



**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) Session 2021-22(Odd Semester)



**Course Structure of the Pre-Ph.D (Chemistry) Course Work:
Applicable for Batch: 2021-22 (Odd Semester)**

SCHEME OF EXAMINATION

Ph.D(Chemistry)

(Effective from Academic Year 2021-22) Odd Semester

Under Choice Based Credit System (CBCS)

**Course Structure of the Pre-Ph.D (Chemistry) Course Work:
Applicable for Batch: 2021-22**

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
Courses											
1.	RM-101	Research Methodology & Computer Application	5	4	1	0	20	20	40	60	100
2.	CHY-102	Discipline Specific Electives (Chemistry)	5	4	1	0	20	20	40	60	100
3.	RLS-103	Review of Literature & Seminar Presentation	4	0	0	8	20	20	40	60	100
4.	RPE-104	Research & Publication Ethics	2	2	0	0	20	20	40	60	100
		Total	16	10	2	8	80	80	160	240	400

List of Electives

S. No.	Course Code	Course Name
1	CHY 102 (i)-	Advanced Instrumentation
2	CHY 102 (ii)-	Advanced Organic Chemistry
3	CHY 102 (iii)-	Biofuels



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SYLLABUS

of

Ph.D(Chemistry)



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	RM-101	Credit	5
Year/Sem	1/1	L-T-P	4-1-0
Course Name	Research Methodology & Computer Application		

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 like statistical methods and computer skills.

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.

UNIT-IV (Total Topics- 7 and Hrs- 10)

Statistical Tools / Methods for research – Univariate and Bivariate Analysis. Hypothesis and Hypothesis Testing: Parametric & Non-Parametric Tests, Correlation and Regression, U Test, Mean Deviation & Standard Deviation, Concept of Permutation, Combination & Probability, Chi Square Test, T-Test.

UNIT-V (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.

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



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ChavaNachmias, "Research Methods in the Social Sciences", New York: St.Marlia's Press.

5. C. R. Kothari, "Research Methodology: Methods and techniques", New Delhi: Vishwa Prakashan.
6. Bhattacharya, D. K. (2004) Research Methodology, New Delhi, Excel Books.
7. Brymann, Alan and Carmer, D. (1995) Qualitative data analysis for social scientist, New York, Routledge Publication.



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	CHY -102(i)	Credit	5
Year/Sem	1/1	L-T-P	4-1-0
Course Name	Advance Instrumentation		
Objectives of the Course:			
<ol style="list-style-type: none"> 1. To learn & apply concept of Chromatography & Thermogravimetric techniques in research. 2. To provide knowledge about spectroscopic techniques for research. 			
UNIT I (Total Topics-12 and Hrs-12)			
Chromatographic Methods of Analysis : Classification, basic principles of chromatography, theories of chromatography, plate theory and rate theory, retention factor, retention time, distribution partition coefficient. HPLC: Principle and instrumentation of HPLC, pumping systems used in HPLC, types of detectors used in HPLC. Gas Chromatography: Theory of gas chromatography, parts of gas chromatograph.GC-MS			
UNIT II (Total Topics- 14 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 chromospheres 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.			
UNIT- III (Total Topics- 12 and Hrs-12)			
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-IV (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.			



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

Thermal methods of analysis:

Thermal methods: Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture. DTA Principle instrumentation and application.

DSC : Principle instrumentation and applications.

Scanning electron Microscopy: Introduction, principle and application.

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 Delpeach 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	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	CHY- 102(ii)	Credit	5
Year/Sem	1/1	L-T-P	4-1-0
Course Name	Advance Organic chemistry		

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 cuprate, 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, λ_{max} , Chromophores and Auxochromes, Bathochromic and Hypsochromic



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shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ_{\max} for the following systems: α,β 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

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 Agarawal, 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	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	CHY -102(iii)	Credit	5
Year/Sem	1/1	L-T-P	4-1-0
Course Name	Biofuels		

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-6 and 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.

Reference Books:-

1. Bioenergy and Biofuel from Biowastes and Biomass, ACE Books, Edited by Samir K. Khanal; ISBN (print): 978-0-7844-1089-9 ISBN (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.



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	RLS- 103	Credit	4
Year/Sem	1/1	L-T-P	0-0-8
Course Name	Review of Literature and Seminar Presentation		

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.

Review of Literature and 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.

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.

For Internal & end semester examination marks will be as per scheme. Each presentation is to be assessed for 10 marks in department.



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	RPE-104	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	Research & Publication Ethics		

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- 3)

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.



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References-

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

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