

**KADI SARVA VISHWA VIDYALAYA,**

**GANDHINAGAR**

**Ph.D. Course Work**

In

**CHEMISTRY**

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**Ph.D. Course work**

**For**

**Chemistry**

**Course structure**

<b>Paper</b>	<b>Title</b>	<b>University Examination (marks)</b>	
		<b>Section A (general)</b>	<b>Section B (specialization)</b>
<b>Paper-I</b>	<b>Research methodology</b>	<b>60</b>	<b>40</b>
<b>Paper-II</b>	<b>Scientific communication</b>	<b>60</b>	<b>40</b>
<b>Paper-III</b>	<b>Recent Trends in Chemistry</b>	<b>100</b>	

# **Paper-I: Research Methodology**

## **SECTION-A ( Common for all candidates) [60 marks]**

### **Syllabus:**

- 1) Introduction to Research Methodology: Meaning of Research, Objectives of Research, Motivations in Research, Types of Research, Research Approaches, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research (Marks 2)
- 2) Defining the Research Problem: What is Research Problem? Selecting the Problem, Necessity of and Techniques in defining the problem (Marks 3)
- 3) Research Design: Meaning, Need, Features of Good Design, Concepts, Types. Basic Principles of Experimental Design, Developing a Research Plan (Marks 3)
- 4) Sample Design : Implication, Steps. Criteria for selecting a sample procedure, Characteristics of Good sampling Procedure, Types of Sample Design, Selecting Random Samples, Complex random sampling Design. (Marks 4)
- 5) Measurement and Scaling Techniques: Measurement in Research, Measurement Scales, Sources of Errors in measurement, Tests of Second measurement, Technique of developing Measurement Tools, Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques. (Marks 6)
- 6) Methods of Data Collection: Collection of Primary Data, Observation Method, Interview method, Collection of Data through questionnaire and Schedules, Other methods. Collection of Secondary Data, Selection of appropriate method for data collection, Case Study Method, Guidelines for developing questionnaire, successful interviewing. Survey v/s experiment (Mark 6)
- 7) Processing and Analysis of Data : Processing Operations (Meaning, Problems), Data Analysis (Elements), Statistics in Research, Measures of Central Tendency, Dispersion, Asymmetry, Relationship. Regression Analysis, Multiple correlation and Regression, Partial Correlation, Association in case of Attributes (Marks 6)
- 8) Sampling Fundamentals : Definition, Need, Important sampling Distribution, Central limit theorem Sampling Theory, Sandler's A-test, Concept of Standard Error, Estimation, Estimating population mean, proportion. Sample size and its determination, Determination of sample size Based on i) Precision Rate and Confidence level ii) Bayesian Statistics. (Marks 7)
- 9) Testing of Hypothesis: Meaning, Basic concepts, Flow diagram, Power of a hypothesis test, Important parametric tests, Hypothesis Testing of Means, Differences between Means, Comparing Two related samples, Testing of Proportion, Difference between proportions, Comparing variance to hypothesized population variance, Equality of variances of two normal populations, hypothesis testing of Correlation coefficients, Limitations of Tests of hypothesis. (Marks 7)
- 10) Chi- square test : Applications, Steps, characteristics, limitations (Marks 2)
- 11) Analysis of Variance and Covariance : Basic Principles, techniques, applications, Assumptions, limitations. (Marks 6)
- 12) Analysis of Non-parametric or distribution-free Tests : Sign Test, Fisher-Irwin Test, McNemer Test, Wilcoxon Matched pair Test (Signed Rank Test), Rank . (Marks 2)
- 13) Sum Tests : a) Wilcoxon-Mann-Whitney Test b) Kruskal-Wallis Test, One sample Runs Test, Spearman's Rank Correlation, Kendall's Coefficient of Concordance, Multivariate Analysis Techniques: Characteristics, Application, Classification, Variables, Techniques, Factor Analysis (Methods, Rotation), Path Analysis. (Marks 4)

## **SECTION-B :(For candidates of chemistry) [40 marks]**

### **1. Experimental Design for the following chemical methods/techniques :**

#### **Techniques of Qualitative and quantitative analysis of organic and inorganic compounds:**

Theoretical bases, Acidometry, Alkalimetry, Iodometry, Iodimetry, redox titration, precipitation & complexometry, gravimetry, miscellaneous methods.

**Instrumental methods:** TLC, GC, HPLC, UPLC,  $P^H$  metry, Conductometry, Polarography, Polarimetry, Refractometry, etc. ASTM Methods

**Spectrometry:** UV-Vis, IR, Mass, NMR, AAS, AES, GC-MS, HPLC-MS, Soectrofluorometry.

**(20 Marks)**

### **2. Chemical control:**

Cleaning of glass wares, Isolation, Purification, Solvents for recrystallization, Sublimation, Fractional/vacuum/steam distillation, Solvent Extraction, Limit tests, Sources of errors in observations, Laboratory safety and waste disposal.

Basic principle, operating method, sample size, sampling and calibration of frequently used laboratory instruments, Development, validation and optimization of analytical methods for chemical analysis based on various techniques of spectrometry, chromatography etc., Quality control and quality assurance in chemical Industries.

**(10 Marks)**

### **3. Modern methods of organic synthesis:**

**Methods of determination of reaction mechanisms:** Product analysis, Determination of the presence of intermediates, Crossover experiments, Isotopic Labeling, Stereo chemical evidence, Kinetic evidence.

**Synthetic routes for:** Formation of c-c, c=c.bonds, Organo metallation, Pericyclic reaction, Reduction, Oxidation, Functionalization of alkenes..

**Retro synthetic approach:** Synthons and reagent equivalents. **(10 Marks)**

## Reference Books:

- (1) Modern methods of organic synthesis, William Carruthers and Iain Coldham, Cambridge University press, Fourth Ed. 2004.
- (2) Experiments and Techniques in organic chemistry, D Casto, C Johnson and M. Miller, Prentice-Hall.
- (3) Practical Pharmaceutical Chemistry, CBS Publishers ND Fourth Ed. In Part I& II, By A H Beckett and J B Stenlake.
- (4) Elementary Practical organic chemistry Part I, II, II, Arthur I. Vogel. (2nd edition) CBS Publishers & Distributors.
- (5) Vogel's Text book of Quantitative analysis, Revised by J Bassett, R C Denney, G H Jeffery, and J Mendham, ELBS.
- (6). Synthesis and Characterization of Inorganic Compounds, W L Jolly, Prentice Hall.
- (7) Microscale and Miniscale Organic Chemistry Laboratory Experiments, McGraw Hill, By A M Schoffstall, B A Gaddis, and M L Druelinger.
- (8) Statistics for Analytical chemists, First Ed. 1983, By R Caulcutt and R Boddy, Chapman & Hall.

# **Paper-II : Scientific Communication**

## **Section-A**

**(Common for all candidates) [60 marks]**

### **Syllabus**

1. Basics of Communication skill.
  - a) English Grammar: Word Choice, Sentence Structure, paragraph structure,
  - b) Comprehension
2. Types of Scientific Communications.
3. Importance of publishing research papers
4. Publishing Research paper :
  - a) Preliminaries, Format, Choosing Journal
  - b) Title, Running Title
  - c) Authors: Single and Multi authorship
  - d) Writing Abstract
  - e) Introduction section
  - f) Materials and Methods Section
  - g) Result Section
  - h) Figures : Design Principles, Legends, Table components, Graphs: Types, Style, Tables v/s Graph
  - i) Discussion Section: Format, Grammar Style, Content.
  - j) Acknowledgements
  - k) References : Different Styles

- l) Selecting Keywords
- m) Communication with the Editor, Handling Referees' Comments, Galey Proofs
- 5. Writing Review Articles
- 6. Preparing and Delivering of Oral and Poster Presentations
- 7. Avoiding Plagiarism
- 8. Preparing documents for MoUs, Confidentiality Agreements.
- 9. IUPAC symbols and Terminology for physicochemical quantities and Units, SI prefixes, Fundamental Constants, Standard Abbreviations and Symbols

## **SECTION-B**

### **(For Chemistry candidates only) [40 Marks]**

1. Exercises on writing chemistry related research papers, preparing project proposals for funding agencies and preparing power point presentations.

**Scavenger Hunt:** Introduction to chemical data, reference books and calculations, Handbook of chemistry, Chemical catalogs, Merck index, Aldrich and other sources, CA, Journals, Searching on the web. **(20 Marks)**

2. Assignment on Critical analysis of research papers of interest published in refereed journals with respect to language, content, title, reference style, data, figures, tables, results and discussion etc. and preparing a report on the same. Assignment on Writing and submitting a review article related to doctoral research topic for an international journal. Awareness with recent trends and challenges in chemistry related issues. **(10 Marks)**

3. **Legislation for Intellectual Property:** Copy right, trade mark and patent, Product licenses and patent protection procedure, Guidelines by FDA, ICH, WHO, ASTM, Codes for GLP/GMP. **(10 Marks)**

#### **Reference Books:**

- (1) Study and Communication Skills for the Biosciences by *Stuart Johnson and Jon Scott*, Oxford University Press
- (2) Write and Publish a Scientific Paper by *Robert A. Day* Oryx Press
- (3) Scientific Easy when you know how by *Jennifer Peat* BMJ Books
- (4) Research Projects and Research Proposals A Guide for Scientists Seeking Funding by *Paul G. Chapin* Cambridge University Press.
- (5) ASTM Book of standards, American Society For Testing and Materials, Philadelphia, revised annually, USA.
- (6) Official methods of analysis, association of official analytical chemistry, Washington, 1984.

# **Paper-III : Recent Trends in Chemistry**

**(For Chemistry candidates only) [100 Marks]**

**(A) Organo Selective Reagents:** Umpolung, Lithium aluminium hydride, Lead tetra acetate, Lithium diisopropylamine, Osmium tetroxide, Selenium dioxide, Crown ethers as PTC, 9-BBN, Dialkyl copper, N-bromo succinimide, Tributyl tin hydride, Grignard reagents, Wilkinson Catalyst, Lindlar Catalyst, Tris(trimethylsilyl)silane, Pper iodic acids Organo metallic compounds, Sharpless reagent, Adam's catalyst, Enamines. **(25 Marks)**

**(B) Reaction Mechanism for Organic Name Reactions:** Favorskii, Orton, Perkin, Norish (I & II), Bayer- Villiger, Claisen, Fischer-Indole, Chichibabin, Robinson annulation, Rosenmund, Hydroboration, Witting, Hoffman, Saytzeff, Chugaev elimination, Markownikoff addition, Reformatsky, Paterno-Buchi, Oppenauer oxidation, MPV-reduction, Mannich, Michael addition, Diels-Alder, Birch, Cope, Beckmann. **(25 Marks)**

**(C) Chemical structure elucidation from molecular spectra:** Electronic spectra, Infrared spectra, NMR spectra, Mass spectra, EPR. **(25 Marks)**

**(D) Recent trends:** Green synthesis: a new approach in pollution control, Development and validation of modern analytical methods, Synthesis and characterization of conducting polymers, Nano materials: an emerging technology in the fields of electronic, pharmacy, etc. Theoretical chemistry: a quantum approach, Latest chromatographic techniques of chemical analysis. **(25 Marks)**

## **References:**

- (1) Levine, I. N. (1978). Physical Chemistry McGraw-Hill publishing ISBN 0-07-037418-X.
- (2) A text books of Quantitative organic Analysis, By A.I. Vogel, (Longman), 5<sup>th</sup> Ed.
- (3) Fundamentals of Analytical Chemistry, By Skoog and West, (Holt-Saunders).
- (4) Analytical Chemistry, By Gary D. Christian (John Wiley & Sons.), 5<sup>th</sup> Ed.
- (5) Modern Methods of Organic Synthesis, By William Carruthers and Iain Coldham, 4<sup>th</sup> Ed., Cambridge Uni. Press
- (6) Organic Chemistry, By Morisson and Boyd.
- (7) Orgnic reaction Mechanism, By Jerry March
- (8) Robert T. Morrison, Robert N. Boyd, and Robert K. Boyd, Organic Chemistry, 6<sup>th</sup> Ed. (Benjamin Cummings, 1992, ISBN 0-13-643669-2).