DEPARTMENT OF CHEMISTRY
RABINDRANATH TAGORE UNIVERSITY

Syllabus for Ph.D. Course Work

Session: 2023 – 2024

Students enrolled into the Ph.D. programme in the Department of Chemistry, RTU must complete a mandatory course of one semester (six months). The syllabus to be followed is designed by the DRC, Department of Chemistry, RTU. The students have to pass an examination at the end of the course to be eligible for provisional registration.

Rabindranath Tagore University
Department of Chemistry

PhD Course Work

COURSE – III

Course Title: **Analytical Methods in Chemistry**

[4 Credit, 40 marks (Internal Assessment) + 60 marks (End Semester Examination)]

Course objective: To implant knowledge of theory, instrumentation and application of different analytical techniques.

Total Course Hour: 45 hrs Duration of Examination: 3 hrs

Unit I. PRINCIPLE AND APPLICATION OF SPECTROSCOPY (15 hrs, 20 marks)

Principles, experimentation and illustration of the scope of following spectroscopic methods in chemistry research: UV-Vis , FTIR, Raman, NMR, ESR, NQR, XPS, Mossbauer and Mass spectral techniques. Applications of various spectroscopic methods in the characterizations of organic and inorganic compounds.

Unit II. CHARACTERIZATION OF MATERIALS (25 hrs, 30 marks)

Basic principles, experimentation and applications of: thermal methods (TG/DTA), X-ray diffraction (XRD) techniques, X-ray fluorescence (XRF), chromatographic methods, electrochemical methods, atomic absorption spectrophotometry (AAS), inductively coupled plasma -atomic emission spectrometry (ICP-AES), -optical emission spectrometry (ICP-OES), -mass spectrophotometry (ICP-MS); Microscopic methods: scanning electron microscopy (SEM), transmission electron microscopy (TEM), energy dispersive X-ray analysis (EDXA), atomic force microscopy (AFM).

Unit III. RISKS AND HAZARDS OF CHEMICALS AND PROCEDURE (5 hrs, 10 marks)

Hazards of handling ordinary, corrosive and poisonous chemicals, fire hazards, handling carcinogens, toxicology of some inorganic elements, inorganic and organic compounds.

LEARNING OUTCOME:

After successfully completing the course, students will have a theoretical understanding of the selection of numerous analytical procedures used for sample characterization, both qualitatively and quantitatively.

REFERENCES:

1. R.S. Drago, Physical Methods in Chemistry, Saunders College Publishers, (1977).
2. D.C. Harris, M.D. Bertolucci, Symmetry and Spectroscopy: An Introduction to Vibrational and Electronic Spectroscopy, Dover Publications Inc., New York, (1989).
3. W. Kemp, Organic Spectroscopy, 3rd edition, McMillan Press Ltd., (1991).
4. R.V. Parish, NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, Ellis Horwood, New York, (1990).
5. K.V. Raman, Group Theory and Its Applications to Chemistry, Tata McGraw-Hill Publishing Company Ltd., (New Delhi).
6. D. Williams, I. Fleming, Spectroscopic Methods in Organic Chemistry, McGraw Hill, (1989).
7. J. Mendham, R.C. Danney, J.D. Barnes, M. Thomas. Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education, (2000).
8. S.M. Khopker, Basic Concepts of Analytical Chemistry, 3rd edition, New Age Science, (2008).
9. J.M. Mermet, M. Otto, R. Kellner, Analytical Chemistry, Wiley-VCH, (2004).
10. D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, 8th edition, Saunders College Publishing, (2007).
11. J.H. Kennedy, Analytical Chemistry: Principles, Saunders College Publishing, (1990).
12. J.G. Dick, Analytical Chemistry, R.E. Krieger Publishing, (1978).
13. C.L. Wilson, D.W. Wilson, Comprehensive Analytical Chemistry, Elsevier, (1982).
14. G.D. Christian, J.E. O'Reilly, Instrumental Analysis, Allyn & Bacon, (1986).
15. T. Pradeep, Nano: The Essentials, Tata McGraw Hill, (2007).
16. K.W. Kolasinski, Surface Science: Foundations of Catalysis and Nanoscience, 2nd edition, Wiley, (2009).

E-resources:

1. www.sciencedirect.com
2. www.rsc.com
3. www.springer.com
4. www.pubs.acs.com
5. www.wiley.com

COURSE – IV

Course Title: Recent Advances in Chemistry

[4 Credit, 70 marks (Seminar/Assignment) + 30 marks (Viva Voce)]

Duration of Course: 45 hrs

Course objective:

The objective of the course is to give research scholars a theoretical foundation in some of the key areas of chemistry research, including green chemistry, nano chemistry, material chemistry, phytochemistry, medicinal chemistry, soil and water chemistry, and more importantly, how to safeguard their research findings from piracy.

Unit-I: GREEN CHEMISTRY

Basic Principles of Green Chemistry. Designing a Green Synthesis: Choice of starting materials, choice of reagents, choice of catalysts, choice of solvents. Green reagents, green catalysts, Phase transfer catalysis for greens synthesis. Organic synthesis in solid phase. Versatile ionic liquids as green solvents. Some examples of synthesis involving basis principles of green chemistry of industrial importance.

Unit-II: NANOCHEMISTRY

Introduction, classification of nanoparticles, synthesis, characterization, properties and application of nanomaterials.

Unit-III: ADVANCED MATERIALS CHEMISTRY

Structure of solids, symmetry concepts, crystal structure. Preparative methods and characterization of inorganic solids. Crystal defects, Interpretation of phase diagrams, phase transitions. Basics of magnetic, thermal, electrical, optical and mechanical properties of solids.

Unit-4: PHYTOCHEMISTRY

Primary and Secondary Metabolites, use of natural products in traditional medicine, isolation and characterization of different classes of phytoconstituents (alkaloids, steroids, saponins, tannins, flavonoids etc.), use of phytochemicals in the synthesis of nanoparticles and carbon quantum dots.

Unit-V: MEDECINAL CHEMISTRY

New drug development strategies (definition and basic principles), Combinational chemistry, QSAR/SAR, drug bio-screening and evaluation (preclinical and clinical), application of nanotechnology in pharmaceutical chemistry.

Unit-VI: SOIL AND WATER CHEMISTRY

Modern concept of soil; Chemical (elemental) composition of the earth's crust and soils. Soil as a disperse system. Concept and importance of soil solution; chemistry of soil water; dynamic nature of soil; soil and plant nutrition, Soil chemical analysis.

Chemical composition of natural water, hydrological and biogeochemical cycles, role of dissolved gases and solids. Introduction to alkalinity, hardness and dissolved organic matter. DO, BOD, COD and TOC. Water pollution and its types.

Unit-VII: **INTELECTUAL PROPERTY RIGHTS**

Historical Perspective, Different Types of Intellectual Properties, Importance of protecting Intellectual Property. Patents and its requirements, art of patent writing and filing.

LEARNING OUTCOME:

After completing the course, research scholars will have a fundamental understanding of aqueous, green, soil, and pharmaceutical chemistry, as well as nano and material chemistry. They can choose the appropriate research question with the aid of this fundamental concept and a literature review. Understanding IPR would undoubtedly aid them in preventing IP infringement on the results of their research.

REFERENCES:

1.S. E. Mahan, *Environmental Chemistry*, 9th Edition, CRC Press.
2. P. T. Anastas & J. C. Warner, *Green Chemistry – Theory and Practice*, Oxford University Press.
2. C. N. R. Rao, *Nanoworld-An Introduction to nanoscience and technology*, Navakarnataka Publications, Pvt. Ltd.
3. K. J. Klabunde & G. B. Sergeev, *Nanochemistry*, Elsevier.
4. C. Egbuna, J. C. Ifemege, S. C. Udedi, S. Kumar, *Phytochemistry - Fundamentals, Modern Techniques and Applications*, CRC Press.
5. J. Bruneton, *Pharmacognosy – Phytochemistry Medicinal Plants*, Lavoisier Publishing.
6. G. L. Patrick, *An Introduction to Medicinal Chemistry*, Oxford University Press.
7. A. Kar, *Medicinal Chemistry*, New Age International Publishers.
8. N. Pandey and K. Dharni, *Intellectual Property Rights*, PHI Learning Pvt. Ltd.