



UTTARANCHAL
UNIVERSITY

UTTARANCHAL UNIVERSITY

Arcadia Grant, P.O. Chandanwari, Premnagar, Dehradun,
Uttarakhand-248007, INDIA

Detailed Course Structure & Syllabus of

**Pre Ph.D. (Chemistry)
Course Work
(As per CBCS system)**

Session: 2019-20 (Even)



Course Structure & Syllabus of Pre Ph.D. (Chemistry)
Session: 2019-20 (Even)

EVALUATION SCHEME
Pre Ph.D. (Chemistry)
Course Work

Course Structure & Syllabus of Pre Ph.D. (Chemistry)
Session: 2019-20 (Even)

Scheme of Pre-Ph.D. Course Work

S. No	Course Code	Course Name	Credits	Evaluation - Scheme								
				Period			Sessional			Examination		
				L	T	P	CT-I	CT-II	Total	ESE	Sub. Total	
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	5	0	0	10	20	20	40	60	100	
4.	RPE-104	Research & Publication Ethics	2	2	0	0	20	20	40	60	100	
Total			17	10	2	10	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 (ii)	Biofuels



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RM 101: Research Methodology

Course Objectives:

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

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

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

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

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.



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UNIT-V

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.

Text Readings

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. 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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CHY 102 (i)- Advanced Instrumentation

Course Objectives:

1. To understand Chromatographic, UV-Visible, IR, NMR and thermal techniques for characterisation of materials in research.
2. To apply analytical techniques for application in chemical research.

Unit 1

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-MS.

Unit 2

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.

Unit 3

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 4

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,



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aldehydes and aromatics, spin-spin coupling, coupling constant, chemical exchange, Simple applications, Interpretation of NMR spectra of aliphatic, aromatic hydrocarbons, carbonyl compounds etc.

Unit 5

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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CHY 102 (ii)- Advanced Organic Chemistry

Course Objectives:

1. To understand specific organic reactions with mechanism with application for compounds synthesis.
2. To apply organic spectroscopic techniques for application in chemical research.

UNIT-I

Selective organic name reactions and their synthetic applications

Aldol, Knoevenagel, Canizzaro, Perkin reaction, Clemmensen reduction, Diels Alder Reformatsky reaction, Robinson's annulation, 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

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

Reagents in organic synthesis

Preparation and use of following reagents in organic synthesis and functional group transformations: Lithium aluminium hydride (LAH), Dicyclohexyl carbodiimide (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.



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UNIT-IV

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

Organic Spectroscopy

General principles Introduction to absorption and emission spectroscopy. UV Spectroscopy: Types of electronic transitions, λ_{\max} , Chromophores and Auxochromes, Bathochromic and Hypsochromic 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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CHY 102 (iii)- Biofuels

Course Objectives:

1. To provide basic and advance concept of biofuel with its characterisation.
2. To apply spectroscopic techniques for application in biofuel.

Unit-1 Production of bioethanol

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

Unit-2 Production of biodiesel

The transesterification reaction Raw materials and pre-treatment processes. Separation and purification stages Qualities of biodiesel.

Unit-3 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-4 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- Infra-red Spectroscopy

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

References: -

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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RLS-103: Review of Literature and Seminar Presentation

Course Objectives:

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 in the concerned field.

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



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RPE-104: Research Publication & Ethics

Course Objectives-

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

Unit 1: Philosophy and Ethics

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

Unit 2: Scientific conduct

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

RPE 03: Publication Ethics

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

Practice

Open Access Publishing

Uttaranchal University-Syllabus of Pre Ph.D. (Chemistry) (Session: 2019-20 (Even))



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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.