The following course structure under FYUP for Multidisciplinary programmes is designed for subjects which have practical based courses or have relatively larger emphasis on practical course-based learning.

[w.e.f. ACADEMIC SESSION 2025-26]

(For Practical based subjects)

First Year – NHEQF Level- 4.5

Course Category	Semester-I					Semester-II			
	Subject/Title	No. of paper	Credits			Subject /Title	No. of paper	Credits	
			T	P				T	P
Discipline Specific core	DSC Subject-I (Major)	1	2	2		DSC Subject-I (Major)	1	2	2
	DSC Subject-II (Minor)	1	2	2		DSC Subject-II (Minor)	1	2	2
M.D/I.D Subject-1	M.D/ I.D-I	1	2	2		M.D/I.D-II	1	2	2
M.D/I.D. Subject-1	M.D/ I.D-I	1	2	2		M.D/I.D-II	1	2	2
SEC/VAC	Field work/SEC/ Communication Skills Or AMSC/Field Work/SEC	1	2	-		AMSC/Field Work/SEC Or Field work/ SEC/ Communication Skills	1	2	-
VAC	Understanding and connecting with environment Or Life Skills & personality development	1	2	--		Understanding and connecting with environment Or Life Skills & personality development	1	2	-
Total		6	12	8			6	12	8
NHEQF Level 4.5	*Student on exit after successfully completing first year (i.e., securing minimum required 40 credits + 4 Credits in one Vocational Course/Skill-Enhancement Course of 4 credits) will be awarded "Undergraduate Certificate" of one year, in related field/discipline/subject.*								

☎ The student may opt for any one course from Field Work/ Skill Enhancement Course (SEC)/ Communication Skills in one semester, and any one course from Additional Multidisciplinary Skill Course (AMSC)/ Field Work/ Skill Enhancement Course (SEC) in the other semester. ☎ Field Work/Discipline Specific Skill Enhancement Course (SEC): Studeny may opt SEC/Field Work related to any discipline subject opted by her/him as a DSC in the first year. ☎ Field Work: In addition to providing students with practical, experience-based learning, field work aims to expose them to real-world socio-economic and societal challenges, allowing them to bridge the gap between theory and practice and develop effective solutions to real-life problems. ☎ AMSC: Additional Multidisciplinary Skill Course (is offered as SEC) Following courses are offered under AMSC, University may add new courses under AMSC in future: 1. Plant Nursery Development and Management 2. Basic Yoga Practices 3. Physical Education and Sports Management 4. Regional Folklores and their Cultural Context 5. Indian Traditional Music 6. Tour and Travel Operations ☎ Communication Skills (AEC): 'Communication Skills' course will be offered in Hindi, English and Sanskrit Languages, student may opt any one language for studying the course ☎ Life Skill & Personality Development (VAC) ☎ Understanding and Connecting with Environment (VAC)

Course structure of Chemistry
First Year – NHEQF Level- 4.5 [w.e.f. ACADEMIC SESSION 2025-26]

Course Category	Semester-I				Semester-II			
	Subject/Title	No. of paper	Credits		Subject /Title	No. of paper	Credits	
			T	P			T	P
Discipline Specific core	Chemistry (Major)	1	2	2	Chemistry (Major)	1	2	2
	OR Chemistry (Minor)	1	2	2	OR Chemistry (Minor)	1	2	2
M.D/I.D Subject-1	M.D/ I.D-I Environmental Chemistry	1	2	2	M.D/ I.D-I Environmental Chemistry	1	2	2
M.D/I.D. Subject-1	M.D/ I.D-I	1	2	2	M.D/I.D-II	1	2	2
SEC/VAC	Basic Analytical Chemistry-I	1	2	-	Basic Analytical Chemistry-II	1	2	-
VAC	Understanding and connecting with environment Or Life Skills & personality development	1	2	--	Understanding and connecting with environment Or Life Skills & personality development	1	2	-
Total		6	12	8		6	12	8
Note: The seats distribution in Chemistry (major and minor) and Environmental Chemistry (MD/ID) will be done as per the HNBGU Admission prospectus 2025-26 or University guidelines.								

B.Sc. First Year (I Semester)
DSC Chemistry (Theory)
Paper Name - Inorganic Chemistry-I, Organic Chemistry-I
(Atomic Structure, Bonding and General Organic Chemistry)

Note: The syllabus for Chemistry Major and Minor is same as the number of credits are same for Major and Minor.

Credits: 02
Theory: 30 Hours
Section A: Inorganic Chemistry-1

Unit I. Atomic Structure (06 Hours)

Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Quantum mechanics, Schrödinger equation for hydrogen atom. Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Significance of quantum numbers, orbital angular momentum and quantum numbers. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, electronic configurations of the atoms. Stability of half- filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit II. Chemical Bonding and Molecular Structure (06 Hours)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination for orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.

Section B: Organic Chemistry-1

Unit III. Fundamentals of Organic Chemistry (06 Hours)

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates:

Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule.

Unit IV. Stereochemistry **(06 Hours)**

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E/ Z Nomenclature (for upto two C=C systems).

Unit V. Aliphatic Hydrocarbons **(06 Hours)**

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetrahalides and dehydrohalogenation of vicinal dihalides.
Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.

Reference Books:

1 Lee, J.D. Concise Inorganic Chemistry ELBS,1991.
2 Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry,3rd ed., Wiley.
3 Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley&Sons.
4 Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of
5 Structure and Reactivity, Pearson Education India, 2006.
6 Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
7 McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India
8 Edition, 2013.
9 Sykes, P. A Guide book to Mechanism in Organic Chemistry, Orient Longman, New Delhi
10 (1988).
11 Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
12 Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
13 Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
14 Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010.

B.Sc. First Year (I Semester)
DSC Chemistry (Practical)
Paper Name - Inorganic Chemistry-I, Organic Chemistry-I (Practical)

Note:

- **The syllabus for Chemistry Major and Minor is same as the number of credits are same for Major and Minor.**
- **The practical of the DSC Chemistry Practical course is Skill-based.**

Credits: 02
Practical: 60 Hours

Section A: Inorganic Chemistry-Volumetric Analysis (30 Hours)

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry (30 Hours)

1. Detection of extra elements (N, S, Cl, Br, I) inorganic compounds (containing up to two extra elements)
2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given).
3. Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper/thin layer chromatography.
4. Identify and separate the sugars present in the given mixture by paper/thin layer chromatography.

Reference Books:

1 Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2 Mendham, J.V ogel's Quantitative Chemical Analysis, Pearson, 2009.
3 Vogel,A.I., Tatchell, A. R., Furnis,B.S., Hannaford, A. J. & Smith, P. W. G., Text book of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4 Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960.

B.Sc. First Year (I Semester)
Chemistry (M.D./I.D., Theory)
Environmental Chemistry
Paper Name: Basics of Environmental Chemistry-I
(Introduction to Environmental Chemistry and Air, Water and Soil Pollutions)

Credits – 02
Theory: 30 Hours

Unit I: Introduction to Environmental Chemistry and Pollution (08 Hours)

Environmental chemistry - introduction, Environmental segments – Lithosphere: components of soils, Hydrosphere: water resources, Biosphere, Atmosphere - regions of atmosphere – Troposphere, stratosphere, mesosphere, thermosphere. Environmental pollution – Concepts and definition – Pollutant, contaminant, receptor and sink – Classification of pollutants – Global, regional, local, persistent and non-persistent pollutants.

Unit II. Air Pollution (08 Hours)

Tropospheric pollution – Gaseous air pollutants – Hydrocarbons, oxides of sulphur, nitrogen and carbon – Global warming, greenhouse effect, acid rain – Particulates – Smog: London smog and photochemical smog – effects and control of photochemical smog – stratospheric pollution - depletion of ozone layer, chlorofluorocarbons - Automobile pollution. Control of air pollution – Alternate refrigerants – Bhopal Gas Tragedy.

Unit III. Water Pollution (08 Hours)

Impurities in water – cause of pollution – natural and anthropogenic – Marine water pollution – Underground water pollution. Sources of water pollution – Industrial waste, Municipal waste, Agricultural waste, Radioactive waste, Petroleum, Pharmaceutical, heavy metal, pesticides, soaps and detergents. Types of water pollutants: Biological agents, physical agents and chemical agents – Eutrophication - biomagnification and bioaccumulation. Water quality parameters: DO, BOD, COD, alkalinity, hardness, chloride, fluoride and nitrate. Toxic metals in water and their effects: Cadmium, lead and mercury – Minamata disaster, itai-itai disease, oil pollution in water. International standards for drinking water.

Unit IV. Soil Pollution (06 Hours)

Soil pollution: Sources by industrial and urban wastes. Pollution due to plastics, pesticides, biomedical waste, and e-waste (source, effects and control measures) – Control of soil pollution - Solid waste Management – Open dumping, landfilling, incineration, re-use, reclamation, recycle, composting. Non-degradable, degradable and biodegradable wastes. Hazardous waste.

Books Suggested:

1. A. K. De, Environmental Chemistry, 7th Edn., New Age International, 2012.
2. A. K. Ahluwalia, Environmental Chemistry, The Energy and Resources Institute, 2017.
3. Balram Pani, Textbook of Environmental Chemistry, I. K. International Pvt Ltd, 2010.
4. S. K. Banergy, Environmental Chemistry, 2nd Edn., Prentice-Hall of India Pvt. Ltd., New Delhi, 2005.
5. V. N. Bashkin, Environmental Chemistry: Asian Lessons, Springer Science & Business Media, 2003.
6. S. E. Manahan, Environmental Chemistry, 8th Edn., CRC Press, Florida, 2004.
7. A. K. Ahluwalia, Environmental Chemistry, The Energy and Resources Institute, 2017.
8. Balram Pani, Textbook of Environmental Chemistry, I. K. International Pvt. Ltd., 2010.
9. S. K. Banergy, Environmental Chemistry, 2nd Edn., Prentice-Hall of India Pvt. Ltd., New Delhi, 2005.
10. J. M. H. Selendy, Water and Sanitation-Related Diseases and the Changing Environment, John Wiley & Sons, 2011.

B.Sc. First Year (I Semester)
Chemistry (M.D./I.D., Practical)
Environmental Chemistry
Paper Name: Basics of Environmental Chemistry (Practical)

NOTE: The practical of the Chemistry (M.D./I.D., Practical) of Environmental Chemistry course is Skill-based.

Credits: 02

Practical: 60 Hours

1. Estimation of the chlorine in water using Mohr's method.
2. Determine the total hardness of water.
3. Determination of the sulphate ion in water using turbidimetric method.
4. Estimate the biochemical oxygen demand of water.
5. Determination of pH of soil of different places using digital pH meter.
6. Preparation of 0.1N HCl or NaOH solution.
7. Electrical conductivity measurement of soil extract (ECe).

Reference Books:

1. A Laboratory Manual for Environmental Chemistry by R. Gopalan, Amirtha Anand, R. Wilgred Sugumar, I. K. International Pvt Ltd.
2. https://eee.poriyaan.in/topic/5--determination-of-chloride-content-of-water-sample-by-argentometric-method--mohr-s-method--10316/
3. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/43328/1/Exp-6.pdf
4. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://web.iitd.ac.in/~arunku/files/CEL212_Y13/Lab7%20BOD,COD.pdf

B. Sc. First Year (I Semester)
Chemistry (SEC)
Paper Name – Basic Analytical Chemistry-I
(Analytical Chemistry and Analysis of Soil, Water and Food Products)

Credits – 02

Theory: 30 Hours

NOTE: Basic Analytical Chemistry – I paper is Chemistry-related Skill Enhancement Course (SEC).

Unit I. Introduction **(08 Hours)**

Introduction to Analytical Chemistry and its inter disciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Unit II. Analysis of soil **(08 Hours)**

Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators. Determination of pH of soil samples. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Unit III. Analysis of water **(07 Hours)**

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. Determination of pH, acidity and alkalinity of a water sample. Determination of dissolved oxygen (DO) of a water sample.

Unit IV. Analysis of food products: **(07 Hours)**

Nutritional value of foods, idea about food processing and food preservations and adulteration. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. Analysis of preservatives and colouring matter.

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis, Authors: J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, Edition: 6th Edition, Publisher: Pearson Education, Publication Year: 2000.
2. Fundamentals of Analytical Chemistry, Authors: Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Edition: 9th Edition, Publisher: Cengage Learning, Publication Year: 2013.
3. Instrmental Methods of Chemical Analysis, Author: B.K. Sharma, Edition: 2014, Publisher: Krishna Prakashan Media (P) Ltd., Publication Year: 2014.

B. Sc. First Year (II Semester)
DSC Chemistry (Theory)
Paper Name: Physical Chemistry-I and Organic Chemistry-II
(Chemical Energetics, Equilibria and Organic Chemistry)

Note: The syllabus for Chemistry Major and Minor is same as the number of credits are same for Major and Minor.

Credits: 02
Theory: 30 Hours
Section A: Physical Chemistry-1

Unit I. Chemical Energetics **(06 Hours)**

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of are action with temperature– Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit II. Chemical Equilibrium and Ionic Equilibrium **(06 Hours)**

Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between G and Go, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

Ionic Equilibrium: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Section B: Organic Chemistry-2

Unit III. Alkyl and Aryl Halides **(06 Hours)**

Alkyl Halides: (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides: Preparation, (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by–OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit IV. Alcohols and Phenols **(06 Hours)**

Alcohols Preparation: Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With

sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenations and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten–Baumann Reaction.

Unit V. Aldehydes and Ketones **(06 Hours)**

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions– Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff-Kishner reduction. Meerwein-Pondorff Verley reduction.

Reference Books:

1 Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S. A. Organic Chemistry, John Wiley & Sons (2014).
2 McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3 Sykes, P. A Guide book to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
4 Finar, I. L. Organic Chemistry (Vol. I & II), E.L.B.S.
5 Morrison, R. T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6 Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010.
7 Barrow, G. M. Physical Chemistry Tata McGraw-Hill (2007).
8 Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
9 Kotz, J. C., Treichel, P. M. & Townsend, J. R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
10 Mahan, B. H. University Chemistry 3rd Ed. Narosa (1998).
11 Petrucci, R. H. General Chemistry 5th Ed. Macmillan Publishing Co. New York (1985).

B. Sc. First Year (II Semester)
DSC Chemistry (Practical)
Paper Name: Physical Chemistry-I and Organic Chemistry-II (Practical)

Note:

- **The syllabus for Chemistry Major and Minor is same as the number of credits are same for major and minor.**
- **The practical of the DSC Chemistry (Practical) course is Skill-based.**

Credits: 02
Practical: 60 Hours

Section A: Physical Chemistry
Thermochemistry:
1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).

Ionic equilibria:
a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
b) Preparation of buffer solutions-
(i) Sodium acetate-acetic acid
(ii) Ammonium chloride-ammonium hydroxide

Section B: Organic Chemistry
1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.
Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
(b) Benzoylation of amines /phenols
(c) Oxime and 2,4-dinitrophenyl hydrazone of aldehyde/ketone

Reference Books

1 Vogel, A.I., Tatchell, A. R., Furnis, B.S., Hannaford, A. J. & Smith, P.W.G., Text book of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2 Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960.
3 Khosla, B.D.; Garg, V.C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co. New Delhi (2011).

B.Sc. First Year (I Semester)
Chemistry (M.D./I.D., Theory)
Environmental Chemistry
Paper Name: Basics of Environmental Chemistry-II
(Introduction to Atmospheric chemistry, Green Chemistry, Noise and Radiation Pollutions)

Credits – 02
Theory: 30 Hours

Unit I: Atmospheric chemistry **(08 Hours)**

Introduction to atmospheric chemistry and its relevance with environment, Photochemical reactions in atmosphere; smog formation, types of smog (sulphur smog and photochemical smog), Chemistry of particulate matters, aerosols; chemistry of acid rain, chemistry of NOx and SOx; free radicals and ozone layer depletion, role of CFCs in ozone depletion.

Unit II. Green chemistry **(08 Hours)**

Introduction to green chemistry and its relevance with environment, Principles of Green Chemistry, the concept of atom economy and chemical synthesis, Important techniques used in green chemistry. Application of green chemistry, viz. replacement of ozone depleting substances including CFCs, manufacture of biodegradable polymers, use of H_2O_2 as benign bleaching agents in paper industry.

Unit III. Noise pollution **(06 Hours)**

Noise pollution-sources; frequency, intensity and permissible ambient noise levels; measurement of noise indices (Leq, L10, L90, L50, LDN, TNI) effect on communication, impacts on life forms and humans - working efficiency, physical and mental health; Noise abatement strategies.

Unit IV: Radioactive and thermal pollution **(08 Hours)**

Radioactive material and sources of radioactive pollution; effect of radiation on human health (somatic and genetic effects); radiation standards, radiation protection. Thermal Pollution- Sources of Thermal Pollution, Heat Islands, causes and effects of thermal pollution.

Reference Books:

1. Fundamentals of Air Pollution by Daniel A. Vallero, 6th Edition — April 25, 2025
2. Green Chemistry: Theory and Practice by Paul Anastas & John Warner — 1998 (First edition).
3. Green Chemistry: Environmentally Benign Reactions by V. K. Ahluwalia.
4. Green Chemistry: An Introductory Text by Mike Lancaster.
5. Textbook of Noise Pollution and Its Control by S.C. Bhatia — 2007.
6. Advanced Environmental Chemistry by V.K. Ahluwalia.
7. Environmental Chemistry: Fundamentals by Mohan Singh & Fregoso-.
8. Understanding Environmental Pollution by Marquita Hill — 4th Edition, 2022.
9. Environmental Chemistry: A Global Perspective by van Loon & Duffy — Latest edition 2017.

B. Sc. First Year (II Semester)
Chemistry (M.D./I.D., Practical)
Environmental Chemistry
Paper Name: Basics of Environmental Chemistry-II (Practical)

Note: The practical of the Chemistry (M.D./I.D., Practical) Environmental Chemistry course is Skill-based.

Credits: 02

Practical: 60 Hours

1. Particulate Matter Collection with Sticky Slides: Coat glass microscope slides with Vaseline or tape and expose them indoors and outdoors for 24 hours. Observe under a microscope to compare PM deposition rates.
2. SO_2 Detection via Flame Color or Gas Sampling: Burn sulfur-impregnated material and pass combustion gas through lead acetate paper—turning it black due to SO_2. Alternatively, detect SO_2 in industrial area air using a simple bubbler + indicator solution (permanganate or pararosaniline).
3. Mini Acid Rain Simulation: Bubble generated NO_2 or SO_2 through distilled water and measure final pH. Use citric acid (a weak, safe acid) to mimic acid rain in a basic IA-style experiment
4. H_2O_2 as a Benign Bleach in Paper Whitening: Compare bleaching efficiency of H_2O_2 versus traditional chlorine bleach on fabric or paper strips—monitor color change, analyze oxidation via starch-iodide test.
5. Ambient Noise Measurement: Use a decibel meter (or smartphone app calibrated with standard source) in various settings (classroom, street, near traffic). Calculate indices like Leq by sampling A-weighted dB readings every minute and averaging.
6. Effect of Noise on Concentration: Conduct a simple attention task (e.g., sequential number recognition or reading comprehension) with and without simulated roadway or factory noise. Compare accuracy/time across conditions to illustrate cognitive impacts.
7. Heat a small water sample to 40–50 °C and add it to a larger sample at room temperature: Monitor dissolved oxygen levels (with a DO kit or simple indicator) to show how elevated temperature reduces aquatic oxygen levels.

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J.V ogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A. R., Furnis, B.S., Hannaford, A. J. & Smith, P. W. G., Text book of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960. Environmental Chemistry in the Lab by David Peng.
5. Experiments in Environmental Chemistry: A Laboratory Manual – Classic manual with hands-on detection of atmospheric pollutants (NO_x, SO_2, oxidants) and radiation.
6. Chemical Processes in Atmospheric Oxidation (Springer) – Lab studies focusing on radical-initiated oxidation of VOCs, peroxy chemistry, and photochemical reactions. Practical Approach to Green Chemistry (Innovare Academic Sciences, 2017).
7. A Guide to Green Chemistry Experiments for Undergraduate Organic Chemistry Labs (J. Chem. Educ., 2005) – Details greener polymerization and solvent-free syntheses like biodegradable poly(aspartate), ideal for unit II practices.

B. Sc. First Year (II Semester)
Chemistry (SEC)
Paper Name: Basic Analytical Chemistry -II
(Chromatography and Analysis of Cosmetics)

Credits: 02
Theory: 30 Hours
NOTE: Basic Analytical Chemistry – II paper is Chemistry-related Skill Enhancement Course (SEC).

Unit I. Introduction to Chromatography **(10 Hours)**

Definition, classification, and principles of chromatography. Mobile phase, stationary phase, polar and nonpolar stationary phase, gradient and isocratic elution. Thin Layer Chromatography. Column Chromatography. Paper chromatography, Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).

Unit II. Ion-exchange Chromatography **(10 Hours)**

Ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchangers in (using batch procedure if use of column is not feasible).

Unit III. Analysis of Cosmetics **(10 Hours)**

Major and minor constituents and their function. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Reference Books:

1. Willard, H. H., Merritt, L. L., Dean, J. & Settoe, F. A. Instrumental Methods of Analysis. 7th Ed.
2. Wadsworth Publishing Co. Ltd., Belmont, California, USA,1988.
3. Skoog, D. A. Holler F.J.& Nieman, T.A. Principles of Instrumental Analysis, Cengage
4. Learning India Ed.
5. Skoog, D. A.; West, D. M. & Holler, F. J. Fundamentals of Analytical Chemistry 6th Ed., Saunders
6. College Publishing, Fort Worth (1992).
7. Harris, D. C. Quantitative Chemical Analysis, W.H. Freeman. Dean, J.A. Analytical Chemistry
8. Note book, McGraw Hill.
9. Day, R. A. & Underwood, A.L. Quantitative Analysis, Prentice Hall of India. Freifelder, D.