

FACULTY OF SCIENCES

SYLLABUS FOR THE

SUBJECT: CHEMISTRY

For the award of the Degree in

Bachelor of Science (Honours)

(Offered under 4 Year U.G. Degree Programme)

(Credit Based Continuous Evaluation Grading System)

Under NEP-2020

Semester V-VI

Session: 2026-27



The Heritage Institution
KANYA MAHA VIDYALAYA
JALANDHAR
(AUTONOMOUS)

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)

**SCHEME AND CURRICULUM OF EXAMINATION OF FOUR YEAR UNDER
GRADUATE DEGREE PROGRAMME**

**Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Session: 2026-27)**

Bachelor of Science (Honours) (Semester V)										
Course Name	Hours Per Week L-T-P	Credits L-T-P	Course Code	Course Type	Total marks	Paper	Ext.		CA	Examination Time (in Hours)
							L	P		
Chemistry	4-0-0	4-0-0	BSNL/BSML-5084	C	100	Chemistry (Organic Chemistry-II : Chemistry of O/N Containing Compounds)	70	-	30	3
	0-0-4	0-0-2	BSNP/BSMP-5084	C	50	Chemistry (Organic Chemistry-II : Lab Preparations-I)	-	35	15	3
	0-0-4	0-0-2	BSNI/BSMI-5084/ CCFC-5522	CCFR	50	Summer Internship (02 Weeks)/ Community Outreach-I/NCC/NSS	-	50	-	3

***C=Compulsory**

CCFR=Co-Curricular Field Work and Report Writing

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester V)

COURSE CODE: BSNL/BSML-5084

COURSE TITLE: Chemistry (Organic Chemistry-II: Chemistry of O/N Containing Compounds)

Course outcomes:

Students will be able to

CO1: Explain the classification, nomenclature, preparation, properties, and reaction mechanisms of alcohols, phenols, ethers, epoxides, and sulphur-containing organic compounds.

CO2: Describe the structure, preparation, properties, and reaction mechanisms of aldehydes, ketones, and carboxylic acids, including important name reactions and synthetic applications.

CO3: Discuss the structure, reactivity, preparation, and nucleophilic acyl substitution reactions of carboxylic acid derivatives and nitrogen-containing organic compounds.

CO4: Analyze the preparation, stereochemistry, basicity, and reactions of amines and heterocyclic compounds, including electrophilic and nucleophilic substitution mechanisms in heterocyclic systems.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester V)
COURSE CODE: BSNL/BSML-5084

COURSE TITLE: Chemistry (Organic Chemistry-II: Chemistry of O/N Containing Compounds)

Exam Time: 3Hrs.

Max.Marks:100

Credit(L-T-P): 4-0-0

(Theory: 70, CA: 30)

Instructions for the Paper Setter

Eight questions of equal marks (14 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Alcohols: Classification, Monohydric and Dihydric alcohols alcohols. Acidic nature, methods of formation, chemical reactions, oxidative cleavage $[Pb(OAc)_4]$ and $[HIO_4]$ and pinacol-pinacolone rearrangement.

Phenols: Structure and bonding, Preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols: electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Reimer Tiemann reaction.

Ethers and epoxides: Preparation and chemical reactions ethers and epoxides.

Sulphur containing compounds: Preparation and reactions of thiols and thioethers

Unit II

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones, Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction. Use of acetals as protecting group. Cannizzaro reaction. Halogenation of enolizable ketones. Addition reactions of unsaturated carbonyl compounds, Active methylene compounds.

Carboxylic Acids: Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Synthesis of acid chlorides, esters and amides. Reactions of carboxylic acids, Hell Volhard-Zelinsky reaction, Reduction of carboxylic acids, Mechanism of decarboxylation.

Unit III

Carboxylic Acids Derivatives: Structure of acid chlorides, esters, amides and acid anhydrides, Relative stability & reactivity of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions.

Organic Compounds of Nitrogen: Preparation of nitroarenes. Chemical reaction and mechanisms of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline media.

Unit IV

Organic Compounds of Nitrogen: Methods of preparation of amines by Reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction and Hofmann bromamide reaction. Physical properties. Stereochemistry of amines, separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts.

Heterocyclic Compounds: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Books Suggested

1. Morrison, R.T., Boyd, R.N., Organic Chemistry; 6th edition, Pubs: Prentice-Hall, 1992.
2. Wade Jr., L.G., Singh, M.S., Organic Chemistry; 6th edition, Pubs: Pearson Education, 2008.
3. Mukherji, S.M., Singh, S.P., Kapoor, R.P., Organic Chemistry; Pubs: Wiley Eastern Limited, 1985, Vol. I, II, III.
4. Solomons, T.W., Fryhle, C.B., Organic Chemistry; 9th edition, Pubs: Wiley India, 2007.
5. Carey, F.A., Organic Chemistry; 4th edition, Pubs: McGraw-Hill, 2000.
6. Streitwieser, A., Clayton, Jr., Heathcock, H., Introduction to Organic Chemistry; 3rd edition, Pubs: Macmillan Publishing Company, 1989.
7. Introduction to Organic Chemistry, Sireitwieser, Heathcock and Kosover, Macmilan.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester V)
COURSE CODE: BSNP/BSMP-5084
COURSE TITLE: Chemistry (Organic Chemistry-II: Lab Preparations-I)

Course outcomes:

Students will be able to

CO1: Apply chromatographic techniques such as Thin Layer Chromatography (TLC) and Column Chromatography for separation, identification, and analysis of organic compounds.

CO2: Perform the synthesis of important organic compounds such as p-nitroacetanilide, methyl orange, quinoline, antipyrine, and flavone using standard laboratory procedures.

CO3: Demonstrate functional group transformations including acetylation, bromination, reduction, and derivative formation in organic synthesis.

CO4: Interpret reaction outcomes, calculate R_f values, determine purity of synthesized compounds, and develop practical laboratory skills in organic chemistry techniques and safety practices.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester V)

COURSE CODE: BSNP/BSMP-5084

COURSE TITLE: Chemistry (Organic Chemistry-II: Lab Preparations-I)

Time: 3 Hr

Marks: 50

Credits: 0-0-2

(Practical: 35, CA: 15)

Thin Layer Chromatography: Determination of R_f values and identification of organic compounds.

Column Chromatography: Separation of o & p nitrophenol

Synthesis of Organic Compounds

1. Preparation of p-nitroacetanilide
2. Preparation of Methyl Orange
3. Preparation of quinoline (Skraup Synthesis)
4. Preparation of 1,2-dihydro-1,5-dimethyl-2-phenyl-3H-pyrazole-3-one (antipyrine)
5. Synthesis of flavone (2-Phenyl-4H-1-benzopyran-4-one, 2-Phenylchromone)
6. Acetylation of amines and phenols
7. Bromination of Acetanilide.
8. Reduction of meta dinitrobenzene and p-nitrobenzaldehyde.
9. Semicarbazone of ethyl methyl ketone and benzaldehyde

Suggested Books

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Vogel's text book of practical organic chemistry, 5th Ed., Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
5. Experimental organic chemistry by Laurence M. Harwood, C. J. Moody, Black well Scientific Publications, Oxford, 1989.
6. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
7. Arthur, I. V. Quantitative Organic Analysis, Pearson.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester V)

COURSE CODE: BSNI/BSMI-5084/CCFC-5522

COURSE TITLE: Summer Internship (02 Weeks)/ Community Outreach-I/NCC/NSS

Course outcomes:

Students will be able to

CO1: Apply theoretical knowledge in real-life situations through community engagement, field-based learning, internships, and minor projects.

CO2: Develop practical, analytical, communication, and problem-solving skills through hands-on training and experiential learning activities.

CO3: Prepare and present a structured internship/project report and PowerPoint presentation following prescribed academic and professional standards.

CO4: Demonstrate professional competence, teamwork, ethical responsibility, and the ability to effectively communicate internship outcomes during viva voce examination.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester V)

COURSE CODE: BSNI/BSMI-5084/CCFC-5522

COURSE TITLE: Summer Internship (02 Weeks)/ Community Outreach-I/NCC/NSS

Exam Time: 3Hrs.

Max.Marks:50

Credit (L-T-P): 0-0-2

(Practical: 50)

Students shall undertake Community Engagement and Service/ field based learning through an internship of four weeks during the fifth semester after completion of classes or during the summer vacation at the end of the fourth semester.

The internship shall be carried out in one of the areas related to the courses of study. Students participating in NCC or NSS activities may submit a certificate of participation for a minimum duration of four weeks in lieu of the internship.

Every student shall submit an internship report in the prescribed format along with the original internship completion certificate and permission letter issued by the college to carry out the internship/ community outreach.

The viva voce examination shall be conducted on the basis of the final internship report submitted and the presentation by the student.

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)

**SCHEME AND CURRICULUM OF EXAMINATION OF FOUR YEAR UNDER
GRADUATE DEGREE PROGRAMME**

**Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Session: 2026-27)**

Bachelor of Science (Honours) (Semester VI)										
Course Name	Hours Per Week L-T-P	Credits L-T-P	Course Code	Course Type	Total marks	Paper	Ext.		CA	Examination Time (in Hours)
							L	P		
Chemistry	4-0-0	4-0-0	BSNL/BSML-6084	C	100	Chemistry (Physical Chemistry-II : Thermodynamics and Equilibrium)	70	-	30	3
	0-0-4	0-0-2	BSNP/BSMP-6084	C	50	Chemistry (Physical Chemistry-II : Lab)	-	35	15	3
	2-0-0	2-0-0	BSNL/BSML-6080	SEC	100	Chemistry of Cosmetics	70	-	30	3

***C=Compulsory**

SEC= Skill Enhancement Course

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester VI)
COURSE CODE: BSNP/BSMP-6084
COURSE TITLE: Chemistry (Physical Chemistry-II: Lab)

Students will be able to

CO1: Explain the fundamental concepts of thermodynamics, thermochemical processes, and the applications of the First Law of Thermodynamics in chemical systems.

CO2: Analyze the Second and Third Laws of Thermodynamics, entropy changes, spontaneity criteria, and thermodynamic functions governing equilibrium processes.

CO3: Interpret the principles of chemical, phase, and ionic equilibria, including equilibrium constants, phase rule, buffer systems, and acid–base equilibria.

CO4: Describe the basic principles of quantum mechanics and apply quantum mechanical models to explain atomic structure, molecular motion, and energy quantization.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester VI)
COURSE CODE: BSNL/BSML-6084

COURSE TITLE: Chemistry (Physical Chemistry-II: Thermodynamics and Equilibrium)

Exam Time: 3Hrs.

Max.Marks:100

Credit(L-T-P): 4-0-0

(Theory: 70, CA: 30)

Instructions for the Paper Setter

Eight questions of equal marks (14 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Thermodynamics-I: Definition of thermodynamic terms, Types of systems, intensive and extensive properties. State and path functions. Thermodynamic process. Concept of heat and work.
First Law of Thermodynamics: Statement and definitions, Heat capacity at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, Calculation of w , q , ΔU & ΔH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: Standard state, types of enthalpies of reactions, Hess's Law of heat summation. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

Unit II

Thermodynamics-II: Second Law of Thermodynamics: Statements, Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature, Entropy as a state function, entropy as a function of V & T ; P & T , entropy change in physical change, Clausius inequality, entropy as a criterion of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases.

Thermodynamics-III: Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as a criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P , V and T .

Unit III

Chemical Equilibrium: Determination of K_p , K_c , K_a and their relationship, Clausius- Clapeyron equation

Introduction to Phase Equilibrium: Phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system, two component systems-solidliquid equilibria, Solid solutions-compound formation with congruent and incongruent melting point, Lower and upper consolute temperature, Nernst distribution law.

Introduction to Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids, calculation of hydrolysis constant, derivation of Henderson equation, applications of buffers in analytical chemistry, applications of solubility product principle Qualitative treatment of acid – base titration curves, Theory of acid–base indicators.

Unit IV

Quantum Mechanics: Black-body radiation, Planck's radiation law, Photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. Sinusoidal wave equation, Hamiltonian operator, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one-dimensional box, quantization of energy levels, extension to two and three-dimensional boxes, degeneracy. Simple harmonic oscillator model of vibrational motion, setting up Schrodinger equation and discussion of solution and wave functions. Rigid rotator model of rotation of diatomic molecules transformation to spherical polar coordinates spherical harmonics and their discussion. Qualitative investigation H-atom, setting up Schrodinger equation, radial and angular part, radial distribution functions of 1s, 2s, 2p, 3s, 3p and 3d.

Books Suggested

1. Atkins, P., Paula, J.de, Atkins, Physical Chemistry; 8th edition, Pubs: Oxford University Press, 2008.
2. Puri, B.R., Sharma, L.R., Pathania, M.S., Principles of Physical Chemistry; 43rd edition, Pubs: Vishal Publishing Co., 2008.
3. Barrow, G.M., Physical Chemistry; 6th edition, Pubs: McGraw Hill Company Inc., 1996.
4. Berry, R.S., Rice, S.A., Ross, J., Physical Chemistry; 2nd edition, Pubs: Oxford University Press, 2000.
5. Albert, R.A., Silbey, R.J., Physical Chemistry; I edition, Pubs: John Wiley & Sons Inc., 1992.
6. Dogra, S.K., Dogra, S., Physical Chemistry Through Problems, Pubs: Wiley Eastern Ltd., 1991.
7. Moore, W.J., Basic Physical Chemistry; Pubs: Prentice Hall of India Pvt. Ltd., 1983.

8. Metz, C.R., Theory and Problems of Physical Chemistry; Schaum's outline series, 2nd edition, Pubs: McGraw-Hall Book Company, 1989.
9. Banwell, C.N., McCash, E.M., Fundamentals of Molecular Spectroscopy; 4th edition, Pubs: Tata McGraw Hill Publishing Co. Ltd., 1999.
10. Atkins, P. Friedman, R., Molecular Quantum Mechanics; 4th edition Pubs: Oxford University Press, 2007.
11. Levine, I.N., Quantum Chemistry; 5th edition, Pubs: Prentice Hall International Inc., 2000.
12. Glasstone, B. (2003) Thermodynamics for Chemists, East West Press, New Delhi. ISBN-10: 8176710148.
13. Rock, P.A. (1983) Chemical Thermodynamics, University Science Books, Sausalito, CA. ISBN 10: 1891389327
14. Maron S.H., Prutton C.F. (1965) Principles of Physical Chemistry, 4th Edition, Mac Millan Publishing Company, New York.
15. Kapoor, K.L (2006) A Text Book of Physical Chemistry, 6th Volume, Macmillan Publishers India Ltd., New Delhi. ISBN10: 0230332765
16. Laidler, K.J. (1995) The world of Physical Chemistry, 3rd Volume, Oxford University Press, London. ISBN-10: 0198559194
17. Jou D., Llebot J.E. (1990) Introduction to the Thermodynamics of Biological Processes, Prentice Hall. ISBN: 9780135028810
18. Rajaram J., Kuriacose J. C. (1986) Thermodynamics for Students of Chemistry, Shoban Lal Nagin Chand & Co. Delhi ISBN-13: 1234567145987.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester VI)
COURSE CODE: BSNP/BSMP-6084
COURSE TITLE: Chemistry (Physical Chemistry-II : Lab)

Course outcomes:

Students will be able to

CO1: Apply principles of thermodynamics and thermochemistry to determine heat capacity, enthalpy of neutralization, heat of solution, lattice energy, and related physicochemical parameters through experimental methods.

CO2: Perform and interpret physicochemical experiments involving phase equilibria, solubility studies, distribution law, and molecular weight determination using standard laboratory techniques.

CO3: Develop practical skills in electroanalytical and instrumental methods such as potentiometry, conductometry, and colorimetry for quantitative chemical analysis and verification of fundamental laws.

CO4: Analyze experimental data, calculate physicochemical constants, and evaluate the relationship between theoretical concepts and laboratory observations with scientific accuracy and critical thinking.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester VI)
COURSE CODE: BSNP/BSMP-6084
COURSE TITLE: Chemistry (Physical Chemistry-II: Lab)

Time: 3 Hrs

Marks: 50

Credits: 0-0-2

(Practical: 35, CA: 15)

1. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2. Determination of heat of solution of Na_2SO_4 .
3. Determination of Lattice energy of NaCl (using Born-Haber cycle).
4. Study of the solubility of benzoic acid in water and determination of ΔH .
5. To determine the dissociation constant of picric acid by studying its distribution between benzene and water.
6. To determine the molecular weight of naphthalene by Rast method.
7. To prepare and draw phase diagram of microemulsions comprising sodium dodecyl sulfate, water and hexanol.
8. Potentiometry: (a) Titration of HCl solution with NaOH solution using quinhydrone solution; (b) Titration of CH_3COOH solution with NaOH ; (c) Titration of oxalic acid solution with NaOH .
9. Conductometry: (a) To find strength of given strong acid; (b) To find dissociation constant of weak electrolyte.
10. Colorimetry: To verify the Lambert – Beer's Law.

Suggested Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry, New Age International: New Delhi (2001).
3. Findlay's Practical Physical Chemistry, Author: Alexander Findlay Publisher: Wiley, 1972, ISBN-10:0470258853.
4. Advanced Practical Physical Chemistry, Author: J. B. Yadav, Publisher: Krishna Prakashan Media (Pvt) Ltd (2015), ISBN-10: 8182835925.
5. Quantitative Organic Analysis by Vogel, Author: A. I. Vogel, Publisher: Wiley, John & Sons, Incorporated, ISBN-13: 780582442504

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester VI)
COURSE CODE: BSNL/BSML-6080
COURSE TITLE: Chemistry of Cosmetics

Course outcomes:

Students will be able to

CO1: Understand the role of raw materials used in cosmetic formulations and explain the basic application of AI in selection of cosmetic ingredients and formulation development.

CO2: Describe the chemistry, preparation, and applications of essential oils and understand the use of AI tools in their identification and quality testing.

CO3: Prepare and explain different cosmetic products and recognize the applications of AI in personalized skin and hair care products.

CO4: Understand methods of quality control, preservation, testing, and packaging of cosmetics and Classify and analyze chemical compounds using ChemDraw and ChemMine Tools.

.

Bachelor of Science (Honours)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Under NEP 2020)
(Session: 2026-27)
(Semester VI)
COURSE CODE: BSNL/BSML-6080
COURSE TITLE: Chemistry of Cosmetics

Exam Time: 3Hrs.

Max.Marks:100

Credit (L-T-P): 4-0-0

(Theory: 70, CA: 30)

Instructions for the Paper Setter

Eight questions of equal marks (14 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Raw Materials for various types of Cosmetics: Surfactants and their types; Additives (thickeners, foam stabilizers, pearlescent agents, conditioning agents, etc.) Oil components (Mineral oil, Natural oils, and Synthetic oils); Waxes (Natural and Synthetic); Silicone oils; Cream bases; Emulsifiers; Humectants; Aerosol Propellants.

Unit II

Essential Oils: Chemistry and methods of preparation, Production of essential oils with special reference to the following; Eugenol, Geraniol, Sandalwood oil, eucalyptus oil, rose oil, Jasmone, Civetone, Muscone.

Unit III

Preparation and uses of the following: Hair dye; hair spray; shampoo; suntan lotions; Face powder; Lipstick, Talcum powder; Nail enamel; Creams (Cold, Vanishing and Shaving creams); Antiperspirants and artificial flavours; Dental products.

Unit IV

Quality control, preservation, testing and packaging of cosmetics: Inspection of raw materials, containers, finished products and packaging material; environmental problems; testing of cosmetics by spectroscopic techniques.

AI in Chemistry: Chemical Compound Classification, Drawing chemical structures by Chemdraw, Clustering Dataset: PubChem / ChEMBL chemical datasets. (<https://pubchem.ncbi.nlm.nih.gov/source/ChEMBL>)

Tool: ChemMine Tools (free web-based). (<https://chemminetools.ucr.edu/>)

Activity: Input chemical structures or SMILES notations, Predict chemical similarity clusters.

Suggested Books

- 1) Earnest Guenther, "The Essential Oils" vol. I Robert E. Kreiger Publishing Co. Huntington, New York, 1972.
- 2) M.S. Balsem, S.D. Genshon, M.M. Rieger, E. Sagarin, S.J. Strianase, "Cosmetics, Science and Technology, Vol. I, II and III, Wiley-Inter science, A Division of John Wiley and Sons., Inc., New York, London, Sydney, Toronto, 1972, Ed. By M.S. Balsam and M. S. Sagarin.
- 3) J. Stephan Jellnick, "Formulation and Functions of Cosmetics", Wiley Inter science, a Division of John Wiley & Sons., Inc.
- 4) Chemistry and Technology of the Cosmetics and Toiletries Industry. By D.F. Williams & W.H. Schmitt, Blackie Academic & Professional, London, 1st Edn., 1992.
- 5) Harry's Cosmetic ology, sixth edn. The principles and Practice of Modern cosmetics, Vol. I by R.G. Harry Chemical Publishing Co., Inc., New York, 1973.
- 6) W.A. Poucher, Poucher's Perfumes, Cosmetics and Soaps: Vol 3, Chapman & Hall, 2012, UK.
- 7) E. Board of consultants & Engineers, Cosmetics Processes and Formulations Handbook.
- 8) H. Bennett, F.A.I.C. The new cosmetic formulary, Chemical Publishing Company, INC. New York. 1970
- 9) N. Board, Handbook on Herbal Products (Medicines, Cosmetics, Toiletries, Perfumes) National Institute of Industrial Research, 2000, New Delhi.