Mangalore University

Department of Industrial Chemistry

Ph.D Course work syllabus

Effective from 2024-2025

Course (16 weeks)	Title	Hours per week (Instruction)	Duration of exams	Internal assessment	External Examination	Total Max Marks	No. of Credits
Paper 1	Research Methodology	04	03	30	70	100	04
Paper 2	Research and Publication ethics	02	03	30	70	100	02
Paper 3	Literature Review	16	--	--	150 (Report)	200	08
					50 (Viva voce)		14

Internal assessment: IA test for 15 Marks (1Hr. duration)+ Seminar 15 Marks for both Paper 1 and Paper 2

Question paper pattern for the external examination: The question paper will contain eight questions of 14 with two questions from each unit. Further each question might contain two to 3 subdivisions. The candidate has to answer five full questions

Paper 1: Research Methodology

Instructions per week : 04 hours Total No of hours: 56

Objectives: To learn the methods in industrial chemistry research

Course specific objectives:

1. To know about the research process
2. To understand the research design and process
3. To familiarize the writing methods in research
4. To describe and explain the importance of the concept of "sampling" in analytical methods of analysis.
5. To describe and discuss the sources and types of sampling error and uncertainty in measurement.
6. To understand quality control systems used in industries
7. To learn the importance of analytical and spectroscopic methods used in chemical research
8. To understand the importance of chemical safety to carry out research in industrial chemistry
9. To know the methods to be followed in intellectual property right related issues

Course out come

CO 1: The candidate would learn to develop hypothesis for research

CO2: The candidate will understand the research process such as developing research question, background survey methods and finding research gap.

CO3: The candidate will know the analytical and spectroscopic techniques to be used in the research process.

CO4: The candidate will understand safety measures to be taken during experiments

CO5: The candidate will be aware of IPR rules to apply to the research outcome during Ph.D tenure

Syllabus

UNIT-I: Research Methodology **14 Hours**

Research processes - Scientific research, formation of the topic, hypothesis, Sources of information. Types and Methods of Research- Classification of Research- Pure and Applied Research- Exploring or Formulative Research-Descriptive Research-Diagnostic Research/Study-Evaluation research/Studies- Action Research - Experimental Research.

Research design and methods - Basic Principles, Need of research design, important concepts relating to research design - Observation and Facts, Development of Models Developing a research plan - Exploration, Description, Diagnosis, and Experimentation.

Writing methods- Introduction, word processing and layout, writing and formatting with the computer, writing the first draft, revising the first draft on content and structure, revising the second draft on style, writing a thesis, writing review article and book reviews, preparing research proposals for grants.

UNIT-II: Sampling and Data analysis
14 hours

Sampling - Introduction - definitions — theory of sampling — techniques of sampling — representative sample, sample storage, sample pretreatment and sample preparation. Statistical criteria of good sampling and required size — stratified sampling v/s random sampling.

Data analysis- Classification of errors - systematic errors-sources, random errors - sources and distribution. Accuracy and precision-Determination of accuracy of methods, improving accuracy of analysis, significant figures, mean, standard deviation, Analysis of variance (ANOVA) — Correlation and Regression. Graphical methods - Linear regression line, correlation coefficient-Multiple linear regression (one variable with two other variables). Comparison of results: "t" test and "f' test rejection of results, gathering of data, analysis of data, revising of hypothesis, presentation of data and conclusion.

Quality in analytical laboratories - quality control and quality assurance, accreditation system.

UNIT-III: Methods in Analytical Techniques
14 Hours

Chromatographic techniques: TLC, Column, HPLC Theory and applications, LC-MS.

Spectroscopic techniques: IR spectroscopy- Molecular vibrations, selection rules , force constant - band assignments , applications, organic structures, finger printing, identification of common functional groups

Nuclear magnetic resonance spectroscopy: Introduction- Magnetic properties of nuclei- Resonance condition. Instrumentation and Sample handling. ^{1}H NMR - Chemical shift- Mechanism and factors influencing of shielding and deshielding, Coupling Constant, First order and second order spectral patterns. NOE. ^{13}C NMR- Off resonance decoupling, ^{19}F - NMR spectroscopy.

Mass spectrometry- Theory — instrumentation —production and reactions of gaseous ions - isotopic abundance — determination of molecular weights and formulae — metastable peaks - nitrogen rule - ion fragmentation mechanisms - rearrangements. Elucidation of structure of compounds on the basis of IR, NMR and Mass Spectrometry.

UNIT- IV: Chemical Safety and Intellectual property rights
14 Hours

General safety and operational rules- Safety equipments, personal protective equipments, compressed gas safety, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, in incineration and transportation of hazardous chemicals.

Emergency response - Chemical spills, radiation spills, biohazard spills, leaking compressed gas cylinders, fires, medical emergency accident reporting. Safety rules of laboratory acquaintance of experimental set up aild instruments,

Intellectual property and intellectual property rights: Data management, importance of safety and security of data, evaluation of inventions. Communication with patent council and publication of data, communication with investors, IP sales process. Intellectual property rights and patent law — Trade Related aspects of Intellectual Property Rights

Reference Books

1. C.R. Kothari, Research Methodology: Methods and Techniques. New Age International, 1990.

2. D.R. Kapoor & Pooja Saigal, Research Methodology Methods & Techniques, Regal Publications, 2013.

3. D. K. Bhattacharya, Research Methodology Pillappa; Third edition, 2013.

4. Suresh Chandra & Mohit K Sharma, Research Methodology, Alpha Science Intl Ltd; I edition, 2013.

5. R. Panneerselvam, Research Methodology, Phi Learning publication, 2009.

Nicholas Walliman, Research Methodology, 2010

6. J. Mohan, Organic Spectroscopy Principles and Applications, CRC; 2nd ed., 2004.

7. W. Kemp, Organic Spec0oscopy, 3rd Ed., MacMillon, 1994.

8. P.M. Silverstein, F.X. Wester, Spectroscopic Identiflcation of Organic Compounds, 6ih Ed., Wiley 1998.

9. Douglas A. Skoog, Donald M. West, F. James Holler, Fundamentals of analytical Chemistry, Saunders College Pub., 1988.

10. Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93-81849-30-9.