



**UTTARANCHAL  
UNIVERSITY**

# **UTTARANCHALUNIVERSITY**

ArcadiaGrant,P.O.Chandanwari, Premnagar,Dehradun, Uttarakhand-

248007,INDIA

## **Detailed Course Structure & Syllabus of Pre Ph.D. (Chemistry) Course Work (As per CBCS system) W.E.F Session 2022-23**



**Course Structure of the Pre-Ph.D (Chemistry) Course Work:  
Applicable for Batch: 2022-23**

**SCHEME OF EXAMINATION**

**Ph.D(Chemistry)**

**(Effective from Academic Year 2022-23)**

**Under Choice Based Credit System (CBCS)**

**Course Structure of the Pre-Ph.D (Chemistry) Course Work:  
Applicable for Batch: 2022-23**

**Scheme of Pre-Ph.D. Course Work**

S.No	Course Code	Subject	Credits	Evaluation - Scheme							
				Period			Sessional			Examination	
				L	T	P	CT- I	CT- II	Total	ESE	Sub. Total
<b>Courses</b>											
1.	RM-101	Research Methodology	4	4	0	0	20	20	40	60	100
2.	RM-102	Computer & Stats Application in Research	2	2	0	0	20	20	40	60	100
3.	RPE-103	Research & Publication Ethics	2	2	0	0	20	20	40	60	100
4.	DSE-104	Discipline Specific Electives	3	3	0	0	20	20	40	60	100
5.	RS-105	Seminar Presentation	2	0	0	4	20	20	40	60	100
		<b>Total</b>	<b>13</b>	<b>11</b>	<b>0</b>	<b>4</b>	<b>100</b>	<b>100</b>	<b>200</b>	<b>300</b>	<b>500</b>

**List of Electives**

S. No.	Course Code	Course Name
1	AR-104	<b>Advanced Research &amp; Instrumentation Techniques</b>
2	CH- 104(ii)	<b>Advance Organic chemistry</b>
3	CH- 104(iii)	<b>Biofuels</b>



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## **SYLLABUS**

**of**

## **Ph.D(Chemistry)**



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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	RM-101	Credit	4
Year/Sem	1/1	L-T-P	4-0-0
Course Name	Research Methodology		

## Objectives of the Course:

1. To Equip the Students with the Concept and Methodology of Research.
2. To provide knowledge about type of research, preparation of reports and thesis, designing of Research using Scientific Methods.

## UNIT I (Total Topics- 7 and Hrs-12)

Introduction to Research: Definition, Nature and significance, Role and Objectives; Types of Research: exploratory, descriptive, experimental and diagnostic research, social and legal research and traditional, analytical, empirical & fundamental research, Doctrinal and non-doctrinal research methods; Various Research Designs; Scientific Research Process: Overview, Problem identification and formulation of research statement.

## UNIT II (Total Topics- 7 and Hrs- 12)

Data Collection: sources, primary and secondary methods, significance of Primary and Secondary Data, questionnaire Vs. schedules; Data Processing: Editing, Coding Organization and Presentation; Attitude Measurement and scaling: Measurement Scales, Sources of Errors in Measurement, Techniques of Developing Measurement Tools, Classification and Testing (Reliability, Verification and Validity) Scales, Designing Questionnaires and Interviews.

## UNIT- III (Total Topics- 5 and Hrs- 10)

Sampling, Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions: Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors, Concept of Permutation, Combination & Probability for research analysis.

## UNIT-IV (Total Topics- 5 and Hrs- 10)

Interpretations and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Steps in Report Writing, Layout of Report and Precautions in Writing Research Reports. Limitations of RM: Ethics in Research, Philosophical Issues in Research.

**CO1.** Acquire in-depth knowledge of various fundamentals, theories and principles related to the research and apply the acquired knowledge in carrying out research studies in the area of interest.

**CO2.** Identify, formulate and critically investigate research problems by applying research-oriented knowledge and analyze relevant data to reach certain conclusions in the form of alternative solutions to these problems.

**CO3.** Apply the acquired knowledge and skills to develop minds to think out of the box while carrying out research operations to conclude something.

**CO4.** Apply parametric and non-parametric statistical tests to verify the developed hypothesis to suggest innovative solutions to the problem being investigated.



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## Reference Books

1. William G. Zikmund, "Business Research Methods", Orlando: Dryden Press.
2. C. William Emory and Cooper R. Donald, "Business Research Methods", Boston, Irwin.
3. Fred N Kerlinger, "Foundations of Behavioural Research", New Delhi: Surjeet Publications.
4. Naresh Malhotra, Marketing Research : An Applied Orientation, Pearson publication David Nachmias and ChavaNachmias, "Research Methods in the Social Sciences", New York: St.Marlia's Press.
5. Bhattacharya, D. K. (2004) Research Methodology, New Delhi, Excel Books.



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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	RM-102	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	Computer & Stats Application in Research		

### Objectives of the Course:

1. To appraise computational skills for research application.
2. To assess statistical method for research analysis.

### UNIT I

Characteristics of Computers, Evolution of computers, computer memory, computer generations, Basic computer organization; System software, Application software, introduction to operating system, single user, multi-user, multi-tasking single tasking, application of computer for business and research, MS-windows, Linux .Application of Internet in research : INFLIBNET, Use of Internet, sights (DOAJ), Use of E Journals, Use of E library, use of EBSCO HOST online database of Academic Libraries. Subject/field specific tools on [www.freeware.com](http://www.freeware.com)

### UNIT II

Computer Application in Research,. Basic concept of Computer, Use of Internet for Research Purpose: E-mail, WWW, Web browsing, technical skills, drawing inferences from data, Research publishing tools-MS Word, Adobe acrobat, Graphics tool-MS Excel, Presentation tool-MS Power, Data Analysis Software and Analysis Techniques point. Creating presentation and adding effects, Introduction to Data analysis software-SPSS: Definition, objectives and features, data analysis using SPSS.

### UNIT- III

Statistical methods for research application in analysis of data, Measurement in Research , data interpretation, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), std deviation, Measures of Relationship, Simple Regression Analysis, Correlation and Regression, Partial Correlation.

### UNIT-IV

Statistical Tools-Hypothesis and Hypothesis Testing: Parametric & Non-Parametric Tests, Important Parametric Tests ,Hypothesis Testing of Correlation Coefficients ,U Test, Chi Square Test, ,T-Test.Analysis of Variance (ANOVA) , The Basic Principle of ANOVA ,ANOVA Technique, Setting up Analysis of Variance Table, Short-cut Method for One-way ANOVA, Coding Method, Two-way ANOVA .

### Course Outcomes:

- CO1.** Acquire knowledge of concept of computer with application in Research.
- CO2.** Apply acquired knowledge of computer for presentation skills.
- CO3.** Acquire knowledge of statistical methods for Research.
- CO4.** Apply acquired knowledge to describe the inductive nature of quantitative data analysis.



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## Reference Books

1. C. R. Kothari, "Research Methodology: Methods and techniques", New Delhi: Vishwa Prakashan.
2. Brymann, Alan and Carmer, D. (1995) Qualitative data analysis for social scientist, New York, Routledge Publication.
3. Jain, Satish: "Introduction to Computer Science and basic Programming." BPB Publications, New Delhi, 1990. •  
Rajaraman, V., "Fundamental of Computers", Prentice Hall of India, New Delhi, 1996.





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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	RPE-103	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	<b>Research &amp; Publication Ethics</b>		

## Objectives of the Course:

Its objectives to provide knowledge about ethics and code of research publication with concept of plagiarism.

### UNIT I (Total Topics- 2 and Hrs-8)

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

### UNIT II (Total Topics- 5 and Hrs- 5)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

### UNIT- III (Total Topics-7 and Hrs-7)

1. Publication ethics: definition, introduction and importance
2. Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

### UNIT- IV (Total Topics-4 and Hrs-4)

#### Practice

##### Open Access Publishing

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/ Journal suggestion tools viz. JANE, Elsevier Journal finder, Springer Journal Suggester, etc.

**CO1.** Recognize the basics of philosophy of science & ethics, research integrity, publication ethics and theories of research ethics.

**CO2.** Familiarize with important issues in research ethics, research integrity, scientific misconduct and misinterpretation of data.

**CO3.** Analyze the best practices for publications, publication ethics and identify the predatory publishers & journals.

**CO4.** Demonstrate & use plagiarism software tools, open-source software tools, citation databases and



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research metrics.

**CO5.** Publish credible & scholarly publications in reputed peer-reviewed journals.

## **References-**

Research and Publication Ethics, Dr Sumanta Dutta, Bharti Publications, 2021

Research and Publication Ethics, Dr Santosh Kumar Yadav, Anne Publications, 2020



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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	RS- 105	Credit	2
Year/Sem	1/1	L-T-P	0-0-4
Course Name	<b>Seminar Presentation</b>		

### **Objectives of the Course:**

Main objective of this course is to develop presentation skills in the scholars and knowledge about review of literature so that they can review properly for utilisation in their research work.

**Seminar** Presentation-Candidate/Research Scholar has to go through the review of literature in the concerned field of research. Review of literature guidelines will be given by the concerned faculty/Dean of Department/School/College. Research Scholar has to prepare presentation on review of literature in the concerned field/ topic assigned by the department (DRC) periodically during course work. There will be minimum 3 presentations of review of literature during pre-Ph.D. course work.

- First presentation will be required in DRC/FRC for review of literature with concerned Department focus on area of research. It will be evaluated and assessment sheet will be sent from Department to Dean Research & Studies office.
- Similarly second presentation will be required by research scholar with extension of first presentation and more number of references would be added.

Internal & end term examination marks will be as per scheme. Each presentation is to be assessed by the department as per instructions from Dean-Research & Studies.

Final presentation would be required at the time of end term/sem. examination on proposed synopsis. General guidelines would be issued by Dean-Research for seminar presentation.

### **Course outcomes**

**CO1.** Research Scholar would be able to develop & explore the review of literature in concerned area.

**CO2.** Analyze review of literature critically for finding the research gap.

**CO3.** Apply acquired knowledge in making systematic seminar presentations.

**CO4.** Apply acquired knowledge for improving development of all-round research.



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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	AR-104	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	<b>Advanced Research &amp; Instrumentation Techniques</b>		

## Objectives of the Course:

1. To learn & apply concept of Thermogravimetric techniques in research.
2. To provide knowledge about spectroscopic techniques for research.

## UNIT I (Total Topics-12 and Hrs-12 )

### UV-Visible spectroscopy

Basic principle, Various electronic transitions Beer-Lambert law, effect of solvent on electronic transitions, molar extinction coefficient, concept of chromophores and auxochromes, bathochromic, hypsochromic, hyperchromic and hypochromic, UV spectra of conjugated enes and enones, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Woodward-Fiesher rules for conjugate dienes and carbonyl compounds.

### Infrared spectroscopy

Infra-red spectroscopy: Basic principle, Instrumentation Selection rules, fundamental modes of vibration, overtones, combination bands, Fermi resonance, Factors affecting IR spectra. Effect of hydrogen bonding, solvent effect on IR of gaseous, solids and polymeric Interactions with molecules: absorption and scattering. Means of excitation (light sources), detection of the signal (heat differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Interpretation of IR spectra of aliphatic, aromatic hydrocarbons, amines, amides, carbonyl compounds etc

## UNIT- II (Total Topics- 12 and Hrs-12 )

### NMR spectroscopy

Principle, Instrumentation, Factors affecting chemical shift, Uses of TMS equivalent and non-equivalent protons, chemical shifts, factors affecting chemical shifts, shielding of magnetic nuclei, deshielding, anisotropic effects in alkene, alkyne, aldehydes and aromatics, spin-spin coupling, coupling constant, chemical exchange, Simple applications, Interpretation of NMR spectra of aliphatic, aromatic hydrocarbons, carbonyl compounds etc.

### Thermal methods of analysis:

Thermal methods: Principle & application of Thermogravimetric analysis; TGA, DTA & DSC, DSC : Principle instrumentation and applications.



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## UNIT-III (Total Topics- 12 and Hrs- 12 )

**Microscopic Techniques:** Preparation of Thin-films, Physical vapor deposition, Evaporation Techniques-Sputtering (RF & DC), Spin Coating, Pulsed Laser deposition, Working Principle of X-ray Diffractometer, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning tunneling microscopy (STM), Introduction & application of Bio analytical techniques

## UNIT-IV (Total Topics- 12 and Hrs-12 )

**Physical instrumentation techniques:** Physical Properties: Introduction, & applications of different physical Characteristics: Viscosity, optical activity & conductivity, Instrumentation: Viscometer, pH meter, Refractometer, Polarimeter.

**CO-1: Inculcate knowledge about advanced techniques for physical parameters of materials.**

**CO-2: Apprise UV visible & Spectroscopic techniques.**

**CO-3: Learn interpretation of data used in spectroscopy analysis.**

**CO-4: Learn principle and method of microscopic & thermogravimetric techniques for characterisation of material for research.**

### Reference Books:

1. Spectroscopy of Organic Compounds, New Age International Publishers; PS Kalsi
2. Spectrometric Identification of Organic Compounds, John Wiley; Silverstein, Robert M.; Webster, Francis X.; Kiemle
3. Practical NMR Spectroscopy, ML Martin, JJ Delpach and GJ Martin, Heyden.
4. Fundamentals of Molecular Spectroscopy Colin N. Banwell and Elaine M. Mc Cash Tata McGraw Hill.
5. Introduction to NMR Spectroscopy: RJ Abraham, J Fischer and P Loftus, Wiley.
6. Spectroscopic Method in Organic Chemistry: DH Williams, I Fleming, Tata MacGraw Hill.
7. Instrumental Method of Analysis: Seventh Edition, Willard Merritt, Dean, Settle. CBS



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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	CH- 104(ii)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	<b>Advance Organic chemistry</b>		

## Objectives of the Course:

1. To provide knowledge about advanced organic.
2. To enhance the knowledge of organic reactions.

## UNIT I (Total Topics-19 and Hrs-12 )

### Selective organic name reactions and their synthetic applications:

Aldol, Knoevenagel, Cannizzaro, Perkin reaction, Clemmensen reduction, Diels Alder, Reformatsky reaction, Robinson's annulations, Shapiro reaction, Michael addition, Mannich reaction, Ene reaction, Barton reaction, Baylis-Hillman reaction, Hofmann-Löffler-Freytag reaction, Stork-enamine reaction, Peterson's reaction and Woodward-Prevost hydroxylation, Wolff Kishner reduction.

## UNIT II (Total Topics- 14 and Hrs- 12 )

### Molecular rearrangements:

(a) Rearrangements involving carbanions:

I. Favorskii rearrangement II. Sommelet-Hauser rearrangement III. Stevens rearrangement

(b) Rearrangement involving carbocations:

I. Baeyer-Villiger oxidation II. Demjanov rearrangement III. Wagner-Meerwein rearrangement

(c) Rearrangements involving electron-deficient nitrogen:

I. Hoffman rearrangement II. Curtius rearrangement III. Wolff rearrangement IV. Schmidt rearrangement V. Lossen rearrangement

(d) Miscellaneous molecular rearrangements:

I. Benzidine rearrangement II. Dienone-phenol rearrangement III. Grovenstein-Zimmerman rearrangement

## UNIT- III (Total Topics- 12 and Hrs-12 )

### Reagents in organic synthesis:

Preparation and use of following reagents in organic synthesis and functional group transformations: Lithium aluminium hydride (LAH), Dicyclohexylcarbodiimide (DCC), Diazomethane, Wittig reagent, Lithium diisopropylamide (LDA), Lithium dimethyl cuperate, DDQ, Trimethylsilyl Iodide, 1,3-dithiane, Wilkinson's catalyst, Baker yeast and Phase transfer catalyst.

## UNIT-IV (Total Topics- 12 and Hrs- 12 )

### Chromatographic separation techniques

Chromatography: Definition, general introduction Classification, basic principles, Adsorption and partition chromatography. Introduction, principle and application of paper chromatography, types of paper chromatography. Principle and applications of Thin layer chromatography. Introduction, principle and theory of column chromatography. Introduction and principles of HPLC, instrumentation of HPLC.

## UNIT-V (Total Topics- 12 and Hrs-12 )

### Organic Spectroscopy

General principles Introduction to absorption and emission spectroscopy. UV Spectroscopy: Types of electronic transitions,  $\lambda_{max}$ , Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of  $\lambda_{max}$  for the following systems:



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$\alpha,\beta$  unsaturated aldehydes, ketones Conjugated dienes: alicyclic, homoannular and heteroannular. IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis. NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing shifts Spin – Spin coupling and coupling constant

**CO-1: Learn about various organic name reactions and their synthetic applications.**

**CO-2: Knowledge of various molecular rearrangements and Reagents in organic synthesis will be provided to students.**

**CO-3: Illustrate Chromatographic separation techniques and learn about general principle of absorption and emission spectroscopy**

**Reference Books:**

1. Spectroscopy of Organic Compounds, New Age International Publishers; PS Kalsi
2. Spectrometric Identification of Organic Compounds, John Wiley; Silverstein, Robert M.; Webster, Francis X.; Kiemle
3. Reactions & Reagents, OP Agarwal, Vol-3, Pragati Prakashan Meerut, 2011
4. Organic chemistry by I.L. Finar
5. Organic chemistry by Morrison Boyd
6. Elementary organic spectroscopy by Y.R. Sharma
7. H. Kaur, Instrumental methods of chemical analysis, Pragati Prakashan
8. Gurdeep R. Chatwal, Sham K. Anand. Instrumental methods of chemical analysis, Himalaya Publishing House.



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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	CH -104(iii)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	<b>Biofuels</b>		

## Objectives of the Course:

To assess the methods of Biofuel with basic concept for application in research.

### UNIT I(Total Topics-7 and Hrs- 10 )

#### Production of bioethanol

Raw materials and pretreatment processes. Enzymatic hydrolysis of cellulose and hemicelluloses. Fermentation of monosaccharides. Types of Reactor. Use of Bioethanol.

### UNIT II(Total Topics-6and Hrs-10 )

#### Production of biodiesel

The transesterification reaction Raw materials and pretreatment processes. Separation and purification stages Qualities of biodiesel.

### UNIT- III (Total Topics- 7 and Hrs-10 )

#### Biogas and Biohydrogen

Anaerobic digestion, Anaerobic digestion, Bioreactors for the production of biogas and scope. Production of biohydrogen by dark fermentation and photo-fermentation.

### UNIT-IV (Total Topics- 8 and Hrs-10 )

#### UV-VIS. Spectroscopy

UV-VIS. Spectroscopy - Electromagnetic spectrum, Basic Principle of Spectroscopy, Lambert Beer Law, Absorption and transmission, Energy Level Transitions In Spectroscopy, UV and Visible Spectroscopy and its Instrumentation.

### UNIT-V (Total Topics- 5 and Hrs-10 )

#### Unit- Infra-red Spectroscopy

Principles of Infra-red and Near Infra-red (NIR) Spectroscopy. Fundamental modes of vibration, Instrumentation and simple Applications.

**CO-1: Learn production of biogas, biohydrogen, biodiesel and bioethanol.**

**CO-2: Knowledge of pre-treatment, transesterification, anaerobic digestion and other processes will be given.**

**CO-3: Inculcate knowledge about UV-Vis and Infrared Spectroscopy.**

## Reference Books:-

1. Bioenergy and Biofuel from Biowastes and Biomass, ACEBooks, Edited by Samir K. Khanal; ISBN





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(print): 978-0-7844-1089-9ISBN (PDF): 978-0-7844-7330-6,2010.

2. Handbook of Biofuels Production, Elsevier,2010.
3. Green Nanotechnology for Biofuel Production,Book, Editor-Pramod W. Ramteke, Himanshu Pandey, Neha Srivastava, Manish Srivastava, P. K. Mishra 2018.