National Education Policy-2020

Common Minimum Syllabus for Uttarakhand State Universities and Colleges

SKILL ENHANCEMENT COURSES SYLLABUS

w.e.f. 2025-2026

DEPARTMENT OF CHEMISTRY
KUMAUN UNIVERSITY, NAINITAL

HEAD
DEPARTMENT OF CHEMISTRY
KUMAUN UNIVERSITY NAINITAL

Dean
Faculty of Science
Kumaun University
Nainital

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12.	Miss. Anchal Aneja	Assistant Professor (Guest)	Chemistry	Kumaun University Nainital
13	Dr. Akanksha Rani	Assistant Professor (Guest)	Chemistry	Kumaun University Nainital
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Contents

List of Papers (SEC) with Semester Wise Titles for 'Chemistry'					
Year	**Semester**	**Course**	**Paper Title**	**Theory/Practical**	**Credits**
Undergraduate Certificate in Chemistry					
FIRST YEAR	I	SEC 1	Applied Aspects of Chemistry I: Introduction to Chemistry Laboratory	Theory	1
		SECP 1	Foundational Laboratory Skills in Chemistry	Practical	1
	II	SEC 2	Applied Aspects of Chemistry II: Laboratory Techniques	Theory	1
		SECP 2	Reagent Preparation and Quality Control in Laboratory Settings	Practical	1
Undergraduate Diploma in Chemistry					
SECOND YEAR	III	SEC 3	Applied Aspects of Chemistry III: Cosmetics and Perfume	Theory	1
		SECP 3	Essential Oils and Skin Care Products: Extraction, and Product Development	Practical	1
	IV	SEC 4	Applied Aspects of Chemistry IV: Soaps and Detergents	Theory	1
		SECP 4	Soap and Detergent Formulation: Principles and Applications	Practical	1
Bachelor of Chemistry					
THIRD YEAR	V	SEC 5	Applied Aspects of Chemistry V: UV and FTIR Spectroscopy	Theory	1
		SECP 5	Spectroscopy in Action: UV-Vis and IR Spectroscopy Experiments	Practical	1
	VI	SEC 6	Applied Aspects of Chemistry VI: HPLC and GC Techniques	Theory	1
		SECP 6	Instrumental Analysis: HPLC and GC Techniques	Practical	1

SKILL ENHANCEMENT COURSE (SEC)
Applied Aspects of Chemistry I: Introduction to Chemistry Laboratory

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC: Skill Development Course: Applied Aspects of Chemistry I: Introduction to Chemistry Laboratory	2	1	-	1	Passed Class XII	Nil

LEARNING OBECTIVES

- To acquire the knowledge about general safety rules and cautions while working in chemistry laboratory.
- To acquire the knowledge about the general apparatus and glasswares used in chemistry laboratory.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- Have a basic information about the general safety measures and cautions for working in chemistry laboratory.
- Have the knowledge about the glasswares and laboratory apparatus.

UNIT-WISE SYLLABUS (TOTAL: 15 HOURS)

UNIT I: INTRODUCTION: CHEMISTRY LABORATORY (5 HOURS)

- General introduction to chemistry lab, safety rules and precautions in chemistry laboratories, storage, ventilation, lighting.
- Fumes, cupboards, hazards, maintenance of laboratory, definition of equipment/apparatus, cleaning of laboratories, apparatus and preparation room.

UNIT II: LAB APPARATUS (10 HOURS)

(A) Glass apparatus:

- Beaker, test tube, boiling tube, conical flask, filtration flask, round bottom flask, flat bottom flask, funnel, separating funnel, watch glass.
- Measuring cylinder, Petridish, desiccator, measuring cylinder, glass rod, and glass tube.

(B) Volumetric and Heating apparatus:

Volumetric flask, burette, analytical balance, electronic balance, Bunsen burner, water bath, hot air oven, heating mantle.

(C) Miscellaneous apparatus:

-Buchner funnel, burner, test tube stand, tong, burette stand, clamp, china dish, wire gauze, cork, vacuum pumps, crucibles, clay pipette, pestle and mortar, spatulas, thermometer.

- pH meter, Kipp's apparatus.

ESSENTIAL READINGS/RECOMMENDED READINGS

- R. Tatchell, "Vogel's Textbook of Practical Organic Chemistry", Pearson Education.
- Willard, H. Hobert, L. L. Merritt, J. Dean, F. A. Settoe, "Instrumental Methods of Analysis", CBS Publishers & Distributors.
- D. Gary Christian, "Analytical Chemistry", John Wiley & Sons.
- Harris and C. Daniel, "Quantitative Chemical Analysis", W. H. Freeman.
- S. M. Khopkar, "Basic Concepts of Analytical Chemistry", New Age International.
- D. A. Skoog, D. M. W. Holler, "Fundamentals of Analytical Chemistry", Cengage Learning

USEFUL WEB LINKS

http://chemcollective.org/vlabs
https://www.vlab.co.in/broad-area-chemical-sciences

PROBABLE JOB ASPECTS IN INDUSTRIES

- Lab Technician
- Lab Assistant

SECP 1 Foundational Laboratory Skills in Chemistry

TOTAL: 30 HOURS

LEARNING OUTCOMES

These practicals introduce students to the chemistry laboratory, lab apparatus, and essential techniques, ensuring a solid foundation for future experiments.

EXPERIMENTS

1. To investigate various types of apparatus in laboratory based on material they are made up of.
2. To carry out calibration of volumetric/graduated glasswares.
3. To carry out a detailed study for various heating equipments in laboratory eg. Burner, oven, hot plate, heating mantle etc.
4. To calibrate pH meter.
5. Preparation of H_2S gas using Kipps' apparatus.
6. To learn the process of filtration and separation using separatory funnel for heterogeneous mixtures.
7. To determine the melting point of a given solid.

Note: Allocation of marks: External assessment: Total marks: 75. Attempt any two experiments. Each carries 30 marks; Viva: 15; Internal assessment: 25

Semester-II
Undergraduate Certificate (in the Field of Multidisciplinary Study)

SKILL ENHANCEMENT COURSE (SEC)
Applied Aspects of Chemistry II: Laboratory Techniques

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC: Skill Development Course: Applied Aspects of Chemistry I: Laboratory Techniques	2	1	-	1	Passed Applied Aspects of Chemistry-I	Nil

LEARNING OBECTIVES

- To have a knowledge of reagents used in the chemistry laboratory.
- To acquire the knowledge of preparing the standard solutions.

LEARNING OUTCOMES

- After studying this course, the students will become familiar with the types of reagents used in chemistry laboratory.
- The students will become competent in preparing the primary and secondary standard solutions.

UNIT-WISE SYLLABUS (TOTAL: 15 HOURS)

UNIT I: LABORATORY REAGENTS AND SOLVENTS (06 HOURS)

- Classification of reagents according to their action: (i) acids (ii) bases (iii) salts (iv) complexing agents (v) oxidizing and reducing agents (vi) precipitating agents (vii) Chelating agents, each type to be explained with at least one suitable example. Fumes, cupboards, hazards, maintenance of laboratory, definition of equipment/apparatus, cleaning of laboratories, apparatus and preparation room.

UNIT II: PRIMARY AND SECONDARY STANDARDS (09 HOURS)

- Definition, characteristics, uses examples for different types of reactions. Each type is to be explained with at least one example.
- Solvents: Solute, Solvent & Solution, classification of solvents (i) Protic and aprotic (ii) Acidic, basic amphiprotic and neutral (iii) Aqueous and non-aqueous (iv) Polar and non polar. Each type is to be explained with at least one example.

ESSENTIAL READINGS/RECOMMENDED READINGS

- Ajay Kr. Gupta, "Handbook on Soaps, Detergents & Acid Slurry", Asia Pacific Business Press Inc.
- P.K. Chattopadhyay, "Modern Technology of Soaps, Detergents & Toiletries", Asia Pacific Business Press Inc.

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- H. Panda, "Herbal Soaps & Detergents Handbook", Asia Pacific Business Press Inc.

USEFUL WEB LINKS

https://onlinecourses.swayam2.ac.in/cec23_cy04/preview

PROBABLE JOB ASPECTS IN INDUSTRIES

- Lab Technician
- Lab Assistant

SECP 2 Reagent Preparation and Quality Control in Laboratory Settings

TOTAL: 30 HOURS

LEARNING OUTCOMES

These practicals help students understand the importance of laboratory reagents, primary and secondary standards, and their applications in various chemical analyses.

EXPERIMENTS

1. Differentiate between acids and bases using pH paper/pH meter.
2. To make saturated solution of given salts at room temperature and show solubility behavior in temperature.
3. Differentiate between organic and inorganic compounds on the basis of solubility.
4. To prepare primary and secondary standard solutions.
5. To determine pH value of a given solution.
6. To differentiate between aqueous and non-aqueous solvents using miscibility test.
7. To differentiate between protic and aprotic solvents using iodine test.

Note: Allocation of marks: External assessment: Total marks: 75. Attempt any two experiments. Each carries 30 marks; Viva: 15; Internal assessment: 25

Semester-III
Undergraduate Diploma (in the Field of Multidisciplinary Study)

SKILL ENHANCEMENT COURSE (SEC)
Applied Aspects of Chemistry III: Cosmetics and Perfumes

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC: Skill Development Course: Applied Aspects of Chemistry III: Cosmetics and Perfumes	2	1	-	1	Passed Applied Aspects of Chemistry-II	Nil

LEARNING OBJECTIVES

- To acquire the knowledge of essential oils extracted from aromatic plants.
- To provide hands-on training on thin layer chromatography and detection of essential oil samples.
- To gain the knowledge and hands-on formulations of skin care products.

LEARNING OUTCOMES

- After studying this course, the students will be able to understand the methods of extraction of essential oils.
- This course will enhance the knowledge of the students about the chemical compositions and sources of essential oils with reference to Uttarakhand.
- The course will also enlighten the students about the Government schemes in the relevant field.
- The course will produce employable students who can be taken readily in the cosmetics and essential oil industries.

UNIT-WISE SYLLABUS (TOTAL: 15 HOURS)

UNIT I: EXTRACTION OF ESSENTIAL OILS (07 HOURS)

- Methods of extractions: steam distillation, hydro-distillation, solvent extraction, Details of assembly for each method and limitations of the methods.
- Chromatographic techniques: Thin Layer Chromatography (TLC)- Preparation of TLC plates, Sampling and detection methods of essential oil samples.
- Use of essential oils in cosmetics, food and beverage industries, day-care products, aromatherapy and health care.

UNIT II: SKINCARE PRODUCTS (09 HOURS)

- Introduction and classification of skincare products.
- Chemical and herbal products: Creams: Introduction, Types of creams- Foundation cream, vanishing cream, hand cream, body cream, night cream, massage cream. Ingredients and methods of preparation of face cream, cold cream, sun tan creams.
- Powder: Introduction, ingredients and methods of preparation of face powder and body powder.
- Colourants: Introduction and ingredients of lipsticks, rouges, Sun tan products: Palliative, simulative. Quality control.

ESSENTIAL READINGS/RECOMMENDED READINGS

- Earnest Guenther, "The Essential Oils", D. Van Nostrand Company.
- Paul Z. Bedoukian, "Perfumery and Flavouring Synthetics", Chemical Publishing Co., Inc.
- Billot, Mareel, F. V. Wells, "Perfumery Technology", D. Van Nostrand Company.
- H. Panda, "Perfumes and Flavours Technology Handbook", Asia Pacific Business Press Inc.

USEFUL WEB LINKS

https://iisdt.in/product/diploma-in-aroma-therapy/
https://perfumeclasses.com/wp-
https://www.tutorialsduniya.com/notes/chemistry-of-cosmetics-perfumes-notes
https://www.tutorialsduniya.com/notes/chemistry-of-cosmetics-perfumes-notes

PROBABLE JOB ASPECTS IN INDUSTRIES

- Technicians in cosmetic and perfume industry.
- Junior Chemist
- Marketing officer

SECP 3 Essential Oils and Skin Care Products: Extraction, and Product Development

TOTAL: 30 HOURS

LEARNING OUTCOMES

These practicals help students understand the extraction methods for essential oils and their applications in skin care products, promoting hands-on experience with natural product development.

EXPERIMENTS

1. To extract essential oil from aromatic plants by hydrodistillation or steam distillation
2. Preparation and monitoring of TLC plates using different visualizing stains.
3. To Monitor the essential oils using TLC.
4. To prepare herbarium of Himalayan herbs.
5. Collection of plant samples and their preservation
6. To prepare plant extract in various solvents.
7. Preparation of herbal lip balm.

Note: Allocation of marks: External assessment: Total marks: 75. Attempt any two experiments. Each carries 30 marks; Viva: 15; Internal assessment: 25

Semester-IV
Undergraduate Diploma (in the Field of Multidisciplinary Study)

SKILL ENHANCEMENT COURSE (SEC)
Applied Aspects of Chemistry IV: Soaps and Detergents

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Prerequisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC: Skill Development Course: Applied Aspects of Chemistry IV: Soaps and Detergents	2	1	-	1	Passed Applied Aspects of Chemistry -III	Nil

LEARNING OBJECTIVES

- To learn about general methods of synthesis of herbal soaps.
- To understand the formulations of detergents.
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LEARNING OUTCOMES

- After studying this course, the students will be capable to formulate both general and herbal soaps.
- The students will able to prepare various detergents both general and herbal.

UNIT-WISE SYLLABUS (TOTAL: 15 HOURS)

UNIT I: FORMULATION OF SOAPS (05 HOURS)

- Introduction, raw materials and its selection, principles of soap making methods**.** Ingredients and methods of preparation of face soap, toilet soap and bathing soap.
- Chemistry and properties imparted by the ingredients.

UNIT II: FORMULATION OF DETERGENTS (10 HOURS)

- Types and properties of detergents, classification (anionic, cationic, nonionic), components of detergents (surfactants, additives, builders) biodegradability.
- Synthetic detergents: Introduction, chemical characteristics of synthetic detergents, general method to making synthetic detergents
- Ingredients and methods of preparation of dish-wash bar. Chemistry and properties imparted by the ingredients.

ESSENTIAL READINGS/RECOMMENDED READINGS

- S. K. Singh, "Handbook on Cosmetics", Asia Pacific Business Press Inc.
- S. Nanda, A. Nanda, R. K. Khar, "Cosmetic Technology", CBS Publishers & Distributors.

- Barel, M. Paye, H. I. Maibach, "Handbook of Cosmetics Science and Technology", CRC Press.
- M. S. Balsem, S. D. Genshon, M. M. Rieger, E. Sagarin, S. J. Strianase, "Cosmetics", Chemical Publishing Co., Inc.
- F. Williams, W. H. Schmitt, "Chemistry and Technology of the Cosmetics and Toiletries Industry", Springer.
- R. G. Harry, "Harry's Cosmeticology", Chemical Publishing Co., Inc.
- N. Board, "Handbook on Herbal Products (Medicines, Cosmetics, Toiletries, Perfumes)", Asia Pacific Business Press Inc.

USEFUL WEB LINKS

https://www.slideshare.net/anujames9066/skin-care-product-ppt

https://www.slideshare.net/joanvijetha/skin-care-cosmetics

https://pharmacy.hebmu.edu.cn/trywhx/resources/43/2019624163611.pdf

PROBABLE JOB ASPECTS IN INDUSTRIES

- Opportunities for self-employment and start-ups.
- Chemists in soap and detergent industries.

SECP 4 Soap and Detergent Formulation: Principles and Applications

TOTAL: 30 HOURS

LEARNING OUTCOMES

These practicals help students understand the formulation principles and properties of soaps and detergents, promoting hands-on experience with surfactants and cleaning products.

EXPERIMENTS

1. To prepare herbal soaps.
2. Preparation of Dish washing bars.
3. To measure the pH of soaps using pH meter/pH strips
4. To measure the pH of detergent using pH meter/pH strips.
5. Compare the acidic and basic behavior of soaps and detergents.

Note: Allocation of marks: External assessment: Total marks: 75. Attempt any two experiments. Each carries 30 marks; Viva: 15; Internal assessment: 25

Semester-V
Bachelor of (in the Field of Multidisciplinary Study)

SKILL ENHANCEMENT COURSE (SEC)
Applied Aspects of Chemistry V: UV and FTIR Spectroscopy

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THECOURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC: Skill Development Course: Applied Aspects of Chemistry V: UV and FTIR Spectroscopy	2	1	-	1	Passed Applied Aspects of Chemistry-IV	Nil

LEARNING OBJECTIVES

- To learn about the working principle and instrumental handling of UV and FTIR spectroscopy.
- To introduce learners these techniques in structure elucidation.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- Understand the theoretical as well as practical aspects of UV and IR spectroscopic techniques.
- To apply these spectroscopic techniques in structure elucidation.
- The course will produce a well-trained high-level manpower that can meet the demands of the modern and devolving society and complete globally with their peers in chemical sciences.

UNIT-WISE SYLLABUS (TOTAL: 15 HOURS)

UNIT I: ULTRAVIOLET (UV)-VISIBLE (VIS) SPECTROSCOPY (07 HOURS)

- Hardware and software knowledge of UV, instrument handling, sample testing. presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, concept of chromophore and auxochrome.
- Bathochromic, hypsochromic, hyperchromic and hypochromic shifts.
-

UNIT II: INFRA-RED (IR) SPECTROSCOPY (08 HOURS)

- Hardware and software knowledge of IR, Basic understanding of instrumentation, Demonstration experiment on IR.
- Measurement of IR spectrum, finger print region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

ESSENTIAL READINGS/RECOMMENDED READINGS

- D. Pavia, G. Lampman, G. Kriz, "Introduction to Spectroscopy", Thomson Learning, Boton.
- C. N. Banwell, E. M. Mccash, "Fundamentals of Molecular Spectroscopy"
- Y. R. Sharma, "Elementary Spectroscopy", S. Chand & Company Pvt. Ltd.
- P.S. Kalsi, Spectroscopy of Organic Compounds, New Age International Publishers.
- Robert M. Silverstein, Francis X. Webster, Kiemle, "Spectrometric Identification of Organic Compounds", Wiley.

USEFUL WEB LINKS

https://www.youtube.com/watch?v=v_R6dXyxRI4
https://www.youtube.com/watch?v=tz0BrCqPTV0
https://www.youtube.com/watch?v=EnB7aw7lGxg
https://www.youtube.com/watch?v=GGFKwxOZHt8

PROBABLE JOB ASPECTS IN INDUSTRIES

- Analyst in related R & D laboratories
- Technical Assistant in Quality Control Units

SECP 5 Spectroscopy in Action: UV-Vis and IR Spectroscopy Experiments

TOTAL: 30 HOURS

LEARNING OUTCOMES

These practicals help students understand the principles and applications of UV-Vis and IR spectroscopy, promoting hands-on experience with spectroscopic techniques.

EXPERIMENTS

1. To measure the UV-Visible absorption spectrum of given compound.
2. To learn the calibration of UV-visible spectrophotometer.
3. To learn the calibration of IR instrument.
4. To determine the concentration of a substance using UV-visible spectroscopy.
5. To identify functional group in given compounds using IR spectroscopy.

Note: Allocation of marks: External assessment: Total marks: 75. Attempt any two experiments. Each carries 30 marks; Viva: 15; Internal assessment: 25

Semester-VI
Bachelor of (in the Field of Multidisciplinary Study)

SKILL ENHANCEMENT COURSE (SEC)
Applied Aspects of Chemistry VI: HPLC and GC Techniques

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC: Skill Development Course: Analytical Techniques: HPLC and GC	2	1	-	1	Passed Applied Aspects of Chemistry -VI	Nil

LEARNING OBJECTIVES

- To gain knowledge on the techniques used in R & D labs.
- To learn samples testing using HPLC and GC techniques.

LEARNING OUTCOMES

Upon successful completion of this course, the students will be able to:
- Understand the chromatographic methods and their industrial applications.
- Gain a comprehensive understanding of various chromatographic techniques.
- Master the theory and practice of gas chromatography.
- Understand the features and instrumentation of high-performance liquid chromatography (HPLC) and its applications.

UNIT-WISE SYLLABUS (TOTAL: 15 HOURS)

UNIT I: HPLC- HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (08 HOURS)

- Introduction to HPLC, principle, normal and reversed phase HPLC
- Instrumentation, types of columns and solvents, types of detectors.
- Experimental handling of HPLC, sample preparation and analysis.
- Applications of HPLC as an analytical tool.

UNIT II: GAS CHROMATOGRAPHY (07 HOURS)

- Introduction of GC, principle.
- Instrumentation, types of columns and detectors (TCD, ECD, FID).
- Experimental handling of GC, sample preparation and analysis.
- Application of GC as an analytical tool.

ESSENTIAL READINGS/RECOMMENDED READINGS

- John R. Dean, “Extraction Techniques in Analytical Sciences”, Wiley.
- McNair, Harold M. James M. Miller, Nicholas Snow, “Basic Gas Chromatography”, Wiley.

USEFUL WEB LINKS

- https://lab-training.com/wp-content/uploads/2014/11/HPLC-E-Book.pdf
- https://www.youtube.com/watch?v=9KkcioAoO-Y
- https://nptel.ac.in/courses/103108100

PROBABLE JOB ASPECTS IN INDUSTRIES

- Analyst in related R & D laboratories
- Technical Assistant in Quality Control Units

SECP 6 Instrumental Analysis: HPLC and GC Techniques

TOTAL: 30 HOURS

LEARNING OUTCOMES

These practicals help students understand the principles, instrumentation, and applications of HPLC and GC, promoting hands-on experience with chromatographic techniques.

EXPERIMENTS

1. To learn the calibration of GC instrument.
2. To learn the calibration of HPLC.
3. To analyze GC chromatograms of known compounds and determine retention time.
4. To separate mixture of volatile compounds using GC.
5. Presentation on GC/HPLC techniques.

Note: Allocation of marks: External assessment: Total marks: 75. Attempt any two experiments. Each carries 30 marks; Viva: 15; Internal assessment: 25