SYLLABUS

MADHABDEV UNIVERSITY

FYUGP 2020

B.Sc. IN CHEMISTRY (NEP)

Approved in the BOS, Chemistry held on

06-07-2023

FOUR-YEARUNDERGRADUATE PROGRAMME (FYUGP)
IN CHEMISTRY,MADHABDEV UNIVERSITY

THE PREAMBLE

Education aims to develop an individual into a human being through moral, spiritual, and cultural development. It also aims to the acquisition of knowledge, skills, and attitudes to adjust properly to one's environment. In a broader sense, it is an instrument to achieve larger societal goals. In addition to these, education has further responsibility of developing core competencies such as communication skills required to articulate thoughts and ideas effectively, using oral and written communication skills, and presenting information and explanations in a well-structured manner.

Change is the law of nature. With the continuously changing society, the nature andscope of education also change and widen. Since education plays a crucial role in thedevelopment of social issues all-around, must be up-to-date to address all these problems. Educators and educational practitioners should also change them accordingly. The main purpose of the Undergraduate Programme in Chemistry is to familiarizestudents with basic-level to high-level Chemistry which connects the post-graduateprogram. Significant efforts are given to motivate students to do research in Chemistry.Due importance is also given to the study of application-oriented topics which is very much relevant and useful to the present scenario.

INTRODUCTION

Undergraduate programmes were traditionally conceived as preparation for post- graduation. The rigidity in choosing subjects through fixed combinations had to be reconsidered. The aspects of all-round development of the students, skill acquisition outside chosen subjects and research were undermined but the National Education Policy-2020 (NEP-2020) has changed all of these in one stroke. The NEP- 2020 recognizes that higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution. It states that quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals.

The curriculum at undergraduate and FYUGP therefore, has incorporated certain new components of learning to make it relevant to contemporary society and modern practices by integrating the humanities and arts with Science, Technology, Engineering and Mathematics (STEM). It is expected that it will show positive learning outcomes, including increased creativity and innovation, problem-solving abilities, teamwork, communication skills, more in-depth learning, and increases social and moral awareness besides increased employability.

The prominent features of the NEP framework are:

1. Flexibility in choosing subjects and even disciplines for the graduate programmes
2. Vertical and horizontal mobility across subjects throughout the programme
3. Multiple entry and exit points
4. Main-streaming of skill-based courses
5. Credit-based evaluation system
6. Integration of research into 4th year of the programme leading to an Honours degree.

The Bachelor of Science in Chemistry degree of Madhabdev University adapted as per the recommendations of NEP 2020 will also be of either a three or four-year duration, with multiple exit options within the period with appropriate certification. After completion of one year a UG certificate, completion of two years a UG diploma, and after completion of three years, a Bachelor's degree in the programme will be provided to the students. The four- year undergraduate programme in chemistry will allow the student an opportunity to experience the full range of holistic and multidisciplinary education, along with the chosen Major and Minor choices of the students.

AIMS OF FOUR YEAR UNDER-GRADUATE PROGRAMME (FYUGP) INCHEMISTRY:

The aims of the Four Year Under-Graduate Programme (FYUGP) in Chemistry are:

1. To equip the students with the potential to contribute to academic and industrialenvironments.

2. To impart knowledge in fundamental aspects of various branches of Chemistry.

3. To apply the key concepts and standard methodologies to solve problemsrelated to Chemistry.

4. To prepare students for higher education and a career in Chemistry.

5. To develop laboratory skills, *viz*. proper handling of apparatus, chemicals, and experimental techniques.

6. To make students apply chemistry in their day-to-day life.

7. To create the students as responsible citizens by creating environmentalawareness.

GRADUATE ATTRIBUTES OF THE FYUGP IN CHEMISTRY

Graduate attributes in Chemistry include both Chemistry knowledge and responsibilities and qualities that Chemistry graduates should acquire and demonstrate. Graduate attributes of the FYUGP in Chemistry are:

Attribute 1: Strong grip on fundamental and practical Chemistry knowledge

Attribute 2: Creative and critical thinking, and problem-solving

Attribute 3: Interest in research-based problem

Attribute 4: Digital Fluency

Attribute 5: Teamwork and communication skills

Attribute 6: Professionalism and leadership readiness

Attribute 7: Social responsibility

Attribute 8: Appreciation and adherence to Ethical integrity

PROGRAMME LEARNING OUTCOMES

By the end of the programme an undergraduate student of Chemistry should be able to:

- Understand the basic principles of various branches of Chemistry.
- Demonstrate a range of practical skills to conduct and infer experiments independently and in groups.
- Apply the key concepts and standard methodologies to solve problems related toChemistry.
- Apply methodologies to the solution of unfamiliar types of problems.
- Exhibit skills leading to employability in Chemistry and allied industries.
- Comprehend the fundamental aspects of research in Chemistry.
- Possess the level of proficiency in the subject required for post-graduation as wellas for pursuing research in Chemistry and related interdisciplinary subjects.
- Demonstrate teaching competencies required for keeping oneself professionallyengaged.

Teaching Learning Process

The programme allows using of varied pedagogical methods and techniques bothwithin the classroom and in laboratories.

- Lecture
- Tutorial
- PowerPoint presentation
- Project Work/Dissertation
- Seminars/workshops/conferences
- Industry Visits/Field Visits and Report

Teaching Learning Tools

- White/Green/Black Board
- LCD projectors/Monitor
- Smart Board
- Model Demonstration
- Learning through lab experiments
- Industry and research visits

Assessment

- Home assignment
- Project Report
- Seminar Presentation
- Objective /MCQ test
- In semester examinations (Theory and Practical)
- End Semester examinations (Theory and Practical)
- Viva-voce

MADHABDEV UNIVERSITY, NARAYANPUR, LAKHIMPUR – 784164

FYUGP Structure as per UGC Credit Framework of July, 2023

Year	Semester	Course	Title of the Course	Total Credit
Year 01	1st Semester	CHMM-101	Fundamentals of Chemistry - I	4
		CHMN-101	Fundamentals of Chemistry - 1	4
		MDCCHM - 101	Chemistry in Daily Life- I	3
		AEC - 101		4
		VAC – 101		2
		VAC – 102		2
		SEC - 101		3
				22
	2nd Semester	CHMM-201	Fundamentals of Chemistry - II	4
		CHMN-201	Fundamentals of Chemistry - 2	4
		MDCCHM - 201	Chemistry in Daily Life- II	3
		AEC - 201	English Language and Communication Skills	4
		VAC – 201	Environmental Science	2
		VAC – 202	Yoga Education	2
		SEC - 201	Basic Analytical Chemistry (Fuel Chemistry)	3
				22
The students on exit shall be awarded Undergraduate Certificate (in the Field of Study/Discipline) after securing the requisite 44 Credits in Semester 1 and 2 provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill based courses earned during 1st and 2nd Semester				
		CHMM-301	Fundamentals of Chemistry - III	4
		CHMM-302	Fundamentals of Chemistry - IV	4

Year 02	3rd Semester	CHMN-301	Fundamentals of Chemistry - 3	4
		MDCCHM - 301	Chemistry in Daily Life- III	3
		AEC - 301		4
		VAC – 301		2
		VAC – 302		2
		SEC - 301		3
				26
	4th Semester	CHMM-401	Inorganic Chemistry - I	4
		CHMM-402	Organic Chemistry - I	4
		CHMM-403	Physical Chemistry - I	4
		CHMM-404	Inorganic Materials of Industrial Importance	4
		CHMN-401	Fundamentals of Chemistry - 4	4
		MDCCHM - 401		3
		AEC - 401		4
		VAC – 401		2
		VAC – 402		2
		SEC - 401		3
				34
Year 03	5th Semester	CHMM-501	Inorganic Chemistry - II	4
		CHMM-502	Organic Chemistry - II	4
		CHMM-503	Physical Chemistry - III	4
		CHMM-504	Green Chemistry	4
		CHMN-501	Fundamentals of Chemistry - 5	4
		MDCCHM - 501		3

		AEC - 501		4
		VAC – 501		2
		VAC – 502		2
		SEC - 501		3
				34
	6^{th} Semester	CHMM-601	Inorganic Chemistry - III	4
		CHMM-602	Organic Chemistry - III	4
		CHMM-603	Physical Chemistry - III	4
		CHMM-604	Spectroscopy	4
		CHMN-601	Fundamentals of Chemistry – 6	4
		MDCCHM - 601		3
		AEC - 601		4
		VAC – 601		2
		VAC – 602		2
		SEC - 601		3
				34

1. Abbreviations Used:
2. C = Major
3. MDC = Multi Disciplinary Course
4. AEC = Ability Enhancement Course
5. SEC = Skill Enhancement Course
6. VAC = Value Added Course

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course: Fundamentals of Chemistry – I
Course Code: CHMM-101
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: To give idea about the basic knowledge of chemistry in different field of specializations, Knowledge of natural science, analytical Chemistry and skill based courses.

Learning outcomes:
After the completion of this course, the learner will be able to understand the periodic properties of elements, bonding in various molecules, properties of gaseous and liquid states of matter, basic organic chemistry, stereoisomerism etc. They also learn to handle the viscometer and stalagometer for determining the viscosity and surface tension of different compounds which have immense applications in industry and day to day life and to purify the various organic compounds through recrystallisations and melting point determinations.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Atomic Structure:** Recapitulation of Bohr's Theory, de Broglie, Theory, Heisenberg Uncertainty Principle) Time independent Schrödinger wave equation (H=E). Significance of wave functions and square of wave functions. Schrodinger equation for Hydrogen atom (qualitative treatment only). Quantum numbers, Electronic configuration of elements based upon electronic configuration in the periodic table **Periodic properties:** Effective nuclear charge, screening constant – Slater's rule only), ionic and covalent radii ionization energy, electron affinity, electronegativity (Pauling, Mulliken'sand Allred-Rochow scales). Redox potential. **Bonding and structure:** Ionic Bonding: Energy consideration in ionic	**15**	-	-	**15**

	bonding, lattice Energy. Born - Haber cycle and its application, polarizing power and polarizability. Fajan's rule, Bond moment, dipole moment and percentage ionic character. Hydrogen Bonding. ***Covalent Bonding***: VB Approach-Concept of hybridization (sp, sp2, sp3, sp3d, sp3d2 and dsp2). VSEPR Theory. Resonance and Resonance energy: Study of some inorganic and rganic compounds (O_3, NO_3^- , CO_3^{2-}, SO_4^{2-}, $RCOO^-$, C_6H_6). Co-ordinate or Dative Bond. Bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals non-bonding combination of orbitals, MO treatment of homonuclear diatomic molecules and heteronucear diatomic molecules such as CO, NO and NO+ **Marks: 17**				
II	**Gas :** Derivation of kinetic gas equation, Maxwell distribution of molecular speed, different types of speeds, collision properties, Mean free path, determination of collision diameter, transport phenomenon in gases, coefficient of viscosity, law of equipartition of energy, degrees of freedom and average energy of a molecule, molecular basis of heat capacity, barometric formula and its uses for determination of Avogadro number. Deviation from ideal behavior, van der Waals and Dieterici's, Virial equation of state, Boyle's temperature, Critical constants, reduced equation of state, co-efficient of compressibility and thermal expansion. **Liquid**: Qualitative treatment of structure of liquids, physical properties of liquids, vapour pressure, surface tension-Explanation of cleansing action of detergents, parachordetermination and application, viscosity, Newtonian and non-Newtonian liquid, liquid crystals. **Marks: 17**	**17**	**-**	**-**	**17**
III	**Basics of Organic Chemistry:** ***Organic Compounds***: classification and Nomenclature. Hybridization: Shape of molecules, Influence of hybridization on bond properties. Electronic displacements: Inductive, Electromeric,	**18**	**-**	**-**	**18**

	Resonance, Mesomeric effects and Hyper conjugation and their applications. Dipole moment. ***Organic acids and bases***: Their relative strength, Homolytic and Heterolytic fission, Electrophiles and ***Nucleophiles***: Nucleophilicity and basicity. ***Reactive intermediates***: Carbocations, carbanions, free radicals, carbenes, nitrenes, Types, Shape and their relative Stability. Energy profile diagrams of one step, two steps and three steps reactions, Rate limiting steps. Activation Energy. Kinetically and thermodynamically controlled reactions**.** **Stereochemistry:** Elements of symmetry and their application in simple organic molecules. Definition and classification of stereoisomerism, Representation of organic molecules in three & two dimension: Fischer Projection, Newman projection, Saw horse and flying wedge projection formula and their interconversions. ***Optical isomerism***: Concepts of asymmetry, dissymmetry, optical activity, Specific rotation, Chirality, enantiomers, Diastereomers, racemic mixture, racemization and Resolution, Threo and Erythro forms, Meso structures &Epimers. Relative and absolute configuration: D/L and R/S designations. Walden inversion. ***Geometrical Isomerism***: Restricted rotation about C=C bonds, physical and chemical properties of diasteroisomers, determination of configuration of geometrical isomers: cis-trans isomerism, syn-anti and E/Z notation with CIP rules. Geometrical isomerism in oximes and alicyclic compounds. **Marks: 18**				
IV	**EXPERIMENTAL WORK (A)** (i) Determine the surface tension of various liquids bydrop number method. (ii) Determination of viscosity of aqueous solutions atroom temperature. **EXPERIMENTAL WORK (B)** (i) Purification of organic compounds by crystallization using the following solvents: a. Water b. Alcohol c. Alcohol-water And determination of the melting points of above compounds.	**-**	**-**	**20**	**20**

	OR (ii) Separation of a mixture of o-and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC) **Marks: 18**				
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examinations - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S.Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
3. Inorganic Chemistry – Puri, Sharma and Kalia
4. Inorganic Chemistry – J.D. Lee
5. General and Inorganic Chemistry (Part-I & II) R. Sarkar
6. Basic Inorganic chemistry – Cotton and Wilkinson
7. Inorganic Chemistry – J.E.Huheey
8. Physical Chemistry-- Atkins, P. W. & Paula, J.
9. A Text Book of Physical Chemistry – Negi& S.C. Anand, Wiley Eastern
10. Physical Chemistry, Castellan G. W., Narosa Publishing
11. Principles of Physical Chemistry, Puri, Sharma, Pathania, ShobanLal, (S. Chand & Co.)
12. Physical Chemistry – P.W. Atkins, Oxford University Press
13. Physical Chemistry – Barrow G.M., Tata-McGraw Hill
14. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, PragatiPrakashan
15. Physical Chemistry – D.S. Pahari
16. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
17. Organic Chemistry – M.K. Jain, S.Chand& Co.
18. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma,(S. Chand & Co.)
19. Organic Chemistry – I.L. Finar, Vol. I & II, ELBS

20. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
21. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
22. Advanced General Organic Chemistry (Part I and Part II) - S. C.Ghosh
23. Organic Chemistry (Oxford) - Clayden,Warren, Greeves and Wothers.
24. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S.Kalsi.

Title of the Course: Fundamentals of Chemistry – 1
Course Code: CHMN-101
Nature of the Course: CHEMISTRY MINOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: To give idea about the basic knowledge of chemistry in different field of specializations, Knowledge of natural science, analytical Chemistry and skill based courses.

Learning outcomes:
After the completion of this course, the learner will be able to After the completion of this course, the learner will be able to understand the periodic properties of elements, bonding in various molecules, properties of gaseous and liquid states of matter, basic organic chemistry, stereoisomerism etc. They also learn to handle the viscometer and stalagometer for determining the viscosity and surface tension of different compounds which have immense applications in industry and day to day life and to purify the various organic compounds through recrystallisations and melting point determinations.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Atomc Structure:** Recapitulation of Bohr's Theory, de Broglie, Theory, Heisenberg Uncertainty Principle) Time independent Schrödinger wave equation (H=E). Significance of wave functions and square of wave functions. Schrodinger equation for Hydrogen atom (qualitative treatment only). Quantum numbers, Electronic configuration of elements based upon electronic configuration in the periodic table **Periodic properties:** Effective nuclear charge, screening constant – Slater's rule only), ionic and covalent radii ionization energy, electron affinity, electronegativity (Pauling, Mulliken'sand Allred-Rochow scales). Redox potential. **Bonding and structure:** Ionic Bonding: Energy consideration in ionic bonding, lattice Energy. Born - Haber cycle and its application, polarizing power and polarizability. Fajan's rule, Bond moment, dipole moment and percentage ionic character. Hydrogen Bonding. ***Covalent Bonding***: VB Approach-Concept of	**15**	-	-	**15**

	hybridization (sp, sp2, sp3, sp3d, sp3d2 and dsp2). VSEPR Theory. Resonance and Resonance energy: Study of some inorganic and rganic compounds (O_3, NO_3^- , CO_3^{2-}, SO_4^{2-}, $RCOO^-$, C_6H_6). Co-ordinate or Dative Bond. Bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals non-bonding combination of orbitals, MO treatment of homonuclear diatomic molecules and heteronucear diatomic molecules such as CO, NO and NO+ **Marks: 17**				
II	**Gas :** Derivation of kinetic gas equation, Maxwell distribution of molecular speed, different types of speeds, collision properties, Mean free path, determination of collision diameter, transport phenomenon in gases, coefficient of viscosity, law of equipartition of energy, degrees of freedom and average energy of a molecule, molecular basis of heat capacity, barometric formula and its uses for determination of Avogadro number. Deviation from ideal behavior, van der Waals and Dieterici's, Virial equation of state, Boyle's temperature, Critical constants, reduced equation of state, co-efficient of compressibility and thermal expansion. **Liquid**: Qualitative treatment of structure of liquids, physical properties of liquids, vapour pressure, surface tension-Explanation of cleansing action of detergents, parachordetermination and application, viscosity, Newtonian and non-Newtonian liquid, liquid crystals. **Marks: 17**	**17**	**-**	**-**	**17**
III	**Basics of Organic Chemistry:** ***Organic Compounds***: classification and Nomenclature. Hybridization: Shape of molecules, Influence of hybridization on bond properties. Electronic displacements: Inductive, Electromeric, Resonance, Mesomeric effects and Hyper conjugation and their applications. Dipole moment. ***Organic acids and bases***: Their relative strength, Homolytic and Heterolytic fission, Electrophiles and ***Nucleophiles***: Nucleophilicity and basicity.	**18**	**-**	**-**	**18**

	Reactive intermediates: Carbocations, carbanions, free radicals, carbenes, nitrenes, Types, Shape and their relative Stability. Energy profile diagrams of one step, two steps and three steps reactions, Rate limiting steps. Activation Energy. Kinetically and thermodynamically controlled reactions**.** **Stereochemistry:** Elements of symmetry and their application in simple organic molecules. Definition and classification of stereoisomerism, Representation of organic molecules in three & two dimension: Fischer Projection, Newman projection, Saw horse and flying wedge projection formula and their interconversions. ***Optical isomerism***: Concepts of asymmetry, dissymmetry, optical activity, Specific rotation, Chirality, enantiomers, Diastereomers, racemic mixture, racemization and Resolution, Threo and Erythro forms, Meso structures &Epimers. Relative and absolute configuration: D/L and R/S designations. Walden inversion. ***Geometrical Isomerism***: Restricted rotation about C=C bonds, physical and chemical properties of diasteroisomers, determination of configuration of geometrical isomers: cis-trans isomerism, syn-anti and E/Z notation with CIP rules. Geometrical isomerism in oximes and alicyclic compounds. **Marks: 18**				
IV	**EXPERIMENTAL WORK (A)** (iii) Determine the surface tension of various liquids bydrop number method. (iv)Determination of viscosity of aqueous solutions atroom temperature. **EXPERIMENTAL WORK (B)** (i) Purification of organic compounds by crystallization using the following solvents: a. Water b. Alcohol c. Alcohol-water And determination of the melting points of above compounds. **OR** (ii) Separation of a mixture of o-and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC) **Marks: 18**	**-**	**-**	**20**	**20**

	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

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3. Inorganic Chemistry – Puri, Sharma and Kalia Inorganic Chemistry – J.D. Lee
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5. Basic Inorganic chemistry – Cotton and Wilkinson
6. Inorganic Chemistry – J.E.Huheey
7. Physical Chemistry-- Atkins, P. W. & Paula, J.
8. A Text Book of Physical Chemistry – Negi& S.C. Anand, Wiley Eastern
9. Physical Chemistry, Castellan G. W., Narosa Publishing
10. Principles of Physical Chemistry, Puri, Sharma, Pathania, ShobanLal, (S. Chand & Co.)
11. Physical Chemistry – P.W. Atkins, Oxford University Press
12. Physical Chemistry – Barrow G.M., Tata-McGraw Hill
13. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, PragatiPrakashan
14. Physical Chemistry – D.S. Pahari
15. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
16. Organic Chemistry – M.K. Jain, S.Chand& Co.
17. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma,(S. Chand & Co.)
18. Organic Chemistry – I.L. Finar, Vol. I & II, ELBS
19. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
20. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor

21. Advanced General Organic Chemistry (Part I and Part II) - S. C.Ghosh
22. Organic Chemistry (Oxford) - Clayden,Warren, Greeves and Wothers.
23. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S.Kalsi.

Title of the Course: Chemistry in Daily Life- I
Course Code: MDCCHM - 101
Nature of the Course: NATURAL SCIENCE
Total Credits: 3
Distribution of Marks: 40 (End Sem) (TH) + 30 (In-Sem)

Course Objective: The course introduces the students to the fascinating chemistry of some food products. Keeping the importance of food industry in mind this course is aimed to introduce food packaging, processing and preservation.

Learning Outcome: At the end of this course, students will be able to understand the composition, processing and analysis of dairy products, to learn about the various food preservatives and artificial food colorants and their rolein food processing industries, to aware the adverse effects of food adulterants in human health.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Dairy Products:** Composition of milk and milk product. Principles of dairy safety; Milk processing.. Qualitative analysis of fat content, minerals in milk and butter. Qualitative analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy. **Marks: 10**	**10**	**-**	**-**	**10**
II	**Food additives:** Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate. **Marks: 10**	**10**	**-**	**-**	**10**
III	**Food adulterants, and contaminants:** Food processing and packaging; Food adulteration: definition and its importance, adulterants present in- coffee, tea, milk, spices, grains and food colour; Difference between food adulteration and contamination **Marks: 10**	**10**	**-**	**-**	**10**
IV	**Artificial food colorants:** Natural and synthetic colors, fake colors, inorganic pigments, application of colors in food industry,	**10**			**10**

	flavoring agents, Coal tar dyes and non-permitted colors and metallic salts. Utility of coal tar dyes in food and cosmetics and its harmful effect. **Marks: 10**				
	Total **Marks: 40**	**40**	**0**	**0**	**0**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

 Two Internal Examination - 20 Marks

 Others - 10 Marks

o Assignment/Seminar

o Lab note book/Attendance

o Group Discussion

Recommended Books:

1. Food Science & Quality Control by SMT. B. Poornima - Centrum Press First edition 2014.
2. Post-Harvest Management of Horticultural crops - S. Saraswathy, T.L. Preethi AGROBIOS (India) 2013.
3. A Handbook of Agn. Food processing and marketing by S.C. Gaur, Agro Bios (India) 2012.
4. Quality Control for value edition in Food processing – by Dev Raj, Rakesh Sharma & V.K. Joshi New India Publishing Agency, 2011.
5. Food processing and preservation – Subbulakshmi, G. Shobha, A. Udipi, New Age International (P) Ltd., 2006.

FYUGP

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course: Fundamentals of Chemistry - II
Course Code: CHMM - 201
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: To give concept about the chemistry of non-transition elements, metallurgy, 1st law of thermodynamics, solid state chemistry and chemistry of aliphatic hydrocarbons.
Learning Outcome: At the end of this course, students will be able to understand the preparation, structure and uses of nontransition elements; extraction techniques of metals; various terms and laws of thermodynamics; crystal structure and crystal defects; preparation & properties of alkanes, alkenes and alkynes etc. They also learn to estimate iron and oxalic acid indifferent stock solutions provided to the learners which have immense applications in industry and day to day life, to detect elements and functional groups indifferent organic samples.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Non Transition elements:** a) Noble Gas: Compounds of Xenon only b) Boron: wade's rule, nomenclature of closo, nido and arachnoboranes, structure of boron hydrides (B2H6), metalloborane and metallocarboranes. borazine, phosphazine, S4N4, (SN)x – preparation, structure and uses. c) Carbon: Fullerenes (C60) d) Silicon: silicones, classifications and structure of silicates. Zeolites, use of Zeolites as catalyst and molecular sieve, aluminosilicates. e) Nitrogen: Hydrazine, hydroxylamine and hydrazoic acid. Phosphorus: Phosphines, oxy acids of phosphorus, organophosphorus compounds. **Metals:** Theory of reduction (Thermodynamic approach),	**15**	**-**	**-**	**15**

	role of carbon and other reducing agents, electrolytic reduction, roasting and calcinations. Method of purification and refining of metals including modern methods like zone refining, vacuum arc process, ion exchange, solvent extraction and electrolytic method, Van- Arkel process andhydrometallurgy. Study of potassium dichromate, manganese dioxide, potassium permanganate, ammonium molybdate, sodium cobaltinitrite, cobalt nitrate, Ni-DMG, vanadium pentoxide). **Marks: 17**				
II	**Chemical Thermodynamics -I:** Extensive and intensive properties of a system, thermodynamic processes: cyclic, reversible, irreversible processes, thermodynamic function, complete differential, Zeroth law of thermodynamics. First law of thermodynamics-internal energy, enthalpy, molar heat capacities, relation between Cp and Cv, work of expansion in reversible and irreversible process, adiabatic process, relation between P, V, T. Variation in internal energy and enthalpy with temperature, Joule Thomson effect, calculation of Joule Thomson co-efficient for ideal and Vander Waal's gas. Thermo chemistry- Hess's law, Kirchhoff's law relation of reaction enthalpy with internal energy, Bond energy and Bond dissociation energy, calculation from thermo chemical data. **Solids:** Basic laws of crystallography, crystal system, crystal lattice, Miller indices, and simple face centered and body centered cubic lattice, number of points in a unit cell. X-Ray diffraction study of crystals, Bragg's law, determination of crystal structure- introduction to powder and single crystal methods of structure analysis, crystal structure of NaCl and KCl, packing of crystals, closed packed structure, radius ratio, crystal defect-point defects, conductors, semiconductors and insulators from band theory. **Marks: 17**	**17**	**-**	**-**	**17**
III	***Organic Compounds***: **Carbon- Carbon sigma**	**18**	**-**	**-**	**18**

	bonds: Chemistry of Alkanes: Formation of alkanes with special emphasis on Corey House Synthesis, Wurtz reaction, Wurtz-Fittig reaction. Reactions of alkanes: Free Radical substitution:- Halogenations-relative reactivities and selectivity. **Carbon-Carbon pi bonds:** Formation of alkenes and alkynes by Elimination: Mechanism of E1., E2, E1cB reactions. Saytzeff and Hoffmann elimination, special emphasis on preparation of alkenes by synelimination:- pyrolysis of esters, Chugaev reaction and Wittig reaction. ***Reaction of alkenes*:** Addition Reaction-Electrophilic and free radical additions, their mechanisms. (Markonikoff/ Anti Markonikoff addition) regioselectivity (directional selectivity), andsteroselective of addition reactions. Mechanism of oxymercuration–demercuration, Hydroboration- Oxidation, Ozonolysis, reduction (catalytic and chemical). ***Syn and Anti hydroxylation***(oxidation), simple effect of stereo selectivity and stereo specificity. ***Reactions of Alkynes***: Acidity, Electrophilic and Nucleophilic additions, Hydration to form carbonyl compounds. Alkylation of terminal alkynes. **Marks: 18**				
IV	**EXPERIMENTAL WORK (A)** **Oxidation-Reduction Titrimetry (any one)** i) Estimation of Fe(II) or oxalic acid using standardized KMnO4 solution. ii) Estimation of Fe(II) with K2Cr2O7using diphenylamine as internal indicator. **EXPERIMENTAL WORK (B)** (i) Detection of elements (N, S and Halogens) Detection of functional groups. **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

 Two Internal Examinations - 20 Marks

 Others - 10 Marks

o Assignment/Seminar

o Lab note book/Attendance

o Group Discussion

Recommended Books:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S.Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
3. Inorganic Chemistry – Puri, Sharma and Kalia Inorganic Chemistry – J.D. Lee
3. General and Inorganic Chemistry (Part-I & II) R. Sarkar
4. Basic Inorganic chemistry – Cotton and Wilkinson
5. Inorganic Chemistry – J.E.Huheey
6. Physical Chemistry-- Atkins, P. W. & Paula, J.
7. A Text Book of Physical Chemistry – Negi& S.C. Anand, Wiley Eastern
8. Physical Chemistry, Castellan G. W., Narosa Publishing
9. Principles of Physical Chemistry, Puri, Sharma, Pathania, ShobanLal, (S. Chand & Co.)
10. Physical Chemistry – P.W. Atkins, Oxford University Press
11. Physical Chemistry – Barrow G.M., Tata-McGraw Hill
12. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, PragatiPrakashan
13. Physical Chemistry – D.S. Pahari
14. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
15. Organic Chemistry – M.K. Jain, S.Chand& Co.
16. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma,(S. Chand & Co.)
17. Organic Chemistry – I.L. Finar, Vol. I & II, ELBS
18. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
19. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
20. Advanced General Organic Chemistry (Part I and Part II) - S. C.Ghosh
21. Organic Chemistry (Oxford) - Clayden,Warren, Greeves and Wothers.
22. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S.Kalsi.

Title of the Course: Fundamentals of Chemistry-2
Course Code: CHMN-201
Nature of the Course: CHEMISTRY MINOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: To give concept about the chemistry of non-transition elements, metallurgy, 1st law of thermodynamics, solid state chemistry and chemistry of aliphatic hydrocarbons.
Learning Outcome: At the end of this course, students will be able to understand the preparation, structure and uses of nontransition elements; extraction techniques of metals; various terms and laws of thermodynamics; crystal structure and crystal defects; preparation & properties of alkanes, alkenes and alkynes etc. They also learn to estimate iron and oxalic acid indifferent stock solutions provided to the learners which have immense applications in industry and day to day life, to detect elements and functional groups indifferent organic samples.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Non Transition elements:** a) Noble Gas: Compounds of Xenon only b) Boron: wade's rule, nomenclature of closo, nido and arachnoboranes, structure of boron hydrides (B2H6), metalloborane and metallocarboranes. borazine, phosphazine, S4N4, (SN)x – preparation, structure and uses. c) Carbon: Fullerenes (C60) d) Silicon: silicones, classifications and structure of silicates. Zeolites, use of Zeolites as catalyst and molecular sieve, aluminosilicates. e) Nitrogen: Hydrazine, hydroxylamine and hydrazoic acid. f) Phosphorus: Phosphines, oxy acids of phosphorus, organophosphorus compounds. **Metals:** Theory of reduction (Thermodynamic approach), role of carbon and other reducing agents, electrolytic reduction, roasting and calcinations. Method of purification and refining of metals including modern methods like zone refining, vacuum arc process, ion exchange, solvent extraction and electrolytic method, Van- Arkel process and hydrometallurgy. Study of	**15**	-	-	**15**

	potassium dichromate, manganese dioxide, potassium permanganate, ammonium molybdate, sodium cobaltinitrite, cobalt nitrate, Ni-DMG, vanadium pentoxide). **Marks: 17**				
II	**Chemical Thermodynamics -I:** Extensive and intensive properties of a system, thermodynamic processes: cyclic, reversible, irreversible processes, thermodynamic function, complete differential, Zeroth law of thermodynamics. First law of thermodynamics-internal energy, enthalpy, molar heat capacities, relation between Cp and Cv, work of expansion in reversible and irreversible process, adiabatic process, relation between P, V, T. Variation in internal energy and enthalpy with temperature, Joule Thomson effect, calculation of Joule Thomson co-efficient for ideal and Vander Waal's gas. Thermo chemistry- Hess's law, Kirchhoff's law relation of reaction enthalpy with internal energy, Bond energy and Bond dissociation energy, calculation from thermo chemical data. **Solids:** Basic laws of crystallography, crystal system, crystal lattice, Miller indices, and simple face centered and body centered cubic lattice, number of points in a unit cell. X-Ray diffraction study of crystals, Bragg's law, determination of crystal structure- introduction to powder and single crystal methods of structure analysis, crystal structure of NaCl and KCl, packing of crystals, closed packed structure, radius ratio, crystal defect-point defects, conductors, semiconductors and insulators from band theory. **Marks: 17**	**17**	**-**	**-**	**17**
III	***Organic Compounds***: **Carbon- Carbon sigma bonds:** Chemistry of Alkanes: Formation of alkanes with special emphasis on Corey House Synthesis, Wurtz reaction, Wurtz-Fittig reaction. Reactions of alkanes: Free Radical substitution:- Halogenations-relative reactivities and selectivity.	**18**	**-**	**-**	**18**

	Carbon-Carbon pi bonds: Formation of alkenes and alkynes by Elimination: Mechanism of E1., E2, E1cB reactions. Saytzeff and Hoffmann elimination, special emphasis on preparation of alkenes by synelimination:- pyrolysis of esters, Chugaev reaction and Wittig reaction. ***Reaction of alkenes*:** Addition Reaction- Electrophilic and free radical additions, their mechanisms. (Markonikoff/ Anti Markonikoff addition) regioselectivity (directional selectivity), andsteroselective of addition reactions. Mechanism of oxymercuration–demercuration, Hydroboration- Oxidation, Ozonolysis, reduction (catalytic and chemical). ***Syn and Anti hydroxylation***(oxidation), simple effect of stereo selectivity and stereo specificity. ***Reactions of Alkynes***: Acidity, Electrophilic and Nucleophilic additions, Hydration to form carbonyl compounds. Alkylation of terminal alkynes. **Marks: 18**				
IV	**EXPERIMENTAL WORK (A)** **Oxidation-Reduction Titrimetry (any one)** i) Estimation of Fe(II) or oxalic acid using standardized KMnO4 solution. ii) Estimation of Fe(II) with K2Cr2O7using diphenylamine as internal indicator. **EXPERIMENTAL WORK (B)** (ii) Detection of elements (N, S and Halogens) Detection of functional groups. **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar

- Lab note book/Attendance
- Group Discussion

Recommended Books:

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2. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
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5. Inorganic Chemistry – J.E.Huheey
6. Physical Chemistry-- Atkins, P. W. & Paula, J.
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8. Physical Chemistry, Castellan G. W., Narosa Publishing
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13. Physical Chemistry – D.S. Pahari
14. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
15. Organic Chemistry – M.K. Jain, S.Chand& Co.
16. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma,(S. Chand & Co.)
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20. Advanced General Organic Chemistry (Part I and Part II) - S. C.Ghosh
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FYUGP

DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course: Fundamentals of Chemistry - III
Course Code: CHMM - 301
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: To understand the chemistry of coordination compounds, inorganic reaction mechanism, 2nd law of thermodynamics, ionic equilibrium, cycloalkanes and conformational analysis, chemistry of halogenated hydrocarbons.

LEARNING OUTCOMES: At the end of this course, students will be able to *understand* the coordination chemistry, inorganic reaction mechanism; second law of thermodynamics, Carnot's theorem, Nernst heat theorm, ionic equilibrium, Henderson Equation and its application; conformation & conformational analysis of alkanes &monosubstituted cyclohexane, $SN1$, $SN2$, and SN_i mechanisms with stereochemical aspects, etc, to *prepare* different double salts, complex salts and buffer solutions of different pH *applicable* in day to day life.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Coordination compounds:** *Types of ligands*: monodentate, bidentate, ambidntate, polydentate and macro cyclic ligand. Effective atomic number rule, VB, crystal field, MO and introduction to ligand field theories and their applications. Spectroscopic terms, RS coupling, Mullikan's symbol (A, B, E, T). Spectrochemical and naphelauxetic series, Electronic spectra of simple Td and Oh complexes, selection rules and Orgel diagram (d^1 to d^9 system). *Magnetic properties:* Paramagnetism, diamagnetism, magnetic properties of octahedral complexes, Antiferromagnetism. **Inorganic reaction mechanism:** Introduction to inorganic reaction mechanism, inert and labile complexes, association, dissociation and concerted paths. Acid and base hydrolysis (with reference to cobalt complexes only). Substitution	**15**	-	-	**15**

	reaction in octahedral and square planar complexes. Trans effect, Irving-William seriespermanganate, ammonium molybdate, sodium cobaltinitrite, cobalt nitrate, Ni-DMG, vanadium pentoxide). **Marks: 17**				
II	**Chemical Thermodynamics II:** Second law of thermodynamics, Carnot's theorem, Carnot cycle, efficiency of heat engines, thermodynamic scale of temperature, concept of entropy, entropy change in a cyclic, reversible, irreversible processes, calculation of entropy changes of an ideal gas with change in P,V,T, entropy change in physical transformation, entropy of mixing. Helmholtz free energy (A) and Gibb's free energy (G), variation of A and G with P,V,T, criteria for spontaneity and equilibrium, Maxwell's relationship, Gibb's–Helmholtz equation. Nernst heat theorem- consequence of the theorem, third law of thermodynamics, and its verification. Determination of absolute entropies of pure substance. **Chemical Equilibrium** Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o , Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases. **Marks: 17**	**17**	**-**	**-**	**17**
III	**Cycloalkanes and conformational analysis**: Synthesis and reactions of three, four, five and six membered cycloalkanes, Their relativestability, Baeyer strain theory. Conformational analysis of Alkanes: (ethane & butane) Relative stability, Energy diagram. Cyclohexane: Chair, Boat and Twist boat forms, Relative stability with energy diagram, axial and equatorial bonds including perspective representation and Newman projections. Conformation & conformational analysis of monosubstituted cyclohexane derivative. **Chemistry of Halogenated Hydrocarbons Alkyl halides:** Methods of preparation including Hunsdiecker reaction from silver or lead (IV) salts of carboxylic	**18**	**-**	**-**	**18**

	Acid). Nucleophilic substitution reactions: SN1, SN2, and SNi Mechanisms with stereochemical aspects and effect of solvent. Nucleophilic substitution vs elimination. Haloform reaction. Aryl halides: Preparation from diazonium salts. Nucleophilic Aromatic Substitution SNAr, Benzyne intermediates. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions**.** **Marks: 18**				
IV	**EXPERIMENTAL WORK (A)** **Inorganic Preparation (Any one)** i. Potash alum ii. Chrome alum iii. Potassium trioxalato chromate iv. Potassium trioxalato ferrate **EXPERIMENTAL WORK (B)** **pH-metry and (Any one experiment)** (i) pH metric titration (a) strong acid vs. strong base (b) weak acid vs. strong base (ii) Preparation of buffer solutions of different pH (a) sodium acetate-acetic acid (b) ammonium chloride-ammonium hydroxide. **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S.Chand & Co. Ltd.)

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9. Principles of Physical Chemistry, Puri, Sharma, Pathania, ShobanLal, (S. Chand & Co.)
10. Physical Chemistry – P.W. Atkins, Oxford University Press
11. Physical Chemistry – Barrow G.M., Tata-McGraw Hill
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15. Organic Chemistry – M.K. Jain, S.Chand& Co.
16. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma,(S. Chand & Co.)
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18. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
19. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
20. Advanced General Organic Chemistry (Part I and Part II) - S. C.Ghosh
21. Organic Chemistry (Oxford) - Clayden,Warren, Greeves and Wothers.
22. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S.Kalsi.

Title of the Course: Fundamentals of Chemistry - IV
Course Code: CHMM-302
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: To make the students familiar with the principle involved in volumetric analysis, acid- base concepts, in details of electrochemistry, chemistry of lanthanide and actinides, chemistry of arenes and C-O bond alcohols.

Learning outcomes: This course will make students to *understand* the redox equation, concepts of acids and bases, chemistry of inner transition elements; electrochemistry, laws governing electrochemical process and their application; synthesis and properties of oxygen containing functional groups. etc, t to *operate* conductivity bridge in *determination* of cell constant and in conductometric titrations of acids and bases and to *handle* calorimeter in *determination* of heat capacity, enthalpy of neutralization, enthalpy of ionization etc. They also to *analyse* the unknown organic compounds qualitatively

UNITS	CONTENTS	L	T	P	Total Hours
I	**Oxidation-Reduction:** Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class**.** **Acids and Bases:** Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB Principle **Chemistry of Lanthanide and actinides:** Electronic structure, oxidation state, ionic radii, Lanthanide and Actinide contraction and separation of lanthanides.	**15**	-	-	**15**
II	**Conductance:** Arrhenius theory of electrolytic conductivity, equivalent and molar conductivity and dissociation, their variation with dilution for weak and strong electrolytes, molar conductivity at infinite dilution, Kohlrausch law of independent migration of ions, Debye-Huckel - Onsagar equation, Wien effect, Debye- Falkenhagen effect,	**17**	-	-	**17**

	Walden's rule. Ionic mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and moving boundary methods (principle only, calculations not required), anomalous transference number, application of conductance measurement: i) degree of dissociation of weak electrolytes ii) ionic product of water iii) solubility and solubility product of sparingly soluble salts iv) Hydrolysis constant of aniline hydrochloride, v) Conductometric titration(Acid-Base and precipitation). **Electrochemistry** Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Electrochemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb2O3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)				
III	**Aromatic Hydrocarbons Aromaticity:** Huckel's rule, aromatic characters of arenes, benzenoid, non-benzenoid- aromatic compounds and heterocyclic and polynuclear hydrocarbons with suitable examples Synthesis and properties of naphthalene and anthracene. Antiaromaticity and nonaromaticity Electrophilic Aromatic Substitution: Halogenation, nitration, sulphonation and Friedel-craft's alkylation / acylation with their mechanism. Activation/deactivation of aromatic ring and	**18**	**-**	**-**	**18**

	directing effects of groups. Partial rate factor (O/P ratio) **Chemistry of C-O Bond Alcohols:** Preparation and properties of Glycol: Oxidation by OsO_4, alkaline, $KMnO_4$, periodic acid and lead tetracetate. PinacolPinacolone rearrangement with mechanism. ***Trihydric alcohol:*** Glycerol: preparation & properties. ***Phenols:*** Preparation and properties:- acidity- comparison with alcohol. Substitution reaction, Reimer- Tiemann and Kolbe-Schmidt reaction, Fries rearrangement with mechanism. **Other aromatic Hydroxy compounds:** Cresol, nitrophenols, picric acid, benzyl alcohol, dihydric phenols. Ethers and Epoxides: Preparation and reactions with acids. **Marks: 18**				
IV	**EXPERIMENTAL WORK (A):** **Conductometryand thermochemistry** **(Any oneexperiment)** (i) Determination of cell constant and hence thespecific conductance of an electrolyte. (ii) Conductometric titrations: (a) strong acid vs. strong base (b) weak acid vs strong base (iii) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide. (iv) Calculation of the enthalpy of ionization ofethanoic acid. **EXPERIMENTAL WORK (B):** Qualitative analysis of unknown organic compounds (alcohols, carboxylic acid , phenols an carbonyl compounds)	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

 Two Internal Examination - 20 Marks

 Others - 10 Marks

- Assignment/Seminar
- Lab note book/Attendance
- Group Discussion

Recommended Books:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S.Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
3. Inorganic Chemistry – Puri, Sharma and Kalia Inorganic Chemistry – J.D. Lee
3. General and Inorganic Chemistry (Part-I & II) R. Sarkar
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5. Inorganic Chemistry – J.E.Huheey
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7. A Text Book of Physical Chemistry – Negi& S.C. Anand, Wiley Eastern
8. Physical Chemistry, Castellan G. W., Narosa Publishing
9. Principles of Physical Chemistry, Puri, Sharma, Pathania, ShobanLal, (S. Chand & Co.)
10. Physical Chemistry – P.W. Atkins, Oxford University Press
11. Physical Chemistry – Barrow G.M., Tata-McGraw Hill
12. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, PragatiPrakashan
13. Physical Chemistry – D.S. Pahari
14. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
15. Organic Chemistry – M.K. Jain, S.Chand& Co.
16. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma,(S. Chand & Co.)
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18. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
19. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
20. Advanced General Organic Chemistry (Part I and Part II) - S. C.Ghosh
21. Organic Chemistry (Oxford) - Clayden,Warren, Greeves and Wothers.
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Title of the Course: Fundamentals of Chemistry - 3
Course Code: CHMN-301
Nature of the Course: CHEMISTRY MINOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: To give the concept of physico-chemical methods involved in metallurgy; first and second law thermodynamics; aromatic hydrocarbons and reactions involved etc.

Learning outcomes:

At the end of this course, students will be able to understand the basic principles involved in metallurgy for some metals. To explain about thermal equilibrium, first and second law of thermodynamics, enthalpy and entropy change of reaction, free energy and their applications. To illustrate the electrophilic and nucleophilic substitution in alkyl halides and aryl halides. To detect elements and functional groups indifferent organic samples

UNITS	CONTENTS	L	T	P	Total Hours
I	**Coordination compounds:** *Types of ligands*: monodentate, bidentate, ambidntate, polydentate and macro cyclic ligand. Effective atomic number rule, VB, crystal field, MO and introduction to ligand field theories and their applications. Spectroscopic terms, RS coupling, Mullikan's symbol (A, B, E, T). Spectrochemical and naphelauxetic series, Electronic spectra of simple Td and Oh complexes, selection rules and Orgel diagram (d^1 to d^9 system). *Magnetic properties:* Paramagnetism, diamagnetism, magnetic properties of octahedral complexes, Antiferromagnetism. **Acids and Bases:** Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB Principle **Marks: 17**	**15**	-	-	**15**
II	**Second law of thermodynamics**	**17**	-	-	**17**

	Second law of thermodynamics, Spontaneous and Non-Spontaneous processes cyclic process-Carnot cycle, Entropy, Entropy change in reversible and irreversible processes and for ideal gas, concept of work function and free energy. **Solution** Types of solutions, concentration units, Solution of gases in liquids-Henry's law. Solution of liquids in liquids: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law –non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule, Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids-Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. Solutions of solids in liquids: the solubility curves. **Marks: 17**				
III	**Aromatic Hydrocarbons:** Preparation (only benzene) from phenol by decarboxylation, fromacetylene,from benzenesulphonic acid. Reactions- Electrophitic substitution in benzene-nitration, halogenations, sulphonation, Fridel-Craft alkylation and acylation with mechanism. **Alkyl and Aryl halides:** **Alkyl halides** Nucleophilic Substitution Reactions (SN2, SN1, & SNi)Preparation: from alkenes and alcohols Reactions;: Hydrolysis, nitrite and nitro formation, Williamson's Synthesis: elimination vs Substitution **Aryl halides** Preparation (chloro, bromo, iodo benzene only): From phenol, Sandmeyer &Gattermann reaction. Reactions (chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH) and effect of nitro substituent. Reactivity and relative strength of carbon-halogen bond in alkyl, allyl, benzyl and vinyl and Aryl halide. **Marks: 18**	**18**	**-**	**-**	**18**

IV	**Experimental Work:** **Organic Qualitative Analysis** Detection of elements (nitrogen, sulphur and halogens) and functional groups of organic compound containing one functional group.	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

Recommended Books:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S.Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
3. Inorganic Chemistry – Puri, Sharma and Kalia
4. Inorganic Chemistry – J.D. Lee
5. General and Inorganic Chemistry (Part-I & II) R. Sarkar
6. Basic Inorganic chemistry – Cotton and Wilkinson
7. Inorganic Chemistry – J.E.Huheey
8. Physical Chemistry-- Atkins, P. W. & Paula, J.
9. A Text Book of Physical Chemistry – Negi& S.C. Anand, Wiley Eastern
10. Physical Chemistry, Castellan G. W., Narosa Publishing
11. Principles of Physical Chemistry, Puri, Sharma, Pathania, ShobanLal, (S. Chand & Co.)
12. Physical Chemistry – P.W. Atkins, Oxford University Press
13. Physical Chemistry – Barrow G.M., Tata-McGraw Hill
14. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, PragatiPrakashan
15. Physical Chemistry – D.S. Pahari
16. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
17. Organic Chemistry – M.K. Jain, S.Chand& Co.
18. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma,(S. Chand & Co.)
19. Organic Chemistry – I.L. Finar, Vol. I & II, ELBS
20. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
21. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
22. Advanced General Organic Chemistry (Part I and Part II) - S. C.Ghosh
23. Organic Chemistry (Oxford) - Clayden,Warren, Greeves and Wothers.
24. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S.Kalsi.

FYUGP

DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course: Inorganic Chemistry-I
Course Code: CHMM - 401
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will develop the knowledge of chemistry in relation to nuclear chemistry and various statistical methods of analysis. It will give the preliminary idea on organometallic chemistry introduce various organic reagents and their applications in inorganic analysis.

Learning Outcome: Students will be able to understand different terms and reaction related to nuclear chemistry, to identify different organic reagents in inorganic analysis, to understand the preliminary concept of organometallic chemistry, to apply organic reagents in inorganic analysis.
They will able to estimate of Ca^{2+} and Mg^{2+} by EDTA and Cu^{2+} by iodometric method

UNITS	CONTENTS	L	T	P	Total Hours
I	**Nuclear Chemistry**: Nuclear structure, mass defect, binding energy and stability of nuclei, nuclear transmutations and artificial radioactivity, fundamentals of radioactive decay, nuclear reactions including fission and fusion reactions, nuclear reactor and its components, measurement of radioactivity, analytical applications of nuclear reactions and radioactive tracers - in studying reaction mechanism, in diagnosis and treatment of diseases, in industry, in agriculture, in analytical chemistry, in determination of the age of the earth by rock dating method and determination of the age of recent objects by radio carbon dating method. **Marks: 16**	**15**	-	-	**15**
II	**Statistical Methods of Analysis**: Accuracy, precession, deviation, standard deviation, classification of errors, minimization of errors, significant figures. Indicators: choice of indicators in neutralization, redox, adsorption and complexometric reactions.	**10**	-	-	**10**

	Marks: 10				
III	**Organometallic Chemistry-I**: Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rules, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. Oxidative addition and reductive elimination reaction, π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. **Marks: 16**	**15**	**-**	**-**	**16**
IV	**Organic Reagents in Inorganic Analysis**: Cupferron, dithizone, benzoin-α-oxime, 1-nitroso-2-naphthol, diphenyl carbazide, diphenyl carbazone, salicylaldoxime, 1,10- phenanthroline, magneson, thiourea, zinc uranyl acetate, oxine. **Marks: 10**	**10**	**-**	**-**	**10**
V	**Experimental Work**: a) Estimation of Ca^{2+} and Mg^{2+} by EDTA b) Estimation of Cu^{2+} by iodometric method **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S. Chand & Co. Ltd.)

2. Advanced Inorganic Chemistry-- Satyaprakash, Basu, Tuli

3. Inorganic Chemistry -- Puri, Sharma and Kalia

4. General and Inorganic Chemistry (Part-I & II) -- R. Sarkar

5. Concise Inorganic Chemistry Wiley India, 2008 -- Lee J. D.

6. Inorganic Chemistry – Principles of structure and reactivity, Pearson Education-- Huheey J. E., Keiter E. A. and Keiter R. L.

7. Qualitative Analysis-- Vogel

Title of the Course: Organic Chemistry-I
Course Code: CHMM-402
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: In this course of organic chemistry students will be introduced about chemistry of carbonyl compounds, carboxylic acids, thiols and amines. They will be providing knowledge about natural as well as synthetic polymers.

Learning Outcome: Students will be able to learn about the preparation and properties of aldehyde, ketone, carboxylic acid, thiols, amines, etc., will also understand and analyze the mechanisms of key name reactions involving organic compounds, such as Aldol condensation, Cannizzaro reaction, and Hofmann rearrangement. Students will able to perform systematic qualitative analysis of organic compounds containing functional groups such as -OH, $-NH_2$, $-NO_2$, $-CONH_2$, -CHO, and -COOH.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Carbonyl Compounds:** (Aliphatic and Aromatic) ***Part A***: Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Clemmensen, Wolff-Kishner, MPV reduction Addition reactions of unsaturated carbonyl compounds: Michael addition. Unsaturated Aldehydes (Acrolein, Crotonaldehyde, Cinnamaldehyde) Unsaturated Ketone (MVK). ***Part B:*** Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate, malanonitrile. **Marks: 16**	**14**	-	-	**14**
II	**Carboxylic Acids and their Derivatives: (Aliphatic and Aromatic):** Preparation, physical properties, and reactions of monocarboxylic acids (Acidity and	**12**	-	-	**12**

	factors affecting it): Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation Dicarboxylic acids: Oxalic acid, malonic acid, and succinic acid Hydroxy acids: lactic acid, tartaric acid, citric acid and salicylic acid. significant figures. Indicators: choice of indicators in neutralization, redox, adsorption and complexometric reactions. **Marks: 12**				
III	**Sulphur containing compounds:** Preparation and reactions of thiols, thioethers and sulphonic acids. **Nitrogen Containing Functional Groups (Aromatic and Aliphatic)** Preparation and important reactions of nitro compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications. Diazomethane & Diazoacetic Ester with synthetic application. **Marks: 3+9**	**12**	**-**	**-**	**12**
IV	**Polymers** Introduction and classification of polymers; Polymerisation reactions -Addition and condensation - Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermos softening (PVC, polythene); Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Biodegradable polymers with examples.	**12**	**-**	**-**	**12**

	Marks: 12				
V	**Experimental Work**: Systematic qualitative analysis of organic compounds having -OH, $-NH_2$, $-NO_2$, $-CONH_2$ -CHO, -COOH, $-CONH_2$ groups. **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3. Advanced Organic Chemistry by Bahl and Bahl (S Chand Publication)

4. A Textbook of Organic Chemistry by KS Tiwari (Vikash Publishing)

5. Modern Organic Chemistry by Jain and Sharma (Vishal Publishing)

6. Advanced and General Organic Chemistry by SK Ghosh (NCBA)

7. Practical Organic Chemistry by OP Agarwal (Krishna)

Title of the Course: Physical Chemistry-I
Course Code: CHMM-403
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: In this course students will be introduced to fundamentals of chemical kinetics, catalysis and surface chemistry.

Learning Outcome: Students will be able to understand and explain the fundamentals of chemical kinetics, surface chemistry, and catalysis principles and their applications. They also able to apply critical thinking skills to design experiments, interpret experimental data, and solve problems related to reaction kinetics and surface chemistry.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Chemical Kinetics:** Order and Molecularity of a reaction, elementary and complex reactions rate laws, differential and integral forms of rate equations of zero, 1^{st}, 2^{nd} order reactions, half-life periods of 1^{st} and 2^{nd} order reactions, determination of order of reaction by method of integration, half-life period, differential method, isolation method, evaluation of rate constant, integrated equation method, graphical method, Guggenheim method (1^{st} order reaction), rate laws and mechanism, steady state approximation. Rate equation of first order, opposite, parallel, consecutive reaction, chain reactions, chain branching, explosion limit, Hydrogen – Bromine thermal reaction. Temperature dependence of reaction rates, Arrhenius equation, energy of activation, collision theory of bimolecular reactions, its limitation. Introduction to activated complex theory, Lindeman's theory of unimolecular gas phase reaction **Marks: 20**	**20**	-	-	**20**
II	**Catalysis** Criteria of catalysis, homogeneous and heterogeneous catalysis, introduction to acid base catalysis. Mechanisms of catalyzed reactions at solid surfaces, effect of temperature on surface reactions, nano particles as catalysts, autocatalysis, catalytic poison, Michaelis-Menten equation. **Marks: 8**	**8**	-	-	**8**

III	**Photochemistry** Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples and reasons of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence, luminescence. Photodimerisation-dimerisation of Anthracene, photochemical reaction– H_2-Cl_2, H_2-Br_2, dissociation of HI, fluorescence, phosphorescence, Joblonski diagram. **Marks: 12**	**12**	**-**	**-**	**12**
IV	**Surface Chemistry** Physical and chemical adsorption of gases on solid surface, adsorption isotherms, types of adsorption isotherm, Freundlich equation, Langmuir adsorption equation. Determination of surface area. Gibbs adsorption equation, application of adsorption in chemical analysis and in industry. **Marks: 12**	**10**	**-**	**-**	**10**
V	**Experimental Work**: (Any two) a) To determine the rate constant of hydrolysis of methyl acetate catalyzed by hydrogen ion concentration at room temperature. b) To determine the rate constant of Saponification of ethyl acetate. c) Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate. d) To study the kinetics of iodination of propanone in acidic medium. e) To study the rate constant of hydrolysis of sucrose by polarimeter. **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

 Two Internal Examination - 20 Marks

 Others - 10 Marks

- Assignment/Seminar
- Lab note book/Attendance
- Group Discussion

Recommended Books:

1. Physical Chemistry- G.W. Castellan, Narosa Publishing House, New Delhi.

2. Physical Chemistry - P.C. Rakshit, Science Book Agency, Kolkata.

3. Physical Chemistry Vols. I, II, III and IV – K.L. Kapoor, MacMillan (India) Ltd., New Delhi.

4. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, Pragati Prakashan.

Title of the Course: Inorganic Materials of Industrial Importance
Course Code: CHMM-404
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will develop the knowledge about industrial chemistry like-glass, ceramics and cements, along with chemistry of fertilizer, alloys, battery.

Learning Outcome: At the end of this course, students will be able to recall key concepts in industrial chemistry, and chemistry of fertilizer, alloys and battery.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Silicate Industries** ***Glass*:** Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass. ***Ceramics***: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre. ***Cements*:** Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements. **Marks: 15**	**15**	-	-	**15**
II	**Fertilizers** Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate. **Marks: 10**	**8**	-	-	**8**
III	**Surface Coatings** Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying	**12**	-	-	**12**

	agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings, metal spraying and anodizing. **Marks: 10**				
IV	**Alloys** Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon, decarbonization, demanganization, desulphurization, dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels **Batteries** Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell. **Marks: 10+7**	**15**	**-**	**-**	**15**
V	**Experimental Work**: (Any two) i. Estimation of Calcium in Calcium ammonium nitrate fertilizer. ii. Estimation of phosphoric acid in superphosphate fertilizer. iii. Electroless metallic coatings on ceramic and plastic material. iv. Determination of composition of dolomite (by complexometric titration) v. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples. **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.

2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.

3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.

4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

5. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.

6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.

7. B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut.

Title of the Course: Fundamentals of Chemistry-4
Course Code: CHMN-401
Nature of the Course: CHEMISTRY MINOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will develop the knowledge about industrial chemistry like-glass, ceramics and cements, develop the knowledge about nuclear chemistry. It will give knowledge on the principles of chemical kinetics and the properties of different types of solutions and also on the preparations and the properties of aryl halides, alcohols, phenols and ethers.

Learning Outcome: At the end of this course, students will be able to recall key concepts in industrial chemistry, nuclear chemistry, chemical kinetics, and solution chemistry. They will also able to explain different reactions and properties related to aryl halides, alcohols, phenols and ethers.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Introduction to Industrial Chemistry:** ***Glass*:** Glassy state and its properties, classification (silicate and nonsilicate glasses). Manufacture and processing of glass. ***Composition and properties of the following types of glasses*:** Soda lime glass, lead glass, safety glass, borosilicate glass, coloured glass, ***Ceramics*:** Important clays and feldspar, ceramic, their types and manufacture. fullerenes carbon nanotubes and carbon fibre. ***Cements*:** Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements **Marks: 8**	**8**	-	-	**8**
II	**Nuclear Chemistry**: Nuclear structure, Mass defect, Binding energy and stability of nuclei, Nuclear transmutations and Artificial radioactivity, Fundamentals of radioactive decay, Nuclear reactions including fission and fusion reactions, Analytical applications of Nuclear Reactions and Radioactive tracers **Marks: 8**	**7**	-	-	**7**
III	**Chemical Kinetics** The concept of reaction rates. Effect of temperature, pressure, catalyst and other	**10**	-	-	**10**

	factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). **Marks: 10**				
IV	**Chemical Equilibrium** Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔGo, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases. **Marks: 8**	**7**	**-**	**-**	**7**
V	**Aldehydes and Ketones (Aliphatic and Aromatic):** (Formaldehyde, Acetadehyde, Acetone &Benzldehyde) Preparation: From acid chlorides and nitriles. Reactions : reaction with HCN, ROH, NaHSO3, NH2-G derivatives , Iodoform test, Aldol Condensation, cannizzaro's reaction, Clemenson and Wolf-Kishner reaction, MPV reduction, Wittig reaction, Bnzoin condensation, Rosenmund reduction. **Marks: 10**	**8**			**8**
VI	**Carboxylic Acid and their Derivatives:** Carboxylic Acids (Aliphatic & Aromatic): Preparation: Acidic and Alkaline hydrolysis of esters. Reaction: Hell-Volhard-Zelinsky Reaction. Preparation of Acid Chloride, Anhydrides, Esters, Amides from Acids and their interconversion. Reactions: Reformatsky reaction, Perkin reaction, Aromatic Carboxylic acid-Benzoic acid, Cinnamic Acid, Phthalic Acid. **Marks: 8**	**10**			**10**
VII	**Experimental Work**: (Any Two) Inorganic Volumetric Analysis: (any one) i. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator. ii. Estimation of oxalic acid by titrating it with	**-**	**-**	**20**	**20**

	$KMnO_4$ iii. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$ iv. Estimation of Fe (II) ions by titrating it with $KMnO_4$. v. Estimation of Cu (II) ions iodometrically using Na_2S_2O **Marks: 18**				
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017

2. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010.

3. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017

4. Physical Chemistry- G.W. Castellan, Narosa Publishing House, New Delhi.

5. Physical Chemistry - P.C. Rakshit, Science Book Agency, Kolkata

6. Physical Chemistry Vols. I, II, III and IV – K.L. Kapoor, MacMillan (India) Ltd., New
Delhi

7. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, Pragati Prakashan.

8. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)

9. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)

FYUGP

DETAILED SYLLABUS OF 5th SEMESTER

Title of the Course: Inorganic Chemistry-II
Course Code: CHMM-501
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will develop the basic knowledge of chemistry in relation to organometallic compounds and catalysis by organometallic compounds, metal clusters and inorganic polymers and different types of chromatographic methods.

Learning Outcome: Students will be able to discuss/explain the synthesis, structure, & reactivity of organometallic compounds, reagents, demonstrate/plan their use in industrially important reactions, able to apply chromatographic methods such as paper, thin layer, column, and gas chromatography for the separation of compounds, and explain the principles of High-Performance Liquid Chromatography (HPLC).
They will able to conduct experimental estimations of Nickel (II) using DMG and determine the percentage of mixed oxides in ores such as hematite, dolomite, and limestone.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Organometallic Chemistry-II:** Isolobal analogy, general methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Role of triethylaluminium in polymerization of ethene (Ziegler–Natta Catalyst), species present in ether solution of Grignard reagent and their structures. Ferrocene: preparation and reactions (acetylation, alkylation, metalation, Mannich condensation), structure and aromaticity, comparison of aromaticity and reactivity with that of benzene. Catalysis by organometallic compounds: study of the following industrial processes and their mechanism: 1. Alkene hydrogenation (Wilkinson's Catalyst) 2. Hydroformylation (Co salts) 3. Wacker Process 4. Synthetic gasoline (Fischer Tropsch reaction) **Marks: 18**	**18**	-	-	**18**

II	**Transition metal clusters:** Definition of cluster, metal-metal bond in cluster, synthesis of metal carbonyl cluster of Cr, Fe and Mo (only low nuclearity clusters up to 4 metal atoms). Closed shell electronic requirement for cluster compounds –rules for polyhedral skeletal electron pair theory (PSEPT). Nitrosyl compounds: synthesis, properties and structures of nitrosyls of Fe, Co and Ni. **Marks: 14**	**14**	**-**	**-**	**14**
III	**Inorganic polymers:** Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates. **Marks: 10**	**10**	**-**	**-**	**10**
IV	**Chromatographic Methods:** Paper, thin layer, column, gas chromatography – separation of compounds, development and Rf values. HPLC – principle only **Marks: 10**	**8**	**-**	**-**	**8**
V	**Experimental Work**: a) Estimation of Nickel (II) using DMG b) Estimation of percentage of mixed oxide in an ore Hematite, dolomite, limestone **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Lee J. D., Concise Inorganic Chemistry Wiley India, 5th Edn., 2008.

2. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, Pearson Education, 4th Ed. 2002.
3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017
4. Selected Topic in Inorganic Chemistry, S. Chand, New Delhi, 17th Ed., 2010
5. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010
6. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017

Title of the Course: Organic Chemistry-II
Course Code: CHMM-502
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: In this course of organic chemistry students will be introduced about the chemistry of carbohydrates Nucleic acids, Lipids, and pharmaceutical compounds etc.

Learning Outcome: Students will be able to appreciate, describe and interpret the chemical and physical processes of living organisms.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Carbohydrates** Occurrence, classification, and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Ascending and descending in monosaccharide; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation. **Marks: 14**	**15**	-	-	**15**
II	**Amino acids and peptides** Amino acids and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis. Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups. Proteins: Elementary idea of primary, secondary and tertiary structures of protein reactions. **Marks: 15**	**15**	-	-	**15**
III	**Lipids and Nucleic Acid** Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.	**12**	-	-	**12**

	Components of nucleic acids, nucleosides and nucleotides; structure, synthesis and reactions of: adenine, guanine, cytosine, uracil and thymine; structure of polynucleotides. structure of DNA (Watson &Crick model) and RNA, genetic code biological role of DNA and RNA, replication, transcription and translation (elementary idea only) Enzymes: classification, active site, specificity, mechanism of enzyme action, co-enzyme **Marks: 15**				
IV	**Pharmaceutical Compounds:** Structure and Importance Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). Synthesis and mode of action of Suphanilamides and other Sulphadrugs (sulphapyridine, sulphathiazole) An elementary treatment of antibiotics and detailed study of chloramphenicol **Marks: 8**	**8**	-	-	**8**
V	**Experimental Work**: (Any Two) 1. Isolation and characterization of DNA from onion/ cauliflower/peas. 2. Separation of different amino acids by paper Chromatography 3. Estimation of proteins by Lowry's method. 4. Preparation of biodiesel from vegetable oil **Marks: 18**	-	-	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3. Advanced Organic Chemistry by Bahl and Bahl (S Chand Publication)

4. A Textbook of Organic Chemistry by KS Tiwari (Vikash Publishing)

5. Modern Organic Chemistry by Jain and Sharma (Vishal Publishing)

6. Advanced and General Organic Chemistry by SK Ghosh (NCBA)

7. Practical Organic Chemistry by OP Agarwal (Krishna)

Title of the Course: Physical Chemistry-II
Course Code: CHMM-503
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: In this course **s**tudents understand physical chemistry in the form of physical forces which govern our surroundings, their mathematical expression and applications.

Learning Outcome: Students will be able to understand and explain the fundamentals of chemical kinetics, surface chemistry, and catalysis principles and their applications. They also able to apply critical thinking skills to design experiments, interpret experimental data, and solve problems related to reaction kinetics and surface chemistry.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Solution and Colligative Properties** Dilute solutions, lowering of vapour pressure, Raoult's and Henry's Laws and their applications, distribution of solutes between two immiscible liquids, Nernst's Distribution law, and solvent extraction. Thermodynamic derivation using chemical potential to derive relation between the four colligative properties [i) relative lowering of vapour pressure. ii) elevation of boiling point iii) depression of freezing point iv) osmotic pressure] and amount of solute, application in calculating molar masses of normal, associated and dissociated solutes in solution. **Marks: 12**	**10**	-	-	**10**
II	**Colloidal state** Electro kinetic phenomenon-electrophoresis, electro-osmosis, electrical double layer and zeta potential, theory of stabilities of colloids, protective action of Lyophillic sol-gold number, determination of Avogadro's number, coagulation of colloids, Schultz – Hardy rule, association of colloids, emulsions, micelles and their structure, critical micelles concentration, Donnan membrane equilibria. **Marks: 10**	**10**	-	-	**10**
III	**System of Variable Composition and Chemical Equilibrium** Partial molar quantities, dependence of	**15**	-	-	**15**

	thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, effect of temperature and pressure on chemical potential, Duhem-Margules equation, change in thermodynamic functions in mixing of ideal gases. Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of activity and activity coefficient, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants Kp, Kc and Kx. Le Chatelier principle; equilibrium between ideal gases and a pure condensed phase. **Marks: 18**				
IV	**Phase Equilibria** Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions. Three component systems, water-chloroform-acetic acid system, triangular plots. Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications. **Marks 12**	**15**	**-**	**-**	**15**
V	**Experimental Work**: (Any Two) Potentiometric titrations i. Strong acid vs. strong base ii. Weak acid vs. strong base Conductometry	**-**	**-**	**20**	**20**

	(i) Determination of cell constant and hence the specific conductance of an electrolyte. (ii) Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. Conductometric titrations: (a) Strong acid vs. strong base (b) Weak acid vs. strong base (c) Mixture of strong acid and weak acid vs. strong base Strong acid vs. weak base **Marks: 18**				
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examinations - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Physical Chemistry- G.W. Castellan, Narosa Publishing House, New Delhi.

2. Physical Chemistry - P.C. Rakshit, Science Book Agency, Kolkata.

3. Physical Chemistry Vols. I, II, III and IV – K.L. Kapoor, MacMillan (India) Ltd., New Delhi.

4. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, Pragati Prakashan.

Title of the Course: Green Chemistry
Course Code: CHMM-504
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will develop the basic knowledge of green chemistry and use of green chemistry in our day to day life.

Learning Outcome: At the end of this course, students will be able understand the concept of green chemistry, use of safer chemicals and green solvents.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Introduction to Green Chemistry** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations? Obstacles in the persuit of the goals of Green Chemistry **Marks: 4**	**5**	-	-	**5**
II	**Principles of Green Chemistry and Designing a Chemical synthesis** Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following i) Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, Calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. ii) Prevention/ minimization of hazardous/ toxic products reducing toxicity iii) Green solvents- supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents. iv) Energy requirements for reactions- alternative sources of energy: use of microwaves and ultrasonic energy. v) Selection of starting materials; avoidance of unnecessary derivatization- careful use of blocking/ protecting groups. vi) Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis. vii)Prevention of chemical	**23**	-	-	**23**

	accidents designing greener processes, inherent safer design, principle of ISD " What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation. viii) Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. **Marks: 25**				
III	**Examples of Green Synthesis/ Reactions and some real world cases Green Synthesis of the following compounds:** adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis) Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents, Diels-Alder reaction and Decarboxylation. Ultrasound assisted reactions: sonochemical Simmons- Smith Reaction (Ultrasonic alternative to Iodine) Surfactants for carbon dioxide- replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning garments. Designing of Environmentally safe marine antifoulant. Rightfit pigments: synthetic azopigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn. Healthier Fats and Oil by Green Chemistry: Enzymatic Inter esterification for production of no Trans-Fats and Oils. Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting **Marks: 15**	**15**	**-**	**-**	**15**
IV	**Future Trends in Green Chemistry:** Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C_2S_3); Green chemistry in sustainable development. **Marks: 8**	**7**	**-**	**-**	**7**
V	**Experimental Work**: (Any Two)	**-**	**-**	**20**	**20**

	i. Preparation of biodiesel from vegetable oil. ii. Preparation of acetanilide from aniline using acetic acid in presence of zinc dust. iii. Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux. iv. Photoreduction of benzophenone to benzopinacol in the presence of sunlight. **Marks: 18**				
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examination - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. V. K. Ahluwalia & M. R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).

2. P. T. Anastas & J. K. Warner: Oxford Green Theory and Practical, University Press (1998).

3. A. S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).

4. M. C. Cann & M. E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).

5. M. A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).

Title of the Course: Fundamentals of Chemistry-5
Course Code: CHMN-501
Nature of the Course: CHEMISTRY MINOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will develop the develop the idea about supra molecular and nano materials, the basic knowledge of chemistry in relation to metal ions present in biological systems, toxicity of metal ions, concepts of electrochemistry concepts such as EMF, Nernst equation, electrode potentials, and their practical applications and the preparations and the properties of aldehydes, ketones and carboxylic acid.

Learning Outcome: At the end of this course, students will gain insight into material chemistry, including supra molecular interactions, solid-state reactions, and the synthesis and characterization of nano materials. They will understand the role of various metals in biological systems and the toxicity of certain metal ions, principle of electrochemistry, and to analyze the properties and reactions of aldehydes, ketones, carboxylic acids, and their derivatives in both aliphatic and aromatic compounds.

They will able to design and conduct experiments in potentiometric titrations and conductometry to determine specific conductance, degree of dissociation, and conductometric titrations for various acid-base systems.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Introduction to Material Chemistry:** Idea about supra molecular interaction. Solid state reactions. Nano materials – synthesis and characterization. C – C composite, polymer and nanocomposite. Introduction of chemistry of clay (Kaolinite, Montmorillonite and Laponite) **Marks: 8**	**7**	-	-	**7**
II	**Bioinorganic Chemistry:** role of alkali metals, Na/K-pump, role of alkaline earth metals, iron, copper, cobalt, zinc and molybdenum. Haemoglobin and myoglobin. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity **Marks: 8**	**8**	-	-	**8**
III	**Conductance** Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch's law of independent migration of ions. Transference number	**10**	-	-	**10**

	and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, Ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid base). **Marks: 10**				
IV	**Electrochemistry** Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode. Commercial applications of galvanic cell, dry cell, lead storage battery, fuel cell. **Marks: 8**	**7**	-	-	**7**
V	**Alcohols, Phenols and Ethers:** Alcohols: Preparation: Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Diols: oxidation of diols. Pinacol-Pinacolone rearrangement. Phenols: Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction Ethers (aliphatic and aromatic): Cleavage of ethers with HI. **Marks: 10**	**8**			**8**
VI	**Nitrogen Containing Functional Groups (Aromatic and Aliphatic)** Preparation and important reactions of nitro compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on	**10**			**10**

	basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications. Diazomethane & Diazoacetic ester with synthetic application. **Marks: 10**				
VII	**Experimental Work**: (Any two) Potentiometric titrations: a) Strong acid vs. strong base b) Weak acid vs. strong base c) Dibasic acid vs. strong base d) Strong acid vs weak base Conductometry: (a) Determination of cell constant and hence the specific conductance of an electrolyte. (b) Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. Conductometric titrations: (a) Strong acid vs. strong base (b) Weak acid vs. strong base (c) Dibasic acid vs. strong base (d) Strong acid vs. weak base **Marks: 18**	-	-	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examinations - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017

2. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010.

3. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017

4. Physical Chemistry- G.W. Castellan, Narosa Publishing House, New Delhi.

5. Physical Chemistry - P.C. Rakshit, Science Book Agency, Kolkata

6. Physical Chemistry Vols. I, II, III and IV – K.L. Kapoor, MacMillan (India) Ltd., New
Delhi

7. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, Pragati Prakashan.

8. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)

9. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)

FYUGP

DETAILED SYLLABUS OF 6th SEMESTER

Title of the Course: Inorganic Chemistry-III
Course Code: CHMM-601
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will develop the basic knowledge of chemistry in relation to metal ions present in biological systems, toxicity of metal ions and give idea about supra molecular and nano materials. It also give knowledge on theoretical principles in qualitative analysis.

Learning Outcome: Students will be able to recognize roles and classifications of metal ions in biological systems and understand supramolecular interactions and nanomaterial properties.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Theoretical Principles in Qualitative Analysis (H_2S Scheme)** Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II. **Marks: 12**	**10**	-	-	**10**
II	**Introduction to material chemistry:** Idea about supra molecular interaction. Solid state reactions. Nano materials – synthesis and characterization. C–C composite, polymer and nanocomposite. Introduction of chemistry of clay (Kaolinite, Montmorillonite and Laponite). **Marks: 10**	**12**	-	-	**12**
III	**Reaction Kinetics and Mechanism** Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans-effect, theories of trans-effect, mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and kinetic stability, kinetics of octahedral substitution, ligand field effects and	**12**	-	-	**12**

	reaction rates, Mechanism of substitution in octahedral complexes. **Marks: 15**				
IV	**Bio-Inorganic Chemistry:** Metal ions present in biological systems, classification of elements according to their action in biological system. role of alkali metals, Na/K-pump, role of alkaline earth metals, iron, copper, cobalt, zinc and molybdenum. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Iron and its application in bio-systems, Haemoglobin and myoglobin. Metalloprotein and metalloenzymes, plastocyanin, vitamin B12, carbonic anhydrase and nitrogenase. Metal ion in medicine -- cisplatin and carboplatin. Use of chelating agents in medicine. **Marks: 15**	**16**	-	-	**16**
V	**Experimental Work**: Qualitative analysis of inorganic salt mixture including interfering radical (5 radicals) **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examinations - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Lee J. D., Concise Inorganic Chemistry Wiley India, 5th Edn., 2008.

2. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, Pearson Education, 4th Ed. 2002.

3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017

4. Selected Topic in Inorganic Chemistry, S. Chand, New Delhi, 17th Ed., 2010

5. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010

6. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017

Title of the Course: Organic Chemistry-III
Course Code: CHMM-602
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: In this course of organic chemistry will provide basic concept of Pericyclic reaction and spectroscopy.

Learning Outcome: Students will be able to understand the fundamental principles and applications of various spectroscopic techniques (UV, IR, NMR, Mass Spectrometry) and their roles in identifying organic molecules, able to evaluate the mechanisms and stereochemistry of pericyclic reactions,

UNITS	CONTENTS	L	T	P	Total Hours
I	**Introduction to absorption and emission spectroscopy. UV Spectroscopy:** Types of electronic transitions, λ_{max}, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward. Rules for calculation of λ_{max} for the following systems: α,β unsaturated aldehydes, ketones; Conjugated dienes: alicyclic, homoannular and heteroannular; distinction between cis and trans isomers. IR Spectroscopy: functional group and Fingerprint region and its significance; application of IR spectroscopy in functional group analysis. NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Concept of Relaxation and Interpretation of NMR spectra of simple compounds. Mass spectrometry: Basic principles, Concept of Molecular ion and base Peak, Mc Lafferty rearrangement. Applications of IR, UV, NMR and Mass for identification of simple organic molecules. **Marks: 18**	**18**	**-**	**-**	**18**

II	**Pericyclic reactions:** Basic concepts of pericyclic reaction and examples of electrocyclic, cycloaddition and sigmatropic rearrangements reactions, FMO analysis and Woodward Hoffmann selection rules. Orbital symmetry, selection rules and stereochemistry of electrocyclic reaction. Cycloaddition: [2+2] and [4+2] cycloaddition FMO approach, DielsAlder reaction-endo/exo regioselectivity. 1,3-dipolar cycloaddition Sigmatropic rearrangements [1,3], [1,5] sigmatropic rearrangements, Claisen, and Cope rearrangement. **Marks: 12**	**12**	**-**	**-**	**12**
III	**Heterocyclic Compound-I** Classification and nomenclature, structure, synthesis, and properties of 3-membered heterocycles: Aziridine, oxirane and thiirane. Aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Indole (Fischer indole synthesis and Madelung synthesis), quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner- Miller synthesis, Bischler-Napieralski reaction **Marks: 14**	**12**	**-**	**-**	**12**
IV	**Disconnection approach in Organic Synthesis** Elementary idea about disconnection, synthon and synthetic equivalent, functional group interconversion (FGI), functional group addition (FGA)., simple examples off retrosynthesis of c-c bond formation (Corey house, Grignard, Aldol condensation, Wittig). retrosynthesis of monofunctionalized and bi-functionalized (1,1 and 1,2) compounds, umpolung. **Marks: 8**	**8**	**-**	**-**	**8**
V	**Experimental Work**: (Any Two) 1. Identification of simple organic compounds by IR spectroscopy and NMR Spectroscopy (Spectra to be provided). 2. Extraction of caffeine from tea leaves. 3. Saponification value of an oil or a fat. 4. Determination of Iodine number of an oil/ fat. 5. To	**-**	**-**	**20**	**20**

	determine the molecular weight of camphor by Rust method. **Marks: 18**				
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

 Two Internal Examinations - 20 Marks

 Others - 10 Marks

- Assignment/Seminar
- Lab note book/Attendance
- Group Discussion

Recommended Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3. Advanced Organic Chemistry by Bahl and Bahl (S Chand Publication)

4. A Textbook of Organic Chemistry by KS Tiwari (Vikash Publishing)

5. Modern Organic Chemistry by Jain and Sharma (Vishal Publishing)

6. Advanced and General Organic Chemistry by SK Ghosh (NCBA)

7. Practical Organic Chemistry by OP Agarwal (Krishna)

Title of the Course: Physical Chemistry and Quantum Chemistry
Course Code: CHMM-603
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will make the students familiar with symmetry elements & point groups and the various aspects of basic quantum mechanics with special reference to classical mechanism.

Learning Outcome: At the end of this course, students will be able develop a comprehensive understanding of symmetry and group theory principles, quantum mechanics foundations, and experimental techniques in analytical chemistry.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Symmetry & Group Theory-I** **Symmetry elements and symmetry operations.** Definition of group, symmetry group, point group. Perspective sketch and point group of some common molecules (H_2, HF, CO_2, C_2H_2, C_2H_4, $CHCl_3$, PCl_5, NH_3, BF_3, $[PtCl_4]^{2-}$, BrF_5). Symmetry and mathematical tools, matrix algebra, reducible and irreducible representation, great orthogonality theorem (deduction not necessary), Character table for C_{2v} and C_{3v} point groups. **Marks: 15**	**11**	-	-	**11**
II	**Quantum Chemistry-I** Background of quantum mechanics; Black body radiation – Planck's hypothesis, photoelectric effect, de Broglie hypothesis and Heisenberg's uncertainty principle. Postulates of quantum mechanics, quantum mechanical operators (Linear and Hermitian operators), Wave functions, Normalized and Orthogonal Wave Functions. Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy; wave functions, probability distribution functions, nodal properties, separation of variables, two- and three-dimensional boxes, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of	**32**	-	-	**32**

	solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy. ***Angular momentum*:** Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule: Schrödinger equation and its solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, energy (only final energy expression). Average and most probable distances. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom). **Marks: 30**				
III	**Electrical & Magnetic Properties of Atoms and Molecules** Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Debye equation Lorentz-Laurenz equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, Ferromagnetism and Antiferromagnetism and their molecular interpretation, Magnetic susceptibility and its measurement. **Marks: 7**	**7**	**-**	**-**	**7**
IV	**Experimental Work**: (Any Two) **pH-metry and Polarimetry** (i) pH metric titration (a) strong acid vs. strong base (b) weak acid vs. strong base (c) strong acid vs. weak base (ii) Preparation of buffer solutions of different pH (a) sodium acetate-acetic acid (b) ammonium chloride-ammonium hydroxide (c) Determination of dissociation constant of weak acid (CH_3COOH) / base (NH_4OH) (iii) To determine the concentration of an optically active substance by polarimetric method. **Marks: 18**	**-**	**-**	**20**	**20**
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

 Two Internal Examinations - 20 Marks

 Others - 10 Marks

- Assignment/Seminar
- Lab note book/Attendance
- Group Discussion

Recommended Books:

1. Quantum Chemistry – Ira N. Levine, PHI, New Delhi.

2. Introductory Quantum Chemistry – A.K. Chandra, Tata- McGraw.

3. Chemical Applications of Group Theory- F.A. Cotton, Wiley Eastern Ltd., New Delhi.

4. Physical Chemistry- G.W. Castellan, Narosa Publishing House, New Delhi.

5. Physical Chemistry - P.C. Rakshit, Science Book Agency, Kolkata.

6. Physical Chemistry Vols. I, II, III and IV – K.L. Kapoor, MacMillan (India) Ltd., New Delhi.

7. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, Pragati Prakashan.

Title of the Course: Spectroscopy
Course Code: CHMM-604
Nature of the Course: CHEMISTRY MAJOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: In this course students understand physical chemistry in the form of physical forces which govern our surroundings, their mathematical expression and applications.

Learning Outcome: Students will be able to understand and explain the fundamentals of molecular spectroscopy and to design and conduct spectroscopic experiments to determine concentrations and study reaction kinetics.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Spectroscopy** General Principles, Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. **Rotation spectroscopy:** Diatomic molecules, Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. **Marks: 12**	**12**	-	-	**15**
II	**Infrared and Raman spectroscopy:** Classical equation of vibration, vibrational energies of diatomic molecules, zero-point energy, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, effect of isotopic substitution, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. Raman Effect, Classical and Quantum theory of Raman scattering, Polarizability tensor, Rayleigh and Raman scattering, Stokes and antistokes lines, structure elucidation by Raman spectroscopy (AB, A_2B, and AB_3), stretching frequencies of bonds and functional groups (Example from both organic and inorganic molecules), Rule of Mutual Exclusion, Depolarization ratio. **Marks: 10**	**10**	-	-	**10**

III	**Electronic spectroscopy** The Beer – Lambert Law, molar absorption coefficient, selection rules for electronic transitions, Franck-Condon principle, chromophores, auxochromes, bathochromic and hypsochromic shift. Electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model. Solvent Effects on Electronic Spectra. **Marks: 20**	**15**	**-**	**-**	**15**
IV	**Spin resonance spectroscopy** Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules. Electron spin resonance (ESR) spectroscopy and its principle, hyperfine structure, ESR of simple free radicals, and copper (II) compounds **Marks: 7**	**10**	**-**	**-**	**10**
V	**Experimental Work**: (Any Two) a) Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1, cm-1, eV). b) Study the pH-dependence of the U V-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$. c) Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds. d) Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration f) Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture. g) Study the kinetics of iodination of propanone in acidic medium. h) Determine the amount of iron present in a sample using 1, 10-phenathroline. i) Determine the dissociation constant of an indicator (phenolphthalein/ methyl red).	**-**	**-**	**20**	**20**

	Marks: 18				
	Total Marks: 70	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- **Two Internal Examinations - 20 Marks**
- **Others - 10 Marks**
  - Assignment/Seminar
  - Lab note book/Attendance
  - Group Discussion

Recommended Books:

1. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. McCash, TataMcGrawHill.
2. . Molecular Spectroscopy, G.M. Barrow.
3. 3. Spectroscopy, Satyanarayana

Title of the Course: Fundamentals of Chemistry-6
Course Code: CHMN-601
Nature of the Course: CHEMISTRY MINOR
Total Credits: 4
Distribution of Marks: 70 (End Sem) (52 TH + 18 PR) + 30 (In-Sem)

Course Objective: This course will develop the develop the knowledge about sampling and purification methods of water, principles and applications of phase and chemical equilibrium, and knowledge about amines, diazonium salts, amino acids, peptides and proteins

Learning Outcome: At the end of this course, students will understand the principles of water analysis, significance of phase equilibrium and chemical equilibrium, understand the preparation and reactions of amines, diazonium salts, amino acids, peptides, and proteins.

They will able to design and conduct experiments to purify organic compounds using crystallization and distillation methods and solve problems related to the determination of purity criteria, such as melting and boiling points, and the preparation of specific organic compounds.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Analytical Chemistry-I:** Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. (a) Determination of pH, acidity and alkalinity of a water sample. (b) Determination of dissolved oxygen (DO) of a water sample **Marks: 10**	**12**	-	-	**12**
II	**Phase Equilibrium** Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic deviation. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead –silver, Zn-Mg, $FeCl_3$-H_2O and Na-K only) **Marks: 12**	**12**	-	-	**12**
III	**Ionic equilibrium:** Strong and weak electrolyte with modern classification of electrolytes (true and potential electrolyte), degree of ionization, factors affecting	**10**	-	-	**10**

	degree of ionization, ionization constant, 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 solution, derivation of Henderson equation and its applications, buffer capacity, buffer range, buffer action. Solubility and solubility product of sparingly soluble salts-application of solubility product principle in salt analysis. Qualitative treatment of acid-base titration curves. Theory of acids- base indicators, selection of indicators and their limitations. **Marks: 12**				
V	**Carbohydrates** Occurrence, classification, and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Ascending and descending in monosaccharide; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation. **Marks: 10**	**8**			**8**
VI	**Amino Acids, Peptides & Proteins:** Classification, Preparation (Gabriel phthalimide method and Strecker Synthesis), Zwitter ion, Isoeleectric point and Electrophoresis. Reactions of Amino Acids-Esterification and Acetylation reactions, Elementary ideas of Peptides and Proteins. **Marks: 8**	**10**			**10**
VII	**Experimental Work: Either (i. + iii.) or (ii. + iii.)** i. Purification of organic compounds by crystallization (from water and alcohol) and distillation. ii. Criteria of Purity: Determination of melting and boiling points. iii. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done. (a) Bromination of Phenol/Aniline (b) Benzoylation of amines/phenols (c) Oxime and 2, 4-dinitrophenylhydrazone of	**-**	**-**	**20**	**20**

	aldehyde/ketone **Marks: 18**				
	Total **Marks: 70**	**50**	**0**	**20**	**70**

L: Lectures **T**: Tutorials **P**: Practical

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

 Two Internal Examinations - 20 Marks

 Others - 10 Marks

- Assignment/Seminar
- Lab note book/Attendance
- Group Discussion

Recommended Books:

1. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017

2. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010.

3. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017

4. Physical Chemistry- G.W. Castellan, Narosa Publishing House, New Delhi.

5. Physical Chemistry - P.C. Rakshit, Science Book Agency, Kolkata

6. Physical Chemistry Vols. I, II, III and IV – K.L. Kapoor, MacMillan (India) Ltd., New
Delhi

7. Advanced Physical Chemistry – J.N. Gurta& H. Snehi, Pragati Prakashan.

8. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)

9. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)