

**COURSE STRUCTURE OF B.SC. (HONS) CHEMISTRY  
APPLICABLE FOR FOUR YEAR DEGREE PROGRAM**

**DIT UNIVERSITY  
Dehradun**



Detailed Course Structure & Syllabus  
of  
B.Sc. (Chemistry) Honors/Honors with Research  
**(4 Year Program with Minor)**

# COURSE STRUCTURE OF B.SC. (HONS) CHEMISTRY APPLICABLE FOR FOUR YEAR DEGREE PROGRAM

## Introduction

The Ministry of Human Resource Development (MHRD), Govt. of India, has initiated development of a New Education Policy (NEP) to bring out comprehensive reforms in the Indian education system.

The University Grants Commission (UGC) has subsequently initiated several steps to foster academic excellence through introduction of paradigm shift in learning and teaching pedagogy, innovation and improvement in course curricula, examination and education system.

While a majority of education institutions have started following the semester-based system of education, it has been observed that this new system is still producing graduates who lack knowledge, values, skills and are not job ready professional. The reason for this lacking could be attributed to the rigidity of our program structures and lack of flexibility to have choices among core subject education, liberal arts, ability enhancement, skill development, etc., that is fundamental to overall development and employability of these graduates.

In accordance with the NEP 2020, the UGC has formulated a new student-centric “Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)” incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options. Further, it also recommends that the undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a UG certificate after completing 1 year in a discipline or field including vocational and professional areas, or a UG diploma after 2 years of study, or a Bachelor’s degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.

### *Advantages of CCFUP:*

- Shift in focus from the teacher-centric to student-centric education. Student can curve out their program structure by choosing minimum number of credits from well-defined baskets.
- Student may undertake as many credits as they can cope with.
- CCFUP allows students to obtain 4 year Honors degree with Minor in a discipline of their interest by choosing courses offered by other departments, from various baskets of inter-disciplinary, intra-disciplinary, skill oriented, ability enhancing, and from other disciplines.

### **Features unique to DIT University CCFUP structure:**

1. A minimum of 120 credits has to be earned by a student to be eligible for a 3 year Under Graduate degree in Sciences and a minimum of 160 credits for a 4-year Undergraduate Degree (Honors) OR (Honors in Research). Each department will decide their total credits for each program, and it can vary across disciplines.
2. Courses are categorized into 8 baskets, and a student will have the option to choose courses in most baskets and earn *minimum number of credits* required in each basket for the award of his/her degree. For each basket, the departments have the flexibility to identify course(s) which will be a core requirement for their program.
3. An Academic Advisory Committee may be formed comprising all HoDs/ Programme Coordinator and one representative each from respective departments. Academic Advisory Committee will meet at the end of every semester after the completion of Board of Examination meeting to discuss and finalize course offerings by respective departments in the upcoming semester. Academic Advisory Committee will be chaired by the Dean Academic Affairs/ Deans of respective Schools/ Competent Authority.
4. To provide sufficient flexibility and room during the program for additional *Internships, Project, Vocational Studies*, 8-week summer semesters (Summer 1, Summer 2, and Summer 3) may have to run. Summer semesters are critical for implementing a fully flexible system. Each department will decide *a priori* which courses to offer in the summer semester and get them finalized at the Academic Advisory Committee meeting.

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5. Project based learning has to be incorporated as a core component of evaluation in each course, and depending on the level and type of the course, the project can be of several types - Study Oriented Project, Lab Oriented Project, Design Oriented Project, Computer Oriented Project, Projects of Organizational Aspects, Research Projects, or Entrepreneurship and Start Up Projects.

6. Courses under each basket may be updated on an annual basis.

7. Each student will be advised by a faculty advisor of his/her department for registration of courses from each basket in the beginning of semester, depending upon the availability of seats. A student advising center may be formed where students will have access to department faculty advisers. Faculty advisers should have complete access to view individual student's academic transcript for advising purposes.

8. A student getting an F grade in a core course (departmental or otherwise) at the end of the semester will have to earn those credits by registering for the same course whenever it is offered in subsequent semesters. If the course is not a core course, the student may choose to register for any other course next semester in that basket as advised by the department faculty adviser. Additional fees for those number of credits may apply.

9. Students may opt for summer training/internships/industrial tours as advised by the department. However, these activities will not have credits.

### Baskets of CCFUP

8 baskets of courses have been identified to provide student comprehensive exposure to a large number of areas, leading to the holistic development of an individual. These baskets are as follows:

S.No.	Basket	Details
1	Major (Core)	In-depth study of a particular subject or discipline
2	Minor	Different interdisciplinary minors After securing the specified credits in minor, student is eligible for a degree in major discipline with minor in the chosen interdisciplinary course
3	Multidisciplinary	Natural and Physical Sciences: Chemistry, Physics, Biophysics, Astronomy and Astrophysics, Earth and Environmental Science etc. Mathematics, Statistics, and Computer Applications: Python, data analysis software, etc. Library, information, and media science: journalism, mass media, and communication Commerce and Management: Business Management, accountancy, finance. Humanities and Social Sciences: Economics, History, Linguistics, Psychology, sustainable development etc.
4	Ability enhancement courses (AEC)	Modern Indian language and English language focused on language and communication skills
5	Skill enhancement courses (SEC)	Courses on Hands on training, soft skills, institutes may design their own courses also
6	Value added courses common for all UG	Understanding India Environmental Science, Digital and technological solutions: AI, 3D machining, big data, machine learning etc. Health and Wellness, Yoga, sports and fitness
7	Summer Internship	From any firm, industry, training lab, organization, own institution also (Students who exit after 2 semesters must undergo a 4 credit work based learning/internship to get UG certificate) Community engagement/service Field based learning/minor project
8	Research Project/Dissertation	Students for 4 year degree (Honours with Research) to take up research project under guidance of faculty member

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### Structure of the B.Sc. (Chemistry) Program

S.No.	Basket	Minimum credit requirement		Credit per Course	Total Courses		
		3 year UG	4 year UG		3 year UG	4 year UG (Honours)	4 year UG (Honours with Research)
1	Major (Core)	62	93	3-5	15	24	20
2	Minor	24	9	4-5	6	8	8
3	Multidisciplinary	9	13	4-5	3	3	3
4	Ability enhancement courses (AEC)	9	9	3	3	3	3
5	Skill enhancement courses (SEC)	9	9	3	3	3	3
6	Value-added courses common for all UG	6	6	2	3	3	3
7	Summer Internship	2	2	2	-	-	-
8	Research Project/Dissertation	-	12	12	-	-	1
	<b>Total</b>	<b>121</b>	<b>153</b>		<b>33</b>	<b>44</b>	<b>41</b>

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## Course Baskets: B.Sc. (Chemistry)

For B.Sc. (Chemistry) with Minor in other Discipline					
Discipline Courses (62 credits for 3-year UG, 93 credits for 4-year UG)					
S.No.	Name of Courses	L	T	P	Credit
1	Inorganic Chemistry -I	3	0	2	4
2	Organic Chemistry-I	3	0	2	4
3	Physical Chemistry-I	3	1	2	5
4	Basic Analytical Chemistry	3	0	2	4
5	Green Chemistry	3	0	0	3
6	Inorganic Chemistry-II	3	0	2	4
7	Organic Chemistry-II	3	0	2	4
8	Physical Chemistry-II	3	1	2	5
9	Fuel Chemistry	3	0	0	3
10	Inorganic Chemistry-III	3	0	2	4
11	Organic Chemistry-III	3	0	2	4
12	Physical Chemistry-III	3	1	2	5
13	Inorganic Chemistry - IV	3	0	2	4
14	Organic Chemistry - IV	3	0	2	4
15	Physical Chemistry-IV	3	1	2	5
16	Inorganic Chemistry -V	3	0	2	4
17	Organic Chemistry - V	3	0	2	4
18	Physical Chemistry - V	3	1	2	5
19	Fundamentals of Biochemistry	3	0	0	3
20	Forensic Chemistry	3	0	0	3
21	Medicinal Pharmaceutical Chemistry	3	0	0	3
22	Chemistry of Cosmetics and Perfumes	3	0	0	3
23	Polymer Chemistry	3	0	0	3
24	Pesticide Chemistry	3	0	0	3
25	Green Methods in Chemistry	3	0	0	3

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<b>Interdisciplinary Courses (9 credits)</b>					
<b>Sr. No.</b>	<b>Name of Courses</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	Calculus-I	3	1	0	4
2	Programming for Problem-Solving	3	0	2	4
3	Waves and Optics	3	1	2	5

<b>Ability Enhancement Courses (8 credits)</b>					
<b>Sr. No.</b>	<b>Name of Courses</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	Professional Communication	2	0	2	3
2	Corporate Communication and Soft Skills	2	0	2	3
3	Human Values	3	0	0	3

<b>Skill Enhancement Courses (9 credits)</b>					
<b>Sr. No.</b>	<b>Name of Courses</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	Introduction to MATLAB	2	0	2	3
2	Technical Writing with LATEX	1	0	4	3
3	Computer Applications in Pharmacy	3	0	0	3
4	Basic Computational Chemistry	3	0	0	3
5	Basic Instrumentation Techniques	3	0	0	3
6	Aptitude and Skill Enhancement-I	3	0	0	3
7	Aptitude and Skill Enhancement-II	3	0	0	3
8	Aptitude and Skill Enhancement-III	3	0	0	3

<b>Common Value Added Courses (6-8 credits)</b>					
<b>Sr. No.</b>	<b>Name of Courses</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	Environmental Science	2	0	0	2
2	Indian Constitution	2	0	0	2
3	Yoga	0	0	4	2
4	Physical Education	0	0	4	2

<b>Project (12 credits)</b>					
	Research Project	0	0	24	12

<b>Internship (2-4 credits)</b>					
	Summer Internship	0	0	4	2

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## Discipline Courses (Semester-I)

<b>Subject Code</b>	CHFNI06	<b>Subject Title</b>	<b>INORGANIC CHEMISTRY-I</b>						
<b>LT P</b>	3 1 2	<b>Credit</b>	<b>5</b>	<b>Subject Category</b>	CC	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

**Course Objectives:** This course unit aims to develop an understanding of the fundamental chemistry of the atomic properties as guided by the electronic configurations of atoms at orbital levels; rules governing the periodicity of properties variance, understanding of VBT and molecular orbital theory to determine the geometry and bonding in polyatomic molecules. The course provides fundamental knowledge and develops skills through performing practicals based on the theoretical concept.

### Unit 1: Atomic Structure

Basic Concept of Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Basic concept of Wave mechanics: de Broglie equation, Heisenberg's uncertainty principle and its significance, Schrödinger's wave equation, significance of  $\psi$  and  $\psi^2$ . Quantum numbers and their significance. Normal and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

### Unit 2: Periodicity of Elements:

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio. properties of the elements, with reference to s & p- block. Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. Atomic radii (van der Waals) Ionic and crystal radii. Covalent radii (octahedral and tetrahedral) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. Electron gain enthalpy, trends of electron gain enthalpy. Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

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## Unit 3: Ionic Bonding

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

## Unit 4: Covalent Bonding

Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule,

Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules  $N_2$ ,  $O_2$ ,  $C_2$ ,  $B_2$ ,  $F_2$ ,  $CO$ ,  $NO$ , and their ions;  $HCl$  (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons:  $H_2O$ ,  $NH_3$ ,  $PCl_3$ ,  $PCl_5$ ,  $SF_6$ ,  $ClF_3$ ,  $I_3^-$ ,  $BrF_2^+$ ,  $PCl_6^-$ ,  $ICl_2^-$ ,  $ICl_4^-$  and  $SO_4^{2-}$ . Multiple bonding ( $\sigma$  and  $\pi$  bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

## Unit 5: Metallic Bond

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. (iv) Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction. Hydrogen bonding (theories of hydrogen bonding, valence bond treatment). Effects of weak chemical forces, melting and boiling points, solubility, energetics of dissolution process.

### Learning outcome: -

At the end of the course, the student will be able to:

**CO1:** Explain the atomic structure based on quantum mechanics and explain periodic properties of the atoms viz. atomic radii, ionization energy and their interpretations.

**CO2:** Explain the structure and bonding in molecules and ions and predict the structure and geometry of molecules on the basis of VBT and VSEPR theory.

**CO3:** Explain electronegativity and dipole moment and its vector in determining ionic characters in covalent compounds.

**CO4:** Explain the band structure of solids and determine the electrical properties, semiconductivity and packing orders of crystals with defects.



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**CO5:** Explain the relationships between weak forces and physical properties of solid compounds

### TEXT BOOKS

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
4. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.

SR.NO.	EXPERIMENT NAME
1	Acid-Base Titrations: Principles of acid-base titrations to be discussed. Estimation of sodium carbonate using standardized HCl. Estimation of carbonate and hydroxide present together in a mixture. Estimation of carbonate and bicarbonate present together in a mixture. Estimation of free alkali present in different soaps/detergents
2	Oxidation-Reduction Titrimetry: Principles of oxidation-reduction titrations (electrode potentials) to be discussed. Estimation of Fe(II) and oxalic acid using standardized $\text{KMnO}_4$ solution Estimation of oxalic acid and sodium oxalate in a given mixture. Estimation of Fe(II) with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator (diphenylamine, N-phenylanthranilic acid) and discussion of external indicator.

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<b>Subject Code</b>	CHFN107	<b>Subject Title</b>	<b>ORGANIC CHEMISTRY-I</b>						
<b>LTP</b>	3 1 2	<b>Credit</b>	5	<b>Subject Category</b>	CC	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

### Course Objectives:

This course aims to develop an understanding of the basic principles of organic chemistry which include organic skeleton build-up, hybridization states, their stereo-electronic properties and different mechanisms involved in organic transformations. The course will develop an insight on the stereochemistry and mechanism of different classes of organic compounds. The course develops skill to the learners for designing of various chemical processes and synthetic reactions.

### Course Outcomes

At the end of the course, the student can:

**CO1:** Identify the name of the functional groups and different class of organic compounds.

**CO2:** Develop an insight of organic reactions classes and their mechanism.

**CO3:** Draw various models of chiral compounds, basis of chirality and determination of absolute configurations

**CO4:** Understand the physico-chemical properties and forces in the organic molecules which govern their reactivities.

**CO5:** Understand the basis of aromaticity of organic compounds, and differences in the reactivity of aromatic vs aliphatic and alicyclic compounds.

### Curriculum Content

#### Unit 1: Basics of Organic Chemistry

**9Hrs**

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of

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Carbocations, Carbanions, Free radicals and Carbenes Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

### **Unit 2: Stereochemistry of Organic compounds:**

**8 Hrs**

Newman projection, Sawhorse, Fischer projection and Flying-Wedge formulae, Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres, diastereomers, meso compounds, resolution of racemic mixtures; relative and absolute configurations – D&L and R&S systems of nomenclature, sequence rules; geometrical isomerism – cis-trans isomerism, E&Z system of nomenclature of alkenes

### **Unit 3: Chemistry of Aliphatic Hydrocarbons:**

**9 Hrs**

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity. Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration. oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes. Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

### **Unit 4: Aromatic Hydrocarbons**

**7 Hrs**

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Aromatic electrophilic substitution – general pattern of the mechanism, role of  $\sigma$  and  $\pi$  complexes, Mechanism of nitration, halogenation, sulphonation, mercuriation and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio, Side

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chain reactions of benzene derivatives, Birch reduction; Methods of formation and chemical reactions of alkyl benzenes, alkynyl benzenes and biphenyl, naphthalene and Anthracene;

### **Unit 5: Alkyl and Aryl Halides**

**6Hrs**

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams; Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions; Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.

### **Textbook(s)**

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), 6<sup>th</sup> Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) (2002).

### **Reference Books**

1. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
3. Organic Chemistry, Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).

<b>Sr.No.</b>	<b>Experiment name</b>
1	<b>Purification of organic solids by</b> i) Sublimation (Naphthalene, camphor etc.) ii) Hot water (Benzoic acid, acetanilide etc.) Checking purity of organic solids by melting point/mixed melting point.

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2	<p><b>Identification of Organic Compounds</b></p> <p>The preliminary examination of physical and chemical characteristics (physical state, colour, odor and ignition tests), elemental analysis (nitrogen, sulphur, chlorine, bromine, iodine), solubility tests including acid-base reactions. Functional group tests of following classes of compounds</p> <ul style="list-style-type: none"><li>– phenols, carboxylic acids</li><li>– carbonyl compounds – ketones, aldehydes</li><li>– carbohydrates</li><li>– aromatic amines</li><li>– amides, ureas and anilides</li><li>– aromatic hydrocarbons and their halo- derivatives</li></ul>
3	<p><b>Preparations</b></p> <ul style="list-style-type: none"><li>i) Acetylation of salicylic acid, aniline</li><li>ii) Benzoylation of salicylic acid, aniline</li><li>iii) Preparation of iodoform from ethanol and acetone</li><li>iv) Preparation of 4-nitroacetanilide from acetanilide</li><li>v) Preparation of 4-bromoacetanilide from acetanilide</li></ul>

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## Discipline Course (Semester-II)

<b>Subject Code</b>		<b>Subject Title</b>	<b>PHYSICAL CHEMISTRY-I</b>						
<b>LTP</b>	3 1 2	<b>Credit</b>	5	<b>Subject Category</b>	CC	<b>Year</b>	1 <sup>st</sup>	<b>Semester</b>	I

### **Course Outline:**

The course covers the gaseous states kinetics and P-V-R relations in the first unit. The second unit is about the properties of liquids. The third unit renders details of the types of crystalline packing and symmetry for prototype crystalline solids. The fourth and fifth unit covers the thermodynamics of gaseous expansions and compressions and changes in intrinsic parameters, like, enthalpy, internal energy during gaseous phase reactions.

### **COURSE OBJECTIVE:**

The objectives of this course involve learning the basics of thermodynamics and to be able to identify and describe energy exchange processes of reactions.

**Course Pre/Co- requisite (if any):** The student must have basic knowledge of gaseous laws and equations regarding the Pressure-Volume-Temperature dependency of gaseous molecules. Students should also have a prior understanding of the crystalline nature of well-known salts (NaCl) to be further explained and the basis of homogenous solutions and colloidal suspensions.

### **Detailed Syllabus**

#### **Unit 1: Gaseous state:**

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity.

#### **Unit 2: Liquid State**

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapor pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of the structure of water.

#### **Unit 3: Solid State:**

Definition of space lattice, unit cell, Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of the rationality of indices (iii) Law of symmetry, Symmetry elements in crystals.

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Lattice sites and coordination number in the unit cell, X-ray diffraction by crystals, Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

### **Unit 4: Thermodynamics and Thermochemistry:**

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat,  $q$ , work,  $w$ , internal energy,  $U$ , and statement of first law; enthalpy,  $H$ , between heat capacities, calculations of  $q$ ,  $w$ ,  $U$  and  $H$  for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Second Law: Concept of entropy; the thermodynamic scale of temperature, statement of the second law of Thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of the third law, the concept of residual entropy, calculation of absolute entropy of molecules.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy, and resonance energy from thermochemical data, the effect of temperature (Kirchhoff's equations) and pressure on the enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

### **Unit 5: Free Energy functions and Systems of Variable Composition:**

Free Energy Functions: Gibbs and Helmholtz energy; variation of  $S$ ,  $G$ ,  $A$  with  $T$ ,  $V$ ,  $P$ ; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

### **Learning Outcome: -**

At the end of the course, the student will be able to:

**CO1:** Explain the kinetics of gaseous diffusion and viscosity based on various parameters; understand gaseous mixture separation based on partial pressures.

**CO2:** Determine of Physical properties of pure Liquids and mixtures (solutions).

**CO3:** Elucidate the structure of crystals using X-ray crystallography

**CO4:** State and apply the laws of thermodynamics in macroscopy systems and thermochemistry of chemical reactions.

## **COURSE STRUCTURE OF B.SC. (HONS) CHEMISTRY APPLICABLE FOR FOUR YEAR DEGREE PROGRAM**

**CO5:** Predict the spontaneity of reactions by using thermodynamic principles.

### **TEXT BOOKS**

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press(2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

<b>SR.NO.</b>	<b>EXPERIMENT NAME</b>
<b>1</b>	To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.
<b>2</b>	To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.
<b>3</b>	Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution of sulphuric acid or enthalpy of neutralization), and (ii) heat gained equal to heat lost by cold water and hot water respectively
<b>4</b>	Determination of heat capacity of a calorimeter for different volumes using heat gained equal to heat lost by cold water and hot water respectively
<b>5</b>	Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
<b>6</b>	Study of the solubility of benzoic acid in water and determination of $\Delta H$ .
<b>7</b>	Determination of integral enthalpy (endothermic and exothermic) solution of salts.
<b>8</b>	Calculation of enthalpy of ionization.



# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

### Interdisciplinary Courses (Semester-I & II)

Department offering the course	Physics
Course Code	PYFN117
Course Title	Waves and Optics
Credits (L:T:P:C)	3:1:2:5
Contact Hours (L:T:P)	3:1:2
Prerequisites (if any)	None
Course Basket	Discipline Course

#### COURSE SUMMARY:

This course develops a strong background of simple harmonic motion, their superposition, wave motion, interference and diffraction.

#### COURSE OBJECTIVE:

This course introduces the physics of waves, oscillations and the formalism of wave behavior in the context of physical optics.

**Course Pre/Co- requisite (if any) :** no restricted pre-requisite

#### COURSE OUTCOME

##### On successful completion of the course, students will be able to achieve the following:

Having successfully completed this course the student will be able to:

1. Understand the principle of linear superposition of waves, use phasor description of waves and learn about construction of Lissajous figures
2. Develop the wave equation to find out the relationship between the speeds of propagation of waves.
3. Learn how stationary/standing waves are produced by the superposition of incident and reflected waves in a string fixed at both ends and understanding of wave impedance.
4. Understand different modes of vibrations in strings, air columns and rods and learn how different harmonics are produced and also find how stringed instruments work.
- 5 Understand how wave nature of light can be used to explain the phenomenon of interference and diffraction.

#### CURRICULUM CONTENT

##### Unit 1: Superposition of Collinear Harmonic oscillations

Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods, Lissajous Figures (1:1 and 1:2) and their uses

6 L

##### Unit 2: Wave Motion

Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Travelling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation, Pressure of a

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

Longitudinal Wave, Energy Transport, Intensity of Wave. Water Waves: Ripple and Gravity Waves

5 L

### Unit 3: Superposition of Two Harmonic Waves

Vibrations of Stretched Strings, Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

7 L

### Unit-4: Wave optics & Interference

**Interference:** Division of amplitude and wavefront. Young's double slit experiment. Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **Interferometer:** Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

9 L

### Unit- 5: Diffraction

**Fraunhofer diffraction:** Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

**Fresnel Diffraction:** Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate.

12 L

### Text book [TB]:

1. Optics, Ajoy Ghatak, McGraw Hill Education, 2017.
2. The Physics of Waves and Oscillations, N.K. Bajaj, Tata McGraw Hill, 2004

### Reference books [RB]:

1. The physics of vibrations and waves, H. J. Pain, Wiley, 2010
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, McGraw-Hill, 2011.

SR.NO.	LIST OF EXPERIMENTS
1	To determine wavelength of sodium light using Newton's Rings.
2	To determine wavelength of sodium light using Fresnel's Biprism.
3	To determine wavelength of prominent lines of mercury using plane diffraction grating.
4	To determine the specific rotation of cane sugar solution using bi-quartz polarimeter
5	To study the diffraction pattern of Single slit and hence determine the slit width.
6	To verify cosine square law (Malus Law) for plane polarized light.
7	To study the nature of polarization using a quarter wave plate.
8	To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

1. Department offering the course	Computer Science and Engineering
2. Course Code	CSF101
3. Course Title	Programming for problem solving
4. Credits (L:T:P:C)	3:0:2:4
5. Contact Hours (L:T:P)	3:0:2
6. Prerequisites (if any)	
7. Course Basket	Engineering Sciences

### COURSE OUTLINE:

This course contains the fundamental concepts about the computer hardware and intends to provide to students about the knowledge of C language

### COURSE OBJECTIVE:

The objective of the course is to make the students to understand the key hardware components in a modern computer system and as to how the software is mapped to the hardware. The student shall also be able to learn make the computer programs using C language by exploring the various features of C.

### COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1. To formulate simple algorithms for arithmetic and logical problems.

CO2. To implement conditional branching, iteration and recursion.

CO3. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

CO4. To use arrays, pointers and structures to formulate algorithms and programs.

CO5. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems

### CURRICULUM CONTENT

#### UNIT 1: Introduction to Computer, Programming & algorithms (8 L)

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm:

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

Flowchart/Pseudocode with examples, From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

**UNIT 2: Arithmetic Expression, and Conditional statements, Loops, Expression: (7 L)** Arithmetic, Logical, Relational expressions and precedence.

Loops & Branching: Writing and evaluation of conditionals and consequent branching, Iteration and loops.

**UNIT 3: Arrays & Functions (7 L)**

**Arrays:** Arrays (1-D, 2-D), Character arrays and Strings.

**Functions:** functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.

**Searching & Sorting:** Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

**UNIT 4: Recursion and Structure (8 L)**

**Recursion:** Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc.

**Structure:** Structures, Defining structures and Array of Structures.

**UNIT 5: Pointers & File handling (7 L)**

**Pointers:** Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list.

**File handling:** different modes of opening a file in C, reading, writing from files.

### **TEXT BOOKS**

1. Byron Gottfried, "Schaum's Outline of Programming with C", 2nd edition 2006 McGraw-Hill.
2. E. Balaguruswamy, "Programming in ANSI C", 8th Edition 2019, McGraw-Hill Education India.

### **REFERENCES**

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd edition 1988, Prentice Hall of India.

### **TEACHING AND LEARNING STRATEGY**

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Team. Refer to your course in MS Team for details.

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

### LIST OF EXPERIMENTS:

S.NO.	EXPERIMENT NAME
1	Familiarization with programming environment.
2	Programming for Simple computational problems using arithmetic expressions.
3	Programming for Problems involving if-then-else structures.
4	Programming for Iterative problems e.g., sum of series.
5	Programming for 1-D Array manipulation.
6	Programming for Matrix problems, String operations.
7	Programming for Simple functions
8	Programming for Recursive functions.
9	Programming for Pointers and structures.
10	Programming for File operations

**Compiler (for lab/ lecture)**

**Offline:** <https://developerinsider.co/download-turbo-c-for-windows-7-8-8-1-and-windows-10-32-64bit-full-screen/>

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

1. Department offering the course	Mathematics
2. Course Code	MAF108
3. Course Title	Calculus-I
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Core

### Course Objectives:

To prepare the students with basic concepts of limit, continuity, differentiability, and integration of functions and their applications.

### Course Outcome: Students will be able to:

- find derivative and anti-derivative of various functions and use them for further study
- draw graph of various functions in Cartesian and Polar coordinates
- determine area, volume, surface of revolutions using definite integrals
- use the concepts of calculus in higher learning.

### Curriculum Content:

#### UNIT I: Limit and Continuity [8]

Review of functions of single variable: Exponential, Logarithmic, Trigonometric and Hyperbolic functions, Limit, Continuity, Algebra of limits and continuous functions.

#### UNIT II: Differentiability [10]

Differentiability, Indeterminate forms, L' Hospital rule, Rolle's Theorem, Mean value theorems & their applications, Successive differentiation, Leibnitz theorem, Maclaurin & Taylor series of functions of one variable.

#### UNIT III: Applications of Derivatives [10]

Review conic sections and their Graphs, Monotonicity, Maxima and Minima, Concavity, Convexity, Point of inflection & Asymptotes, Polar coordinates, Curvature, Envelope of a family of curves, Graphs of functions and curves.

#### UNIT IV: Integral Calculus [12]

Review of indefinite and definite integrals, Fundamental theorem of integral calculus, Integral as the limit of sum, Area, Volume and surface of revolution, Arc lengths, Double and triple integrals, Change of order of integration, Change of variables, Beta and Gamma function, Dirichlet's integral, Application of multiple integrals.

### Text Books:

1. G. B. Thomas and R. L. Finney, "Calculus and Analytic Geometry", 9<sup>th</sup> Edition, Pearson Education India, 2010

### Reference Books:

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

1. R. K. Jain, & S. R. K. Iyenger, "Advanced Engineering Mathematics", 4<sup>th</sup> Edition, Narosa Publishing House, New Delhi, India, 2014.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10<sup>th</sup> Edition, John & Wiley Sons, U.K., 2016.
3. Gorakh Prasad, "Integral Calculus", Pothishala Private Limited, 2015

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

### Ability Enhancement Courses (Semester I & II)

Subject Code	HLAN146	Subject Title	Professional Communication						
LTP	202	Credit	3	Subject Category	AEC I	Year	I	Semester	I

**Course Summary:** This course is to enhance the Communication Skills of the students. It also focuses on Basic facets of communication. It introduces the students to LSRW and Non-verbal Language and how to master these aspects to be an effective communicator.

**Course Objective:**

- The course aims at developing the LSRW skills of students for effective communication.
- Also, to equip them for a business environment.
- It also focuses on preparing the students to understand and present themselves effectively.

**UNIT I:**

**Communication (7)**

Communication: Meaning; Types of Communication: General and Technical Communication; Knowledge and adoption of Non-Verbal cues of communication: Kinesics, Proxemics, Chronemics, Oculistics, Haptics, Paralinguistics; Barriers to Communication: Overcoming strategies.

**UNIT II:**

**Listening & Speaking Skills (4)**

Listening Comprehension: Identifying General and Specific information, Note-taking and Drawing Inferences; Introduction to Phonetics: Articulation of Consonants and Vowel sounds.

**UNIT III:**

**Reading Skills & Technical Writing Skills (8)**

Reading Strategies and Vocabulary Building; Reading Comprehension; Paragraph Development; Intra-office Correspondence: Notice, Agenda, Minutes and Memorandum; Technical Proposal and Technical Report

**UNIT IV:**

**Communication at Work**

(7)

Business Letter Writing; Job Application Letter & Resume; Interview Skills; Impression Management; SWOT Analysis; EQ and Its Dimensions,

**Learning Outcome:**

On successful completion of the course, students will be able to achieve the following:

1. Communicate smoothly
2. Greater self-confidence and knowledge of life skills helps them to develop healthier interpersonal relationships.
3. Present themselves effectively



# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

4. Prepares the students to face future challenges and excel in their personal and professional lives.

### **Text Book [TB]:**

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Raman, Meenakshi and Sangeeta Sharma, Technical Communication: Principles and Practice, 2nd Edition. New Delhi: Oxford University Press. 2011.

### **Reference Book [RB]:**

1. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
2. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
3. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.
4. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications, Hyderabad. 2010.
5. Tyagi, Kavita& Padma Misra. Basic Technical Communication, PHI, New Delhi. 201

### **Lab:**

Lab 1: Neutralizing Mother Tongue Influence

Lab 2: Listening (Biographies through software) & Presentation of Biographies

Lab 3: Listening & Role Play on Situational/ Telephonic Conversation (through software)

Lab 4: Picture Perception

Lab 5: Public Speaking

Lab 6: Group Discussion

Lab 7: Case Studies

Lab 8: SWOT Analysis

Lab 9: Mock Interview

Lab 10: Final Evaluation

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

<b>Subject Code</b>	<b>HLAN149</b>	<b>Subject Title</b>	<b>Corporate Communication &amp; Soft Skills</b>						
<b>LTP</b>	2 0 2	<b>Credit</b>	3	<b>Subject Category</b>	AEC II	<b>Year</b>	I	<b>Semester</b>	II

### 1. Course Summary:

This course is to enhance the soft skills of the students. It also focuses on Business communication. It will help the students to develop professional skills and how to be effective communicator at work place.

### 2. Course Objectives:

- To introduce to students to the business & corporate environment and its expectations.
- To help students to identify and sharpen their personal and professional skills.
- To ensure employability of students through a perfect blend of hard & soft skills.

#### UNIT I:

##### **Business Communication** (6)

Importance & Features of Business Communication, Flow of Communication: Channels & Networks

Business Presentation, Business Etiquette, Telephonic Etiquette

#### UNIT II: (6)

SWOT Analysis: Self-Assessment, Identifying Strength & Weakness

Self-Awareness, Self-Disclosure & Self-Management (Stress, Anger)

Interview Skills, Impression Management

#### UNIT III: (6)

##### **Personal Skills for Corporate Communication**

Goal Setting: Personal & Professional Goals, SMART-ER Goals

Human Perception: Understanding People, Perceptions, Attitudes

Personality (Personality Test)

#### UNIT IV: (6)

##### **Professional Skills for Corporate Communication**

Decision Making: Techniques, Six Thinking Hats: Creative Thinking, Lateral Thinking

Team Building & Leadership Skills

Time Management, Conflict Management

### Course Outcomes:

**On successful completion of the course, students will be able to achieve the following:.**

Students identify their goals and through enhanced soft skills work towards achieving them.

- Greater self-confidence and knowledge of life skills helps them to develop healthier interpersonal relationships.
- Prepares the students to face future challenges and excel in their personal and professional lives.

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

### **Lab:**

- Lab 1** Telephone Etiquette: Making an appointment, answering calls (Role Play)
- Lab 2** Telephone Etiquette: Making an appointment, answering calls (Role Play)
- Lab 3** Business Presentations (PPT Presentation)
- Lab 4** Business Presentations (PPT Presentation)
- Lab 5** Interview Skills: Mock Interview
- Lab 6** Interview Skills: Mock Interview
- Lab 7** Panel Discussion
- Lab 8** Panel Discussion
- Lab 9** Conflict & Negotiation (Situational Role Play)
- Lab 10** Conflict & Negotiation (Situational Role Play)
- Lab 11** Evaluation
- Lab 12** Evaluation

### **Text Book [T.B]:**

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Gulati, Sarvesh. Corporate Soft skills, Rupa & Company, 2006

### **Reference Book [R.B]:**

1. Steven R. Covey. The Seven Habits of Highly Effective People, Simon and Schuster, London, 2007.
2. Robbins, Stephen. Management, Pearson Prentice Hall. 2009
3. Carnegie, Dale. How to win Friends and influence People, Simon and Schuster, London, 2009.
4. Dr. Alex. Soft Skills: Know Yourself & Know the World, S. Chand Publications, 2001.
5. Gopalswamy, Ramesh. The ACE of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson, New Delhi, 2008.
6. Ghosh, B. N. Managing Soft skills for Personality development, Laxmi Publications Ltd., New Delhi, 2013.
7. Elizabeth B. Hurlock. Personality Development, TMH Publication, 2010.

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

SKill Enhancement Courses (Semester I & II)

Subject Code	HLAN176	Subject Title	Aptitude & Skill Enhancement-I						
LTP	3 0 0	Credit	3	Subject Category	SEC I	Year	1	Semester	1

### Course Summary

Aptitude and Verbal Ability training module is crafted to bridge the gap between skills possessed by the students and the abilities that are looked for by the organization. It not only provides career guidance about the selection process but also helps students in profile building and enhancing their cognitive skills and enhance their employability quotient.

### Course Objectives

- Interpret the questions of aptitude building objectively and prepare for various competitive examinations/campus recruitment exams.
- Understand the optimized approach of dealing with placement questions
- Learn ways of representing themselves effectively in formal settings

### Course Outcomes

On successful completion of the course, students will be able to achieve the following:

By the end of this semester, students will be able to perceive and analyze the requirements of placement trends as detailed information about the selection process would be provided by career guidance. They will be more confident and will be able to develop a professional profile, both online and offline.

### UNIT-1

#### QUANTITATIVE APTITUDE:

##### Number System

Types of numbers; Factors; Divisibility test; Place and face Value; Base system; Remainder theorem; digits at the unit places and finding last two digits in a given expression; Calculating number of zeroes, Finding maximum power of any prime number or any composite number in any factorial, HCF and LCM.

Fractions–Types of fractions; Conversion of terminating and non-terminating types of decimals into fraction; Subtraction, addition and multiplication of terminating and non-terminating decimals.

##### Percentage

Basic concepts; Conversion from fraction to percentage; Application of percentage in – Expenditure, Cost, Consumption problems; Population increase or decrease problems; Production, Manpower and Working hour problems; successive increment or decrement; Comparison of salary or numbers; Percentage change in area or volume, etc.

##### Time Speed Distance

Introduction & types; Speed, Distance and Time: Average Velocity; Race tracks - Straight and Circular; Trains; Boats and Streams

##### Time and Work & Partnership

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

Basic concepts (relationship between men, days and work); Understanding group efficiency; Alternate work; Negative work; Wages; Pipes and Cisterns. Concept of partnership.

### **Simple / Compound Interest**

Simple Interest and compound Interest: Basic concept of Principal, Time, Amount and Rate of Interest; Concept of Lent money.

### **Profit and Loss**

Introduction; Concept of single, double and triple discount and marked price.

## **UNIT-2**

### **LOGICAL REASONING**

#### **Coding Decoding and Sequences**

Coding Decoding, Crypt arithmetic, Sequence and Series - Finding the missing term/wrong term in the logical sequence of letter/number/word/alphanumeric, Continuous pattern series.

#### **Deductive Logic**

Conditional Arguments- If-then, only if then, If and only if , Either or; Premises and conclusion structure, Quality of deductive argument, Syllogism,

#### **Blood Relation and Direction Sense**

Blood Relation- Indicating form / puzzle form / coding form, Direction Sense, Direction puzzles.

#### **Verbal Analogies and Odd man out**

Verbal Analogy based on various parameters - Antonym / synonym relationship, Quantity and unit, Individual and Group, Product and Raw material, cause and Effect etc.

Odd man out based on several kind of relationship – Relationship based on meaning, functional relationship, even- odd or prime-composite, divisibility rule, etc.

## **UNIT-3**

### **VERBAL APTITUDE**

#### **Tenses and Grammar drills.**

Creative Writing: Essay, Report Writing, Article, Letters, E-mail: difference between formal and informal tone, appropriate use of transition words, creating a signature, understanding different situations and the responses they require (situation- based writing), Proper use of connectors.

#### **Textbook(s)**

1. Quantitative Aptitude: How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill
2. Logical Reasoning: A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Aggarwal, S Chand Publishing
3. Verbal Aptitude: English is Easy- Chetanand Singh, BSC Publication

#### **Reference Books**

1. Quantitative Aptitude: Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications  
Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat Savera Publishing House

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

2. Logical Reasoning: Analytical & Logical Reasoning by Peeyush Bhardwaj-Arihant Publications  
Logical Reasoning: Analytical Reasoning by M.K.Pandey BSC publishing
3. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

1. Department offering the course	Mathematics
2. Course Code	MAFN119
3. Course Title	Introduction to MATLAB
4. Credits (L:T:P:C)	2:0:2:3
5. Contact Hours (L:T:P)	2:0:2
6. Prerequisites (if any)	None

### Course Summary:

### Course Objective:

The objective of this course is to introduce the students with basics of MATLAB, curve plotting and use of basic commands to solve various algebraic and differential equations through MATLAB.

### Course Outcomes:

After successful completion of this course students will be able to:

- Understand the basics functions of MATLAB.
- Plot the 2D, 3D figures.
- Use basic commands of MATLAB.
- Solve various differential equations using MATLAB.

### Curriculum Content:

#### Unit I

Introduction to MATLAB: vector and matrix generation, subscripting and the colon notation, matrix and array operations and their manipulations, introduction to some inbuilt functions related to array operations. m-files: scripts and functions, editing, saving m-files, and interaction between them.

#### Unit II

Two & three-dimensional graphics: basic plots, change in axes and annotation in a figure, multiple plots in a figure, saving and printing figures, mesh plots, surface plots and their variants.

#### Unit III

Relational and logical operators: flow control using various statements and loops including If-End statement, If-Else-End statement, nested If-Else-End statement, For-End and While-End loops with Break commands.

#### Unit IV

Introduction to builtin functions: related to matrix inversion, eigenvalues, eigenvectors, condition number; for data representation: bar charts, histograms, pie chart, stem plots etc; for solving various type of differential equations; for specialized plotting e.g., contour plots, sphere, and animations.

### Text Books

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

1. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers by Rudra Pratap, Oxford University Press.

### **Reference Books**

1. Applied Numerical Methods with Matlab for Engineers and Scientists by Steven Chapra, McGraw Hill.
2. MATLAB: An introduction with applications: Amos Gilat, 5th Edition, Wiley India.



# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

### BP205 T. COMPUTER APPLICATIONS IN PHARMACY (Theory)

30 Hrs (2 Hrs/Week)

**Scope:** This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

**Objectives:** Upon completion of the course the student shall be able to

1. know the various types of application of computers in pharmacy
2. know the various types of databases
3. know the various applications of databases in pharmacy

#### Course content:

#### UNIT – I

06 hours

**Number system:** Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division

**Concept of Information Systems and Software :** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project

#### UNIT –II

06 hours

**Web technologies:** Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products

Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

#### UNIT – III

06 hours

**Application of computers in Pharmacy** – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring

Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

### **UNIT – IV**

**06 hours**

**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery

### **UNIT-V**

**06 hours**

**Computers as data analysis in Preclinical development:**

Chromatographic data analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMs)

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

Subject Code		Subject Title	Basic Instrumentation Techniques						
LTP	3 0 0	Credit	3	Subject Category		Year	I <sup>st</sup>	Semester	2 <sup>nd</sup>

### Course Objective

1. Provides essential theoretical background on basic spectroscopic techniques.
2. Involve to solve chemical problems related to water.
3. Students will be exposed to their research and development career.

**Course Pre/Co- requisite (if any):** no restricted pre-requisite

### Course Content:

#### Unit 1: Colorimetry:

**6 hrs**

Intn, interaction of electromagnetic radiation with matter, transmittance, absorbance, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter: Principle, Construction and components, & it's Working, Determination of unknown concentration of Fe(III) by thiocyanate method.

#### Unit 2: Conductometry and Electrophoresis:

**9 hrs**

Introduction, Electrolytic Conductance, Resistance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, effects of concentrations on equivalent and specific conductance, Kohlrausch's law and its applications, conductivity cell, Conductivity meter, determination of cell constant, conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base)

Electrophoresis: Principle, Instrumentation, Working conditions, various factors affecting separation and applications on different process: Paper electrophoresis, Gel electrophoresis, Capillary electrophoresis, Moving boundary electrophoresis

#### Unit 3: UV spectroscopy:

**6 hrs**

Introduction to UV spectroscopy and basic instrumentation, Applications of UV spectroscopy, Qualitative and Quantitative analysis of iron, phosphate and sulfates using UV-Visible absorption techniques.

#### Unit 4: Techniques for water sample analysis:

**8 hrs**

Characteristics of pure water, water contamination, water sampling methods, Water analysis techniques: pH meter, Nephelometry, Turbidity meter. Determination of pH, dissolved oxygen (DO), microorganisms, alkalinity, BOD and COD in the water sample.

#### Unit 5: Chromatography:

**9 hrs**

Basic introduction, Various chromatographic techniques: Gas chromatography, High-Pressure Liquid Chromatography (HPLC), Paper Chromatography, Thin Layer

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

Chromatography (TLC), Liquid-liquid Extraction and Column Chromatography. Determination of mixture of metal ion ( $\text{Fe}^{3+}$  and  $\text{Al}^{3+}$ ) using Paper chromatography, Comparison of paint samples by TLC method.

### **Learning outcomes:**

1. Critically assess the applicability of methods to specific problems in science and successfully apply appropriate techniques in their academic, research, and development careers.
2. Knowledge of different analytical techniques.

### **Reference Books**

1. Engineering Chemistry Book, Shikha Agarwal.
2. Fundamentals of Analytical Chemistry 9<sup>th</sup> Edition by Donald M. West, F. James Holler, and Stanley R. Crouch.
3. Introduction to Spectroscopy by Pavia, Lampman, Kriz and Vyuyan

# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

### Common Value-added courses (Semester I)

1. Department offering the course	Humanities & Liberal Arts
2. Course Code	LAF285
3. Course Title	Indian Constitution
4. Credits (L:T:P:C)	2:0:0:2
5. Contact Hours (L:T:P)	2:0:0
6. Prerequisites (if any)	NIL

#### **COURSE SUMMARY:**

The Constitution of India is the supreme law of India. The document lays down the framework demarcating fundamental political code, structure, procedures, powers, and duties of government institutions and sets out fundamental rights, directive principles, and the duties of citizens. The course will provide knowledge of their constitutional rights to the students and also familiarize the students with the features of the Indian Constitution.

#### **COURSE OBJECTIVE:**

To familiarize the students with the features of the Indian Constitution

To provide a knowledge of their constitutional rights

#### **COURSE OUTCOMES**

**On successful completion of the course, students will be able to achieve the following:**

1. Enable the students to protect their rights
2. The students will be engaged in the political system of India

#### **CURRICULUM CONTENT**

##### **Unit 1: Introduction**

Constitution- meaning of the term, basic features Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy, debates on Fundamental Rights and Directive

##### **Unit 2: Union Government and its Administration**

Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha Institutional Functioning: Prime Minister, Parliament and Judiciary, Power Structure in India: Caste, class and patriarchy

##### **Unit 3: State Government and its Administration**

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions.

##### **Unit-4 Local Administration**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected, Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

### **Unit 5: Election Commission**

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

### **TEXT BOOKS**

1. Abbas, H., Kumar, R. & Alam, M. A. (2011) Indian Government and Politics. New Delhi: Pearson, 2011.
2. Chandhoke, N. & Priyadarshi, P. (eds.) (2009) Contemporary India: Economy, Society, Politics. New Delhi: Pearson.

### **REFERENCE BOOKS**

1. Chakravarty, B. & Pandey, K. P. (2006) Indian Government and Politics. New Delhi: Sage.
2. Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) India After Independence. New Delhi: Penguin.
3. Singh, M.P. & Saxena, R. (2008) Indian Politics: Contemporary Issues and Concerns. New Delhi: PHI Learning.
4. Vanaik, A. & Bhargava, R. (eds.) (2010) Understanding Contemporary India: Critical Perspectives. New Delhi: Orient Blackswan.

### **Teaching and Learning Strategy**

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.



# Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program

## Applicable for Batch: 2023-27

Common Value-added courses (Semester II)

1. Department offering the course	Chemistry
2. Course Code	CHF201
3. Course Title	Environmental Science
4. Credits (L:T:P:C)	2:0:0:2
5. Contact Hours (L:T:P)	2:0:0
6. Prerequisites (if any)	None

### COURSE OBJECTIVE

To impart basic knowledge about the environment and its allied problems and to develop an attitude of concern for the environment. Further the course structure will create the awareness about environmental problems among students and motivate the students to participate in environment protection and environment improvement programs. The course aims to develop skills to help the concerned individuals in identifying and solving environmental problems.

### COURSE OUTCOME:

1. At the end of the course, the student will be able to:
2. Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.
3. Able to identify the structure and functioning of natural ecosystems.
4. Establish man-wildlife harmonious relationship.
5. Adapt to 3R (Reuse, Recovery, Recycle). Identify the causes and control measures related to Pollutions.
6. Illustrate and analyze various Case Studies related to Environmental issues and Env. Legislation.

### CURRICULUM CONTENT

#### Unit 1: Basics of Environment and Natural Resources:

04 L

Definition and Concept of Environment, Multidisciplinary nature of environmental studies. Scope and importance of environmental studies, Need for public awareness, Environmental concerns and people. Introduction and classification of natural resources. Energy Resources, Water Resources, Land Resources, Forest Resources, Food Resources, Mineral Resources, Case studies related to over exploitation of resources and their impacts. Role of an individual in conservation of natural resources, Sustainable lifestyles.

#### Unit 2: Ecosystems:

04 L

Definition and concept of ecology, Structure and Function of an Ecosystem, Energy Flow in Ecosystems, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus, Oxygen, Hydrological). Species interactions in ecosystems. Ecological succession and ecological

# **Course Structure & Syllabus of B.Sc. (Chemistry) 4 Year Program**

## **Applicable for Batch: 2023-27**

pyramids. Characteristic features of grassland, pond, desert and forest ecosystems. Ecosystem services and conservation.

### **Unit 3: Biodiversity and its conservation:**

**04 L**

Introduction and types of biodiversity. Bio-geographic classification of India, Value and significance of biodiversity, Biodiversity at global, national and local levels, India: A mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity: Poaching and man-wildlife conflicts, IUCN Red Data Book and endangered & endemic species of India. Biodiversity conservation strategies, Institutes and organizations.

### **Unit-4 Environmental Pollutions:**

**05 L**

Introduction and Definition. Causes, consequences and control measures of: Air pollution, Water pollution, Noise pollution, Nuclear pollution, Soil pollution, Thermal and Marine pollution. Solid waste management, Bio-medical waste management. Disasters and its mitigation strategies, Global warming, Climate change, Acid rain, Ozone depletion and Smog. Pollution case studies. Role of an individual in pollution prevention.

### **Unit-5 Social Issues and Environment:**

**04 L**

Sustainable Development: Concept and importance, Environmental Impact Assessment (EIA), GIS, Remote sensing. Water conservation and rain water harvesting. Resettlement and rehabilitation problems, Environmental audit, eco-labeling and eco-friendly business. Environmental Legislation in India, Population explosion and its impact on environment and human health, Value Education and environmental ethics.

### **Field work:**

**03 L**

- Visit to a local area to document environmental asset: river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common flora and fauna.
- Study of a common ecosystem-pond, river, hill slopes, etc.

### **Text book [TB]:**

1. BharuchaErach, 2004. Textbook for Environmental Studies, University Grants Commission, New Delhi.
2. Kaushik A & Kaushik C P. 2007. Perspectives in Environmental Studies, New Age International Publ.
3. S. Deswal & A. Deswal 2015. A Basic Course in Environmental Studies. Dhanpat Rai & Co.