Department of Chemistry
Kumaun University, Nainital

Pre-Ph.D. Course work

Chemistry Paper- II MM: 75

The question paper will have eight questions. Any five questions have to be attempted. Each question carries 15 (fifteen marks).

1. **Nanoscience & Nanotechnology:** Definition, classification based on particle's shape and composition, 1D 2D 3D nanomaterials, CNT graphene, size effects and surface effects on the properties of nanomaterials, general methods of synthesis of nanomaterials, top- down and down-up approach for synthesis of nanomaterials, nucleation and growth of nano systems, self assembly, biogenic synthesis using microorganism. Chemical reduction and oxidation, hydrothermal, micelles, sol-gel processes. Applications of nanomaterials in biomedical science, optics, electronics, building materials.

2. **Natural products Chemistry:** General introduction, occurrence and classification of natural products, flavonoids, phenolics, saponins, steroids and terpenoids, natural products in traditional medicine, methods of extraction and isolation- reflux extraction, Soxhlet extraction, Clevenger extraction, liquid-liquid extraction, supercritical fluid extraction, ultrasound and microwave assisted extraction, pulsed electric field and enzyme assisted extraction, theory of distillation, fractional distillation, steam distillation, vacuum distillation, fractional evaporation, crystallization.

3. **Chemical dynamics:** General introduction, order and molecularity, first, second and third order reactions, temperature on reaction rate, activation energy, catalysis, homogeneous versus heterogeneous catalysis, phase transfer catalyst, green catalyst, solid surface supported catalyst kinetics of reactions taking place in solution, methods for kinetics of fast reactions, Lindmann's theory for unimolecular reaction rate.

4. **Surface Chemistry:** Adsorption, characterization of adsorbent, kinetics and thermodynamics of adsorption, Freundlich, Langmuir, B.E.T. and Temkin models of adsorption, applications of adsorption in environmental protection.

5. **Instrumentation Techniques**: Working principles and instrumentation of UV-visible, infrared (IR), FT-IR, Raman spectroscopy, NMR, X-Ray diffraction, X-Ray photoelectron spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), atomic force microscopy (AFM) techniques, flame emission spectroscopy, atomic absorption spectroscopy, inductively coupled plasma atomic emission spectroscopy, thin layer chromatography, paper chromatography, column chromatography, gas chromatography (GC), GC-MS, HPLC, TGA/DTA.

6. Soil and water chemistry

Soil- Definition, classification, soil fertility, productivity. Properties- Colour, temperature, pH, electrical conductivity, water holding capacity, organic carbon, macro- and

micronutrients. Soil pollution- causes and remedies. Uses of soil analysis. Water- Hydrosphere, Resources of water. Properties- Colour, odour, pH, turbidity, electrical conductivity, total dissolved solids, total suspended solids, hardness, DO, COD, BOD, nutrients. Water pollution - causes and water treatment methods.

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