Introduction: Meaning, Objectives, Motivation, Types of research, Approach and Significance, Characteristics of scientific research, Value of and value–free scientific research, definition and selecting a problem, Scientific methods in research, criteria for good research, sources for selecting research topics

Research Design: Meaning, need, features, concepts, goals, characteristics, different phases in research Design, Designs for different types of research, advantages of a research design. Basic principles and experimental design

Measurement and Scaling Techniques: Measurement in research, measurement in Scales, source of error in measurement, tests for sound measurement, measurement tools. Observations–purpose, types, process, factors affecting observation, recording observation, observation schedule, Scaling- means, techniques

Statistical techniques:
Measures – Means, median, mode and comparison
Analysis of variance and covariance - Analysis of variance and covariance (ANOVA)- Definition, types, basic principle, techniques, methods, two way ANOVA, analysis of covariance
Multivariate Analysis techniques : Growth, characteristics and applications, classification, variables, multivariate techniques , factor analysis–rotation , R-type and Q-type factor analysis, path analysis

Interpretation and report writing: Meaning, technique, precaution, significance, different steps in writing report, layout, and presentations, mechanism and precautions in writing research reports

Computers – Role in research and Applications in Chemistry: Computer and computer technology. Computer system, characteristics, binary number system,
MS Office: Tools and Application, Internet Web programming: Hardware and software requirement for internet, ISP and internet account, web home page, URL, Browser, Security on web, Searching tools and search engines
Internet as Resource for Chemical Literature: The structure of chemical information, important electronic based resources, and how to find information on compounds-synthetic routes, physical and chemical properties; abstracts and journals in chemistry. Electronic form of journals and their Resource, patents and the disclosure of chemistry inventions.

Books for Suggested Further Reading

2. Research Methods, Ram Ahuja, Rawat Publication, Jaipur.
Department of Chemistry
Sardar Patel University
Pre-Ph.D. (Course)

Paper – II
Techniques in Chemistry

Purification / Crystallization:
Isolation and purification of organic compounds (solids and liquids) with special emphasis on chromatographic techniques: TLC, column chromatography and HPLC. Drying and dehydration agents.

X-ray diffraction and Voltametry:
Single crystal and power pattern: Basic principle, application with some typical examples, Energy Dispersive X-ray Methods. Voltametric methods.

Thermal techniques:
Thermogravimetry (TG): Instrumentation and balances, X' – Y' recorder, thermogram, factors affecting thermogram, correlation of DTA and TGA data. VSP and HDT. Differential Thermal Analysis (DTA): Theories of DTA, factors affecting DTA curve, instrumentation and application of DTA. DSC-principle, technique and applications.

Molecular weight determination techniques:
Osmometry: Membrane and vapor pressure, Light Scattering, Viscometry, Size exclusion chromatography, Ultracentrifugate.

Books suggested:
1. Instrumental Analysis by Skoog and Hollar.
2. Instrumental Methods of Analysis by H. H. Willard, L.L.Merritt, J. A. Dean and F. A. Settle  
3. Qualitative Analysis by R. A. Day and A. L. Underwood  
11. Thermal methods of analysis, principles, applications, & problems, By P.J. Hains, 1995 Blackie academic & Professional

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Paper – III  
**REVIEW WRITING AND PRESENTATION/SEMINAR**

Each student will submit a literature review report on his chosen research topic and student will give a presentation/seminar.