CURRICULUM AND CREDIT FRAMEWORK
As per NEP 2020

For

Under Graduate Programme
(Subject: Chemistry)

(To be effective from the Academic Session 2024-25)

Department of Chemistry

Gurugram University, Gurugram

(A State Govt. University Established Under Haryana Act 17 of 2017)

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Background

- The Chemistry Department of Gurugram University, Gurugram, Haryana - India was established in 2020.
- The vision of the Department of Chemistry is to promote excellence and innovation in teaching and research.
- The Department believe to create an academically stimulating atmosphere for students.
- The Mission of the Department of Chemistry is to educate and train students to achieve excellence in science via chemistry, which will empower them to contribute to the development of the nation.
- The Department aims to encourage critical thinking and develop research skill.

Vision and Mission

Vision

1. To impart knowledge and skills in the area of Chemistry, to promote excellence and innovation, instill curiosity and ignite interest in relevant areas to inspire young minds to make significant contributions for the betterment of mankind.

2. To develop a department that can effectively harness its strength to create an academically inspiring atmosphere by inculcating students with cultural and ethical values.

Mission

1. To promote, inspire and nurture the fundamentals of chemistry through courses offered to the students.
2. To provide high quality and innovative education with emphasis on both theory and practical training for transformation of young budding chemists into productive scientists, excellent teachers, entrepreneurs and creative independent researchers.
3. To support inter disciplinary research with focus on solving problems of global significance by working jointly with other universities and research Institutes.

Programme Outcomes

On completing B.Sc Programme with the subject Chemistry, the students shall be able to realize following programme outcomes:

PO	Description
PO-1	Understand the advance concepts of organic, physical, and inorganic along their application.
PO-2	Execute innovative and critical thinking in chemical sciences, which they have developed from theory classrooms and practical labs.
PO-3	Identify the given chemical problems and analyse them using scientific tools.
PO-4	Interpret the data collected from an experiment.
PO-5	Communicate well with others, make effective presentations, and write scientific reports and documents.
PO-6	Handle analytical techniques such as UV-Vis spectrophotometer, FTIR, Polarimeter, Potentiometer, Colorimeter, Chromatography etc.
PO-7	Understand the major thrust areas in chemical sciences to do their future Masters and jobs in industries or academia.

Programme Specific Outcomes

On completing B. Sc Programme with the subject Chemistry, the students shall be able to realize following outcomes:

PSO	Description
PSO-1	The detailed functional knowledge of theoretical concepts and experimental aspects of Chemistry.
PSO-2	To integrate the knowledge gained with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical, etc.
PSO-3	To understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.
PSO-4	Provide opportunity to excel in academia, research or industry.

Undergraduate Attributes

An Undergraduate B.Sc. student with Chemistry Subject is envisaged to have the following attributes:

- Disciplinary Knowledge
- Creative and Critical Thinking
- Reflective Thinking
- Problem Solving
- Communication Skills
- Research Skills
- Life Skills
- Multidisciplinary Competence
- Moral and Ethical Values
- Inculcate the importance of Life-long Learning
- Global Competence

Qualification Descriptors

To be eligible for admission in B.Sc programme the candidate should have minimum 50% marks in their Senior secondary (10+2) from a recognized school education board with Physics, Chemistry and Biology/Mathematics as the main subject.

Scheme of Programme

(Scheme UG A1: Undergraduate Programmes (Multidisciplinary)

Semester 1

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A1	**Chemistry-I**	240/CHEP/CC/101	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	**100**

Semester 2

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A2	**Chemistry-II**	240/CHEP/CC/201	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	**100**

Semester 3

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A3	**Chemistry-III**	240/CHEP/CC/301	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	**100**

Semester 4

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A4	**Chemistry-IV**	240/CHEP/CC/401	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	**100**

Semester 5

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A5	**Chemistry-V**	240/CHEP/CC/501	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	**100**

Internship is to be done during summer break after 4th Semester, Marks will be added in 5th Semester.

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A6	**Chemistry-VI**	240/CHEP/CC/601	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	**100**

The curriculum of semester 7 and 8 will is provided in due course of time.

Core Course (Multidisciplinary)

COURSE DETAILS:

Course Title	**Chemistry-I**
Semester	**Semester-1**
Course Code	**240/CHEP/CC/101**
Course ID	**CC-A1**
Level of Course	**100-199**
Total Credits	**04 (Lecture: 03, Tutorial: 0, Practical: 01)**
Total Marks	**100**
Marks Distribution	**Theory External: 50** **Theory Internal: 25** **Practical External: 20** **Practical Internal: 05**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 5	
Lectures (L) Hours per Week: 3	**Practical (P) Hours per Week: 2**

COURSE OBJECTIVES:

- Understanding of the quantum mechanical model of the atom.
- Understanding the trends in the periodic table, such as atomic and ionic radii, ionization enthalpy, electron gain enthalpy, and electronegativity using different scales
- Understanding of Basics of Organic Chemistry and Stereochemistry.
- Study the development of quantum mechanics and its application to atomic structure.
- Understand the concepts of quantum mechanics through the particle in a box model and the hydrogen atom.

COURSE OUTCOMES: Student will learn about**: -**

- The quantum mechanical model of the atom
- Periodic Table and trends in periodic properties
- Chemical bonds, molecular interactions and shapes of various molecules/ions
- General introduction to the important aspects of organic chemistry
- Stereochemistry and Conformational Analysis
- Fundamental of Quantum Mechanics

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	**Atomic Structure & Periodic Properties** Quantum numbers, Aufbau and Pauli exclusion principles, Hund's rules of maximum multiplicity. Periodic classification of elements into s, p d & f block elements and electronic configuration, screening effect, effective nuclear charge and Slater's rules, discussion and trends of the following properties of representative elements (s & p block): atomic and ionic radii, ionization enthalpy, electron gain enthalpy and electronegativity (Pauling's/ Mulliken's/ Allred Rachow's scale).	11
II	**Chemical Bonding - Part I** Ionic Bonding: Lattice energy, Born-Haber cycle, ionic radii; Metallic Bonding: conductors, semiconductors, and insulators; Weak forces: Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, instantaneous dipole-induced dipole interactions, hydrogen bonding. Covalent Bonding: Valence bond theory (Heitler-London approach) and its limitation, directional characteristics of covalent bond, type of hybridization and shapes of simple inorganic molecules and ions (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7, SO_4^{-2}, ClO_4^{-1}, NO_3^{-1})	11
III	**Basic Concepts in Organic Chemistry** Classification and Nomenclature of organic compounds. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their comparison & applications. Reaction intermediates: Carbocations, Carbanions, Free radicals, Carbenes, arynes and nitrenes (Types, shape, structure, Mechanistic study and relative stability) **Stereochemistry and Conformational Analysis** Isomerism: Types of isomerism, Optical isomerism: elements of symmetry, Optical Activity, Molecular chirality/asymmetry, Enantiomers, Diastereoisomers, Meso compounds, Racemic mixture and resolution. Relative and absolute configuration: D/L designation, Geometric isomerism: Cis-Trans and E & Z nomenclature, Conformational isomerism: Conformational analysis of ethane and n-butane; chair, boat, half chair and twist boat conformations of cyclohexane (interconversions and energy level diagram).	12
IV	**Quantum Mechanics:** Planck's black body radiation, Photoelectric effect, Bohr's theory, de Broglie postulate, Heisenberg's Uncertainty Principle; Schrödinger's wave equation (including mathematical treatment), postulates of quantum mechanics, normalized and orthogonal wave functions, its complex conjugate (idea of complex numbers) and significance of Ψ^2; Operators; Particle in one-dimension box, radial and angular wave functions for hydrogen atom, radial probability distribution; Finding maxima of distribution functions (idea of maxima and minima), energy spectrum of hydrogen atom; Shapes of s, p, d and f orbitals.	11

V	**Practicals**: 1. Titrimetric Analysis: (i) Calibration and use of apparatus (ii) Preparation of solutions of different Molarity/Normality. 2. Chromatography of metal ions Principles involved in chromatographic separations. Paper chromatographic separation of the following metal ions: (i) Ni (II) and Co (II) (ii) Fe (III) and Al (III) 3. To study the process of sublimation of camphor and phthalic acid. 4. Organic Preparation: a. Bromination of acetanilide/aniline/phenol, b. Nitration of nitrobenzene/toluene 5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method). 6. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds. 7. Determination of surface tension of a liquid using the drop number method. 8. Determination of surface tension of a liquid using the drop weight method. 9. Determination of the viscosity of a liquid using Ostwald's viscometer.	**30**

COURSE EVALUATION METHODS

Theory Exams: Total Marks: 75 (External: 50 + Internal: 25)

Internal Assessment: 25 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 15 Marks
External Assessment: 50 Marks (03 Hours)	• End Term Exam: 50 Marks

Practical Exam: Total Marks: 25 (External: 20 + Internal: 05)

Internal Assessment: 05 Marks	• Class Participation: 05 Marks
External Assessment: 20 Marks (03 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End-Term Theory Exam:

The Examiner is requested to set nine questions in total, selecting two questions from each section. Question-1 will be a compulsory question consisting short answer type questions covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

RECOMMENDED BOOKS

1. "Inorganic Chemistry" by J.D. Lee
2. "Inorganic Chemistry" by Puri, Sharma, and Kalia
3. "Quantitative Inorganic Analysis" by A. I. Vogel
4. "Practical Paper Chromatography" by A. J. P. Martin
5. "Physical Chemistry" by P. Bahadur
6. "Principles of Physical Chemistry" by Puri, Sharma, and Pathania
7. "Vogel's Textbook of Quantitative Chemical Analysis" by G. H. Jeffery, J. Bassett, J. Mendham, and R.C. Denney
8. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. J. E. McMurry, Fundamentals of Organic Chemistry, 7thEdition, Cengage Learning India, 2013.
10. R. N. Boyd, R. T. Morrison and S. K. Bhattcharjee, Organic Chemistry, 7thEdition, Pearson, 2014.
11. P. S. Kalsi, Stereochemistry Conformation and Mechanism, New Age International, 2005.
12. J. Singh, L.D.S. Yadav, Organic Chemistry (Volume I), 14th Edition, Pragati Prakashan, 2019.
13. E. L. Eliel & S. H. Wilen, Stereochemistry of Organic Compounds, Wiley: London, 1994.
14. S. M. Mukerji, S. P. Singh, K.P.Kapoor and R. Das, Organic Chemistry (Volume I), 2nd Edition, New Age International Publishers, 2010.
15. S. M. Mukerji, S. P. Singh, K.P. Kapoor and R. Das, Organic Chemistry (Volume II), 2nd Edition, New Age International Publishers, 2012.
16. B.S. Furniss ; A. J. Hannaford ; P.W.G. Smith ; A. R. Tatchell, Practical Organic Chemistry, 5th Edition., Pearson, 2012.
17. F.G. Mann & B.C. Saunders, Practical Organic Chemistry, Pearson, 2009.
18. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.(2012),Vogel's textbook of Practical Organic Chemistry, Pearson.