UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

Pre Ph.D. Course

(CHEMISTRY)

ONE SEMESTER

2019 ONWARDS
Pre Ph.D. Course (Chemistry)

Scheme of examination: one semester

There shall be four papers in all. Two papers are compulsory and two papers are elective.

Teaching Pattern: Stress will be on self study and the students will be given opportunities to seek guidance from faculty in general and research supervisor in particular. Research supervisors, faculty members and guest faculty will also deliver lectures to all the students regularly as per the requirement of Theory papers.

The list of compulsory and elective papers is given below:

Compulsory Papers

P CHY-C1: Research methodology (common to all).

P CHY-C2: Analysis of published research papers / Literature. A short dissertation is to be submitted by each student under the supervision of his/her research supervisor.

Electives papers (Any two)

PCHY-E1: Synthetic Inorganic, Organometallic & Bioinorganic chemistry.

PCHY-E2: Synthetic Organic Chemistry.

PCHY-E3: Natural Products.

PCHY-E4: Electrochemistry.

PCHY-E5: Environmental Chemistry.

PCHY-E6: Spectroscopy and Biomolecules.

All students have to study and qualify two compulsory and two elective papers before getting registered for Ph.D. in chemistry. The student may opt for any two out of the six elective papers (i.e. PCHY-E1 to PCHY-E6) according to their research interest/subject area.

Duration of EoSE of each theory paper: 3hrs
Max. Marks of EoSE 80
Internal assessment 20
Total Marks 100

Dissertation (PCHY-C2) – Based on Review of Literature on Selected Topic - 100 Marks

Internal assessment will be done by the teacher concerned / research supervisor on the basis of the regularity in the class, internal tests and overall performance of the student during the course work.

It is expected that the course work should complete at least fifteen days before the commencement of the examination. The minimum number of students necessary for starting a paper will be as per university rules.

[Signature]
Dy. Registrar
(Academic)
University of Rajasthan
Jaipur
PCHY-C1: Research Methodology (common to all)

Max. Marks: 100 (80+20)  Time: 3 hrs.

Note: Examiner will set ten questions two from each unit and the candidates will be required to attempt five questions in all selecting at least one question from each unit. All questions will carry equal marks.

Unit-I  12 Hours


Research Design and methodology: Identification of the problem, Assessing the status of the problem, Components of Research Problem, Research Design, Formulating the objectives, Preparing design (experimental or otherwise), Review of Research Work, devising a research proposal.


Research Ethics & Morals: Issues related to research ethics, plagiarism, collaborative models and ethics, acknowledgements.

Unit-II  12 Hours


Scientific Writing - Organization and writing of research paper, short communications, review articles and technical reports, references and bibliography.

Unit-III  12 Hours

Data Analysis and presentation data: Handling Numeric Data - Presenting data in tables, using spreadsheets, word processors, databases and other packages, simple calculations, statistical analysis, data sheets creation, tables and generation of graphs using a spreadsheet and other related softwares. Hints for solving numerical problems. Drawing chemical structures, chemometrics. Application of standard equation drawing software like, Chemdraw, ISIS/Draw, ACD/Chemsketch. Incorporation of chemical structures into word processing documents, presentation graphics, on-line publication, multimedia animations.

Unit-IV  12 Hours

Intellectual Property Right
Patents and patent writing, parts of patent application, characteristics of the disclosure for an invention. IPR (Intellectual Property Rights), Types, Objectives, Limitations, Agreements, Laws and Government Enforcement, Ethical Consideration.

Unit-V  12 Hours

Fundamental Laboratory Techniques: Basic principles, Health and safety, working with liquids, Basic laboratory procedures I, Basic laboratory procedures II, Principles of solution chemistry, pH and buffer solutions, procedures for neutralization of strong acids and strong bases.
Chemical safety and Disaster Management: Handling of hazardous chemicals, incompatible chemicals, flammable solvents, fire hazards in chemical laboratory, toxicity of chemicals, forms of toxic materials. Emergency response: chemical spills, radiation spills, biohazard spills, leaking compressed gas cylinders, fires, medical emergency accident reporting, health effects and first aid. General safety: General safety and operational rules, waste minimization strategies and safety practices for disposal of chemical waste.

Books & Literature suggested:
11. Research methodology techniques and methods by C L Kothari, New age International Publishers
PCHY-C2: Analysis of published research papers / scientific literature

Maximum Marks: 100

Dissertation: 50
Viva: 30
Internal Assessment: 20

Analysis of published research papers / scientific literature. A short dissertation on review of literature is to be submitted by each student under the supervision of his/her research supervisor.
PChy-E I: Synthetic Inorganic, Organometallic & Bioinorganic Chemistry.

Max. Marks: 100 (80+20)

EoSE Time: 3 hrs.

Note: Examiner will set ten questions two from each unit and the candidates will be required to attempt five questions in all selecting at least one question from each unit. All questions will carry equal marks.

Unit-I

12 Hours


Unit-II

12 Hours

Green Synthesis: Basic principles of green chemistry, green chemistry in day-to-day life, green reagents, green catalysts, microwave induced green synthesis, ultrasound assisted green synthesis, biocatalysts in green synthesis, versatile ionic liquids as green solvents, synthesis involving basic principles of green chemistry: some examples, green chemistry in sustainable development.

Unit-III

12 Hours

Organometallic Compounds: Definition, Classification, nature of carbon-metal bond, methods of preparation, general properties, stability, cyclopentadienyl complexes, arene transition metal complexes, structures, catalytic properties and applications.

Unit-IV

12 Hours


Unit-V

12 Hours

Basic Biochemical Methods: Fundamental of inorganic biochemistry, essential and non essential elements in biosystems, structure and function of metalloproteins in electron transport processes, cytochromes and iron-sulfur proteins, flavoproteins and synthetic models, orientation, units in biochemistry, calibration of volumetric glassware, introduction to biochemical instrumentation. Care and handling of instruments, colorimetry and spectrophotometry.

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PCHY-E2: Synthetic Organic Chemistry

Max. Marks: 100(80+20)

EoSE Time: 3 hrs.

Note: Examiner will set ten questions two from each unit and the candidates will be required to attempt five questions in all selecting at least one question from each unit. All questions will carry equal marks.

Unit-I 12 Hours


Disconnection approach of synthesis: Introduction, synthetic strategies of 1,2- and 1,4-difunctionalised compounds. Group disconnection, Umpolung Strategies, functionalisation of carbonyl compounds. Synthetic approach to cyclic systems. Retrosynthetic and reconnection strategies.

Unit-II 12 Hours

Reagents and Reactions:
Application of following reagents with specific examples - Organoboron reagents (IBBN, CATB, IpC2BH, PINB), Organosilicon compounds, Triflates. Trimethylsilyl iodide, Bakers yeast, Hypervalent iodine, Phase transfer catalysts, Lithium dimethylecuprate, Lithium disopropylamide (LDA), Dicyclohexyl carbodiimide (DDC),1,3-Dithiane, DDQ, Heck, Vilsmyer, Mukaiyama and McMurray reactions and Suzuki and Sonogashira coupling.

Protecting groups: Hydroxy, carbonyl, amines, carboxylic etc. Multistep synthesis, protection and deprotection of functional groups with examples.

Unit-III 12 Hours

Green Chemistry
Basic principles of green chemistry, application of non-conventional techniques in organic synthesis and natural products (ultrasonic, microwave and electrochemical synthesis). Solid state synthesis and synthesis under solvent free conditions. Use of ionic solvents, biocatalysts, nanoparticles etc.

Unit-IV 12 Hours


Unit-IV 12 Hours

Molecular Recognition: Fullerences: as host as well as guest, enzyme modeling using an artificial host framework, cyclodextrins as esterase mimics, functionalized cyclodextrins, chiral corands.

Books recommended:
5. Green Chemistry by M. Kidwai and V. K. Ahluwalia.
PCHY-E3: Natural Products

Max. Marks: 100 (80+20)  
Time: 3 hrs.

Note: Examiner will set ten questions two from each unit and the candidates will be required to attempt five questions in all selecting at least one question from each unit. All questions will carry equal marks.

Unit-I  
12 Hours

Novel herbal formulations: Phytosomes, Liposomes, Microspheres, novel vesicular herbal formulations etc. Standardization of herbal drugs/formulations

Unit-II  
12 Hours

Extraction Techniques: Conventional methods of extraction of plant material, introduction to Super critical fluid extraction, microwave extraction and ultra-sound extraction methods

Unit-III  
12 Hours

Isolation Methods: Column and Flash chromatographic methods for the separation of alkaloids, steroids, terpenoids and flavonoids

Unit-IV  
12 Hours

Purification Technologies: Purification and separation of secondary metabolites by using TLC, HPTLC and HPLC

Unit-V  
12 Hours

Assessment of Plant material and regulatory guidelines for herbal Drugs


References

1. Flash chromatography on cartridges for the separation of plant extracts: Rules for the selection of chromatographic conditions and comparison with medium pressure liquid chromatography Petra Weber et.al, Fitoterapia, Volume 82, Issue 2, March 2011, Pages 155-161
2. Flash Column Chromatography Guide - MIT OpenCourseWare
4. HPLC e-Book - Lab-Training.com
8. High-Performance Thin-Layer Chromatography (HPTLC), Man Mohan Srivastava, Springer
PCHY-E4: Electrochemistry

Max. Marks: 100(80+20) Time: 3 hrs.

Note: Examiner will set ten questions two from each unit and the candidates will be required to attempt five questions in all selecting at least one question from each unit. All questions will carry equal marks.

Unit-I 12 Hours

Volammetry: Principle and Application. Cyclic volammetry, square wave volammetry, stripping volammetry, coulometry, applications of these techniques in Electro-organic synthesis, Electroanalysis of therapeutic compounds (quantitative and qualitative) and analytical method validation of drugs.

Unit-II 12 Hours


Unit-III 12 Hours

Electrochemical Energy Conversion: Nickel- Cadamium battery, Silver-Zinc cells, Dry cells, Fuel cells- the important quantity in electricity storage- electricity storage density- energy density, the Lead acid storage battery.

Unit-IV 12 Hours

Bio-electrochemistry : Biosensors, bioelectrocatalysis, electrocatalysis of nanostructured materials in Biological systems, electrochemical mechanism of nervous system, enzymes as electrodes

Unit-V 12 Hours

Technological aspects of electrochemistry: Corrosion and the stability of metals, the mechanism of the corrosion-thermodynamics and the stability of metals. The corrosion current and the corrosion potential, the influence of air and H upon the rate of corrosion. Passivation: the transportaion from a coroding and unstable surface to a passive and stable surface-the mechanism of passivation.

Books recommended:
5. Techniques of Electroanalytical cemistry P.T. Kissinger (Marcel-Dekker)

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PCHY-E5: Environmental Chemistry

Max. Marks: 100 (80+20)  
Time: 3 hrs.

Note: Examiner will set ten questions two from each unit and the candidates will be required to attempt five questions in all selecting at least one question from each unit. All questions will carry equal marks.

Unit-I  
12 Hours
Chemistry of Air Pollution-I: Introduction to environmental pollution; Concept, nomenclature and segments; Composition of atmosphere; Pollution of atmosphere; Types of air pollutants; Oxides of Carbon, Sulphur, Nitrogen and Hydrocarbons etc; Effect on health and environment; Green house effect, Acid rain and Photochemical smog.

Unit-II  
12 Hours
Chemistry of Air Pollution-II: Effect of Ozone on Health & Environment; Chlorofluorocarbons; Effect of Gasoline on air pollution; Presence of Lead in the atmosphere; Reducing toxic emission from the fuel combustion in vehicles; Control of NO emission; Catalytic control device for automobiles.

Unit-III  
12 Hours
Chemistry of Water Pollution: Environmental role of water; The Hydrological cycle of water; Classification of water pollutants; Measurement of BOD, COD, TOC; Waste chemicals; Oil spills, Heavy metals; Waste water treatment - Primary, Secondary (Aerobic & Anaerobic) and Tertiary treatments.
Chemistry of Soil Pollution: Soil pollution; Classification of Soil Pollutants; Source and Classification of Solid Waste; Disposal of Solid Waste on land and sea; Techniques of recycling of Solid Waste.

Unit-IV  
12 Hours
Pollutants from Industry: Polymers and Plastics; Sugar and Distillery; Drugs and Pharmaceuticals; Paper and Pulp; Metallurgical industries; Nuclear Power Plants Chernobyl and Minimata disasters.
Pesticide pollution: Classification of Pesticides; Environmental implication of Pesticides; Alternate methods of Pest Control; Control methods of Pesticide Pollution; Bhopal gas disaster.
Water Treatment: Characteristics of Municipal water; Stages involved in the purification of drinking water; Removal of micro-organisms; Break-point chlorination; Desalination of Brakish water; Electro dialysis; Reverseosmosis; Chemical analysis of water; Estimation of Free Chlorine; Dissolved oxygen; Alkalinity of water.

Unit-V  
12 Hours
Analytical methods: Environmental evaluation- Applications of the following methods for measurement of environmental condition; Atomic Absorption Spectroscopy, GC-MS and Chemical methods.

Books recommended:
PCHY-E6: Applications of Analytical Spectroscopy

Max. Marks: 100 (80+20)  
Time: 3 hrs.

Note: Examiner will set ten questions two from each unit and the candidates will be required to attempt five questions in all selecting at least one question from each unit. All questions will carry equal marks.

UNIT I  
12 Hours

Introduction to IR, UV Spectroscopy:  
UV Spectroscopy: Absorption laws, effect of solvents on transitions, UV spectra of dienes, polyenes, carbonyl compounds and \( \alpha,\beta \)-unsaturated carbonyl compounds. Woodward's rule and its application. Steric effect on coplanarity.  

UNIT-II  
12 Hours

\(^1\text{H} \) NMR spectroscopy: Double Resonance experiments; relaxation; Multipulse experiments; Nuclear Overhauser effect; Interpretation of spectra, chemical shift, shielding mechanism and anisotropic effects. Second order spectrum and analysis of AB, AMX and ABX systems. Simplification of Complicated Spectra: Aromatic induced shifts spin decoupling, spectra at higher fields. Hindered rotation and rate products.

UNIT-III  
12 Hours

\(^1\text{C} \) CMR Spectroscopy: General considerations, chemical shift, coupling constants. Nuclear Overhauser effect. Spin-spin, spin-lattice relaxations. Off resonance decoupling. DEPT. Interpretation of \(^1\text{H} \) and \(^1\text{C} \) NMR spectra. Introduction to 2D NMR: Techniques like, COSY, HSQC, HMBC, NOESY, ROESEY, etc.

UNIT-IV  
12 Hours

Mass Spectrometry: Introduction, ion production. EI and CI, techniques fragmentation, factors influencing ion abundance, single and multiple bond cleavage, doubly charged ions rearrangements, cleavage associated with common functional groups. Mc Lafferty rearrangement, molecular ion peak, metastable ion peak. Nitrogen rule and interpretation of mass spectra, HRMS. Structure elucidation based on spectroscopic data.

UNIT V  
12 Hours

Introduction to application of Techniques like X-ray, LCMS, GCMS, HPLC.