RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Chemistry

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit – I

Nanomaterials-I

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.

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

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, 3 Syllabus for PhD Course Work in Chemistry, G. M. University, 2018-19 metallomacrocycles, catenates, rotaxanes, helicities 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

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, chemo selectivity, 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

Text Books: -

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 naonmaterials - 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,