Syllabus
for
B.Sc. (Honours) Chemistry
[Choice Based Credit System]

Structure of B.Sc. (Honours) Chemistry Program under CBCS:

The B.Sc. (Honours) Chemistry Program under CBCS includes Core Courses and Elective Courses. The Core Courses are all compulsory courses. There are three categories of Elective Courses, which are Discipline Specific Electives (DSE), Generic Electives (GE), and Skill Enhancement Courses (SEC). In addition, there are two compulsory Ability Enhancement Courses (AECC).

To obtain a degree in this program students will go through fourteen Core Courses (CC), two Ability Enhancement Compulsory Courses (AECC), two Skill Enhancement Courses (SEC), four Discipline Specific Elective Courses (DSE) and four Generic Elective Courses (GE).

The students will study two Core Courses each, in Semesters I and II, three Core Courses each in Semesters III and IV and two Core Courses each in Semesters V and VI. The program offers several Discipline Specific Electives, of which the student will study two in each of the Semesters V and VI. Different Generic Elective courses are offered to students of B.Sc. (Honours) Chemistry Program by other departments in the university and the students will have the option to choose one GE course each in Semesters I, II, III, and IV. Students will study one Skill Enhancement Course each in Semesters III and IV. The two compulsory Ability Enhancement Courses are Environmental Sciences and English Communication and the student will study one each in Semesters I and II.

Credit Structure:

In CBCS, all courses have credits assigned to them. For any course, one of the following three modes teaching will be used.

1. Theory + Practical
2. Theory + Tutorial
3. Theory only

Class Assignments:

Class assignment for different course segments (theory, practical, tutorial) is as follows.

• **Theory:** 1 credit = 1 hour / week

• **Practical:** 1 credit = 2 hours / week

• **Tutorial:** 1 credit = 1 hour / week

Structure of the B.Sc. (Honours) Chemistry Programme under CBCS

Semester	Core Courses (CC)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Electives (DSE)	Generic Electives (GE)
I	CC-1, CC-2	AECC-1			GE-1
II	CC-3, CC-4	AECC-2			GE-2
III	CC-5, CC-6, CC-7		SEC-1		GE-3
IV	CC-8, CC-9, CC-10		SEC-2		GE-4
V	CC-11, CC-12			DSE-1, DSE-2	
VI	CC-13, CC14			DSE-3, DSE-4	

Distribution of semester-wise credits and total credits

	Sem-1	Sem-2	Sem-3	Sem-4	Sem-5	Sem-6	**Total Courses**	**Credits**		**Total Credits**
								Th	**Pr**	
CC	Th-2 Pr-2	Th-2 Pr-2	Th-3 Pr-3	Th-3 Pr-3	Th-2 Pr-2	Th-2 Pr-2	**Th-14 Pr-14**	**14 x 4 = 56**	**14 x 2 = 28**	**56 + 28 = 84**
DSE					Th-2 Pr-2	Th-2 Pr-2	**Th-4 Pr-4**	**4 x 4 = 16**	**4 x 2 = 8**	**16 + 8 = 24**
GE	Th-1 Pr-1	Th-1 Pr-1	Th-1 Pr-1	Th-1 Pr-1			**Th-4 Pr-4**	**4 x 4 = 16**	**4 x 2 = 8**	**16 + 8 = 24**
AECC	Th-1	Th-1					**Th-2**	**2 x 2 = 4**	**-**	**4**
SEC			Th-1	Th-1			**Th-2**	**2 x 2 = 4**	**-**	**4**
Semester-wise Credits	**20**	**20**	**26**	**26**	**24**	**24**				**140**

[Th-Theory, Pr-Practical, Tu-Tutorial]

Semester-wise courses and distribution of marks:

Sem	Course Type	Course Name	Teaching Mode	Credit	Marks			
					ESA	MTA	FCA	Total
1	CC	Inorganic Chemistry-I	Theory	4	70	20	10	100
	CC	Inorganic Chemistry Lab-I	Practical	2	-	-	-	100
	CC	Physical Chemistry-I	Theory	4	70	20	10	100
	CC	Physical Chemistry Lab-I	Practical	2	-	-	-	100
	GE	GE-1	Theory	4	70	20	10	100
	GE	GE-1L	Practical	2	-	-	-	100
	AECC	AECC-1	Theory	2	70	20	10	100
2	CC	Organic Chemistry-I	Theory	4	70	20	10	100
	CC	Organic Chemistry Lab-I	Practical	2	-	-	-	100
	CC	Physical Chemistry-II	Theory	4	70	20	10	100
	CC	Physical Chemistry Lab-II	Practical	2	-	-	-	100
	GE	GE-2	Theory	4	70	20	10	100
	GE	GE-2L	Practical	2	-	-	-	100
	AECC	AECC-2	Theory	2	70	20	10	100
3	CC	Inorganic Chemistry-II	Theory	4	70	20	10	100
	CC	Inorganic Chemistry Lab-II	Practical	2	-	-	-	100
	CC	Organic Chemistry-II	Theory	4	70	20	10	100
	CC	Organic Chemistry Lab-II	Practical	2	-	-	-	100
	CC	Physical Chemistry-III	Theory	4	70	20	10	100
	CC	Physical Chemistry Lab-III	Practical	2	-	-	-	100
	GE	GE-3	Theory	4	70	20	10	100
	GE	GE-3L	Practical	2	-	-	-	100
	SEC	*SEC-1	Theory	2	70	20	10	100
4	CC	Inorganic Chemistry-III	Theory	4	70	20	10	100
	CC	Inorganic Chemistry Lab-III	Practical	2	-	-	-	100
	CC	Organic Chemistry-III	Theory	4	70	20	10	100
	CC	Organic Chemistry Lab-III	Practical	2	-	-	-	100
	CC	Physical Chemistry-IV	Theory	4	70	20	10	100
	CC	Physical Chemistry Lab-IV	Practical	2	-	-	-	100
	GE	GE-4	Theory	4	70	20	10	100
	GE	GE-4L	Practical	2	-	-	-	100
	SEC	*SEC-2	Theory	2	70	20	10	100
5	CC	Organic Chemistry-IV	Theory	4	70	20	10	100
	CC	Organic Chemistry Lab-IV	Practical	2	-	-	-	100
	CC	Physical Chemistry-V	Theory	4	70	20	10	100

	CC	Physical Chemistry Lab-V	Practical	2	-	-	-	100
	DSE	*DSE-1	Theory	4	70	20	10	100
	DSE	*DSE-1L	Practical	2	-	-	-	100
	DSE	*DSE-2	Theory	4	70	20	10	100
	DSE	*DSE-2L	Practical	2	-	-	-	100
6	CC	Inorganic Chemistry-IV	Theory	4	70	20	10	100
	CC	Inorganic Chemistry Lab-IV	Practical	2	-	-	-	100
	CC	Organic Chemistry-V	Theory	4	70	20	10	100
	CC	Organic Chemistry Lab-V	Practical	2	-	-	-	100
	DSE	*DSE-3	Theory	4	70	20	10	100
	DSE	*DSE-3L	Practical	2	-	-	-	100
	DSE	*DSE-4	Theory	4	70	20	10	100
	DSE	*DSE-4L	Practical	2	-	-	-	100

*Students will choose required number of course/s from a number of courses offered by the department in the respective semester.

Semester-wise Distribution of Courses for B.Sc. (Hons.) Chemistry Programme under CBCS and Credit Distribution

CORE COURSES –14 (six credits each) Each course has 4 Periods/week for Theory, 4 Periods/week for Practical			
SEMESTER	**COURSE CODE**	**NAME OF THE COURSE**	**CREDITS T=Theory Credits P=Practical Credits**
I	1) TIU-UCH-T101 2) TIU-UCH-L101	1) Inorganic Chemistry I: Atomic Structure & Chemical Bonding 2) Inorganic Chemistry Lab-I	1) T=4 2) P=2
I	1) TIU-UCH-T102 2) TIU-UCH-L102	1) Physical Chemistry I: States of Matter & Ionic Equilibrium 2) Physical Chemistry Lab-I	1) T=4 2) P=2
II	1) TIU-UCH-T201 2) TIU-UCH-L201	1) Organic Chemistry I: Basics and Hydrocarbons 2) Organic Chemistry Lab-I	1) T=4 2) P=2
II	1) TIU-UCH-T202 2) TIU-UCH-L202	1) Physical Chemistry II: Chemical Thermodynamics and its Applications 2) Physical Chemistry Lab-II	1) T=4 2) P=2
III	1) TIU-UCH-T301 2) TIU-UCH-L301	1) Inorganic Chemistry II: s- and p-Block Elements 2) Inorganic Chemistry Lab-II	1) T=4 2) P=2
III	1) TIU-UCH-T302 2) TIU-UCH-L302	1) Organic Chemistry II: Halogenated Hydrocarbons and Oxygen Containing Functional Groups 2) Organic Chemistry Lab-II	1) T=4 2) P=2
III	1) TIU-UCH-T303 2) TIU-UCH-L303	1) Physical Chemistry III: Phase Equilibria and Electrochemical Cells 2) Physical Chemistry Lab-III	1) T=4 2) P=2
IV	1) TIU-UCH-T401 2) TIU-UCH-L401	1) Inorganic Chemistry III: Coordination Chemistry 2) Inorganic Chemistry Lab-III	1) T=4 2) P=2
IV	1) TIU-UCH-T402 2) TIU-UCH-L402	1) Organic Chemistry III: Nitrogen containing functional groups, Polynuclear Hydrocarbons, Heterocyclic Chemistry, Alkaloids and Terpenes 2) Organic Chemistry Lab-III	1) T=4 2) P=2
IV	1) TIU-UCH-T403 2) TIU-UCH-L403	1) Physical Chemistry IV: Conductance & Chemical Kinetics 2) Physical Chemistry Lab-IV	1) T=4 2) P=2

V	1) TIU-UCH-T501 2) TIU-UCH-L501	1) Organic Chemistry IV: Biomolecules 2) Organic Chemistry Lab-IV	1) T=4 2) P=2
V	1) TIU-UCH-T502 2) TIU-UCH-L502	1) Physical Chemistry V: Quantum Chemistry & Spectroscopy 2) Physical Chemistry Lab-V	1) T=4 2) P=2
VI	1) TIU-UCH-T601 2) TIU-UCH-L601	1) Inorganic Chemistry IV: Organometallic Chemistry& Bioinorganic Chemistry 2) Inorganic Chemistry Lab-IV	1) T=4 2) P=2
VI	1) TIU-UCH-T602 2) TIU-UCH-L602	1) Organic Chemistry V: Spectroscopy& Applied Organic Chemistry 2) Organic Chemistry Lab-V	1) T=4 2) P=2
Credits: 14 × 6 = 84			

ABILITY ENHANCEMENT COMPULSORY COURSES (AECC) – 2 (two credits each) **Each course has 2 Periods/week for Theory**			
SEMESTER	**COURSE CODE**	**NAME OF THE COURSE**	**CREDITS** **T=Theory Credits** **P=Practical Credits**
I	TIU-UCH-T103	Environmental Science	T = 2
II	TIU-UEN-T201	English Communication	T = 2
Credits: 2 × 2 = 4			

SKILL ENHANCEMENT ELECTIVE COURSES (SEC) – 2 (two credits each) **Each course has 2 Periods/week for Theory**			
SEMESTER	**COURSE CODE**	**NAME OF THE COURSE**	**CREDITS** **T=Theory Credits** **P=Practical Credits**
III	TIU-UCH-S301	IT Skills for Chemists	T=2
III	TIU-UCH-S302	Basic Analytical Chemistry	T=2
IV	TIU-UCH-S401	Pharmaceutical Chemistry	T=2
IV	TIU-UCH-S402	Fuel Chemistry	T=2
Credits: 2 × 2 = 4			

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) – 4 (six credits each) Each course has 4 Periods/week for Theory, 4 Periods/week for Practical			
SEMESTER	**COURSE CODE**	**NAME OF THE COURSE**	**CREDITS T=Theory Credits P=Practical Credits**
V	1) TIU-UCH-T503 2) TIU-UCH-L503	1) Novel Inorganic Solids 2) Inorganic Solids Lab	1) T=4 2) P=2
V	1) TIU-UCH-T504 2) TIU-UCH-L504	1) Applications of Computers in Chemistry 2) Applications of Computers in Chemistry Lab	1) T=4 2) P=2
V	1) TIU-UCH-T505 2) TIU-UCH-L505	1) Analytical Methods in Chemistry 2) Analytical Methods in Chemistry Lab	1) T=4 2) P=2
V	1) TIU-UCH-T506 2) TIU-UCH-L506	1) Polymer Chemistry 2) Polymer Chemistry Lab	1) T=4 2) P=2
VI	1) TIU-UCH-T603 2) TIU-UCH-L603	1) Green Chemistry 2) Green Chemistry Lab	1) T=4 2) P=2
VI	1) TIU-UCH-T604 2) TIU-UCH-L604	1) Industrial Chemicals & Environment 2) Industrial Chemicals & Environment Lab	1) T=4 2) P=2
VI	1) TIU-UCH-T605 2) TIU-UCH-L605	1) Instrumental Methods of Chemical Analysis 2) Instrumental Methods of Chemical Analysis Lab	1) T=4 2) P=2
VI	1) TIU-UCH-T606 2) TIU-UCH-L606	1) Nano Materials and Their Applications 2) Nano Materials Lab	1) T=4 2) P=2
VI	TIU-UCH-D601	Dissertation	6
Credits: 4 × 6 = 24			

GENERIC ELECTIVES COURSES (GE) – 4 (six credits each) Offered by other Departments. Please refer to the syllabus of other departments (Mathematics, Physics, Biotechnology and Computer science). Each course has 4 Periods/week for Theory, 4 Periods/week for Practical			
SEMESTER	COURSE CODE	NAME OF THE COURSE	CREDITS T = Theory Credits P = Practical Credits
I		GE-1	6
II		GE-2	6
III		GE-3	6
IV		GE-4	6
Credits: 4 × 6 = 24			

Note-1: Wherever there is a practical there will be no tutorial and vice-versa.
Note-2: Detail syllabus will be published soon.

Detail Syllabus

Chemistry (General Elective)

SEMESTER-I

Chemistry-I
TIU-GCH-E101

L-T-P: 3-1-0 **Credit: 4**

Module 1: [10L]
Inorganic Chemistry-I
1. Atomic Structure: Schrodinger equation; Radial and angular parts of wave function; quantum numbers; Orbitals and their shape.
2. *Covalent bonding:* Lewis structure; VSEPR theory; Structure of simple molecules and ions of main group elements. VB and MO approach; MO treatment of homonuclear and heteronuclear (CO & NO) diatomic molecules; HOMO, LUMO, Bond order.
***3. Ionic Bonding*:** General characteristics of ionic compounds: ionization energy, electron affinity etc. Sizes of ions, radius ratio rule and its limitation. Lattice energy, Born-Haber cycle.
Ionic Solids: Close packing, Radius ratio rule and crystal coordination number.
4. Metallic Bonding: Theories of bonding in metals; Free electron, VB and Band theories.
5. Weak Interactions: Hydrogen bonding and van der Waal's interactions

Module 2: [14L]
Organic Chemistry-I
1. Fundamentals of Organic Chemistry
Electronic displacements: inductive effect, resonance and hyperconjugation; nucleophiles and electrophiles; reactive intermediates: carbocations, carbanions and free radicals.
2. Stereochemistry
Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity (upto two carbon atoms); asymmetric carbon atom; interconversion of Fischer and Newman representations; enantiomerism and diastereomerism, *meso* compounds; *threo* and *erythro,* D and L, *cis* and *trans* nomenclature; CIP Rules: *R/S* (only one chiral carbon atoms) and *E/Z* nomenclature.
3. Nucleophilic Substitution and Elimination Reactions
Nucleophilic substitutions: SN1 and SN2 reactions; eliminations: E1 and E2 reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations.

Module 3: [16L]
Physical Chemistry-I
1. *Gaseous State*: Kinetic theory of gases, ideal gas laws based on kinetic theory. Collision in a gas- mean free path, collision diameter, collision number. Behaviour of real gases - the van der Waal's equation. Critical phenomena - critical constants of a gas and their determination, the van der Waals equation and critical state, Principle of corresponding states.
2. *Liquid State*: Surface tension of liquids - capillary action, experimental determination of surface tension, temperature effect on surface tension. Viscosity of liquids, experimental determination of viscosity coefficient, its variation with temperature.

3. *Chemical Kinetics*: Order and molecularity of chemical reactions, pseudo order. Kinetic law for second order reactions, determination of the rate constant and order of reaction from kinetic data. Effect of temperature on rate of reaction: collision theory of rates of bimolecular reactions and its comparison with Arrheninus equation.
Complex reactions: Reversible (first order in both directions), concurrent, consecutive reactions. Unimolecular gas reactions (Lindmann theory), steady-state approximations, theory of absolute reaction rate and its thermodynamic formulation.Enzymatic reactions.

Books Recommended
For Module 1
1. *Basic Inorganic Chemistry*, F. A Cotton and G. Wilkinson, John Wiley & Sons.
2. *Concise Inorganic Chemistry*, J. D. Lee, Chapman & Hall.

For Module 2
1. *Organic Chemistry*, I. L. Finar, Vol. I & Vol. II, ELBS and Longman Ltd., New Delhi.
2. *Organic Chemistry*, R. T. Morrison and R. N. Boyd, Prentice-Hall of India (P) Ltd., New Delhi.
3. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, and E. Wothers, , Oxford Univ. Press.

For Module 3
1. *Physical Chemistry*, P. Atkins and J. De Paula, , International Student Edition, Oxford University Press.
2. *Physical Chemistry*, P. C. Rakshit, Sarat Book House, Calcutta.
3. *Principles of Physical Chemistry*, B. R. Puri, L. R. Sharma, and M. S. Pathania**,** Shoban Lal Nagin Chand & Co., Jalandhar.

Chemistry Practical
TIU-GCH-L101

L-T-P: 0-0-3 **Credit: 2**

1. *Qualitative Analysis (Organic and Inorganic):*
   (i) Detection of elements (X, N, S)
   (ii) Detection of functional groups: PhOH, -COOH, C=O, -CHO, Ar-NH_2, Ar-NO_2, -$CONH_2$
   (iii) *Qualitative Inorganic Mixture Analysis:* Anions, interfering anions, cations and insolubles.
2. Quantitative Analysis (Physical and Volumetric):
   (i) Determination of Surface Tension of liquids.
   (ii) Determination of viscosity coefficients of liquids.
   (iii) Coagulation of a sol.
   (iv) Determination of strength of an unknown acid or base by acid-base titration
   (v) Determination of strength of a weak acid or base by conductometric titration

Note: Experiments may be added/deleted subject to availability of time and facilities.
SEMESTER-II

Chemistry-II
TIU-GCH-E102

L-T-P: 3-1-0 **Credit: 4**

Module 1: [12L]

Inorganic Chemistry-II

1. Periodic trends and properties: Size, Ionization Energy, Electron Affinity, Electronegativity, Lattice and Hydration Energies, Use of redox potential and reaction feasibility

2. Comparative study of p-block elements:

Group trends in electronic configuration, modification of pure elements, common oxidation states, inert pair effect, and their important compounds in respect of the following groups of elements:

i) B-Al-Ga-In-Tl
ii) C-Si-Ge-Sn-Pb
iii) N-P-As-Sb-Bi
iv) O-S-Se-Te
v) F-Cl-Br-I

3. Coordination Chemistry

Werner's coordination theory, Valence Bond Theory (VBT): Inner and outer orbital complexes. Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT.

4. Crystal Field Theory

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of Δ. Spectrochemical series. Comparison of CFSE for *Oh* and *Td* complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination

Module 2: [16L]

Organic Chemistry-II

1. Hydrocarbons: Akanes: Chlorination of methane, Alkenes: Addition reactions (Electrophilic and Free radical), Hydration, hydroxylation, hydroboration, epoxidation and ozonolysis. Alkynes: Reduction, Electrophilic addition, acidity and metal acetylides. Conjugated and isolated Dienes: 1,2-verses 1,4-addition. Diels - Alder reaction.

2.**Alcohols & Ethers:** Comparative study of substitution, dehydration, oxidation, and esterification of primary, secondary and tertiary alcohols. Ethers, methods of synthesis, Chemical reactivity.

3. **Aromaticity:** Aromaticity and Huckel rule - A general concept. Molecular orbital picture of benzene.

4. **Aromatic Electrophilic Substitution:** Mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts (alkylationa and acylation) reactions. Effects of substituents on orientation and reactivity.

5. **Chemistry of Carbonyl compounds:** Preparations and reactions: addition and condensation reactions; Cannizzaro, Perkin, aldol, benzoin, haloform, oxidation and reduction reactions. Important reactions of acids, HVZ reaction, Relative reactivity of acid chlorides, acid anhydrides, amides and esters. Comparative acidity of carboxylic and sulphonic acids.

6. **Phenols:** General methods of preparation and reactions. Reimer-Tiemann and Kolbe reactions. Relative acidity of phenol, alcohol and carboxylic acid.

7. **Nitrogen Containing compounds:** Nitronbenzene and reduction products. Comparative basicity of aliphatic and aromatic amines. Diazonium Salts: Preparation and synthetic applications.

8. Biomolecules:

Amino acids, Peptides and Protenins: Amino acids (Nature, Chemical reaction, Detection and Configaration); Peptides (The Peptide Linkage, Structure of Polypeptides); Proteins (General Characteristics, Classification, Structure).
Carbohydrate: Introduction, occurrence, classification, constitution of glucose, osazone formation.
Brief descriptions of lipids, fats and nucleic materials (DNA, RNA)

Module 3: [14L]

1. *Thermodynamics:* First Law of thermodynamics and internal energy, state and state functions, sign convention for heat and work, nature of work, path dependence of heat and work. Enthalpy, heat changes at constant volume and constant pressure, heat capacities (C_V, C_P) and their relationship for ideal gases. Thermodynamic quantities (*w*, *q*, ΔU, ΔH) for isothermal and adiabatic reversible expansion of ideal gases and their comparison.
Change in internal energy (ΔU) and enthalpy (ΔH) of chemical reactions, relation between ΔU and ΔH, variation of heat of reaction with temperature (Kirchhoff's equation).

2(A). Chemical Equilibrium: Thermodynamic conditions for equilibrium, degree of advancement; Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs free energy change; Definitions of K_P, K_C and K_X and relation among them; van't Hoff's reaction isotherm, isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle

2(B). Ionic Equilibria

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

3(A). Electrolytic Conductance

specific, equivalent and molar conduction, their variation with concentration in case of strong and weak electrolytes, measurement of conduction, Kohlrausch's law of independent migration of ions, ionic mobility and conductance, transferrance number, conduct metric titration.

3(B). Electromotive force (EMF)

Electro chemical cells, half-cell, electrodes potential standard electrode potential, Nernst equation, redox potential, reference electrode,standered cell, measurement of emf, determination of pH, potentiometric titration, storage battery, corrosion.

Books Recommended

For Module 1

1. *Basic Inorganic Chemistry,* F. A Cotton, G. Wilkinson, John Wiley & Sons.
2. *Concise Inorganic Chemistry,* J. D. Lee, Chapman & Hall.

For Module 2

1. *Organic Chemistry",* R. T. Morrison and R. N. Boyd, Prentice-Hall, New Delhi.
2. *Organic Chemistry,* I. L. Finar, [Vol. I & Vol. II], ELBS and Longman Ltd., New Delhi.
3. *Organic Chemistry,* J. Clayden, N. Greeves, S. Warren, and E. Wothers, , Oxford Univ. Press.

4. L. Stryer, Biochemistry, Freeman & Co.
5. D. L. Nelson and M. M. Cox, Lehninger, Principles of Biochemistry, McMillan North Publication.

For Module 3

1. *Physical Chemistry*, P. C. Rakshit**,** Sarat Book House, Calcutta.
2. *Principles of Physical Chemistry*, B. R. Puri, L. R. Sharma, and M. S. Pathania**,** Shoban Lal Nagin Chand & Co., Jalandhar.

Chemistry Practical
TIU-GCH-L102

L-T-P: 0-0-3 **Credit: 2**

1. *Preparation of Inorganic Compounds:*
(i) Potassium trioxalato chromate (III); (ii) $CoHg(SCN)_4$; (iii) Cu(I) thiourea complex
(iv) Bis (2,4-pentanedionate) zinc hydrate; (v) Double salts (Chrome alum/ Mohr's salt)

2. Preparation of Organic Compounds:
(i) m-dinitrobenzene, (ii) Acetanilide, (iii) Bromoacetanilide, (iv) Oxidation of primary alcohols-Benzoic acid from benzylacohol, (v) azo dye

3. *Quantitative Analysis through titrations (Physical and Volumetric)*
i) Preparation of standard solution of oxalic acid and standardization of (a) NaOH solution and (b) $KMnO_4$ solution.
ii) Preparation and standardization Mohr's solution by $KMnO_4$ solution.
iii) Preparation of standard $K_2Cr_2O_7$ solution and standardization Mohr's Salt solution.
iv) Estimation of Fe(II) +Fe (III) mixture using standard solution of $K_2Cr_2O_7$
v) Determination of Cu (II) using standard sodium thiosulphate solution
vi) Complexometric titrations**:** Zn^{2+}, Mg^{2+}, Ca^{2+}, Fe^{2+} with EDTA; Hardness of water.

Note: Experiments may be added/deleted subject to availability of time and facilities.