in PhD course work is displayed in the Table given below for 2018 batch.

| Semester | Paper Code | Nomenclature | Maximum Marks | Credit |
|------------------------|------------|----------------------------|-----------------------------------------------------------|-----------|
| Semester - I | CH-711 | Recent Trends in Chemistry | 100 (80 + 20) | 04 |
| | CH-712 | Research Methodology - I | 100 (80 + 20) | 04 |
| | CH-713 | Research Methodology - II | 100 (80 + 20) | 04 |
| | CH-714 | Review Work | 200 (Written150, Presentation-25, Viva Voce- 25) | 08 |
| Complete Course | | | 500 | 20 |

SEMESTER - I**Recent Trends in Chemistry****CH-711****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 naomaterials - 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. Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical 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.
18. Supramolecular Chemistry, Wiley, 2000- J. W. Steed and J. L. Atwood

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-712****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-713

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
 Kjehldal's method of estimation of Nitrogen in a sample
 UV-Visible Spectrophotometry
 IR Spectrophotometry
 NMR Spectroscopy
 Mass Spectrophotometry
 ESR spectroscopy
 Polarography

References:

1. Mastering Internets - Coleman P and Dyson P
2. How the Internet Works - Gralla P
3. Inside Microsoft Office Professional - Cassel P *et al.*
4. Microsoft Office 2003 All in One, Microsoft Office 2010 In Depth - Habraken J
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
9. Cyber Law Simplified - Sood V
10. Cyber Law - Kumar Anupa P

11. Plagiarism: Why it happens, How to prevent it? - Gilmore B
12. Perspectives on Plagiarism and Intellectual Property in a Post-Modern World- Buranen L and Roy AM
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-714

Review Work

Full Marks: 200 (8 Cr)
