Centre for Applied Chemistry
Central University of Jharkhand

SYLLABUS OF COURSE WORK

for

DOCTOR OF PHILOSOPHY (PhD)

GENERAL

- Total duration of Course Work : One Semester (6 Months)
- Total Credits 16
- Examination for each unit will be held at the end of the semester

Compulsory Units:

- Research Methodology & Review of Literature: 8 credits
- (a) Research Methodology: 4 credits
- (b) Review of literature: 4 credits

- Characterization of materials: 4 credits

Elective Units:

- One subject course work to be chosen: 4 credits

SYLLABUS OF COURSE WORK

Course	Subject	Credits
Compulsory Unit I	A. Research Methodology	4
	B. Review of Literature	4
Compulsory Unit II	Instrumental techniques for characterization of materials	4
Elective Units	**E1.**Polymer chemistry with special emphasis on block copolymer and conjugated polymer **E2.**Nanochemistry of metal and semi conducing nanocrystals **E3.**Nanochemistry of carbon based nanostructured materials **E4.**Introduction to Materials Chemistry and Catalysis **E5.**Advanced Organic Synthesis **E6**.Fundamentals of magnetic and optical properties of materials **E7.**Modern bio-inorganic chemistry and supramolecular chemistry **E8**.Water pollution and its remediation	4

DESCRIPTION OF COURSES

COMPULSORY UNIT I

A. Research Methodology:

Definition of the research problem; identification of clear objectives; approach to be adopted for solution of the problem ; techniques to be used; method of data collection; statistical analysis of data; error analysis**;** basics of a measurement and its interpretation, mean, median, standard deviation, variance, correlation coefficient; T-test, F-test, usage of packages (e.g. ORIGIN; EXCEL) for data analysis; Curve Fitting*:* Linear and Non-linear fitting of data; basics of computer operations; using windows – directory structures – command structure (document preparation, EXCEL, Power Point Presentation); word Processing; web browsing for research; usage of webs as a tool for scientific literature survey.

B. Review of published literature

Comprehensive and critical review of the published literature in the proposed field of study. The candidate will be evaluated on the basis of a comprehensive report to be submitted and a seminar to be delivered at the end of the semester.

COMPULSORY UNIT II

Instrumental Techniques for the Characterization of Materials

Application of spectroscopic (FTIR, FT-NMR, ESR, UV-Visible, luminescence, Mass), thermal (TGA, DTA, DSC, DMA), ENDOR, CD and ORD techniques to research problems; X-ray diffraction studies including single crystal X-ray structure determination, use of softwares such as SHELX, PLATON, ORTEP, Mercury, Diamond etc.; Polarography; Chronopotentiometry; Chronoamperometry, Chronocoulometry, Linear Potential Sweep Voltametry; Cyclic Voltammetry (CV), half wave potential, differential pulse polarography (DPP);Surface analytical techniques such as XPS, AES, SIMS, EELS, SEM, TEM, STM and AFM

ELECTIVE UNITS

E1. Polymer chemistry with special emphasis on block copolymer and conjugated polymers:

Definition, molecular weights of polymer and their determination, thermodynamics of polymer solution, block copolymer: synthesis, phase separation, application, and conjugated polymer: synthesis and applications

E2. Nanochemistry of metal and semi conducing nanocrystals

Chemical synthesis of metal and semiconducting nanocrystals, study of their size dependent physical properties, characterization of these nanocrystals using different experimental techniques, applications of these nanocrystals

E3. Nanochemistry of carbon based nanostructured materials:

Synthesis of carbon based nanostrucrures (carbon nanotube, graphene, carbon dot), physical properties, characterization and applications

E4. Introduction to Materials Chemistry and Catalysis

Synthesis of materials particularly nanomaterials: characterization of materials including surface analytical techniques; introduction to the basic principles of heterogeneous catalysis; applications of catalysis particularly in the energy sector.

E5. Advanced Organic Synthesis

Application of photochemistry (di-pi methane and oxa di-pi methane rearrangement) and radical chemistry (Barton deoxygenation, Hoffman-loeffler-wittig etc.) in Organic Synthesis; Pericyclic Reactions; electrocyclic reactions (with special emphasis on stereoselectivity, torquoselectivity); cycloaddition reactions (selection rules, periselectivity), sigmatropic rearrangements, Total synthesis with retro synthetic analysis.

E6: Fundamentals of Magnetic and Optical properties of materials

Types of materials, magnetic properties, para, dia, ferro and antiferromagnetism, temperature dependence of magnetic susceptibility;Solid state magnetism and its experimental determinations, Faraday techniques, Gouy balance method, RT and low temperature measurement, vibrating sample magnetism (VSM), hysteresis, hysteresis loop, residual magnetism, Superconducting quantum interference device (SQUID), induced ferromagnetism solution magnetism, Evans techniques, analysis of spectrum, High spin-low spin equilibrium, application in human body;.Optical properties of materials- Fluorescence, fluorescence quenching, light emitting diodes (LED) and its applications.

E7: Modern Bio-Inorganic Chemistry and Supra-molecular chemistry

Heme containing metalloproteins like haemoglobin, myoglobin, cytochromes, non-heme metalloproteins, ferridoxin, rubredoxins; Active site structure and mechanistic action of enzymes such as Catalase, Peroxidase, xanthenes oxidase, superoxide dismutase (SOD), methane monoxigenase (MMO), Vitamin B-12, copper containing enzymes like hemocyanine, hemerythrine; Supramolecular interactions, methods of preparation of supramolecular compounds, top down and bottom up approach; porphyrins, calixpyrroles, calixarenes and their derivatives.

E8: Water pollution and its Remediation

Sources of water pollution, pollutants, types of pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality;Chemistry of toxicants like arsenic, fluoride, chromium, lead and mercury, cause and effects of water pollution; Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonda techniques, reverse osmosis, activated charcoal detoxification, applications of non-toxic oxides and mixed oxides, regeneration and recycling, mechanisms of detoxification, bio-remediation, need of green chemistry, future duties.