

Department of Studies and Research in Industrial Chemistry
Jnana Sahyadri, Shankaraghatta – 577451, Shimoga
Ph : 9900513796, 9945798433

Entrance Examination for Ph.D. Admissions-2022-2023.

Instructions to Candidates

Entrance Test : 2022-2023

Date of Entrance Test	:	<u>27-06-2022 (Monday)</u>
Time	:	2.00 PM to 5.00 PM
Venue	:	Department of Industrial Chemistry

1. Maximum Marks for Entrance Test: 90

2. Duration of Entrance Test : 3 hours.

3. Question Paper pattern :

Part A :- 20 multiple choice questions each carrying one mark (20x1=20)

Part B :- 05 questions to be answered out of 08 questions. Each question carries 06 marks. (05x06=30)

Part C :- 04 questions to be answered out of 06 questions. Each question carries 10 marks. (04x10=40)

Total Marks - 90

4. Syllabus for Entrance Test: Research Methodology and Cognate Subject

5. The Candidates willing to appear for Entrance Test should collect their Hall Ticket from the Department of Industrial Chemistry Office in between 10 AM to 1 PM on 20-01-2020 (Monday)

6. The Candidates should bring a passport size photograph so as to affix to their Hall Ticket.

KUVEMPU UNIVERSITY

Department of Industrial Chemistry

Syllabus For Ph.D Entrance Test

Purification of compounds: General methods of isolation and purification of chemicals. Solvent extraction both cold and hot methods of crystallization, fractional crystallization, sublimation, Distillation; fractional distillation, distillation under reduced pressure, steam distillation, drying methods of solvents.

Handling of chemicals; hazardous chemicals; air/water sensitive, corrosive, toxic, explosive, carcinogenic and radioactive materials. Safety measures in laboratory, Good laboratory practices (GLP)

Classification of errors-Accuracy-Precision-Minimization of errors-Significant figures. Statistical treatment of data: Mean and Standard Deviation-distribution of random and normal errors-Reliability of results- Confidence interval- Comparison of mean results students t-distribution and t-tests-Comparison of mean with expected value, comparison of the results of the two different methods, comparison of precision of two methods- Linear regression, regression line, standard deviation, correlation coefficient – Multiple linear regression (one variable with two other variables).

Research manuscript preparation Full length research paper, short communication, letters, reviews, popular science articles in magazines, Few case studies with reference to journals and periodicals. Presentation of research papers: Oral and poster presentation in seminars, workshops and conferences etc.. Preparation of synopsis and Thesis, Preparation of research project proposals. Product development process and its evaluation; opportunity identification use of breakdown structure; concept generation and its evaluation, concept generation techniques, concept testing; Constitution of team organization structure, cross functional team: Technical development quality function deployment, project planning techniques, Gantt charts, mile stone chart, PERT and CPM network analysis product validation; market planning, test marketing, pricing, promotion, positioning and distribution, evaluation of market feedback; environmental concerns; intellectual property – patent protection.

Chromatographic technique: Classification, basic principle, theory of chromatography, ion exchange chromatography, resolution, resolution, retention parameters, applications in the removal of interfering ions lanthanide separation, contraction and recovery of tracer ions.

Gas Chromatography: characteristics, of mobile stationary phase used in GSC and GLC, characteristics of carrier gases, detectors, applications of GC and GC-MS

HPLC: Scope of HPLC, introduction, principle, instrumentation and applications.

Electroanalytical Techniques: Principle and applications of Electrogravimetry-Coulometric analysis – D.C Polarography- CV- Stripping analysis.

Spectroanalytical Techniques: Principle and applications of colourimetry – Flame photometry – Atomic absorption spectroscopy and atomic emission spectroscopy.

¹H NMR Spectroscopy :Introduction to NMR, quantum description of NMR, chemical shift, spin-spin coupling, coupling constant, instrumentation, applications, interpretation and limitations.

EPR Spectroscopy: Factors affecting the magnitude of g and A tensors in metal species – ZFT and Kramer's degeneracy –Spectra of V (II), Mn(II), Fe(II), Co(II), Ni(II), and Cu(II) complexes- Applications of EPR to a few biological molecules containing Cu(II), Fe(II) and Fe (III) ions – Spin densities and McConnell relationship- Application of EPR to some simple systems such as CH₃, p-benzoquinone and Xe²⁺.

Mossbauer Spectroscopy; Isomer shifts- Magnetic interactions – Mossbauer emission spectroscopy – application to iron and tin compounds.

Spectroscopic applications: UV-visible, IR, ¹H NMR, ¹³C NMR, mass spectroscopy in structural elucidation of organic compounds. Problems on structural elucidation involving all the above spectroscopic methods.

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reactions, Kinetic salt effects and steady state kinetics. Kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Spontaneous reactions, standard free energies change. The law of mass action, Reaction potential, Homogeneous equilibrium, temperature dependence of the equilibrium constant. The hydrodimerisation of acetonitrile, other commercial electro synthetic process, indirect electro synthesis, and the future electro synthesis. Electrochemical sensors. Synthesis of carbon nanotubes and its applications.

Aromatic nitro compounds; Mechanism of nitration, nitro compounds, charge transfer complexes, aromatic nitroso compounds, reduction products of nitro compounds.

Aromatic amino compounds: Strength of bases, Hofmann- Martius rearrangement, Fischer-Hepp rearrangement, Orton rearrangement, Ullmann reaction and diamines.

Diazonium salts:

Diazotization, reactions of diazonium salts, diazoamino and aminoazo compounds. Azoxybenzene, azobenzene, hydrozobenzene, benzidine rearrangement.

Reactions and rearrangement: Arndt- Eistert reaction, Baeyer- Villiger rearrangement, Mannich reaction, Oppenauer oxidation, Reformatsky reaction, Sommelet reaction, Stobbe condensation, Wittig reaction, Wolf rearrangement, Michael reaction.

Heterocyclic compounds: Synthesis and reactivity of furan, thiophene pyrrole, benzofuran, indole, benzothiophene, imidazole, pyrazoles, isoxazolesoxazoles, thiazoles, quinoline, isoquinoline and pyrimidine.

Periodic table: Properties of d-block elements, Nomenclature Preparation of co-ordination compounds.

Co-ordination chemistry :Introduction of co-ordination compounds,

Structural elucidation of coordination compounds by conductivity measurements, UV-visible, magnetic susceptibility, IR, ¹H NMR and TGA methods.

Industrial applications of Organometallic compounds: Homogeneous catalysis, hydrogenations of olefins, oxo-process, Wacker process, water gas shift reactions, carbonization. Heterogeneous catalysis, Fischer-Tropsch reaction, Ziegler-Natta polymerization.

Metal complexes in medicine: Interaction of metal complexes with nucleic acids, metal ion deficiency effects, toxicity of metal ions and treatment of toxicity, chelating agents in medicine, bacterial agents, antiviral agents and anticancer agents, metal complexes as drugs and therapeutic agents.

Bonding in solids: Covalent, Metallic, Ionic, mixed bonds.

Synthesis : Reduction, Sol-gel method, Reverse micelles, combustion method, microwave and co-precipitation method.

Characterization: Powder X-ray diffraction (PXRD), Scanning Probe Microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM)

Properties of Nanomaterials: role of size in nanomaterials, Electronic Properties: Dielectric Properties, Magnetic Properties: Diamagnetic, Paramagnetic, Ferromagnetic and Antiferromagnetic, Optical Properties, Semiconductor nanoparticles, Luminescence in Semiconductor nanoparticles: Photoluminescence, Cathodoluminescence and Thermoluminescence.

Applications: Automobiles, Textiles, Cosmetics, Domestic Appliances, Biotechnology and Medical field, Space and Defence, Nanotechnology and Environment

Synthesis of Metal Complexes, Characterization by UV, IR, NMR and Mass spectrometry .

Theory: Factors influencing DNA binding and Cleavage activity, Types of DNA binding and Cleavage

Procedure involved in analysis of DNA binding and cleavage: Preparation of TBE buffer, Tris-HCl buffer, agarose gel, preparation of various concentration of DNA and metal complexes. Instrumentation and application of Electronic absorption spectra, Viscosity measurement, Thermal denaturation, Fluorescence spectra, Cyclic voltammetry, Circular dichroism, Gel electrophoresis in DNA binding and cleavage studies.

Introduction to Thermodynamics : The first and second laws of thermodynamics. Thermodynamic functions, heat capacity, enthalpy, entropy. Equilibrium in one phase system, real gases, the reactions between gases, reactions of solid-state phases, reaction kinetics, rate equations.

Theory of Solution and related topics: The theory of solutions, Free energy as a function of composition. Methods for calculation of thermodynamic equilibrium. Electrochemical processes.

Polymer Chemistry and Technology: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: Condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and

heterogeneous systems, Polymerization Techniques. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers- chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance. Electropolymerization, Drug delivery systems.

Electrochemistry and applications : Introduction of electrochemistry, reversible and irreversible cells, Nernt's theory of electrode potential, standard electrode potential, measurement of electrode potential, rate of electrode processes, concentration cells, liquid-liquid junction potential or diffusion potential, applications of EMF measurements, oxidation and reduction systems, Electromotive series or potential series, decomposition voltage or decomposition potential, over voltage, potentiometric titrations, polarography, cyclic voltammetry, theory, instrumentation and applications, solvent effects, supporting electrolytes, reference electrode, working electrode, auxiliary electrode, modified electrodes, differential pulse voltammetry, square wave voltammetry, stripping voltammetry, coulometry, amperometric titrations, Introduction, fundamentals of batteries, classification of batteries, sizes of batteries, battery characteristics, primary batteries, dry cell, alkaline MnO_2 batteries and other batteries. Secondary batteries - lead-acid, alkaline storage batteries-battery charging theory and practice. Energy economics. Fuel cells - types - electrochemistry of fuel cells.

Separation and Purification Techniques:

Principle of:

1. Re crystallization: using various solvents and mixture of solvents
2. Fractional crystallization: e.g. Separation of naphthalene and diphenyl
3. Fractional distillation: e.g. Separation of Benzene, acetone, ethyl alcohol etc.
4. Steam distillation
5. Soxhlet Extraction.

A. Biological and Pharmacological Screening of compounds

Principle, material and methodology for the following activities:

1. Antimicrobial (Antibacterial, antifungal and antiviral)
2. Analgesic
3. Anti-inflammatory
4. Anthelmintic

Mechanism of action

Oxidations and Reductions in Organic Synthesis

Oxidation reactions involving – Chromium and manganese compounds, air, ozone, hydrogen peroxide, per acids, periodic acid, N-Bromosuccinimide

Reduction reactions involving- Catalytic hydrogenation, Complex metal hydrides, dissolving metals.

A. Reagents in Organic Synthesis

1. Gilman reagent
2. Lithium diisopropyl amide (LDA)
3. Dicyclohexylcarbodiimide (DCC)
4. 1,3-Dithiane
(Reactivity umpolung)
5. Trimethylsilyliodide
6. Tri-n-butyl hydride (TNBH)

7. DDQ
9. Osmium tetroxide
11. Selenium dioxide
13. Crown ether
15. Baker's yeast

8. Woodward-Prevost hydroxylation
10. Stannic chloride
12. Phase transfer catalyst
14. Merrifield resin
16. Peterson synthesis

Bio significant heterocyclic molecules (Pyrimidine, Pyridine, indole and Purine).

Synthetic heterocycles as chemotherapeutic agents. (Related to indoles and benzofurans).
Heterocyclic agrochemicals. Naturally occurring heterocycles of physiological importance.
Biosynthesis of typical nitrogen and oxygen heterocycles.

Recent developments in the chemistry of indoles, benzofurans and benzothiophenes and their comparative study.

Applications of Spectroscopic techniques like UV, IR, ¹H NMR, ¹³C NMR and Mass for Characterization of synthetic organic compounds.

Chemical Engineering- Unit Operations and Unit Processes, Stoichiometry, Theory, Industrial applications and Numerical Problems

Research Methodology : Selection of research problems and literature survey: primary sources- Journals periodicals, abstracts; Secondary listing of titles, reviews –annual Treatises, serials, monographs and textbooks, encyclopedia, catalogues, index of tabulated data- Science citation index- Searching the chemical literature- location of journal article- materials on a given topic- information about specific compound- Choosing a problem- abstract of a research paper.

Internet: Introduction to internet- web Browsers- World Wide Web- Search engines- literature survey in Chemistry- popular website in Chemistry- Database in chemistry.

E-Mail: Introduction to e-mail- creating e-mail- Receiving and sending e-mail.

Patent: Introduction, patentable subject

CHAIRMAN

Dept of Industrial Chemistry
Kuvempu University
Shankaraghatta - 577451,
Shimoga

Email :

bek@kuvempu.ac.in Cell :

9900513796