DEPARTMENT OF CHEMISTRY

Vision

Imbibing the service attitude and to transform the graduates through learning experience for achieving excellence in research and to create the transformative impact on women through sustained global innovation and entrepreneurship.

Mission

- Offering innovative research projects for budding chemists
- To produce quality entrepreneurs to meet the global challenges

Programme Educational Objectives (PEO)

PEO1: To create and strengthen women leaders through disciplinary knowledge, professional skills and ethical sensitivity

PEO2: To transform students as successful entrepreneurs to face the modern challenges.

PEO3: To nurture the students to invent, innovate and create solutions for current moral, ecological and economic issues

Programme Outcome (PO)

PO1: Disciplinary Knowledge: Acquiring knowledge of different dimensions in the related areas of study and identifying the assumptions that frame thinking and actions.

PO2: Effective Communication: Ability to share thoughts, ideas, and applied skills of communication in its various perspectives

PO3: Research Skill and Critical Thinking: Ability to plan, execute and report theresults of an experiment and to draw conclusions from the evidence and the capability to apply analytical thought by following a scientific approach toknowledge development

PO4: Moral Ethical Awareness/Reasoning: Ability to embrace moral/ethical values in conducting one's life, about an ethical issue from multiple perspectives, and use ethical practices in all works and appreciating environmental and sustainability issues and adopting unbiased and truthful actions in all aspects of work

PO5: Information/Digital Literacy: Capability to use ICT in case of need and the ability to access, evaluate and use the relevant information

PO6: Problem solving: Ability to apply their competence to solve non-familiar everyday problems in real-life situations

PO7: Self–directed and Lifelong Learning: Acquire the ability to engage in independent and lifelong learning through self-paced and self-directed learning to meet out the change in life

MSc CHEMISTRY

(Two years Regular Programme)

(For Students Admitted from 2025-26)

Programme Specific Objectives:

PSO1: The student will acquire knowledge on Physical, Inorganic, Organic, Analytical, Computational and Industrial Chemistry

PSO2: Apply appropriate techniques for the qualitative and quantitative analysis of chemicals in laboratories

PSO3: Relate the knowledge acquired about chemical reactions and their mechanisms to design novel eco-friendly and sustainable synthetic pathways

PSO4: Deduce the chemical structures using data set obtained with the help of spectroscopic techniques

PSO5: Students will gain knowledge and practical skills to work in research projects at different industries and research/academic institutions

PSO6: Consolidate and deliver the chemistry related knowledge through an effective written, graphical/virtual communications and interact effectively with people from various backgrounds

PSO7: Students will achieve in noble profession of teaching and helping in nation building through innovative research and entrepreneurship

PREAMBLE

1. Core-I- Organic Chemistry-I has been modified as Organic Reaction Mechanism. Unit I- Nature of Bonding and Aromaticity was replaced by the course content of Methods of Determination of Reaction Mechanism. Unit V- Molecular Rearrangements and Reactions was added instead of Oxidation and Reduction.
2. Core II-Inorganic Chemistry-I has been modified as Structure and Bonding in Inorganic Chemistry. Course content also changed.
3. Core-III Physical Chemistry-I has been modified as Thermodynamics and Chemical Kinetics. In unit III, Irreversible Thermodynamics was added and Surface Chemistry was changed as Unit IV. From Unit IV, Chemical kinetics moved as Unit V.
4. Core-IV Organic Chemistry Practical- New experiments were included.
5. Discipline Specific Elective I (A) - Instrumental Methods of Analysis- In Unit I-title with content also changed to Precipitation Techniques and Radio Analytical Techniques. In unit II, Precipitation Techniques was changed to Extraction Methods.
6. Discipline Specific Elective I (B) –Green & Sustainable Chemistry was changed to Sustainable Chemistry. In unit I- Introduction of Green Chemistry was changed into Concept of Sustainability. In unit II- Designing Green synthesis was changed into Designing Green Chemical Strategies for Sustainable Development. In unit IV- Sustainable chemistry was changed into Future Trends in Sustainable Chemistry.
7. Core V –Organic Chemistry-II has been modified to Organic Synthesis. In unit I- Molecular Rearrangements and Reactions was replaced by Stereochemistry and Conformation Analysis. In

unit II- Stereochemistry and Conformation Analysis was changed into Photochemistry. In unit III- Photochemistry was changed into Pericyclic Reactions. In Unit IV- Pericyclic Reactions was changed into Oxidation and Reduction. In Unit-V- Biomacromolecules was changed into Carbohydrates, Amino acids, proteins and Nucleic acids.

8. Core VI- Inorganic Chemistry-II has been modified to Coordination and Nuclear Chemistry. In Unit III-Lanthanides and Actinides was changed into Reaction Mechanism of Coordination Chemistry. In unit IV- Photochemistry was changed into Nuclear Chemistry and Nuclear forces. In unit V- Bioinorganic chemistry was changed into Radiation Chemistry.
9. Core VII- Physical Chemistry-II has been modified to Electrochemistry. In unit I- Photochemistry was changed into Electrochemistry-I. In unit II- Electrochemistry-I was changed into Electrochemistry-II and Kinetic of Electrode Process. In unit-III- Electrochemistry-III was changed into Electrochemical Energy Storage. In unit-IV- Nuclear Magnetic Resonance was changed into Corrosion. In unit V- Nuclear Quadruple Resonance and Electron Spin Resonance was changed into Application of Electrochemistry.
10. Core VIII- Inorganic Chemistry Practical, two familiar and two less familiar cations were introduced instead of one familiar and one less familiar cation in the qualitative analysis. Instead of Nickel ammonium sulphate to introduced as Tris(thiourea) copper (II) sulphate in preparation of inorganic complexes.
11. Discipline Specific Elective II (A)- Applied Electrochemistry was removed.
12. Discipline Specific Elective II (A) & (B) Applied Electrochemistry and Computational Chemistry were changed into Nano science and Nanotechnology and Material Chemistry.
13. Discipline Specific Elective II (B) – Material Chemistry, in unit V- Thin Film Deposition Techniques was changed into Composites.
14. Core IX –Organic Chemistry-III has been modified to Spectroscopy. In unit-II Nuclear Magnetic Resonance and Carbon-13 NMR Spectroscopy was changed into H^1 -NMR Spectroscopy. In unit-III- Mass Spectrometry was changed into Carbon-13 NMR Spectroscopy and ^{31}P and ^{19}F NMR spectroscopy. In unit IV Small Ring Heterocyclic was changed into Mass Spectrometry. In unit V Chemistry of Natural Products was changed into Nuclear Quadruple Resonance and Electron Spin Resonance Spectroscopy.
15. Core X–Inorganic chemistry-III has been modified to Organometallic and Bioinorganic Chemistry. In unit I –Organometallic Chemistry-I was changed into Organometallics. In unit II- Organometallic Chemistry-II was changed into Reactions and Catalysis of Organometallic Compounds. In unit III- Application of IR, Raman and Mossbauer Spectroscopy to the study of inorganic compounds was replaced by Inorganic Spectroscopy, Raman spectroscopy and Mossbauer Spectroscopy. In unit IV- Electronic Spectra and NMR Spectroscopy of Inorganic compounds was replaced by Bioinorganic Chemistry. In unit V- Supramolecular Chemistry and Medicinal Bioinorganic Chemistry was replaced by Medicinal Bioinorganic Chemistry.
16. Core XI- Physical Chemistry-III has been modified to Quantum Chemistry & Group Theory. Unit I- Classical Quantum Chemistry was changed into Photochemistry. Unit II- Approximate Methods was replaced by Quantum Chemistry-I. Unit III- Quantum Chemistry-II was changed instead of Mechanism of Gas Phase Reactions. Unit IV- Computer Applications in Chemistry was changed into Group Theory-I. Unit V- Group Theory was changed into Group Theory-II.
17. As per the suggestions of university nominee, in Core XII- Physical Chemistry Practical

experiments were rearranged in proper way.

18. Discipline Specific Elective III (A) & (B) - Nanoscience and Nanotechnology and Material Chemistry was changed into Polymer Chemistry and Computational Chemistry.

19. Core XV- Polymer Chemistry was removed and replaced by the new course of Chemistry of Natural Products and Heterocyclic Chemistry.

20. Introduced new course-Research Methodology in IVth Semester.

Programme Structure 2025-2026
Program Code: PCH

Sem	Subject Code	Course	Subject Title	Hrs/ wk.	Credit	@ SD | ENT | EMP	$ REG | NAT | GLO	CIA	ESE	Total
I	JMCHC11	Core-I	Organic Reaction Mechanism	6	5	SD	GLO	25	75	100
	JMCHC12	Core-II	Structure and Bonding in Inorganic Chemistry	6	5	SD	NAT| GLO	25	75	100
	JMCHC13	Core-III	Thermodynamics and Chemical Kinetics	6	5	SD	NAT | GLO	25	75	100
	JMCHC14P	Core –IV	Organic Chemistry Practical	6	4	SD| EMP	NAT	25	75	100
	JMCHE1A/ JMCHE1B	DSE –I	a. Instrumental Methods of Analysis (or) b. Sustainable Chemistry	6	5	SD| EMP	REG | NAT | GLO	25	75	100
	JMCHX1/ JMCHX1O	Extra Credit- I	Forensic Chemistry / Online Course*	-	2	SD| EMP	REG | NAT | GLO	-	100	100
			Total	**30**	**24+2**			**125**	**375 + 100**	**500 + 100**
II	JMCHC21	Core-V	Organic Synthesis	6	5	SD	NAT| GLO	25	75	100
	JMCHC22	Core-VI	Coordination and Nuclear Chemistry	6	5	SD	NAT| GLO	25	75	100
	JMCHC23	Core-VII	Electro Chemistry	6	5	SD	REG | NAT | GLO	25	75	100
	JMCHC24P	Core-VIII	Inorganic Chemistry Practical	6	4	SD	NAT | GLO	25	75	100
	JMCHE2A/ JMCHE2B	DSE-II	a. Nanoscience and Nanotechnology (or) b. Material Chemistry	6	5	SD| EMP	NAT | GLO	25	75	100
	JMCHX2/ JMCHX2O	Extra Credit- II	Applied Chemistry / Online Course*	-	2	SD| EMP	REG	-	100	100
			Total	**30**	**24+2**			**125**	**375 + 100**	**500 + 100**

III	JMCHC31	Core –IX	Spectroscopy	6	5	SD| EMP	GLO	25	75	100
	JMCHC32	Core – X	Organometallic and Bioinorganic Chemistry • Integrated with Online Course	6	5	SD	NAT | GLO	25	75	100
	JMCHC33	Core –XI	Quantum Chemistry and Group Theory	6	5	SD	NAT | GLO	25	75	100
	JMCHC34P	Core- XII	Physical Chemistry Practical	6	4	SD| EMP	NAT | GLO	25	75	100
	JMCHE3A/ JMCHE3BI	DSE –III	a. Polymer Chemistry (or) b. Computational Chemistry # internship	6	5	SD| EMP	NAT | GLO	25	75	100
	JMESX3/ JMCHX3O	Extra Credit-III	Employability Skills/ Online Course*	-	2	EMP	GLO	100	-	100
			Total	**30**	**24+2**			**125**	**375 + 100**	**500 + 100**
IV	JMCHC41	Core XIII	Aromaticity, Heterocyclic and Natural Products	6	5	SD	NAT | GLO	25	75	100
	JMCHC42	Core XIV	Research Methodology	6	5	SD| EMP	GLO	25	75	100
	JMCHC43DW	Core –XV	Project	16	8	SD| ENT| EMP	REG | NAT | GLO	100	100	200
			Library	2	-			-	-	-
	JMCHX4/ JMCHX4O	Extra credit-IV	Agricultural Chemistry/ Online Course*	-	2	SD| EMP	REG	-	100	100
			Total	**30**	**18+2**			**150**	**250 + 100**	**400 + 100**
			Grand Total	**120**	**90+8**			**525 + 100**	**1375 + 300**	**1900 + 400**

For Online Course credit alone will be assigned on submission of certificate obtained by appearing for online examination from EdX, Spoken Tutorial, NPTEL or Coursera etc.

For internship course, refer www.internshala.com or any online internship course. For online course integration, syllabus will be taken from spoken tutorial

@SD- Skill Development ENT-Entrepreneurship EMP-Employability $ R-Regional N-National G-Global

Core I – Organic Reaction Mechanism

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 6**
Subject Code: JMCHC11 **Credit: 5**

Course Objectives:

1. To enable the students to learn the principle and reagent used in different types of aliphatic and aromatic reaction.
2. To understand various factors deciding the types and bonding in various classes of organic reaction.

Unit I **(18 hours)**

Methods of Determination of Reaction Mechanism: Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.

Unit II **(18 hours)**

Aliphatic and Aromatic Nucleophilic Substitution Reactions:SN1, SN2 and SNi mechanisms – effect of substrate structure, leaving group, attacking nucleophiles and solvent – neighbouring group participation – substitution at allylic carbons and vinylic carbons - Ambident nucleophiles, hydrolysis of esters-Wurtz reaction, Claisen and Dieckmann condensation, Williamson reactions.

Aromatic nucleophilic substitution- Chichibabin reaction, Cine substitution, Diazonium group as leaving group-Benzyne mechanism

Unit III **(18 hours)**

Aliphatic and Aromatic Electrophilic Substitution Reactions: S_E1 and S_E2 reactions-mechanisms and reactivity, typical reactions involving migration of double bond-Keto-enol tautomerism, Halogenation of carbonyl compounds, Stork enamine reactions,

aromatic electrophilic substitution (Ortho and Para ratio)-reactivity, orientation and mechanisms-Nitration, Halogenation and Sulphonation, Friedel Crafts alkylation and arylation (Scholl reaction) Formylation with (i) Disubstituted formamides (Vilsmeyer- Haack reaction) (ii) Gatterman reaction (iii) Chloroform (Reimer - Tiemann reaction)

Unit IV **(18 hours)**

Addition Reaction: Addition to C-C and C-O multiple bonds -Electrophilic, Nucleophilic and Free-radical additions, additions to conjugated systems Orientation, Birch reduction, Michael addition, 1,3 dipolar additions, carbene addition to double bonds-Mannich reaction, Meerwein-Pondorf reduction, Grignard reactions, Aldol, Stobbe, Wittig, Cannizarro reaction.

Elimination reactions-E1 and E2 Mechanisms, Orientations, Hofmann and Saytzeff‟s rules, elimination versus substitution-Chaugav reaction, Bredt‟s rule, dehydration of alcohols,

dehydrohalogenation-mechanisms and orientation in pyrolytic elimination.

Unit V **(18 hours)**

Molecular Rearrangements and Reactions: Types of organic rearrangements- migration to electron deficient carbon- Wagner-Meerwein, Wolf , migration to electron deficient nitrogen - Hofmann, Curtius, Schmidt, Lossen, Beckmann, migration to electron deficient oxygen- Bayer-Villiger, Hydroperoxide, migration to electron rich carbon- Favorskii, Stevens, Wittig, Sommelet, Hauser, Neber, aromatic rearrangement - Fries, Hofmann-Martius, Orton, Smiles, Zimmermann, Chapman, and borane rearrangements.

Note

Questions related to the above units, from various competitive examination to be solved. (To be discussed during the skill development course hours)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: To recall the basic principles of organic chemistry.

CO2: To understand the formation and detection of reaction intermediates of organic reactions.

CO3: To predict the suitable reagents for the conversion of selective organic compounds.

CO4: To correlate the principles of substitution, elimination, and addition reactions.

CO5: To design new routes to synthesis organic compounds.

Text Book:

1. J. March and M. B. Smith, *March's Advanced Organic Chemistry: Reactions,Mechanisms, and Structure*, Wiley, New York, 8th Edition, 2020.

Reference Books:

1. J. Clayden, N. Greeves, *Organic Chemistry*, Oxford University Press, UK, 2nd Edition, 2014.
2. Raj K Bansal, *Organic Reaction Mechanisms*, New age International Private Ltd-Publishers, 4th Edition, 2012.

Journals:

1. Royal Society of Chemistry
2. ACS Organic and Inorganic Journal
3. The Journal of Organic Chemistry

E- Resources:

1. http://maharajacollege.ac.in/material/nature_of_bonding_in_organic_molecules_converted.pdf
2. https://www.scribd.com/doc/25382780/Aliphatic-Nucleophilic-Substitution-Reactions
3. https://www.organic-chemistry.org/namedreactions/
4. https://nptel.ac.in/content/storage2/courses/104101005/downloads/LectureNotes/chapter%209.pdf
5. https://nptel.ac.in/content/storage2/courses/104101005/downloads/LectureNotes/chapter%207.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	3	3	**27**

CO2	9	3	9	3	9	3	3	**39**
CO3	9	9	3	3	9	3	3	**39**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	9	1	9	9	9	**49**
Total	**45**	**21**	**33**	**12**	**39**	**27**	**27**	**203**

Low-1 Medium-3 High-9

Core II – Structure and Bonding in Inorganic Chemistry

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 6**
Subject Code: JMCHC12 **Credit: 5**

Course Objectives:

1. To introduce the concept and application of theories in chemical bonding.
2. To determine the structure and nature of main group compounds and clusters.
3. To evaluate and understand the structure of solids and their properties.
4. To get insight on inorganic rings, cages and clusters and supramolecules.

Unit I **(18 hours)**

Nature of chemical bonds: Covalent bond; Hybridization – Calculation of s and p characters – Bent's rule – VSEPR theory – VBT applied to odd electron molecules like ClO2, NO, NO2 etc., M.O. theory; LCAO approximation – application of MOT to heteronuclear molecules like NO, CO, BeCl2, BeH2 and H2O – Walsh diagram (diatomic & triatomic molecules) – concept of multi centered bond as applied to electron deficient molecules like diborane and metal alkyls. Bond properties– electronegativity & electron affinity and their applications – lattice energy – Born Haber cycle – Covalent character in Ionic compounds – Fajans rule - Different types of electrostatic interactions – Hydrogen bond and their applications

Unit II **(18 hours)**

Structure of main group compounds: Silicates: Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three dimensional silicates. Structure of silicones; Zeolites-sodalite and pentasil units, synthesis and structure of ZSM-5, zeolite A, faujasite and their uses. **Interhalogen compounds:** Structure and properties of interhalogen compounds [ClF, ICl, ClF_3, BrF_3, IF_3, ClF_5, BrF_5, IF_5] poly halides - pseudohalogens [cyanide,thiocyanate and azide] and Xenon compounds. **Polyacids:** classification of polyacids, synthesis, structure and bonding in polyanions and isopolyanions of phosphorous molybdenum and tungsten.

Unit III **(18 hours)**

Solid State Chemistry: Defects in solids-point, line and plane defects, stoichiometry and non-stoichiometry defects and effects of defects on physical properties, band theory and free electron theory, metals and insulators, semiconductors-types of semi-conductors, semiconductors in solar energy conversion, hoping semiconductors rectifiers and transistors, bonding in metals, electronic specific heat, hall effect, electrical and thermal conductivity of metals, superconductors, Illustrative

examples of ionic, covalent and hydrogen bonded solids-Perovskite, Iilmenite and Rutile, Spinel and Inverse Spinel.

Unit IV **(18 hours)**

Inorganic Rings, Cages and Metal Clusters: Inorganic Rings-P-N compounds, cyclophosphazanes and cyclophosphazenes, S-N compounds-S_2N_2, S_4N_4, $(SN)_x$, polythiazyl S_xN_4 compounds, S-P compounds-molecular sulphides such as P_4S_3, P_4S_7, P_4S_9 and P_4S_{10}.

Cages-Borane and carboranes-nomenclature, synthesis, properties, structure and bonding in diborane and tetraborane, Wades rule, Styx numbers, synthesis, properties and structure of ferrocene.

Metal clusters: Dinuclear compounds of Re, Ce and Cr,metal –metal multiple bonding in $(Re_2x_8)^{2-}$, trinuclear clusters, tetranuclear clusters, hexanuclear clusters.

Unit V **(18 hours)**

Supramolecular Chemistry: Definition and terminology, Intermolecular forces- ion pairing, ion dipole and dipole-dipole interaction, hydrogen bonding; Cation -pi,anion-pi, pi-pi, interactions and Van der waal forces. supra molecular host-guest compounds, supramolecular devices and sensors, various types of supramolecular devices-supramolecular photochemistry, molecular and supramolecular photonic devices - light conversion and energy transfer devices, role of supramolecular chemistry in the development of nanoscience and technology.

Note

Questions related to the above units, from various competitive examination to be solved. (To be discussed during the skill development course hours)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: understand the nature of bonding in inorganic and supramolecule

CO2: Predict the geometry of main group compounds and clusters

CO3: Understand solid state defects and its impact on properties and application in electronic device.

CO4: Understand the formation, nature and application of rings, cages and clusters.

CO5: To consulate the types of electron interaction on properties of supramolecules and their application in nanotechnology.

Text Book:

1. James E. Huheey, Ellen A. Keiter, Richard L. Keiter and Okhil K. Medhi, *Inorganic Chemistry – Principles of Structure and Reactivity*, Pearson Education, Indian Edition, New Delhi, India, 4th Edition, 2013.

Reference Books:

1. Weller, Overton, Rourke, Armstrong, *Inorganic Chemistry*, Oxford University Press 6th Edition, 2015.
2. E. H. Catherine, & G. S. Alan (2012*). Inorganic Chemistry* (IV Edition). England: Pearson Education Limited, Harlow.
3. J.W. Steed and J.L. Atwood, *Supramolecular Chemistry*, John Wiley &Sons, Chichester 2012.

Journals:

1. European Journal of Inorganic Chemistry
2. International Journal of Inorganic Chemistry
3. Journal of Inorganic Chemistry

E-Resources:

1. organometallic chemistry basic principles.pdf
2. inorganic-chemistry-gary-l-miessler-donald-a-tarr-pdf.pdf
3. organometallic chemistry of transition metals- msc-iii-inorganic chemistry-s-11.12.13.pdf
4. organometallic & bioinorganic chemistry-dr. ramsharan-2-1-pdf-pdf.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	9	3	3	**39**
CO2	9	9	3	9	9	9	9	**57**
CO3	9	9	9	3	9	3	9	**51**
CO4	9	9	3	3	9	9	3	**45**
CO5	9	3	3	3	9	3	3	**33**
Total	**45**	**42**	**21**	**21**	**45**	**27**	**27**	**225**

Low-1 Medium-3 High-9

Core III – Thermodynamics and Chemical Kinetics

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 6**
Subject Code: JMCHC13 **Credit: 5**

Course Objectives:

1. To enable the learners to understand the significance of classical thermodynamics and thermodynamic approach in surface chemistry.
2. To acquire the knowledge of chemical and biochemical reaction.

Unit I **(18 hours)**

Thermodynamics: Concepts involved in first, second and third law of thermodynamics, thermodynamic equation of state, Maxwell relations, free energy and entropy of mixing, partial molar quantities, Gibbs-Duhem equation, equilibrium constant, temperature- dependence of equilibrium constant, Phase rule for one and two component system, thermodynamic description of phase transitions, experimental determinations of fugacity of real gases, activity, activity co-efficient and its determination.

Unit II **(18hours)**

Statistical Thermodynamics: Combinatory rule, probability theorem, permutations and combinations, concept of ensembles energy states and energy levels, macro-states and micro- states, Maxwell-Boltzmann statistics, thermodynamic probability, Sterling‟s approximation, Legrange‟s undetermined multiplier, distribution functions. Partition function and thermodynamic functions - molar partition function, separation of partition function, translational, rotational, vibrational and

electronic partition functions, combined partition function, equilibrium constant and partition function. Quantum statistics -Fermi-Dirac and Bose-Einstein statistics, population inversion.

Unit III **(18 hours)**

Irreversible Thermodynamics- Nernst heat theorem-Third law of thermodynamics-Applications of third law-Entropy change- Calculation of absolute entropies-Apparent exceptions to third law-non-equilibrium thermodynamics- Basic Concepts-Forces and fluxes-Entropy of irreversible processes-Entropy production-Clausius Inequality-Phenomenological equations-Onsager reciprocity relations-Coupled reactions. The principal of microscopic reversibility, the Onsager reciprocal relations – verification. Entropy production- rate of entropy production, entropy production in chemical reactions.

Unit IV **(18 hours)**

Surface Chemistry: Different types of surfaces, thermodynamics of surfaces, Gibbs adsorption equation and its verification, surfactants and micelles, surface films. Technological applications of surface chemistry- Industrial technologies for chemical and energy conversion, health care and environmental protection. Adsorption - Introduction, adsorption of gases on solids, physisorption and chemisorption, adsorption isotherms - Freundlich, Langmuir, BET, Temkin adsorption isotherms, adsorption on liquid surface, surface tension, surface area determination by electro-osmosis and electrophoresis. Colloids - Zeta potential, sedimentation potential and streaming potential, Donnan membrane equilibrium.

Unit V **(18 hours)**

Chemical Kinetics: Parallel, consecutive and reversible reactions, determination of order of reaction, Arrhenius equation, energy of activation and its experimental determination, simple collision theory mechanism of bimolecular reaction, Lindemann's theory, activated complex theory of reaction rate, Kinetics of reactions in solution-salt effects, effect of dielectric constant (single sphere and double sphere model), homogeneous catalysis-acid-base catalysis, Kinetics of enzyme catalysed reactions-derivations of Michaelis-Menton equation; Lineweaver-Burk plots; Eadie-Hofstee plots. Kinetics of heterogeneous reactions-unimolecular and bimolecular surface reactions, Advanced unimolecular theory-Marcus's theory or Rice, Ramsperger, Kassel and Marcus (RRKM) theory.

Note: Questions related to the above units, from various competitive examination to be solved. (To be discussed during the skill development course hours)

Course Outcomes:

After successful completion of his course, student will be able to

CO1: To understand the laws and equation of thermodynamics and apply to describe phase transition.

CO2: To acquire detailed knowledge on statistical thermodynamics.

CO3: Applying thermodynamic concepts in irreversible process and surface chemical reaction.

CO4: Determine the order and rate of any reaction.

CO5: Develop the practical knowledge of adsorption.

Text Book:

1. Peter Atkins, Atkins‟ *Physical Chemistry*, Oxford University Press, New York, 11th Edition,

2018.

Reference Books:

1. I.N.Levine, *Quantum Chemistry* New Delhi: PearsonEducation Pvt. Ltd.8th Edition, 2016.
2. J. Rajaram and J. C. Kuriacose, *Thermodynamics for Students of Chemistry -Classical, Statistical and Irreversible,* Pearson Education, New Delhi, 2013.
3. P. Atkins, & J. De Paula, *Atkins Physical Chemistry* (X Edition). Oxford:Oxford University Press.10th Edition, 2014.

Journals:

1. The Journal of Physical Chemistry
2. Journal of Physics and Chemistry Solids
3. Journal of Physical Chemistry

E- Resources:

1. https://www3.nd.edu/~powers/ame.20231/notes.pdf
2. https://soaneemrana.org/onewebmedia/THE%20PRINCIPLES%20OF%20THERMODYNAMICS%20BY%20N.D%20HARI%20DASS.pdf
3. http://www0.unsl.edu.ar/~cornette/ME/An-Introduction-to-Statistical-Mechanics-and-Thermodynamics.pdf
4. https://uh.edu/engines/StatisticalThermodynamics.pdf
5. https://www.saurashtrauniversity.edu/docs/eBooks/Chemical-Kinetics.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	9	9	**63**
CO2	9	9	9	3	9	9	9	**60**
CO3	9	3	9	3	9	3	3	**42**
CO4	9	9	3	3	9	3	3	**39**
CO5	9	9	3	9	9	3	3	**45**
Total	**45**	**42**	**33**	**27**	**45**	**27**	**27**	**249**

Low-1 Medium-3 High-9

Core IV – Organic Chemistry Practical

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 6**

Subject Code: JMCHC14P **Credit: 4**

Course Objectives:

1. To learn the technique for separation and analysis of organic mixture and quantitative estimation of compounds with a particular functional group.
2. To learn the preparation of any organic compounds using two types of reaction.

1. Qualitative analysis: **(30 hours)**

Separation and Analysis of two component mixtures: Identification of the components (Phenols, Carbonyl compounds (Aldehydes & Ketones), Acids, Nitro compounds, Amines, Amides and Carbohydrates.) and preparation of solid derivative.

2. Quantitative analysis: **(30 hours)**

i. Estimation of phenol, aniline, ketone and reducing sugars.
ii. Estimation of functional groups like hydroxyl, methoxyl, carbonyl and nitro groups.
iii. Estimation of amino group by acetylation.
iv. Estimation of acetyl group in ester by alkalimetry.

3. Preparation of organic compounds (Double stage) **(30 hours)**

i. benzillic acid from benzoin (rearrangement)
ii. p-amino benzoic acid from p-nitro toluene (oxidation and reduction)
iii. p-bromoaniline from acetanilide (bromination and hydrolysis)
iv. Acetyl salicylic acid from methyl salicylate (acetylation and hydrolysis)
v. p-bromo acetanilide from aniline (acetylation and bromination)

Evaluation Scheme:

For examination either qualitative analysis with double stage preparation or quantitative analysis with double stage preparation to be given

Distribution of external marks - 75

Record - 10 marks
Viva - 5
Qualitative analysis – 35
a) Separation - 5
b) Aromatic / Aliphatic – 3
c) Saturated / unsaturated – 3
d) Elements present – 6
e) Functional group present – 12
f) Derivation – 6

Quantitative analysis – 35

a) Procedure – 10
b) Error (< 2 % - 25, 2-3% - 20, 3-4% - 15, > 4% - 10)

Organic preparation - 25

a) Procedure – 10
b) Crude sample - 10
c) Recrystallization sample – 5

Course Outcomes:

After successful completion of this course, student will be able to
CO1: Understanding the separation of organic mixture based on solubility and apply knowledge on analysis of the components.
CO2: Acquiring skills in precise estimation of compounds with different functional group.
CO3: To designing synthetic procedure for organic compounds from the given standard materials.
CO4: Explain the preparation of organic compound by double stage.
CO5: Discuss the preparation of organic compound.

Reference Books:

1. A. O. Thomas, *Practical Chemistry*. Cannanore, Scientific Book Center. 2013.
2. Arun Sethi, *Systematic Lab Experiments in Organic Chemistry*. New Delhi: New AgePublisher, 2010.

Journals:

1. Beilstein Journal of Organic Chemistry
2. Bulletin of the chemical Society of Japan
3. The Journal of Organic Chemistry

E-Resources:

1. https://people.chem.umass.edu.PDF Web results 70 Qualitative Organic Analysis.
2. http://rushim.ru Manned practical organic chemistry

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	9	3	9	9	3	**34**
CO2	9	3	9	3	9	9	1	**43**
CO3	9	3	9	1	9	3	9	**43**
CO4	3	3	9	3	9	9	3	**39**
CO5	9	3	1	3	9	1	3	**29**
Total	**33**	**13**	**37**	**13**	**45**	**31**	**19**	**188**

Low-1 Medium-3 High-9

Discipline Specific Elective I (A) - Instrumental Methods of Analysis

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 6**
Subject Code: JMCHE1A **Credit: 5**

Course Objectives:

1. To learn and apply various analytical techniques
2. To get insight into the thermoanalytical and Spectro analytical methods

Unit I **(18 hours)**

Precipitation Techniques: Introduction, properties of precipitates and precipitating reagents, colloidal precipitates, co-precipitation, post precipitation, precipitates from homogeneous solution, surface adsorption, drying and ignition of precipitates, application of gravimetric methods.

Radio-analytical Methods:

Determination of nuclear radiation and counting devices, radioactivity tracer's principal and applications, isotopic analysis-direct and inverse, special analytical application-radiometric titrations, neutron activation analysis principle, instrumentation, applications and limitations, radio-chromatography and radioimmunoassay.

Unit II **(18 hours)**

Extraction Methods: Basic principles, classification of extraction systems, factors affecting extraction process, mechanism of extraction, extraction of liquids, extraction by chelation,

extraction by solvation, extraction equilibria for chelates, extraction equilibria for solvation, separation of metals by extraction, extraction by ion-pair formation, solid- phase extraction (SPE), supercritical fluid extraction (SFE), supramolecular extraction, centrifugation and ultra-centrifugation, membrane separation, extraction by sonication

Unit III **(18 hours)**

Chromotography: Partition chromatography, Paper chromatography, thin layer chromatography, R_f value, chromatogram, ascending and descending chromatography, applications of partition chromatography.

Adsorption chromatography- principle, classification of column chromatography, column efficiency, preparation of column.

Exclusion or Gel chromatography-technique in gel chromatography, gel preparation, packing of column, theory and application of gel chromatography.

HPLC-Principle, instrumentation, advantages of HPLC, Effect of temperature in HPLC and HPTLC. Gas Chromatography-principle, GC columns, instrumentation, methodology, GC-MS, applications of GC.

Unit IV **(18 hours)**

Thermoanalytical Methods: Thermal analysis, theory and principles of DTA and TGA, factors affecting the position of DT and TG traces, application of DTA and TGA to the thermal behavior of the following compounds, crystalline copper sulphate, calcium oxalate monohydrate, calcium acetate monohydrate, zinc hexafluorosilicate, complementary nature of DTA and TGA , principle and application of DSC, determination of degree of conversion of high alumina cement, purity determination phase transition study in forensic laboratory.

Unit V **(18 hours)**

Spectroanalytical Methods: Colorimetry-Beer and Lambert's law, terminology-condition for a satisfactory colorimetric analysis, method of colour measurement or comparison, principles of colorimetric determinations of NH_3, Cr, Cu, Fe, Mn, simultaneous spectrophotometer determination of Cr and Mn. Nephelometry and Turbidimetry-principle, determination of sulphate and phosphate, Fluorimetry- principle, application of Fluorimetry in the determination of Cd, Ca and Zn and determination of codeine and morphine in a mixture, Flame spectrometry-theory, interferences, AAS-applications in the determination of Mg^{+2} and Ca^{+2} in tap water, V in lubricating oil, trace lead in a ferrous alloy and trace elements in contaminated soil.

Note

Questions related to the above units, from various competitive examination to be solved. (To be discussed during the skill development course hours)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Understand the precipitation techniques for accurate result

CO2: Understand the principle of factors affecting extraction method of different type of compounds.

CO3: Choose the appropriate chromatographic techniques foe given compound analysis and

separation.

CO4: Review and select a suitable thermoanalytical and Spectro analytical technique for analytical and application.

CO5: It refers to a section dedicated to the study and application of techniques used to measure and analyze radioactive substances.

Text Book:

1. Douglass A. Skoog, F. James holler, S.R. Crouch, *Instrumental Analysis*, Indian Reprint, Cengage Learning India Pvt. Ltd., New Delhi, 7th Edition 2020.

Reference Books:

1. J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, *Vogel's Textbook of Quantitative Chemical Analysis*, Pearson Education, New Delhi, India, 6th Edition, 2012.
2. Douglass A. Skoog, E.J. Holler and T.A. Nieman, *Principles of Instrumental Analysis*, Thomson Asia Pvt. Ltd., Singapore, 5th Edition, 2004.

Journals:

1. Journal of Analytical Chemistry
2. International Journal of Analytical Chemistry
3. Journal of Analytical Chemistry

E- Resources:

1. http://www.uoxray.uoregon.edu/phys290/ErrorNotes.pdf
2. https://lcn.people.uic.edu/classes/che205s17/docs/che205s17_reading_12b.pdf
3. https://pg.gda.pl/info/polimery/files/2013/10/im-swp-l-002f.pdf
4. http://web.iyte.edu.tr/~serifeyalcin/lectures/chem305/cn_1.pdf
5. https://www.britannica.com/science/nephelometry

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	9	3	9	9	3	**34**
CO2	9	3	9	3	9	9	1	**43**
CO3	9	3	9	1	9	3	9	**43**
CO4	3	3	9	3	9	9	3	**39**
CO5	9	3	1	3	9	1	3	**29**
Total	**33**	**13**	**37**	**13**	**45**	**31**	**19**	**188**

Low-1 **Medium-3** **High-9**

Discipline Specific Elective I (B) – Sustainable Chemistry

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 6**

Subject Code: JMCHE1B **Credit: 5**

Course Objectives:

1. To learn the need and concept of various green synthetic technique.
2. To create awareness on green analytical and synthetic method in the context of sustainable development.

Unit I **(18 hours)**

Concept of Sustainability: Definition and Principles of sustainable development. Concept of Economy, Environmental and Social sustainability. Goal of sustainability. principles of sustainable and green chemistry, Sustainability and cleaner production, eco efficiency, environmental protection laws, challenges ahead for a chemist-education on green chemistry, dreaming green chemistry-Innovations for a cleaner world, pollution - a price tag of modern society, Pollution control to pollution prevention, recycling of waste

Unit II **(18 hours)**

Designing Green Chemical Strategies for Sustainable Development Green synthesis-designing, choice of starting materials, choice of reagents, choice of solvent sand choice of catalyst organic synthesis in water. Areas of green chemistry, Reaction mass balance-Atom Economy, Evaluation for Chemical Reaction Efficiency, Green Solvents/ reaction Media, Catalysis and Bio catalysis. Microwave oven as a reactor, Theory of Microwave Heating

Unit III **(18 hours)**

Solvent-Free Organic Synthesis: Microwave assisted synthesis–microwave activation, advantages of microwave exposure and specific effects of microwaves. Microwave assisted Synthes is in water-Hoffmann elimination, hydrolysis of benzamide and Oxidation of toluene.

Ultrasound assisted organic synthesis Introduction, types of sonochemical reactions, homogeneous sonochemical reactions-Curtius rearrangement, heterogeneous liquid-liquid reactions-esterification, heterogeneous solid-liquid reactions- Hydroboration.

Phase Transfer Catalysts- Advantage, types and application in conversion of nitriles from alkylandaryl halides. Biocatalyst-Microbial oxidation and enzymatic hydrolysis, polymer supported catalysts.

Unit IV **(18 hours)**

Future Trends in Sustainable Chemistry: Sustainable development goals (SDG): Definition and concepts, SDGs of United Nations, current developments and agenda for 2030. Bioeconomy & Circular economy: Definition and concept. Biorefinery – concept and its role in bioeconomy. Biofuel – current research and future prospective. Green chemistry in sustainable development.

Unit V **(18 hours)**

Environmental Chemistry and Toxicology: Scope of environmental toxicology, assessment of toxic substances in the environment, the monitoring of environments for the presence of toxic substances, the effects of toxins on biotic and abiotic components of ecosystems, and the metabolism and biological and environmental fate of toxins.

Note

Questions related to the above units, from various competitive examination to be solved. (To be discussed during the skill development course hours)

Course Outcomes (CO):

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

CO1: Understanding the significance of technique foe sustainable development.

CO2: Incorporating catalysts into chemical reaction using solvent free, ultrasonic and PTC techniques.

CO3: Understand and apply future trends in bio and environmental safety.

CO4: Create awareness on toxicology.

CO5: Understanding how environmental toxins interact with biological systems at the cellular and molecular level.

Text Book:

1. Shweta Sharma and Pooja Sharma, *Environmental Chemistry*, Narosa Publishing HousePvt.Ltd., New Delhi, 2014.

Reference Books:

1. V. K. Ahluwalia, & M. Kidwai, *New Trends in Green Chemistry* Germany: Kluwer Academic Publisher, 7th Edition, 2012.
2. Rashmi Sanghi & M. M. Shrivastav, *Green Chemistry, Environment FriendlyAlternatives*,Narosa Publishing House Pvt. Ltd., New Delhi, 2012.

Journals:

1. Current Research in Green and Sustainable Chemistry
2. The Journal of Green Chemistry
3. ACS Sustainable Chemical Engineering

E- Resources:

1. https://www.asdlib.org Gree...PDF green chemistry
2. http://www.upv.es files tra...PDF Green Chemistry A Synthetic Chemist's Perspective –UPV
3. http://alpha.chem.umb.edu...PDF Advanced Organic Chemistry/ Organic Synthesis –CH 621
4. https://www.researchgate.net3155... (PDF) The Minimization and Prevention ofPollution; Green
5. http://pustaka.unp.ac.id file. PDF Web results Environmental Toxicology, Third Edition

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	9	3	3	3	**33**
CO2	3	1	9	1	9	9	1	**33**
CO3	3	1	9	1	9	1	9	**33**
CO4	9	3	9	1	9	9	3	**43**
CO5	9	9	3	9	9	3	1	**43**
Total	**33**	**17**	**33**	**21**	**39**	**25**	**17**	**185**

Low-1 Medium-3 High-9

Extra Credit I – Forensic Chemistry

(For Students Admitted from 2025-26)

Semester: I **Credit: 2**

Subject Code: JMCHX1

Course Objectives:

1. To give an insight on the medicinal, legal and analytical aspects of forensic chemistry
2. To find out a suitable method to detect the crime

Unit I

Introduction of Forensic Chemistry: Basic principles and its significance, History & development of forensic science, nature and scope of forensic science, organizational structure offorensic science laboratories at central & State level, ethics in forensic science, method of analysis in forensic science -spectrometry and microscopy.

Unit II

Scene of Crime: Types, protection of scene of crime, preservation (recording) of scene of crime-photography and sketching methods.

Physical evidence: Meaning, types, search methods, collection and preservation, forwarding, chain of custody, collection, preservation, packing and forwarding of blood, semen and other biological stains, firearm exhibits, documents, fingerprint, viscera, hair & fiber, glass, soil and dust, petroleum products, drugs and poisons, etc.

Unit III

Crime: Definition, theories of causation of crime - pre-classical and neo-classical, constitutional, geographical, economic, psychological, sociological, multiple causation approach.

Unit IV

Indian Penal Code: Introduction, General exceptions, Offences against person, Offences against property, Attempt to suicide, Sexual offences.

Criminal Procedure Code: Introduction and general idea of sections - 291-93, 154, 155, 156, 157,158, 159, 160, 161, 162, 172, 173, 174, 175, and 176.

Indian Evidence Act: Introduction and general idea of sections - 32, 45, 46, 47, 57, 58, 60, 73,135, 136, 137, and 159.

Unit V

Forensic Medicine: Definition of Forensic Medicine and medical jurisprudence, Dying declaration, Death – definition, types, somatic, sudden natural and unnatural deaths, medical aspects aids – misuse of scheduled drugs, burns and their treatment by plastic surgery.

Forgery: Detecting forgery in bank cheques / drafts and educational records (mark lists, certificates), using UV-light, hand writing comparison - genuine and forged writing, collection of samples, detection.

Transportation: Drunken driving – breath analyzer for ethanol, Incendiary and timed bombs in road and railway tracks, defusing live bombs, Accidental explosions during manufacture of matches and fire-works (as in Sivakasi).

Course Outcomes:

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

CO1: Define the importance of forensic chemistry and relate the methods to detect the crime

CO2: Build the scene of crime
CO3: Categorize the crimes against person
CO4: Evaluate the suitable method to detect the crime
CO5: Construct the theories of causation of crime

Text Book:

1. Saferstein, Richard and Criminalistics, *An Introduction to Forensic Science*, Prentice Hall,Fifth edition, 2018.

Reference Books:

1. B.R. Sharma, Forensic Science Griminal *Investigation & Trials*, Universal Publishing, 6th Edition, 2020.
2. Dr.C.F. Mulimani, *Fundamentals of Forensic Science*, Manjugounda R. Patil Publishing, 1st Edition,2020

Journals:

1. Journal of Forensic chemistry
2. Forensic science International
3. Royal Society of Chemistry Advance

E-Resources:

1. http://www.remondini.net n...PDF FORENSIC CHEMISTRY – Remondini
2. https://www.cbsd.org DomainPDF Crime Scene Investigation
3. https://www.slideshare.net shakib07 Web results Theories of Crime (Criminology) Slideshare
4. https://legislative.gov.in files PDF Web results Indian Penal Code - Legislative Department
5. https://www.pdfdrive.com/search?q=Scene+of+Crime&pagecout=&pubyear=&searchin=&em

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	9	9	**63**
CO2	3	3	3	1	3	1	1	**15**
CO3	9	3	3	1	3	3	3	**25**
CO4	3	3	9	3	9	9	9	**45**
CO5	9	3	1	1	1	1	1	**17**
Total	**33**	**21**	**25**	**15**	**25**	**23**	**23**	**165**

Low-1 **Medium-3** **High-9**

Core V – Organic Synthesis

(For Students Admitted from 2025-26**)**

Semester: II **Hours/Week: 6**
Subject Code: JMCHC21 **Credit: 5**

Course Objectives:

1. To enable the students to learn the synthesis and the isolation of amino acids proteins,Enzymes and nucleic acids
2. To impart the knowledge on photochemistry reactions.

Unit I **(18 hours)**

Stereochemistry and Conformation Analysis: Stereochemistry-Elements of symmetry, Chirality, R-S nomenclature, Diastereoisomerism in acyclic and cyclic systems, E-Z isomerisms, interconversion of Fischer, Newman and Sawhorse projections, molecules with more than one chiral center, Threo and Erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, asymmetric synthesis-Cram‟s rule, Prelog‟s rule.

Conformational analysis: acyclic compounds-conformation of monosubstituted and disubstituted cyclohexanes.

Unit II **(18 hours)**

Photochemistry: Introduction, photochemistry of alkenes-intramolecular reactions of the olefinic bond, geometrical isomerism, photochemistry of carbonyl compounds-intramolecular reactions of carbonyl compounds, saturated, cyclic and acyclic (Norrish type I) and Norrish type-II reactions, photochemistry of aromatic compounds-isomerisations, additions and substitutions, Photo-Fries rearrangement. Barton reaction, singlet molecular oxygen reactions– Paterno - Buchireaction.

Unit III **(18 hours)**

Pericyclic Reactions: Molecular orbital symmetry, frontier orbitals of ethylene, 1,3- butadiene, 1,3,5- hexatriene and allyl systems, classification of pericyclic reactions, Woodward-Hoffmann correlation diagrams, FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems cycloaddditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements-suprafacial and antarafacial shifts of H, 3,3- and 5,5-sigmatropic rearrangements, Claisen, Cope and Aza-Cope rearrangements, fluxional tautomerism, Ene reaction (with selected examples).

Unit IV **(18 hours)**

Oxidation and Reduction: Formation of C=C, C-C bonds by dehydrogenation, allylic oxidation, oxidation of alcohols, glycols, halides and amines to aldehydes and ketones, ozonolysis, oxidation of olefinic double bonds and unsaturated carbonyl compounds.

Sommelet reaction and selectivity in reduction, metal hydride reduction, metal alkoxide reduction, reduction by dissolving metals, reduction of nitro compounds and carbenes and nitrenes - structure and generation, addition reaction with alkenes and insertion reactions.

Unit V **(18 hours)**

Carbohydrates, Amino acids, proteins and Nucleic acids : Classification of proteins – peptides – structure of peptides - synthesis of peptides – Chemisty of gluthathione and oxytocin – an elementary treatment of enzymes, coenzyme and nucleic acids – biosynthesis of amino acids – RNA and protein synthesis – Genetic code – DNA and determining the base sequence of DNA. Pyronose and furanose, forms of aldohexoses and keto hexoses – methods used for determination of ring size – conformations of aldohexopyranoses – structure and synthesis of maltose, lactose, sucrose and cellobiose. A brief study of starch and cellulose.

Note

Questions related to the above units, from various competitive examination to be solved. (To be discussed during the skill development course hours)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: To recall the basic principles of organic chemistry

CO2: To understand the versatility of various special reagents and to correlate their reactivity with various reaction conditions.

CO3: To implement the synthetic strategies in the preparation of various organic compounds

CO4: To predict the suitability of reaction conditions in the preparation of tailor- made organic compounds.

CO5: To design and synthesize novel organic compounds with the methodologies learnt during the course.

Text Books:

1. J. Clayden, N. Greeves, S. Warren, and P. Wothers, *Organic Chemistry*, Oxford University Press, UK, 2nd Edition, 2012.
2. J. March and M. B. Smith, *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*, Wiley, New York, 8th Edition, 2020.

Reference Books:

1. Mukhergji and S. P. Singh, *Reactions Mechanisms in Organic chemistry*, Mc Millan2015.
2. P.S. Kalsi, *Stereochemistry – Conformation and Mechanism*, New Age International Publishers, New Delhi, India, 10th Edition, 2019

Journals:

1. Royal Society of Chemistry
2. ACS Organic and Inorganic Journal
3. The Journal of Organic Chemistry

E-Resources:

1. http://courses.washington.edu/medch562/pdf/MEDCH400_Stereochem.pdf
2. https://www.asu.edu/courses/chm332/PericyclicReactions.pdf
3. https://web.pdx.edu/~wamserc/C336S09/Wade_Ch24.pdf
4. https://kvmwai.edu.in/upload/StudyMaterial/Photochemistry.pdf
5.https://www.msuniv.ac.in/images/distance%20education/learning%20materials/ug%20pg%202023/pg%202021/Msc%20chemistry%202023/SCHM21_II_Sem_Organic_Reaction_anism_II.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	9	9	9	9	**60**
CO2	9	3	9	3	9	9	9	**57**
CO3	9	3	3	3	3	3	1	**25**
CO4	9	3	9	3	9	9	9	**51**
CO5	9	1	9	1	9	3	9	**41**
Total	**45**	**19**	**33**	**19**	**39**	**33**	**47**	**234**

Low-1 Medium-3 High-9

Core VI– Coordination and Nuclear Chemistry

(For Students Admitted from 2025-26)

Semester: II **Hours/Week: 6**

Subject Code: JMCHC22 **Credit: 5**

Course Objectives:

1. To gain insights into the modern theories of bonding in coordination compounds.
2. To learn various methods to determine the stability constants of complexes.
3. To understand and construct correlation diagrams and predict the electronic transitions that are taking place in the complexes
4. To get knowledge about properties of nuclear chemistry and application of radioisotopes in agriculture, industry and medicine

Unit I **(18 hours)**

Coordination Chemistry: Nomenclature of coordination complexes, labile and inert complexes, stability constants of complexes, stepwise and overall stability constant, their determination-Jobs Continuous variation method and spectrophotometric method, factors affecting the stability constants, Valence Bond Theory-explanation with examples, drawbacks of VBT. Metal-ligand bonding- crystal field theory - d-orbitals splitting in linear, trigonal, octahedral, square planar, tetrahedral, trigonal- bipyramidal and cubic complexes, Measurement of CFSE (d^1 to d^{10}) in weak and strong ligand fields, and ligand field theories of 4-, 5- and 6- coordinated complexes, Jahn-Teller distortion, Nephelauxetic series, variation of lattice energy, ionic radii and heat of hydration across 1^{st} row transition metal ions.

Unit II **(18 hours)**

Reaction Mechanism of Coordination Chemistry: Substitution reactions - square planar substitution reactions - Factors affecting reactivity of square planar complexes, Trans effect - theories of Trans effect, substitution reactions in octahedral complexes, ($S_N{}^1$, $S_N{}^2$, $S_N{}^i$CB) - reactions of coordinated ligands, acid hydrolysis - anation reactions and base hydrolysis. Mechanism of electron transfer reactions - outer sphere, inner sphere electron transfer reactions, synthesis of coordination compounds using electron transfer and substitution reaction, applications of coordination compounds. Magnetic properties in coordination compounds - diamagnetic, paramagnetic, ferromagnetic antiferroma gnetic and ferromagnetic behavior of transition metal complex compounds.

Unit III **(18 hours)**

Photochemistry in inorganic complexes: Electronic transitions in metal complexes, metal-centred and charge-transfer transitions, various photophysical and photochemical processes of coordination compounds, unimolecular charge-transfer photochemistry of cobalt (III) complexes, ligand-field photochemistry of chromium(III) complexes, adamson"s rules, photoactive excited states, V-C model, photophysics and photochemistry Of ruthenium, polypyridine complexes, photochemistry of organometallic compounds, metal carbonyl compounds.

Unit IV **(18 hours)**

Nuclear Chemistry: Different types of nuclear reaction, nuclear fission and fusion, theories of fission-fissile and fertile isotopes characteristics of nuclear fission and fusion, chemical effects of nuclear transformations, positron annihilation and autoradiography, synthesis of transuranic elements such as neptunium, plutonium, curium, berkelium, einsteinium, mendelevium, nobelium, lawrencium.

Nuclear forces: Liquid drop model and shell model, nuclear reactors-classification of nuclear reactors, breeder reactor, applications of radioactive isotopes in chemical investigations, age determination, medicinal and agricultural field.

Unit V **(18 hours)**

Radiation Chemistry: Interaction of radiation with matter-range of alpha, beta and gamma radiations, neutron through matter, analytical applications of radioisotopes-Radiometric titrations, kinetics of exchange reactions, measurement of physical constants including diffusion constants, Radioanalysis-neutron activation analysis, prompt gama neutron activation analysis and Neutron absorptiometry, applications of radioisotopes-industry, medicine, autoradiography, radiopharmacology, radiation safety precaution, nuclear waste disposal, radiation chemistry of water and aqueous solutions.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Understand and comprehend various theories of coordination compounds.

CO2: Understand the spectroscopic and magnetic properties of coordination complexes

CO3: Assume the principles of nuclear and radioactivity and relate to chemistry

CO4: Predict the electronic transitions in a complex based on correlation diagrams and UV visible spectral details.

CO5: Comprehend the kinetics and mechanism of substitution reactions in octahedral and square planar complexes

Text Book:

1. Weller, Overton, Rourke, Armstrong, *Inorganic Chemistry*, Oxford University Press 6th Edition, 2015.

Reference Books:

1. C. V. Shekar, *A Text Book of Nuclear Chemistry*. New Delhi Dominant publishers andDistributors (P) Ltd., 1st Edition 2014.
2. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993

Journals:

1. European Journal of Inorganic Chemistry
2. International Journal of Inorganic Chemistry
3. Journal of Inorganic Chemistry

E-Resources:

1. https://www.dalalinstitute.com/wp-content/uploads/sites/2/Books/A-Textbook-of-Inorganic-Chemistry-Volume-1/ATOICV1-3-1-Inert-and-Labile-Complexes.pdf
2. http://tumkuruniversity.ac.in/oc_pg/chem/coordination%20reaction%20mechanisms%202019-20.pdf
3. https://www.usb.ac.ir/FileStaff/6941_2019-9-16-10-53-44.pdf
4. https://qa.ff.up.pt/rq2020/Bibliografia/Books/Nuclear_and_radiochemistry.pdf
5. https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch103-allied-health-chemistry/ch103-chapter-3-radioactivity/

Course Outcomes	Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	1	3	9	1	3	**34**
CO2	9	3	9	1	9	9	1	**41**
CO3	9	3	9	3	9	9	3	**45**
CO4	9	3	3	1	3	3	3	**25**
CO5	9	3	9	9	9	3	9	**51**
Total	**45**	**21**	**33**	**17**	**39**	**25**	**19**	**196**

Low-1 Medium-3 High-9

Core VII – Electrochemistry

(For Students Admitted from 2025-26**)**

Semester: II **Hours/Week: 6**
Subject Code: JMCHC23 **Credit: 5**

Course Objectives:

1. To provide a comprehensive understanding of electrochemical principles and their applications in energy storage systems such as batteries, fuel cells, and supercapacitors.
2. To analyze corrosion mechanisms and develop strategies for corrosion prevention using electrochemical techniques and sustainable material design.

Unit I **(18hours)**

Electrochemistry-I: Mean ion activity and activity coefficient of electrolytes in solution, ion association, ionic strength, Debye-Huckel theory and Debye-Huckel limiting law – its validity and limitations, Ostwald's dilution law, Debye theory of electrolytic conductance, Debye- Huckel-Onsager equation - verification and limitations, electrochemical cells and applications of standard redox potentials. The electrical double layer, polarizable and non-polarizable interfaces, structure of electrical double layer, Double layer models-Helmholtz, Guoy-Chapman and Stern models,

Unit II **(18 hours)**

Electrochemistry-II: kinetics of electrode processes, current-potential curve, Butler-Volmer relation and its approximations, symmetry factor and transfer coefficient, Tafel equation, charge transfer resistance, Nernst equation from Butler-Volmer equation, Linear free energy relationship-Hammett equation

Kinetic of Electrode Process: Methods of determining kinetic parameters for quasi-reversible and irreversible waves- Koutecky's methods, Meits Israel method, Gellings method. Electrocatalysis-chemical catalysts and electrochemical catalysts with special reference to porphyrin oxides of rare earths, electrocatalysis in simple redox reactions, in reaction involving adsorbed species, Influence of various parameters.

Unit III **(18 hours)**

Electrochemical Energy Storage: Properties of electrochemical energy stores-measure of battery performance, charging and discharging of a battery, storage density, energy density, classical batteries -(i) Lead acid (ii) Nickel-cadmium, (iii) Zinc manganese dioxide, Modern batteries-(i) Zinc-air (iii) Lithium battery. Properties of electrochemical energy stores-measure of battery performance, charging and discharging of a battery, storage density, energy density, classical

batteries -(i) Lead acid (ii) Nickel-cadmium, (iii) Zinc manganese dioxide, Modern batteries-(i) Zinc-air (iii) Lithium battery.

Unit IV **(18 hours)**

Corrosion: Definition and types of corrosion. Civilization and surface mechanism of the corrosion of the metals -thermodynamics and the stability of metals, potential - pH (or Pourbaix) diagram, uses and abuses, corrosion current and corrosion potential -Evans diagrams, measurement of corrosion rate- (i) weight loss method, (ii) Electrochemical method, inhibiting corrosion-cathodic and anodic protection, organic inhibitors, passivation-structure of passivation films, mechanism of passivation

Unit V **(18 hours)**

Application of electrochemistry- Primary and Secondary batteries, Electrochemical generators (fuel cells) -Hydrogen Oxygen cells, Hydrocarbon air cell, Alkaline fuel cell and Phosphoric fuel cell, Applications of fuel cells. Cyclic Voltammetry-theory and applications, diagnostic criteria of Cyclic voltammetry, Chronopotentiometry-theory and applications, Bulk electrolysis methods-Controlled potential coulometry, Controlled coulometry, Stripping analysis-anodic and cathodic modes, Bioelectrochemistry- bioelectronics, membrane Potentials, simplistic theory and modern theory.

Note

Questions related to the above units, from various competitive examination to be solved.(To be discussed during the skill development course hours)

Course Outcomes:

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

CO1: Explain the fundamental concepts of electrochemistry, including redox reactions, electrode potentials, and electrochemical cell design.

CO2: Evaluate the working principles, performance characteristics, and applications of various energy storage devices such as batteries, supercapacitors, and fuel cells.

CO3: Identify different types of corrosion mechanisms and apply techniques for corrosion prevention and control in engineering materials.

CO4: Develop and assess electrochemical systems for sustainable energy solutions, with consideration of environmental impact and material selection.

CO5: Use electrochemical methods such as cyclic voltammetry, impedance spectroscopy, and polarization curves to study material behavior and device performance.

Text Books:

1. J. Bockris, *Modern Electrochemistry*, Plenum Publication, New York, 2018.
2. Samuel Glasstone, *An Introduction to Electrochemistry*, Litton Educational Publishing,Inc., New York, 2008.

Reference Books:

1. H. Vessor Basil & W. Galen, *Electroanalytical Chemistry*, Wiley Interscience. 2012
2. S.K. Rangrajan, *Topics in pure and Applied Chemistry*, SAEST Publication,Karaikudi (India). 2014

Journals:

1. Journal of Applied Electrochemistry
2. Journal of electroanalytical chemistry
3. International journal of Electrochemistry

E- Resources:

1. https://ceramrtr.ceramika.agh.edu.pl/~szyszkin/eis/Modern%20Electrochemistry%20Vol%202B%20Electrodics%20in%20Chemistry, %20Engineering.pdf
2. https://ia804607.us.archive.org/1/items/introductiontoel031801mbp/introductiontoel031801mbp.pdf
3. http://www.sfu.ca/~aroudgar/Tutorials/OLD/Electrochemistry-09-2004/Lecture_14-16.pdf
4 .https://suschem.org/wpcontent/uploads/2024/02/Suschem_energy_storage_final_preview.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	1	3	3	1	3	**29**
CO2	9	3	3	3	9	3	3	**33**
CO3	9	3	9	3	9	9	9	**51**
CO4	9	3	9	1	9	3	9	**43**
CO5	9	3	1	3	3	1	3	**23**
Total	**45**	**21**	**23**	**13**	**33**	**17**	**27**	**179**

Low-1 Medium-3 High-9

Core VIII – Inorganic Chemistry Practical

(For Students Admitted from 2025-26**)**

Semester: II **Hours/Week: 6**
Subject Code: JMCHC24P **Credit: 4**

Course Objectives:

1. To develop practical skills in qualitative and quantitative analysis of inorganic compounds using classical and instrumental techniques.
2. To train students in the preparation, purification, and characterization of inorganic compounds through laboratory synthesis methods.

List of Experiments: **(90 hours)**

1. **Qualitative analysis:** Semi - micro qualitative analysis - Analysis of mixtures containing two familiar and two less familiar cations from the following W, Pb, Se, Te, Mo, Cu, Cd, As, Sb, Ce, Th, Zr, Ti, V, Cr, Mn, U, Ni, Co, Zn, Ca, Ba, Sr, Li, Mg.
2. **Quantitative analysis:**
   i. Complexometric titrations involving estimations of calcium, magnesium, nickel, zinc and hardness of water.
   ii. Estimation involving volumetric and gravimetric (four experiments)
   iii. Estimation of mixture of metal ions- pH control, masking and demasking agents (three experiments.).
3. **Titrimetry:** Complexometric titrations involving estimations of calcium, magnesium, nickel, zinc and hardness of water.
4. **Preparation of inorganic complexes:** About five preparations involving different techniques selected from the following.

i. Potassium tris (oxalato)aluminate
ii. Tris(thiourea) copper(I) sulphate
iii. Tris(thiourea) copper(I) chloride
iv. Potassium tris(oxalato)ferrate
v. Hexammine cobalt (III) chloride
vi. Ammonium hexachloro stannate (IV)
vii. Tetrammine copper(II) sulphate
viii. Cis and trans bis(glycinate) copper

Evaluation Scheme:: For examination qualitative analysis with preparation of inorganic complexes or quantitative analysis with preparation of inorganic complexes has to be given Distribution of external marks - 75

Record - 10 marks
Viva - 5
qualitative analysis - 40
Anion analysis with procedure – 40 (10 marks for each Cation with suitable procedure)
Quantitative analysis – 40
Procedure – 10
Error (< 2 % - 30, 2-3% - 25, 3-4% - 15, > 4% - 10)
preparation of inorganic complexes - 20
Procedure – 5
Preparation – 15

Course Outcomes:
After successful completion of this course, students will be able to
CO1: Systematically identify cations and anions in inorganic mixtures using classical qualitative analysis techniques.
CO2: Perform accurate quantitative estimations of metal ions through volumetric and gravimetric methods.
CO3: Synthesize inorganic coordination and salt compounds and understand their reaction mechanisms.
CO4: Handle laboratory equipment and chemicals safely and effectively, following standard lab protocols.
CO5: Record, interpret, and report experimental data with precision and clarity in laboratory reports.

Reference Book:
1. J. Mendham, R.C. Denney, J.D. Barnes, and M. J.K. Thomas, *Vogel's Textbook ofQuantitative Analysis*, Pearson Education, 7th Edition, 2013

Journals:
1. European Journal of Inorganic Chemistry
2. International Journal of Inorganic Chemistry
3. Journal of Inorganic Chemistry

E- Resources:

1. http://www.iscnagpur.ac.in ...PDF semi micro qualitative analysis of inorganic
2. https://www.academia.edu semi_... (PDF) semi – micro qualitative analysis of simple
3. https://www.pdfdrive.com/search?q=2.%09Quantitative+analysis+involving+volumetric&pagecount=&pubyear=&searchin=&em=&more=true
4. https://www.pdfdrive.com/search?q=5.%09Preparation+of+inorganic+complexes&pagecount=&pubyear=&searchin=&em=&more=true

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	3	**39**
CO2	9	1	9	1	9	9	1	**39**
CO3	9	3	9	3	9	9	3	**45**
CO4	9	1	9	3	3	9	3	**37**
CO5	9	3	9	3	3	9	3	**39**
Total	**45**	**11**	**45**	**13**	**27**	**45**	**13**	**199**

Low-1 Medium-3 High-9

Discipline Specific Elective II (A) – Nanoscience and Nanotechnology

(For Students Admitted from 2025-26**)**

Semester: II **Hours/Week: 6**
Subject Code: JMCHE2A **Credit: 5**

Course Objectives:

1. To provide a comprehensive understanding of the fundamental principles of nanoscience and the synthesis, properties, and applications of inorganic nanomaterials.
2. To develop a comprehensive understanding of nanoscale phenomena and their implications in technology and industry.

Unit I **(18 hours)**

Introduction to Nanoscience and Nanotechnology: Background to nanotechnology scientific revolution, types of nanostructures, definition of a nanosystem, types of nanocrystals-one dimensional (1D), two dimensional (2D), three dimensional (3D) nanostructured materials, quantum dots, quantum wire-core/shell structures, nanomaterials and properties-carbon nanotubes (CNT), metals (Au, Ag), metal oxides (TiO_2, CeO_2, ZnO), semiconductors (Si, Ge, CdS, ZnSe), applications of nanomaterials.

Unit II **(18 hours)**

Synthesis of Nanomaterials: Bulk synthesis of bulk nanostructured materials, sol-gel processing, mechanical alloying and milling, inert gas condensation technique, bulk and nanocomposite materials, grinding, high energy ball milling, physical and chemical approaches self-assembly-self-assembled monolayers (SAM), vapour liquid solid (VLS) approach- chemical vapour deposition (CVD), introduction to vacuum technology, physical vapour deposition techniques.

Unit III **(18 hours)**

Characterization Techniques for Nanomaterials: Electron Microscopy- Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), scanning probe microscopic techniques, atomic force microscopy (AFM) and scanning tunneling microscopy, particle size

analyzer (dynamic light scattering), X-ray diffraction (XRD), auger emission spectroscopy,electron spectroscopy for chemical analysis (ESCA).

Unit IV **(18 hours)**

Carbon Clusters, Inorganic and Organic Nanomaterials: Nature of carbon bond -new carbon structures, Carbon clusters- Discovery of C_{60}, Alkali doped C_{60}, Superconductivity in C_{60}, larger and smaller fullerenes.

Inorganic nanomaterials − nano TiO_2 / ZnO/CdO/CdS. Organic nanomaterials – Rotaxanes and Catenanes.

Unit V **(18 hours)**

Nanomedicine and Nanodevices : DNA as a nanomaterial, DNA - knots and junctions, DNA-nanomechanical device, Force measurements in simple protein molecules and polymerase - DNAcomplexes,molecular recognition and DNA based sensor, protein nano array, nanopipettes,molecular diodes, self-assembled nano transistors, nanoparticle mediated transfection, Molecularnanotechnology -MEMS, NEMS, nanofluidics and microfluidics, self-assembly of nanoparticlesfor biomedical applications, nanomolecular diagnostics and biosensor nanodiagnostics. Smartdeliverysysteminagriculture -Nanofertilizers-Nanoureaandmixedfertilizers-Nanopesticides.

Note

Questions related to the above units, from various competitive examination to be solved.(To be discussed during the skill development course hours)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Understand the basic principles of nanoscience and the unique properties of materials at the nanoscale.

CO2: Explain various methods for synthesizing inorganic nanomaterials, including top-down and bottom-up approaches.

CO3: Characterize nanomaterials using techniques such as TEM, SEM, XRD, and spectroscopy.

CO4: Analyze the structure-property relationships of inorganic nanomaterials.

CO5: Evaluate the applications and implications of inorganic nanotechnology in fields like electronics, catalysis, medicine, and energy

Text Book:

1. Dr. A.K. Bandyopadhyay, *Nano Materials*, 2nd Edition, 2020.

Reference Books:

1. G.Cao, Nanostructures and Nanomaterials: *Synthesis, Properties and Applications*,Imperical College Press, 2011.
2. K.K. Choudhary, *Nanoscience & Nanotechnology*, Narosa Publishing House Pvt.Ltd- New Delhi 2016.

Journals:

1. Journal of Nano science
2. International Journal of Nano Science and Nano Technology
3. Journal of Nano Science

E-Resources:

1. https://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf
2. http://web.pdx.edu/~pmoeck/phy381/workbook%20nanoscience.pdf
3. https://lkouniv.ac.in/site/writereaddata/siteContent/20200412080803947 4anupam_tripathi_engg_Nanotechnology.pdf
4. http://www.ggu.ac.in/download/Class- Note13/Intriduction%20to%20Nanosc.24.10.13.pdf
5. https://www.pdfdrive.com/search?q=Synthesis+of+Nanomaterials&pagecount=&pubyear=&searchin=&em=

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	9	3	**45**
CO2	9	3	9	3	9	9	9	**51**
CO3	9	1	9	1	9	9	9	**47**
CO4	9	3	3	3	3	3	3	**27**
CO5	9	9	3	3	3	1	3	**31**
Total	**45**	**25**	**33**	**13**	**27**	**33**	**27**	**201**

Low-1 Medium-3 High-9

Discipline Specific Elective II (B) – Material Chemistry

(For Students Admitted from 2025-26**)**

Semester: II **Hours/Week: 6**

Subject Code: JMCHE2B **Credit: 5**

Course Objectives:

1. To provide in-depth knowledge of the structure, bonding, and properties of various classes of materials
2. To develop an understanding of the correlation between material composition, processing, and resulting physical and chemical properties.

Unit I **(18 hours)**

Structure of Matter: Atomic structure -Wave mechanical model, electronic configurations, ionic, covalent, metallic and secondary bond, space lattices and crystallographic systems,influence of radius ratio on coronation, structure of common metallic, semi conducting, ionic, polymeric and ceramic materials. Use of X-ray diffraction for determination of simple structures, point, line and surface defects, geometry of edge and screw dislocations, Burger‟s vector, grain and twin boundaries.

Unit II **(18 hours)**

Diffusion Behaviour: Mechanism of diffusion Fick's laws, solution to Fick's second law, surface and grain boundary diffusion, experimental determination of diffusion coefficient.

Phase behavior – solid solutions - intermediate phases and intermetallic compounds, phase rule, binary phase diagrams like Cu-Ni, Pb-Sn, Cu-Zn and Fe-C, transformation in steels, nucleation and growth phenomena, solidification including directional solidification, crystal growth, zone melting and purification.

Mechanical properties – Elastic, anelastic and viscoelastic behaviours of materials, atomic model of elastic behaviours, rubber – like elasticity, relaxation processes, displacement model for viscoelasticity, plastic deformation, slip systems in crystals, critical resolved shear stress, work hardening, strengthening mechanism, ductile and brittle fracture, Griffith's criterion, failure of materials due to creep and fatigues, deformation behaviours of polymers and ceramics.

Unit III **(18 hours)**

Electrical Properties: Electrical / Electronic behaviours of materials, electronic and ionic conductivity, free electron and band theory of solids, intrinsic and extrinsic semiconductors, conduction mechanisms, junctions and devices, viz-diodes, rectifiers, transistors and solar cells; super conductivity.

Dielectric Behaviours of Materials: Polarization phenomena, polarizability, frequency and temperature dependence of dielectric constant.

Unit IV **(18 hours)**

Magnetic Properties: Magnetic behaviours of materials– dia, para, ferro and ferri magnetisms, soft and hard magnetic materials including ceramic magnets.

Optical Properties: Optical properties of materials, elementary ideas about absorption, transmissions and reflection refractive index, lasers and their application, optoelectronic devices.

Thermal Properties: Thermal properties of materials, specific heat, thermal conductivity and thermal expansions.

Unit V **(18 hours)**

Composites-Metal matrix composites- polymer matrix composites - ceramic matrix composites - reinforcements - whisker reinforced ceramics - carbon-carbon composites - design of composite materials - hybrid composites - angled plied composites- unidirectional fiber composites - discontinuous fiber composites - applications of composites in electrical components and nuclear industry.

Note

Questions related to the above units, from various competitive examination to be solved.(To be discussed during the skill development course hours)

Course Outcomes:

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

CO1: Explain the fundamental principles of material chemistry and classify materials based on their structure and bonding.

CO2: Analyze the physical, mechanical, thermal, and chemical properties of different material types.

CO3: Understand the synthesis, processing, and fabrication techniques for advanced materials and composites.

CO4: Evaluate the performance and applications of materials in real-world scenarios, including nanomaterials and composites

CO5: Apply knowledge of material selection and design for specific technological and industrial applications.

Text Book:

1. Klaus Friedrich, Gennady E. Zaikov , A.K Gahi, *Material Chemistry*, Apple AcademicPress; 1st edition, 2016.

Reference Books:

1. Bipin Thakur, *Basics of Material Science & Engineering*, IES Master Publication, 2019.
2. G.K. Naru;a, K.A. Narula, V.K. Gupta, *Material Science*, Mc. Graw Hill Education,2017.

Journals:

1. Materials Chemistry and Physics
2. Materials Today Chemistry
3. The Journal of Materials Science

E-Resources:

1. https://powerpoint.crystalgraphics.com/templates/search/material+chemistry-powerpoint-templates
2. https://www.pdfdrive.com/search?q=Magnetic+optical+and+thermal+properties+of+materials&pagecount=&pubyear=&searchin=&em=
3. https://www.pdfdrive.com/search?q=Diffusion+Behaviour+of+materials&pagecount=&pubyear=&searchin=&em=
4. https://www.pdfdrive.com/search?q=Structure+of+Matter&pagecount=&pubyear=&searchin=&em=

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	1	3	3	1	3	**29**
CO2	9	3	9	3	9	9	9	**51**
CO3	9	9	9	3	9	3	3	**45**
CO4	9	1	9	1	9	9	9	**47**
CO5	9	3	3	3	3	1	1	**29**
Total	**45**	**25**	**31**	**13**	**33**	**23**	**25**	**201**

Low-1 Medium-3 High-9

Extra Credit II – Applied Chemistry

(For Students Admitted from 2025-26**)**

Semester: II **Hours/Week: 6**

Subject Code: JMCHX2 **Credit: 2**

Course Objectives:

1. To understand the basic concept of lubricants and protective coatings
2. To enable the learners to understand the water

Unit I

Water: Methods of treatment of water for domestic supply-sedimentation, coagulation, filtration, sterilization, break point chlorination, hardness-different types of hardness, determination of hardness of water-demineralization of water by ion exchange process, zeolite process and reverse osmosis process.

Unit II

Cement: Manufacture of cement – dry and wet process, important process parameters for manufacturing a good cement clinker, setting mechanism of cement, different types of cement - special Cement, white Cement.

Unit III

Glass: Composition of glass - raw materials for manufacture of glass, manufacturing of glass-composition and uses of optical glass, colored glasses, lead glass and neutron absorbing glass.

Unit IV

Lubricants: Functions of lubricant, mechanism of lubrication, classification of lubricants, lubricating oil-Greases, properties of lubricating oil and greases, solid lubricants (graphite and molybdenum)-fluid or hydrodynamic lubrication, thin film or boundary lubrication & extreme pressure lubrication.

Unit V

Paints: Constituents, functions & mechanism of drying, varnishes and lacquers, surface preparation for metallic coatings, electroplating (gold) and electrodeless plating Nickel anodizing, phosphate coating, powder coating & antifouling coating.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: List out the quality parameter for water, cement, glass, lubricants and paints
CO2: Apply the concept of lubricants and protective coatings
CO3: Analyse the quality of cement and glass materials
CO4: Compare the various types of lubricants
CO5: Formulate the new additive for paints

Text Books:

1. R. P. Mani, K. N. Mishra, *Chemistry of Engineering Materials*, Cengage Learning, 3rdEdition, 2015.
2. S.S. Dara & S.S. Umare, *A Text Book of Engineering Chemistry*, New Delhi, S. Chand & Company Ltd, 2013.

Reference Books:

1. P.C. Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Company Ltd., New Delhi,2010.
2. Shikha Agarwal, *Engineering Chemistry*; Cambridge University Press, 2015.

Journals:

1. International Journal of Applied Chemistry
2. Russian Journal of Applied Chemistry
3. American Journal of Applied Chemistry

E-Resources:

1. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/1%20BCH101%20%20-%20chemistry%201%20-%20NOTES.pdf
2. https://www.madeeasy.in/uploads/examsolution/Building-Materials-mpsc.pdf
3. http://www.forensicscience.pl/pfs/47_zadora.pdf
4. https://www.pdfdrive.com/search?q=Lubricants&pagecount=&pubyear=&searchin=&em
5. https://www.pdfdrive.com/search?q=Glass%3A&pagecount=&pubyear=&searchin=&em

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Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	1	3	3	1	1	27
CO2	9	3	3	3	9	3	3	36
CO3	9	3	9	3	9	9	9	51
CO4	9	3	9	3	9	9	9	51
CO5	9	3	9	9	9	9	9	57
Total	45	21	31	21	39	31	31	222

Low-1 Medium-3 High-9

Core IX – Spectroscopy

(For Students Admitted from 2025-26**)**

Semester:III **Hours/Week: 6**
Subject Code: JMCHC31 **Credit: 5**

Course Objectives:

1.To gain more knowledge in Spectroscopy of UV, IR, NMR & Mass Spectroscopy.
2.To impart the knowledge on Nuclear Quadruple Resonance and Electron spin resonance spectroscopy.

Unit I **(18 hours)**

Ultraviolet and Visible: Ultraviolet and Visible spectroscopy- introduction, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, Fieser- woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds, steric effect in biphenyls (problem to bediscuss), Calculation of $\lambda_{max.}$

Infrared spectroscopy- Introduction, factors influencing group frequencies, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines, detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides and conjugated carbonyl compounds).

Unit II **(18 hours)**

^{1}H -NMR Spectroscopy: Introduction – Relexation process –Chemical shift – Factors influencing chemical shift – Inductive effect, Vanderwaals deshielding, anisotropic effects, Hydrogen bonding, solvent effects. Coupling constant J-factors influencing coupling constant J-classification (ABX, AMX, ABC & A2B2) simplification of complex spectra, spin decoupling, double resonance-Shift reagents, CIDNP.

UNIT III **(18 hours)**

Carbon-13 NMR Spectroscopy-Basic principle of FT technique, relaxation time, assignment of the signals, off-resonance decoupling-2D NMR, structural problems based on all the above techniques-correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic alkyne, aromatic, hetero aromatic and carbonyl carbon) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines & amides).

^{31}P and ^{19}F NMR spectroscopy-Introduction, application in structural problem, evaluation of rate constants, monitoring the course of reaction, NMR of fluxional molecules, NMR of paramagnetic molecules, contact shifts and shift reagents.

Unit IV **(18 hours)**

Mass Spectrometry: Introduction, principle, type of ions-base peak, parent ion, metastable ion and isotopic ions, fragmentation, general rules, pattern of fragmentation for various classes of organic compounds-Mc Lafferety rearrangement, Retro Diels - Alder reaction, Nitrogen rule, high resolution mass spectrometry, examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Unit V **(18 hours)**

Nuclear Quadruple Resonance: Nuclear quadruple resonance spectroscopy - quadruple nuclei, quadruple moments, electric field gradient, coupling constant, splitting, applications.

Electron spin resonance spectroscopy - basic principles, zero field splitting and Kramer's degeneracy, factors affecting the "g" value, isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.

Note

Questions related to the above units, from various competitive examination to be solved. (To be discussed during the skill development course hours)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Analyze the nature of organic compounds based on the Electronic and vibrational transitions.

CO2: Predict the Chemical environment of the protons of organic compounds based on its chemical shift values.

CO3: Solve the molecular structure of organic compounds by combined spectral data.

CO4: Analyze the stereo chemical orientation of molecules using correlation spectroscopy.

CO5: Elucidate the structure of organic compound using Spectroscopy.

Text Books:

1. William Kemp, *Organic spectroscopy*, 3rd Edition, 2019
2. P. M. Silverstein and F. X. Western, *Spectroscopic Identification of Organic Compounds,* John Wiley, New York, 8th Edition, 2014

Reference Books:

1. O. P. Agarwal, *Organic Chemistry - Natural Products*, GOEL Publishing House, Meerut, India, Vol. I, 2015
2. I.L. Finar, *Organic Chemistry*, Pearson Education Pvt. Ltd, Vol 2, 25th Edition, 2011.
3. J.March and M. B. Smith, *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*, Wiley, New York, 7th Edition, 2013.

Journals:

1. Royal Society of Chemistry
2. ACS Organic and Inorganic Journal
3. Journal of Natural Products

E- Resources:

1. https://tech.chemistrydocs.com/Books/Spectroscopy/Organic-Spectroscopy-By-William-Kemp-3rd-Edition.pdf
2. https://tech.chemistrydocs.com/Books/Spectroscopy/Organic-Spectroscopy-By-William-Kemp-3rd-Edition.pdf
3. **http://dl.iranchembook.ir/ebook/organic-chemistry-2753.pdf**

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	1	3	**25**
CO2	9	3	3	3	9	9	9	**45**
CO3	9	3	9	3	9	9	9	**51**
CO4	9	3	9	3	9	3	9	**45**
CO5	9	9	1	9	9	1	1	**39**
Total	**45**	**21**	**25**	**21**	**39**	**23**	**31**	**205**

Low-1 Medium-3 High-9

Core X– Organometallic and Bioinorganic Chemistry

(For Students Admitted from 2025-26)

Semester: III **Hours/Week: 6**
Subject Code: JMCHC32 **Credit: 5**

Course Objectives:

1. To understand the structure, bonding, and reactivity of organometallic compounds and their role in homogeneous and heterogeneous catalysis
2. To explore the principles and application of spectroscopic techniques in elucidating the structure of inorganic compounds.
3. To examine the roles of metal ions in biological systems and their interactions with biomolecules in natural and artificial contexts.
4. To study metal-based drugs, diagnostic agents, and the biochemical mechanism of metal ions in medicine.

Unit I **(18 hours)**

Organometallics: Classification of organometallic compounds based on M-C bond, Hapticity, -18 and 16 electron rule and its limitations, Bonding in metal olefin complexes (example: Ziese's salt); Metal-acetylene and metal- allyl complexes; Metal- cyclopentadienyl complexes and metal-carbonyl complexes; π bonded organometallic compounds- structure and bonding in η^2- ethylene and η^3-allylic compounds, structure and bonding in metallocenes. Classification of fluxional organometallic Compound, mechanism and analysis of fluxionality in compounds.

Unit II **(18 hours)**

Reactions and Catalysis of Organometallic Compounds: ligand associati on and dissociation, oxidative addition and reductive elimination, insertion reactions. Organometallic Catalysis-Hydrogenation of olefins (Willkinson catalyst) -Tolman catalytic loops , hydroformylation

(Oxoprocess) - acetic acid from methanol, oxidation of alkenes to aldehydes and ketones (Wacker process), olefin polymerization (Ziegler-Natta), Cyclo oligomerisation of acetylenes (Reppe's catalysts), Synthetic gasoline (Fischer Tropsch process and mobile process), Photodehydrogenation catalyst (Platinum POP).

Unit III **(18 hours)**

Inorganic Spectroscopy: IR spectroscopy- Introduction, selection rules, stretching frequency of some inorganic ions- effect of coordination on the stretching frequency- sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes.

Raman spectroscopy – Introduction, combined applications of IR and Raman spectroscopy in the structural elucidation of N2O, ClF3, NO3-,ClO4, metal carbonyls.

Mossbauer Spectroscopy-Mossbauer Effect, resonance absorption, Doppler Effect, Doppler velocity, isomer shift, magnetic hyperfine splitting, application of Mossbauer spectroscopy in the study of iron and tin complexes.

Unit IV **(18 hours)**

Bioinorganic Chemistry: Reversible oxygenation in life process O_2-uptake proteins-myoglobin, haemoglobin, hemerythrin, hemocyanin and model systems, electron transport proteins-Fe-S proteins, ferredoxin, rubredoxin and model systems, respiratory electron transport chains-cytochromes, photosynthetic electron transport chain (PS-I and PS-II) chlorophyll, biological nitrogen fixation (nitrogenase) and a biological nitrogen fixation, metal dependent diseases Wilsons, Alzheimer, Vitamin B_{12} -enzyme, metal complexes in therapeutic use of chelated and non-chelated compounds.

Unit V **(18 hours)**

Medicinal Bioinorganic Chemistry-Chemotherapy with compounds of certain non-essential elements, Platinum complexes in cancer therapy, Cisplatin and its mode of action, cytotoxic compounds of other metals, Gold containing drugs as anti-rheumatic agents and their mode of action, Lithium in pschycopharmocological drugs, radiopharmaceuticals technetium. Vanadium based diabetes drugs. Diagnostics agents: Technetium imaging agents; Gadolinium MRI imaging agents. Temperature and critical magnetic field.

Course outcome:

After successful completion of this course, student will be able to

CO1: Understand the fundamental concepts, structure and bonding principles of organometallic compounds and their application in catalysis

CO2: Analyze inorganic compounds using spectroscopic techniques such as UV-Vis, IR, NMR, EPR and Mossbauer spectroscopy.

CO3: Evaluate the biological roles of essential and trace metal ions in enzyme, protein and other biomolecules

CO4: Assess the design, mechanism and effectiveness of metal – based drugs and diagnostic agents in medicinal chemistry.

CO5: Apply theoretical and practical knowledge to solve problems in catalysis, bioinorganic systems and medicinal application involving inorganic compounds.

Text Books:

1. F. Albert Cotton, Geoffrey Wilkinson, Carlos A. Murillo, and Manfred Bochmann, *Advance Inorganic Chemistry*,John Wiley and Sons, INC, New York, 6th Edition, 2014
2. James E. Huheey, Ellen A. Keiter, Richard L. Keiter and Okhil K. Medhi, *Inorganic Chemistry – Principles of Structure and Reactivity*, Indian Edition, New Delhi, India, 4th Edition, 2013.
3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993.
4. B D Gupta and A K Elias, Basic Organometallic Chemistry: Concepts, Syntheses andz Applications, University Press, 2013.
5. F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6th edition Wiley Inter-science: New York, 1988.

Reference Books:

1. W. Kaim and B. Schewederski, *Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life*, John Wiley and Sons, New York, USA, 2nd Edition, 2013.
2. Weller, Overton, Rourke, Armstrong, *Inorganic Chemistry*, Oxford University Press 6th Edition, 2015.
3. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. 3rd ed. New York, NY: John Wiley, 2000

Journals:

1. European Journal of Inorganic Chemistry
2. International Journal of Inorganic Chemistry
3. Journal of Inorganic Chemistry

E-Resources:

1. **https://tech.chemistrydocs.com/Books/Organic/Basic-Organometallic-Chemistry-Concepts-Syntheses-and-Applications-by-BD-Gupta-&-AJ-Elias-2nd-Edition.pdf**
2. **https://batch.libretexts.org/print/Letter/Finished/chem-172716/Full.pdf**
3. **https://www.perlego.com/book/1873694/spectroscopy-in-inorganic-chemistry-v1-pdf**

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	1	3	9	1	3	34
CO2	9	3	9	1	9	9	1	41
CO3	9	3	9	3	9	9	3	45
CO4	9	3	3	1	3	3	3	25
CO5	9	3	9	9	9	3	9	51
Total	45	21	33	17	39	25	19	196

Low-1 Medium-3 High-9

Core-XI – Quantum Chemistry & Group Theory

(For Students Admitted from 2025-26)

Semester: III **Hours/Week: 6**
Subject Code: JMCHC33 **Credit: 5**

Course Objectives:

1.This course aims to provide a foundational understanding of photochemistry, quantum chemistry,

and group theory, emphasizing their interrelated principles.
2.To analyze molecular structure, reactivity, and spectroscopy.

Unit I **(18 hours)**

Photochemistry: Fundamentals of photochemistry, unimolecular photochemical processes, Jablonski diagram, quantum yield, chemical actinometry, excimers, exciplexes, E-type and P- type fluorescence, short range and long range energy transfer, quenching and sensitization, kinetics of photochemical processes, Stern- Volmer equation, photochemical techniques flash photolysis, radiation chemistry - pulse radiolysis, solar energy conversion and storage, solar cell and its working, photochemistry of environment – ozone layer in the stratosphere, greenhouse effect and photochromism.

Unit II **(18 hours)**

Quantum Chemistry-I: Introduction of quantum chemistry, operators, postulates of quantum chemistry, eigen value and eigen function, normalization and orthogonality, Schrodinger wave equation. Application of quantum chemistry to simple systems translational motion-particle in one dimensional box, particle in three-dimensional box-rectangular and cubical box, particle with finite potential barrier, one finite potential barrier, two finite potential barrier vibrational motion-Hooke's law, harmonic oscillator, the quantum mechanical derivation for a harmonic oscillator model of a diatomic molecule.

Rotational motion-rigid rotator, derivation of energy and wave function of rigid rotator, rotation in one plane, rotation in space Hydrogen and Hydrogen like atoms-spherically symmetric potential and the Hamiltonian, spherical coordinates, Schrodinger wave equation in terms of r, θ, Φ, radial eigen functions.

Unit III **(18 hours)**

Quantum Chemistry-II: Variation principle-linear and non-linear variation theory, perturbation theory-first order, application of variation and perturbation theory to He atom Theory of angular momentum-Angular momentum, quantum mechanical operator for angular momentum, ladder operator, eigen function and eigen values of angular momentum using ladder operator. Molecular orbital theory (MOT)-LCAO approximation, the H^{+2} ion, the LCAO-MO wave function of H2+ ion, electron density and bonding in H2+, physical representation, Huckel MOT of conjugated systems, Huckel rule of aromaticity, applications of Huckel MOT to ethylene, butadiene, elementary idea of extended Huckel theory.

Unit IV **(18 hours)**

Group Theory- I: Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup, conjugacy relation and classes, point symmetry group, Schon flies symbols, representations of groups by matrices (representation for the Cn, Cnv, Cnh, Dnh), character of a representation.

Character table and their uses-The great orthogonality theorem and its importance, construction of character tables, reducible and irreducible representations, group theory and quantum mechanics, projection operator, using projection operator to construct symmetry adopted linear combinations (SALCs).

Unit V **(18 hours)**

Group Theory- II: Applications of group theory- Determination of representations of vibrational modes in non-linear molecules such as water, ammonia, BF_3, CH_4 and XeF_4.Determination of Hybrid orbitals in non-linear molecules – Examples: H_2O, NH_3, BF_3, CH_4 and XeF_4. SALC procedure-evaluation of energies and molecular orbitals for systems like ethylene and butadiene. Selection rules for spectral transitions. Electronic spectra of formaldehyde and ethylene.

Note
Questions related to the above units, from various competitive examination to be solved. (To be discussed during the skill development course hours)

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Understand the fundamental principles of photochemical processes and their applications.
CO2: Apply quantum mechanical models to explain atomic and molecular structure.
CO3: Analyze molecular symmetry using group theory and predict spectroscopic transitions.
CO4: Solve problems related to electronic transitions, reaction mechanisms, and molecular orbitals.
CO5: Integrate concepts from photochemistry, quantum chemistry, and group theory to interpret experimental data.

Text Book:
1. R.K. Prasad, *Quantum Chemistry*, New Age International Publishers, New Delhi, 4th Edition, 2020.
2. Symmetry and Group Theory in Chemistry" by A. F. West

Reference Books:
1. I. N. Levine, *Quantum Chemistry* New Delhi: Pearson Education Pvt. Ltd. 7th Edition,2016.
2. P. Atkins, & De Paula, J. Atkins *Physical Chemistry* Oxford UniversityPress10th Edition, 2014.
3. "Group Theory" by A.K. Sharma.

Journals:
1. The journal of Physical Chemistry
2. Journal of Physics and Chemistry Solids
3. Journal of Physical Chemistry

E-Resources:
1. **https://tech.chemistrydocs.com/Books/Spectroscopy/Quantum-Chemistry-&-Spectroscopy-by-Thomas-Engel.pdf1.**
2. **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==**
3. **https://www.jmilne.org/math/CourseNotes/GT.pdf**

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	3	3	3	**33**
CO2	9	3	9	3	9	9	9	**51**
CO3	9	3	9	3	9	9	9	**51**
CO4	9	3	9	3	9	9	9	**51**
CO5	9	9	3	3	9	3	3	**39**
Total	**45**	**36**	**33**	**15**	**39**	**33**	**33**	**225**

Low-1 Medium-3 High-9

Core-XII – Physical Chemistry Practical

(For Students Admitted from 2025-26**)**

Semester: III **Hours/Week: 6**
Subject Code: JMCHC34P **Credit: 4**

Course Objectives:

1.To develop experimental skills in physical chemistry by performing laboratory techniques.
2.Toillustrate core concepts such as thermodynamics, kinetics, electrochemistry, and phase equilibria, with an emphasis on data analysis, accuracy, and scientific reporting.

List of Experiments **(90 hours)**

Part – A

1. Conductometric Experiments
i. Determination of equivalent conductance of weak electrolyte at infinite dilution using Kohlrausch‟s law
ii. Determination of dissociation constant of weak acids.
iii. Double displacement & acid base titration
   a. NH_4C1 – NaOH – Mixture of CH_3COOH & HCl
   b. NH_4C1 – NaOH – Mixture of NH_4C1 & HCl
iv. Precipitation titration
   a. KCl – $AgNO_3$ – KCl
   b. K_2SO_4 – $BaC1_2$ – K_2SO_4

2. Adsorption Experiments - Adsorption of Oxalic acid / Acetic acid on charcoal.

3. Kinetic Experiments
i. Kinetics of alkaline hydrolysis of ester by conductometric method
ii. Perdisulphate and iodide ion reaction: study of Primary salt effect and determination of concentration of given KNO_3

4. Potentiometric methods
i. Precipitation titration: Ag Vs halide mixture.
ii. Redox titration:
a) permanganate Vs iodide ion
b) Ceric ammonium Sulphate Vs ferrousion
iii. Determination of dissociation constant of weak acids and pH of buffer solutions.
iv. Determination of solubility product of sparingly soluble salts.

5. Titrations using pH meter - Determination of first, second and third dissociation constants of phosphoric acid.

6. Thermochemistry:
i. Determination of heat of neutralisation
   a. NaOH vs. HCl
   b. NaOH vs. CH_3COOH
   c. NaOH vs. Oxalic acid
ii. Determination of Heat of solution and Heat of hydration of $BaCl_2$ and $CuSO_4$

7. Surface tension
To determine interfacial tension of two immiscible liquids

8. Distribution Law
a. To determine partition coefficient of benzoic acid between benzene and water
b. To determine partition coefficient of Iodine between Carbon tetrachloride and water

c. Determination of Equilibrium constant for $I_2 + I^- = I_3^-$

Evaluation scheme: Distribution of marks – 75 (Record – 10, Viva – 15, Experiments – 50)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Perform experiments related to thermodynamics, kinetics, electrochemistry, and surface chemistry with precision.

CO2: Analyze experimental data using appropriate scientific and mathematical methods.

CO3: Interpret results to understand underlying physical chemistry principles.

CO4: Demonstrate proper handling of laboratory instruments and adherence to safety protocols.

CO5: Prepare clear, concise, and accurate laboratory reports reflecting scientific observations and conclusions.

Reference Books:

1. B Viswanathan, P.S. Raghavan, *Practical Physical chemistry*, Viva Books Original,2017
2. James Brierley Firth, *Practical Physical chemistry*, Andesite Press, 2015

Journals

1. Journal of Physical chemistry
2. The Journal of Chemical Physics
3. Chemical Physics

E-Resources:

1. https://people.ok.ubc.ca/pphillips/DRAFT%20464%20Manual.pdf
2. https://web.iitd.ac.in/~nkurur/2015-16/Isem/cmp511/lab_handout_new.pdf
3. https://www.vpkbiet.org/pdf/FE/Lab_Manual_Chem.pdf
4. http://nie.lk/pdffiles/other/eALOM%20Chemistry%20Practical%20Handbook.pdf
5. https://www.pdfdrive.com/search?q=Potentiometric+methods&pagecount=&pubyear=&searchin=&em=

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	9	3	**45**
CO2	9	3	9	3	9	9	9	**51**
CO3	9	9	9	3	9	3	1	**43**
CO4	9	3	9	3	9	9	9	**51**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**27**	**45**	**18**	**39**	**39**	**31**	**241**

Low-1 Medium-3 High-9

Discipline Specific Elective III (A) – Polymer Chemistry

(For students admitted from 2025-26**)**

Semester: III **Hours/Week: 6**

Subject Code: JMCHE3A **Credit: 5**

Course Objectives:

1. To understanding of polymer chemistry, including polymer synthesis, characterization, properties,

and applications.

2. To analyze structure-property relationships and the industrial relevance of various polymers.

Unit I **(18 hours)**

Introduction to Polymers: Definition and Basic Terminology-Monomers, Polymers, Plastics, Elastomers, Fibers, and Resins. Classification of Polymers– Classification Based on Composition-Homo and Co-Polymers, Classification Based on Physical Properties-Thermoplastic and Thermosetting, Difference Between Thermoplastic and Thermosetting Polymers, Classification Based on Reaction Mode of Polymerization, Addition and Condensation Polymers, Difference between Addition and Condensation Polymers. Molecular Weight of Polymers-Number Average Method, Weight Average Method, Glass Transition Temperature and Characteristics of Polymers.

Unit II **(18 hours)**

Mechanism and process of polymers : Addition Polymerisation-Mechanism of Free Radical Addition Polymerisation, Ionic Polymerisation, Anionic Polymerisation, and Cationic polymerization, Co-Polymerisation, Coordination polymerization, Ziegler Natta Catalysis and Mechanism. Polymerization Process -Bulk Polymerisation, Solution Polymerisation, Suspension Polymerisation and Emulsion Polymerisation, Vulcanization process. Processing techniques – compression, blow and injection mouldings, film extrusion and calendaring, die casting and rotational casting, 44hermos foaming, reinforcing.

Unit III **(18 hours)**

Conducting Polymers and Bio Polymers: Introduction, Conductivity, Reason for Conductivity, Uses of Conducting Polymers, Process of Doping, Potential Application of Conductivity Polymers, Uses of Conducting Polymers. Biodegradable Polymers, Composition of Biopolymer: Classification, types, chemistry and uses. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Unit IV **(18 hours)**

Analytical Chemistry of polymers: Instruments and specimen, elucidation of structure – Proton NMR and C^{13} NMR phenomenon, broad line spectra, analysis of molecular structure of simple polymers, Thermogravimetric analysis, differential thermal analysis and DSC – introduction, instrumentation and application, determination of kinetic parameters, thermal degradation behaviour of some polymer by TGA methods.

Unit V **(18 hours)**

Industrial polymers and additives: Preparation, properties and Uses of Polyethylene, PTFE, PVC, PVA, Polypropylene and Polystyrene, Polyamides, Nylon-6 and Nylon-6, 6, Polyesters, Terylene and Viscose Rayon. Preparation and Uses of Butyl Rubber, Buna-S, Buna-N, Neoprene, Thiocol, Polyurethane, and Silicon rubbers.

Polymer Additives-Definition and Examples-Fillers, Reinforcements, Antioxidants, and Thermal Stabilizers, UV Stabilizers and Absorbers, Fire Retardants, Colorants,Curing agents, Plasticizers, Lubricants and Catalysts

Note

Questions related to the above units, from various competitive examination to be solved.(To be discussed during the skill development course hours)

Course Outcomes:

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

CO1: Analyze and compare various polymerization mechanisms and their kinetic principles.

CO2: Characterize polymers using advanced techniques such as spectroscopy, chromatography, and thermal analysis.

CO3: Correlate polymer structure with physical, mechanical, and thermal properties.

CO4: Evaluate the design and synthesis of functional and specialty polymers for industrial and research applications.

CO5: Critically assess recent advances and trends in polymer science and technology.

Text Book:

1. Fred W. Billmayer, *Textbook of Polymer Science*, John Wiley & Sons Pvt. Ltd.,Singapore, Indian Edition, 9th Edition, 2017.

Reference Books:

1. Alka L Gupta, *Polymer Chemistry*, Anu Books Publishing, 2019.
2. P.V. Anil Kumar, *Polymer Chemistry*, Vishal Publishing, 1st Edition, 2021.

Journals:

1. Polymer Chemistry
2. European Polymer Journal
3. Reactive & Functional Polymers

E- Resources:

1. https://www.slideshare.net/guest32ca93/polymer-course
2. https://chemistryklipz.files.wordpress.com/2016/12/condensation-polymers.pdf
3. http://pioneer.netserv.chula.ac.th/~sanongn1/processing.pdf
4. https://www.pdfdrive.com/search?q=Condensation+Polymerization&pagecount=&pubyear=&searchin=&em=
5. https://www.pdfdrive.com/search?q=Analytical+Chemistry+of+polymers&pagecount=&pubyear=&searchin=&em=

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	9	3	3	**39**
CO2	9	9	3	3	9	3	3	**39**
CO3	9	3	3	9	9	1	3	**37**
CO4	9	9	9	3	9	3	1	**43**
CO5	9	3	9	3	9	9	3	**45**
Total	**45**	**33**	**27**	**21**	**45**	**19**	**13**	**203**

Low-1 Medium-3 High-9

Discipline Specific Elective - III (B) Computational Chemistry

(For Students Admitted from 2025-26)

Semester III **Hours/Week: 6**
Subject Code: JMCHE3BI **Credit: 5**

Course Objectives:
1: To compare the computational methods with insight gained from quantum chemistry.
2: To develop analytical skills for interpretation of experimental results with insight from Computational data.

Unit I **(18 hours)**
Hartree-Fock Theory: Molecular Hamiltonian - Born-Oppenheimer approximation - Mean field theory - Fock operator - trial wave functions - LCAO approximation - Roothan‟s equations - Fock matrix - Self-Consistent Field theory – MO, Total Energies - Koopman‟s Theorem - open shell systems - UHF vs ROHF - broken symmetry solutions - spin polarization - spin contamination.

Unit II **(18 hours)**
Post-Hartree Fock Methods: Static vs dynamic correlation - Configuration Interaction (CI) –CI matrix - Brillion‟s Theorem - Slater-Condan‟s rules - configuration state functions - Multiconfiguration SCF - choice of active spaces - Many body perturbation theory - Moller- Plesset (MP_n) method - Coupled cluster methods - size consistency and extensivity - time, space complexities.

Unit III **(18 hours)**
Basis of Sets: Single center (vs) Multi center expansions - Slater type Orbitals-minimal vs extended basis sets-split-valence basis sets-Gaussian Type orbitals-Primitive and Contracted Gaussians-polarization functions-diffuse functions - Effective Core Potential (ECP)-Pople's Notation-Basis set Limit - Basis set superposition Error (BSSE)-Counterpoise Correction.

Unit IV **(18 hours)**
Density Functional Theory: Electron Density vs Wave functions - Hole functions-Thomas- Fermi model-Slater's approximation-Hohenberg-Kohn theorems-Kohn-Sham theory-exchange and Correlation holes-Local Density Approximation (LDA), Gradient-corrected Methods-Kohn- Sham orbitals-hybrid functionals-performance of DFT models.

Unit V **(18 hours)**
Molecular Properties: Geometry optimization-Symmetry-Hellmann Feynman Theorem - properties (time dependent and independent)-normal modes-vibrational analysis and characterization of stationary points IR Raman spectra-anharmonic corrections-electrical, magnetic and thermodynamic properties-characterizing transition states-solvent models.

Note
Questions related to the above units, from various competitive examination to be solved.(To be discussed during the skill development course hours)

Course Outcomes:
After successful completion of this course, student will be able to

CO1: Recall and understand the basic theories of quantum chemistry
CO2: Compare the computational methods with insight gain from quantum chemistry
CO3: Correlate approximation applied in basis sets to better accuracy
CO4: Evaluate the vibrational and rotational spectra for arriving various properties ofmaterials
CO5: Develop an analytical skills for interpretation of experimental results with insight from computational data

Text Book:

1. David C. Young, *Computational Chemistry: A Practical Guide for Applying Techniquesto Real-World Problems*, John Wiley & Sons, Inc. 2018.

Reference Books:

1. Ram Yatan Prasad, *Computational Quantum Chemistry*, 2nd Edition, 2021.
2. David Young, *Computational Chemistry*, Wiley, 1st Edition, 2018.

Journals:

1. The Journal of Computational Chemistry
2. Journal of Chemical Theory and Computations
3. Journal of Computer Aided Chemistry

E- Resources:

1. https://encyclopedia.pub/7607
2. https://nptel.ac.in/courses/104/101/104101095/
3. http://vergil.chemistry.gatech.edu/courses/chem4681/background/node1.html
4. https://www.cs.mcgill.ca/~rwest/wikispeedia/wpcd/wp/c/Computational_chemistry.html
5. https://www.pdfdrive.com/computational-chemistry-books.html

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	9	3	3	3	**42**
CO2	9	9	9	1	9	3	9	**49**
CO3	9	3	9	3	9	9	9	**51**
CO4	9	3	9	3	9	9	9	**51**
CO5	9	9	9	3	9	9	9	**57**
Total	**45**	**33**	**39**	**19**	**39**	**33**	**39**	**250**

Low-1 Medium-3 High-9

Core-XIII– Aromaticity, Heterocyclic and Natural Products

(For Students Admitted from 2025-26**)**

Semester: IV **Hours/Week: 5**
Subject Code: JMCHC41 **Credit: 5**

Course Objectives:

1. To enable the students to learn the aromaticity and heterocyclic compounds.
2. To impart the knowledge on alkaloids and terpenoids.

Unit I **(18 hours)**

Nature of Bonding and Aromaticity: Delocalized chemical bonding-Conjugation, Cross conjugation, Resonance, Hyper Conjugation, Tautomerism, Aromaticity, Alternant and non-alternant hydrocarbons, Huckel's rule, Craig's rule, Energy level of π-molecular orbitals, Annulenes, Anti-aromaticity, Homo-aromaticity, Bonds weaker than covalent, addition compounds, non-covalent bonding and inclusion complexes.

Unit-II **(18 hours)**

Nomenclature and five membered heterocycles: Systematic nomenclature for fused and bridged heterocycles, Five membered heterocycles with two heteroatoms: Synthesis and reactions of pyrazole, imidazole, isoxazole, oxazole, isothiazole and thiazole.

Unit III **(18 hours)**

Small Ring Heterocycles: Three-membered and four-membered heterocycles - synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and thietanes.

Benzo-fused five-membered heterocycles - synthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes.

Unit IV **(18 hours)**

Alkaloids: Classificaion of alkaloids-occurrence-Structural elucidation and synthesis of quinine, papaverine camptothecin.

Steroids- Cholesterol (without synthesis), bile acid, testosterone, estrone, progesterone and prostaglandins: PGE_1 & PGE_2.

Unit V **(18 hours)**

Terpenoids : Classfication of terpenoids –occurence- structure, stereochemistry and synthesis α, pinene, camphor, zingiberene, α - cadinene.

Vitamins : Classification-Structural determination and synthesis of Vitamin A1, Vitamin B6, Vitamin B12, Folic acid, Vitamin H, Vitamin E and Vitamin K2.

Note

Questions related to the above units, from various competitive examination to be solved.(To be discussed during the skill development course hours)

Course Outcome

CO1: To recall the synthesis and reactions of heterocyclic compounds.
CO2: To understand the brief knowledge of heterocyclic compounds.
CO3: Identify the name of organic compound using IUPAC.
CO4: Analyze the nature of organic compound using Huckel's rule.
CO5: Elucidate the structure of natural products of alkaloids, terpenoids, steroids and vitamins.

Text Book:

1. V.K. Ahluvaliya Lalita s. kumar Sanjiv kumar, chemistry of natural products.
2. Fred W. Billmayer, *Textbook of Polymer Science*, John Wiley & Sons Pvt. Ltd.,Singapore, Indian Edition, 9th Edition, 2017.

Reference Books:

1. R.R.Gupta , M.Kumar, V.Gupta, Heterocyclic chemistry, published by springer, 1999

2. Alka L Gupta, *Polymer Chemistry*, Anu Books Publishing, 2019.
3. P.V. Anil Kumar, *Polymer Chemistry*, Vishal Publishing, 1st Edition, 2021.

Journals:

1. Journal of natural products
2. Phytochemistry
3. Journal of heterocyclic chemistry.

E- Resources:

1. https://oms.bdu.ac.in/eccolleges/admin/contents/1_16SCCCH8_2020051904202312.pdfhttps://chemistryklipz.files.wordpress.com/2016/12/condensation-polymers.pdf
2. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/heterocy.htm
3. https://chem.libretexts.org/Courses/Athabasca_University/Chemistry_350%3A_Organic_Chemistry_I/15%3A_Benzene_and_Aromaticity/15.03%3A_Aromaticity_and_the_Huckel_4n__2_Rule

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	9	3	3	**39**
CO2	9	9	3	3	9	3	3	**39**
CO3	9	3	3	9	9	1	3	**37**
CO4	9	9	9	3	9	3	1	**43**
CO5	9	3	9	3	9	9	3	**45**
Total	**45**	**33**	**27**	**21**	**45**	**19**	**13**	**203**

Low-1 Medium-3 High-9

Core-XIV– Research Methodology

(For Students Admitted from 2025-26)

Semester: IV **Hours/Week: 6**
Subject Code: JMCHC42 **Credit: 5**

Course Objectives:

1. Understand some basic concept of research and its methodology
2. To identify appropriate research topic, organize and conduct research in a appropriate manner
3. To write research report, thesis and research proposal

Unit I **(18 Hours)**

Concept of research and research design: Meaning and importance of Research-Types of Research- Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical, Selection and Formulation of Research.defining research problem-research process and steps involved in research process- research proposal or synopsis.

Research Design (RD): Meaning of RD-Need of RD-Features of good RD-Important concepts relating to RD: Dependent-Independent variables-Extraneous variables-Control Confounded relationship-Research hypothesis-.

Unit II **(15 hours)**

Literature Survey: Literature review, Approaching the literature, Scholarly literature, Data provenance and evaluation, Intellectual property. Sources of information: Primary, Secondary, Tertiary sources, Patents, Journals (Print and e-journal),Type of Journals, Conference Proceedings. Journal Impact Factor, Citation index, h-index.

Understanding of literature: Reading A Scientific Paper, Abstracts, Current titles, Reviews, Monographs, Books, Current contents, Cross referencing, Indian patent database. Tools for Digital Literature Survey: Scientific data bases, e-journals, INFLIBNET, Shod sindhu, Shodh ganga, Google/Google Scholar, Research Gate, PubMed, finding and citing Information.

Unit III **(18 Hours)**

Scientific Writing: Introduction to scientific writing, writing science laboratory Notebook.

Writing Research Paper: Title, Abstracts, Keywords, Introduction, Material and Methods, Results and discussion, Conclusion, Acknowledgement, References and Supplementary data. Difference between research communication and Review article, Reply to Referee comments for science research paper. Preparation of Poster and Oral Presentation.

Unit IV **(18 Hours)**

Research ethics, plagiarism and laboratoty safty: Research ethics, responsibility and accountability of the researchers- ethical consideration during animal experimentation including CPSSEA guidelines.plagiarism and use of plagiarism detection software.

Laboratory Safety- Laboratory safety, Laboratory manual, Lab as a safe place: habits, Cause of accidents and What to do in case of an accident, Personal protective 12 Page 17 of 45 equipment, Emergency equipment for general purpose. Laboratory ventilation.

Unit V **(18Hours)**

Cost management and Funding Agency: Cost Analysis of the project, Cost incurred on raw materials , procedure,instrumentation and biological testing.

Introduction to various research funding agencies such as DST, DBT, AICTE, JGC, CSIR, ICMR, AAYUSH and DRDO along with their function in India.

Note

Questions related to the above units, from various competitive examination to be solved.(To be discussed during the skill development course hours)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: To learn the basics of science, scientific research its importance.

CO2: To learn the Ethics and plagiarism precautions to be taken while doing research.

CO3: To understand the detailed referencing and literature review procedure before beginning the research.

CO4: To understand the process of writing research papers, research project report and research proposal.
CO5: To learn various advanced tools useful for the science and aware about the laboratory safety

Text book:
1. Jaap Bos, Research Ethics for students in the social science.
2. Dr shanti Bhushan Mishra, Dr Shashi alok, Hand book of Research methodology.

Reference Books:
1.Kothari C.R. (2014) Research Methodology Methods & Techniques, New age international publisher.
2.Ghose, C., and Singh, M. Research Methodology.
3.Wilson J. (2010) Essential of Research Methods, SAGE Publication.
4. Chawla D. &Sondhi N. Research Methodology Concepts and Cases, S. Chand & Company Ltd.
5.Bouchoux, D. E. Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets

Journals:
1. Development studies research
2. IJNRD Research Journal

E.Resourses:
1. https://www.slideshare.net/slideshow/research-methodology-cr-kotharibookpdf/267190890
2. https://mrcet.com/downloads/digital_notes/CSE/Mtech/I%20Year/RESEARCH%20METHODLOGY.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	9	9	**27**
CO2	3	9	9	9	3	9	9	**51**
CO3	9	9	3	9	9	3	9	**33qqq**
CO4	3	9	9	9	3	3	9	**35**
CO5	3	9	3	9	3	3	9	**25**
Total	27	45	33	45	27	27	45	**249**

Low-1 Medium-3 High-9

Core-XV– Project

(For Students Admitted from 2025-26**)**

Semester: IV **Hours/Week: 16**
Subject Code: JMCHC43DW **Credit: 8**

Course Objectives:
1. To gain the hands-on experience of different instruments and will give the exposure of Research potential.
2. To enable students to measure various physical and chemical properties.

The program encourages the students to experience the research in the field of chemistry. A project work to be done individually by the students either in the department laboratory or in a chemical industry or in institutions like CECRI, Agricultural research station, Water testing centres,

pharmaceutical laboratories etc. The project work should help the students to create research attitude and apply that theory they have learnt throughout the course.

Evaluation Scheme: Project internal is evaluated on the basis of presentation of the project such as, follow review 75 marks, dissertation (record) 20 marks and 5marks for attendance.
The external 100 marks is distributed as follows, for dissertation and lab record 40 marks, for presentation 30 marks and for viva- voce 30 marks.

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Understand the basic concepts in chemistry project and list the literature background ofthe work
CO2: Apply the related protocol for their research work
CO3: Explain the optimization parameters to identify the reaction conditions
CO4: Evaluate the principles and procedures employed in the thesis writing
CO5: Synthesis the novel compound and study their properties

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	9	9	**63**
CO2	9	3	9	3	9	9	9	**51**
CO3	9	9	9	9	9	9	9	**63**
CO4	9	3	9	3	9	9	9	**51**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**27**	**45**	**27**	**45**	**45**	**45**	**279**

Low-1 Medium-3 High-9

Extra Credit-IV – Agricultural Chemistry

(For Students Admitted from 2025-26**)**

Semester: IV **Credit: 2**
Subject Code: JMCHX4

Course Objectives:
1. To acquire the knowledge of soil fertility and soil productivity
2. To learn mode of action of soil and fertilizer phosphorus

Unit I
Soil Chemistry: Chemical (elemental) composition of the earth‟s crust and soils, elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics, Soil organic matter-classification, fractionation of soil organic matter and different fractions, genesis and nature of soil organic matter and humus formation, humus decomposition, separation of humus from soil particles, clay-organic interactions.

Unit II
Soil fertility and Soil Productivity: Nutrient sources-fertilizers and manures, essential plant nutrients – functions and deficiency symptoms, law of soil fertility soil and fertilizer nitrogen-

sources, forms, immobilization and mineralization, nitrification, denitrification, biological nitrogen fixation, nitrogenous fertilizers and their fate in soils, management of nitrogenousfertilizers.

Unit III

Soil and Phosphorous Fertilizer: Forms, immobilization, mineralization, reactions in acids and alkali soils, factor affecting on availability in soils, phosphatic fertilizers- behaviour in soils and management under field conditions, potassium - forms, equilibrium in soils and its significance, mechanism of potassium fixation, management of potassium fertilizers under field conditions.

Unit IV

Sulphur, Calcium and Magnesium: Source, forms, fertilizers and their behaviour in soils, factors affecting their availability in soils, management of fertilizers, Micronutrients-criticallimits in soils and plants, factors affecting their availability and correction of their deficiencies inplants, role of chelates in nutrient availability.

U**nit** V

Chemistry of acids soils: Active and potential acidity, lime potential, sub-soil acidity, chemistryof salt-affected soils and amendments, soil pH, ECE, ESP, SAR and important relations, soil management and amendments, chemistry and electrochemistry of waterlogged soils.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Define soil chemistry and understand the concepts of soil fertility and productivity

CO2: Identify the suitable fertilizers available in soils.

CO3: Analyse the soil samples for the nutrient contents.

CO4: Compare the knowledge of insecticides, fungicides and herbicides.

CO5: Discuss the importance of calcium, sulphur and magnesium.

Text Book:

1. Ajay Singh, *Agricultural Chemistry*, Pushbanjali Prakashan, Ist Edition, 2019.

Reference Books:

1. K. Mengel and E. A. Kirkby, *Principles of Plant Nutrition*, International Potash Institute, Switzerland, 2001.

2. G.M. Pierzinsky, T. J. Sims and J. F. Vance, *Solis and Environmental Quality*, CRC Press, 2nd Edition, 2002.

3. Beaton D. James, Tisdale L. Samuel, Werner Nelson and L. John Havlin, *Soil Fertility and Fertilizers: An Introduction to Nutrient Management*, Pearson College Div. Publications, 7th Edition, 2004.

Journals:

1. Journal of Agricultural and Food Chemistry
2. The Journal of the Science of Food and Agriculture
3. Journal of Agricultural and Environmental Ethics

E-Resource:

1. https://www.slideshare.net/mzk57/agricultural-chemistry-147003348
2. https://www.pdfdrive.com/search?q=Soil+and+Phosphorous+Fertilizer&pagecount=&pubyear=&searchin=&em=

3. https://www.pdfdrive.com/search?q=Soil+fertility+and+Soil+Productivity&pagecount=&pubyear=&searchin=&em=

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	1	3	3	1	1	**27**
CO2	9	3	9	3	9	9	9	**51**
CO3	9	1	9	1	9	1	3	**33**
CO4	9	3	9	1	9	1	3	**35**
CO5	9	3	3	3	3	1	3	**25**
Total	**45**	**19**	**33**	**11**	**33**	**13**	**19**	**171**

Low-1 **Medium-3** **High-9**

B. Sc. CHEMISTRY
(Three Years Regular Programme)
(For Student Admitted from 2025-26)

PSO1: Understand basic concepts of Organic, Physical, Inorganic, Environmental, Computational and Analytical chemistry.
PSO2: Develop skills in the safe-handling of chemicals, taking into account of their characteristic properties including any particular hazards.
PSO3: Ability to apply the basic principles of different analytical methods to identify the properties of the compounds.
PSO4: Establish and convey the relevance of chemistry to global issues towards sustainable future through effective written, virtual communications and interact productively with people from varied backgrounds.
PSO5: Students will be applying appropriate methods of qualitative and quantitative analysisto estimate inorganic salt mixtures and organic compounds in practical classes.
PSO6: Students will learn to synthesize the new compounds by making correct choice of the reagents and find the optimum reaction conditions.
PSO7: Develop practical skills and knowledge in chemistry which helps student in their employability.

Preamble

1. Core-V - Organic Chemistry−I, unit I- Optical and Geometrical Isomerism was replaced by Aliphatic Hydrocarbons and Aliphatic Unsaturated Hydrocarbons. Unit II-Aliphatic Hydrocarbons was changed into Cycloalkanes and Aromatic Hydrocarbons. In unit III- Halogen compounds was moved to V unit. The title of unit III was changed as Polynuclear Hydrocarbons, Oils, Fats and Dyes. In unit V- Phenols, Ethers and Epoxides was replaced by Organometallic Compounds and Alcohols.
2. Core VIII-Organic Chemistry-II, unit I- Cycloalkanes and Aromatic Hydrocarbons was changed into Aldehydes and Ketones. In unit II- Aldehydes and Ketones was replaced by Carboxylic acids and acids derivatives. In unit III- Phenols, Ethers, and Epoxides was added as title instead of Carboxylic acids and acids derivatives. In unit V- Pericyclic reactions and Organic Photochemistry was transformed to Optical and Geometrical Isomerism.
3. Core-X - Organic Chemistry−III, unit-I Polynuclear Hydrocarbons, Oils, Fats and Dyes `was changed into Aromatic Sulphonic Acids, Alkaloids and terpenoids. Unit IV Molecular Rearrangements and Tautomerism was replaced by Pericyclic reactions and organic photochemistry. Unit IV Molecular Rearrangements and Tautomerism was changed as V unit.
4. Semester IV, Skill Enhancement Course-IV -Computer Fundamentals and C Programming was removed.
5. New experiments were introduced in the Skill Enhancement Course - IV - Industrial Chemistry Practical.
6. Green Synthesis of Paracetamol using microwave and water as solvent was introduced in Core-VI- Organic Analysis and Organic Estimation Practical.

7. In Semester VI- Skill Enhancement Course-VI Analytical Chemistry practical was introduced.
8.Open Elective Course-Chemistry in the Service of Mankind was changed into Preparation of Personal Care Products as practical.

Programme Structure 2025-2026
Program code: UCH

Sem	Part	Subject Code	Course	Subject Title	Hrs. /wk.	Credit	@ SD | ENT | EMP	$ REG | NAT | GLO	CIA	ESE	Total
I	I	JBLT11	Part I Language	Tamil-I	5	3	SD	GLO	25	75	100
		JBLA11		Arabic I			SD| ENT| EMP	REG| NAT| GLO			
		JBLHB11/ JBLHA11		Hindi-I			SD| ENT| EMP	GLO			
	II	JBLEB12/ JBLEA12	Part II Language	English- I a or b	5	3	SD| ENT| EMP	REG| NAT| GLO	25	75	100
	III	JBCHC11	Core –I	General Chemistry	6	6	SD	NAT | GLO	25	75	100
		JBCHC12	Core –II	Inorganic Chemistry – I	6	6	SD	NAT | GLO	25	75	100
		JBCHA13/ JBCHA14	AECC – I	Mathematics-I/ Biochemistry-I	4	4	SD	NAT	25	75	100
	IV	JBCHS15P	SEC – I	Preparation of Industrial Products and Applied Chemistry Practical	2	1	SD | ENT | EMP	REG| NAT	-	50	50
				Library/Browsing	1	-			-	-	-
				Games	1						
				Total	**30**	**23**			**125**	**425**	**550**
II	I	JBLT21	Part I Language	Tamil-II	5	3	SD	GLO	25	75	100
		JBLA21		Arabic II			SD| ENT|	REG| NAT|			

							EMP	GLO			
		JBLHB21/ JBLHA21		Hindi-II			SD| ENT| EMP	NAT			
	II	JBLEB22/ JBLEA22	Part II Language	English II a or b	5	3	SD| ENT| EMP	REG| NAT| GLO	25	75	100
	III	JBCHC21	Core –III	Physical Chemistry-I	5	5	SD	NAT	25	75	100
		JBCHC22P	Core –VI	Inorganic Qualitative Analysis and Volumetric Analysis Practical	5	3	SD| EMP	NAT	25	75	100
		JBCHA23/ JBCHA24	AECC-II	Mathematics-II/ Biochemistry-II	4	4	SD	NAT	25	75	100
	IV	JBCHS25	SEC-II	Fundamentals of Applied Chemistry	2	1	SD| EMP	NAT| REG	-	50	50
		JBUI2V	CVAC-I	Understanding India	2	2			-	50	50
				Library/ Browsing	1				-	-	-
				Remedial / Games	1	-			-	-	-
		JBCHX2P/	Extra Credit-I	Industrial Visit Report / Online Course	-	2	SD| ENT| EMP	REG	-	100	100
				Total	**30**	**21 + 2**			**125**	**475 + 100**	**600 + 100**
III	I	JBLT31	Part I Language	Tamil-III	5	3	SD	GLO	25	75	100
		JBLA31		Arabic III			SD| ENT| EMP	REG| NAT| GLO			
		JBLHB31/ JBLHA31		Hindi-III			SD| ENT| EMP	NAT			
	II	JBLEB32/	Part II	English-III a or b	5	3	SD|	REG|	25	75	100

		JBLEA32	Language				ENT| EMP	NAT| GLO			
	III	JBCHC31	Core-V	Organic Chemistry – I	4	4	SD	NAT	25	75	100
		JBCHC32P	Core –VI	Organic Analysis &Organic Estimation Practical	4	3	SD	NAT| GLO	25	75	100
		JBCHA33	AECC – III	Pharmaceutical Chemistry-I	4	4	SD| EMP	NAT| GLO	25	75	100
	IV	JBCHS34	SEC-III	Introduction to MarineChemistry	2	1	ENT| EMP	REG| NAT| GLO	-	50	50
		JBMD31CH	MD I	Chemistry of Cosmetics and Perfume	2	1	SD	REG| NAT	-	50	50
		JBES3V	CVAC II	Environmental Science for Sustainable Development	2	2			-	50	50
	V	JBXTN3	Extension	NSS/CSS	2	2			100	-	100
		JBCHX3P/ JBCHX3O	Extra Credit-II	Industrial Training Report/ Online course*	-	2	ENT| EMP	REG	-	100	100
				Total	**30**	**23 + 2**			**225**	**525 + 100**	**750 + 100**
IV	I	JBLT41	Part I Language	Tamil-IV	5	3	SD	GLO	25	75	100
		JBLA41		Arabic-IV			SD| ENT| EMP	REG| NAT| GLO			
		JBLHB41/ JBLHA41		Hindi-IV			SD| ENT| EMP	GLO			
	II	JBLEB42/ JBLEA42	Part II Language	English IV a or b	5	3	SD| ENT| EMP	REG| NAT| GLO	25	75	100
	III	JBCHC41	Core -VII	Inorganic Chemistry – II	5	5	SD	NAT	25	75	100
		JBCHC42	Core-VIII	Organic Chemistry – II	4	4	SD	NAT	25	75	100

		JBCHA43	AECC-II	Pharmaceutical Chemistry-II	4	4	SD| EMP	NAT| GLO	25	75	100
	IV	JBCHS44P	SEC – IV	Industrial Chemistry Practical	2	1	SD	REG| NAT	-	50	50
		JBMD41CHP	MD II	Preparation of Personal Care Product Practical	3	2			-	50	50
		JBDT4V	CVAC III	Digital and Technology Solution	2	2			-	50	50
	V	JBCHX4P/ JBCHX4O	Extra credit-III	Internship Report on Soil Testing or Food Quality Testing/ Online Course*	-	2	SD| EMP	REG	-	100	100
				Total	**30**	**24 + 2**			**125**	**525 + 100**	**650 + 100**
V	III	JBCHC51	Core-IX	Physical Chemistry –II	6	6	SD	NAT| GLO	25	75	100
		JBCHC52	Core-X	Organic Chemistry – III	6	6	SD	NAT	25	75	100
		JBCHC53P	Core-XI	Advanced Physical Chemistry Practical	6	4	SD| EMP	NAT	25	75	100
		JBMD51CHA/ JBMD51CHB	MD III	a. Industrial Chemistry/ b. Biological Chemistry	4	3	EMP	REG| NAT	25	75	100
		JBMD52CHA/ JBMD52CHBI	MD IV	b.Textile Chemistry/ b.Analytical Methods -# internship	4	3	SD| EMP	REG| NAT| GLO	25	75	100
	IV	JBCHS54	SEC – V	Selected topics in Applied Chemistry	2	1	SD	REG| NAT	-	50	50
		JBHW5V	CVAC IV	Health and Wellness	2	2			-	50	50
		JBESX5/ JBCHX5O	Extra Credit-IV	Employability Skills/ Online Course*	-	2			100	-	100
				Total	**30**	**25 + 2**			**125 + 100**	**475**	**600 + 100**

VI	III	JBCHC61	Core-XII	Inorganic Chemistry –III ● Integrated with online Course	6	6	SD	NAT	25	75	100
		JBCHC62	Core -XIII	Physical Chemistry – III	6	6	SD	NAT| GLO	25	75	100
		JBCHC63P	Core-XIV	Gravimetric Analysis and Organic Preparation Practical	5	3	SD| EMP	NAT	25	75	100
		JBCHC64PW	Core-XV	Project	6	5	SD| ENT| EMP	REG| NAT| GLO	25	75	100
		JBMD61CHA/ JBMD61CHB	MD V	a. Introduction to Green Chemistry / b. Introduction to Nano Chemistry	4	3	SD| EMP	NAT| GLO	25	75	100
	IV	JBCHS65P	SEC-VI	Analytical Chemistry Practical	2	1	SD| EMP	REG| NAT| GLO	-	50	50
	V	JBCHX6I/ JBCHX6O	Extra credit-V	Internship on Clinical Sample Testing or Forensic Analysis /Online Course*	-	2	ENT| EMP	REG| NAT		100	100
				Library/ Browsing	1	-			-	-	-
				Total	**30**	**24 + 2**			**125**	**425 + 100**	**550 + 100**
				Grand Total	**180**	**140 + 10**			**850 + 100**	**2850 + 400**	**3700 + 500**

Sem	Part	Subject Code	Course	Subject Title
I	I	JBLT11	Part I Language	இக்கால இலக்கியமும் சிற்றிலக்கியமும்
		JBLA11		Basic Arabic I
		JBLHB11/ JBLHA11		General Hindi-I (Basic) / Hindi Grammar & Translation (Advanced)
	II	JBLEB12/ JBLEA12	Part II Language	English for Everyday Communication (Basic) / Literature and Language for Life (Advanced)
II	I	JBLT21	Part I Language	காப்பிய லக்கியமும் புதினமும்
		JBLA21		Basic Arabic II
		JBLHB21/ JBLHA21		General Hindi II(Basic) / Hindi Prose, Poem & Story (Advanced)
	II	JBLEB22/ JBLEA22	Part II Language	English for Academic and Social Interaction (Basic) / Critical Reading and Reflective Writing (Advanced)
III	I	JBLT31	Part I Language	இடைக்கால இலக்கியமும் இதழியலும்
		JBLA31		Classical Arabic Prose
		JBLHB31/ JBLHA31		General Hindi III (Basic) / Hindi Literature & Letter Writing (Advanced)
	II	JBLEB32/ JBLEA32	Part II Language	Workplace English: Foundations of English Communication Skills (Basic) / English for the Corporate World (Advanced)
IV	I	JBLT41	Part I Language	பண்டைய இலக்கியமும் நாட்டுப்புறப் பாடல்களும்
		JBLA41		Hadeeth
		JBLHB41/ JBLHA41		General Hindi-IV (Basic) / Computer and Hindi (Advanced)
	II	JBLEB42/ JBLEA42	Part II Language	Professional Communication Skills (Basic) / Strategic Communication for Global Careers (Advanced)

For Online Course credit alone will be assigned on submission of certificate obtained by appearing for online examination from EdX, Spoken Tutorial, NPTEL or Coursera etc.

For internship course, refer www.internshala.com or any online internship course. For online course integration, syllabus will be taken from spoken tutorial

@SD- Skill Development ENT-Entrepreneurship EMP-Employability

$ R-Regional N-National G-Global

Core-I - General Chemistry

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 6**
Subject Code: JBCHC11 **Credit: 6**

Course objectives:

1. To understand basic concepts of nuclear chemistry, organic chemistry and thermodynamics
2. To gain knowledge on atomic structure and sub atomic particles

Unit I **(18 hours)**

Atomic Structure: Historical Development, Dalton's atomic theory, Limitation of Dalton's atomic theory. Electron - its discovery and properties, e/m ratio of an electron by Thomson's method, Charge on an electron by Milliken's oil drop method. Proton - its discovery and properties, Thomson's Atomic model and its drawbacks, Rutherford's alpha particles scattering experiments, Rutherford's atomic model and its drawbacks, Prouty's hypothesis, Moseley experiment, and its importance. Neutron-its discovery and properties, Atomic spectra, Ritz- combination principle. Bohr's model of Hydrogen atom-Postulates, derivation for its radius and energy, and limitations of Bohr's theory, Quantum number, Pauli's Exclusion principle, Hund's principles of maximum multiplicity and Aufbau's principle. Application - spectra and ionization potential of hydrogen.

Unit II **(18 hours)**

Basic Concepts of Organic Chemistry: IUPAC-Nomenclature of organic compounds; Molecular weight determination of organic acids and bases-Silver salt and platonic chloride methods; Problems arriving empirical and molecular formula using percentage composition of elements and molecular weight.

Fundamental concepts-homolytic fission and heterolytic fission of carbon-carbon bonds. Reaction intermediates-formation and stability of free radicals, carbonium ions, carbanions, nucleophilic and electrophilic reagents.

Types of reactions- substitution, addition, elimination, rearrangement and polymerization with suitable examples. Inductive effect and Electrometric effect-explanation with suitable examples.

Unit III **(18 hours)**

Nuclear Chemistry: Constitution of nuclei, stability of nuclei and (n-p) ratio, Magic number, Mass defect, and Binding energy, Mass - Energy relationship. Radioactivity -Natural radioactivity, Soddy's group displacement law, Radioactivity equilibrium, rate of radioactive disintegration, Half-life period and average life period, radioactive disintegration series.Nuclear fission - Theory, applications, principle of the atom bomb. Nuclear fusion-theory, solar and stellar energy, Principle of a Hydrogen bomb. Applications of radioactivity–medicine, agriculture, industry, rock dating, and Carbon dating, particle accelerators - linear accelerator andcyclotron.

Unit IV **(18 hours)**

First law of Thermodynamics: Definition of thermodynamics term, system, surroundings, types of systems, intensive and extensive properties, State and path functions and their differential, thermodynamic processes, concept of heat, and work. First law of thermodynamics -statement and mathematical form, definition of internal energy and enthalpy, calculation of w, q, ΔE and ΔH for

the expansion of ideal gases under isothermal and adiabatic conditions for a reversible process, Bond dissociation energy and its calculation from thermochemical data, Work obtained during adiabatic and isothermal change; Heat capacity - Heat capacities at constant volume and pressure and their relationship $C_p - C_v = R$; Joule's law- Joule Thomson coefficient and inversion temperature (only definition). Zeroth Law of Thermodynamics - Mathematical treatment of Zeroth law and its limitation and various statements of law.

Unit V **(18 hours)**

Acid-Base Reactions and Computer Programming: Acid-base Concept - Arrhenius concept, Theory of solvent system in H_2O, NH_3, SO_2, and HF, Bronsted – Lowry's concept, relative strength of acids, Pauling rules, amphoterism, Lux-Flood concept, Lewis concept, super acids, HSAB principle, acid-base equilibria in aqueous solution and pH. Acid-base neutralization curves - indicator, Choice of indicators.

Introduction to BASIC programming - Application of BASIC computer programming in the computation of some simple parameters such as Half-life period, Normality and Molarity of a solution.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recollect the historic development subatomic particles and comprehend the IUPAC-nomenclature of organic compounds

CO2: Identify the acid base nature of the solution medium with insight gained from the theories

CO3: Analyse atomic structure theories and make in ferences

CO4: Determine the Enthalpy of the reaction by applying acquired knowledge onthermodynamics

CO5: Create awareness about radioactive elements and ill effects on human and environment

Text Books:

1. Arun Bahl, B. S. Bahl, G.D. Tuli**,** *Essentials Of Physical Chemistry***,** S. Chand & Company Ltd.,New Delhi, 2020**.**
2. Arun Bahl and B. S. Bahl, *Text book of Organic Chemistry* S. Chand & CompanyLtd., New Delhi, 2019. [Chapter 1, 2, 4, 7, 8 & 27]

Reference Books:

1. M.S. Chouhan, *Organic Chemistry (*New edition) for JEE (Main & Advanced)Wiley's Solomons & Fryhle, 3rd Edition, 2018.
2. M. K. Jain and S. C. Sharma**,** *Modern organic chemistry***,** Vishal Publishing & co,2020.
3. Hari Jeevan Arnikar, *Nuclear chemistry Through Problems***,** New Age International Private limited, 2016.

Journals:

1. Russian Journal of General Chemistry
2. Journal of general chemistry
3. Journal of chemistry Education

E-Resources:

1. https://www.univie.ac.at/zbph/broda/dokumente/160-Nuclear_Chemistry.pdf
2. http://www.phys.ens.fr/~ebrunet/Thermo-en.pdf
3. https://docplayer.net/amp/20852352-Chemistry-3202-Unit-2-acids-and-bases.html
4. https://chem.libretexts.org/Bookshelves/General_Chemistry/

5. https://chemistrydocs.com/essentials-of-physical-chemistry-by-arun-bahl-b-s-bahl-g-d- tuli/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	3	3	3	25
CO2	9	3	9	1	3	9	3	37
CO3	9	3	9	1	3	3	3	31
CO4	9	3	9	1	3	9	3	37
CO5	9	9	3	9	3	9	3	45
Total	**45**	**21**	**33**	**13**	**15**	**33**	**15**	**175**

Low-1 Medium-3 High-9

Core-II - Inorganic Chemistry–I

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 6**
Subject Code: JBCHC12 **Credit: 6**

Course objectives:

1. To develop a foundational understanding of chemical bonding, properties of hydrogen, metallurgical processes, principles of volumetric analysis and periodic properties. .
2. To enable students to apply theoretical concepts to real-world chemical reactions, laboratory techniques, and industrial applications in metallurgy and analytical chemistry.

Unit I **(18 hours)**

Periodic Properties: Atomic and ionic radii, determination of covalent radii, ionic radii, radius ratio, factors influencing the magnitude of ionic radii, periodic variation of atomic and ionic radii, ionisation potential and its periodic variations, applications to the concept of ionization potential; electron affinity-factors influencing the magnitude of electron affinity, periodic variation of electron affinity, impact of electron affinity on chemical behaviour, electronegativity- periodic variation of electronegativity- scales of electronegativity, Pauling's bond energy scale, Mulliken scale, Allred-Rochow electrostatic approach, correlation of ionization potential and electron affinity with electronegativity, relation between oxidation state of the element and its electronegativity, applications of electronegativity concept.

Unit II **(18 hours)**

Chemical Bonding: Ionic bond - lattice energy and its determination using Born-Haber Cycle. Covalent bond- Fajan's rule and its applications. Theories of covalent bonding - Heitler-London theory and Pauling theory, types of overlapping, Sigma and Pi bonds, Formation of simple molecules like H_2, HF, F_2, N_2 and O_2.The geometry of molecules and hybridization- hybridisation of orbitals. sp, sp^2, sp^3 - hybridisation with examples- shapes of the hybridized molecule. VSEPR theory – geometry of H_2O and NH_3 molecular orbital theory–M.O diagram of H_2, O_2, N_2, F_2, CO, and HF. Metallic bond - introduction, properties of metallic bond. Non covalent interactions- elementary ideas of hydrogen bonding, Van der Waal's forces, Keesom forces, Debye and London forces.

Unit III **(18 hours)**

Hydrogen, H_2O_2, H_2O, O_2 & O_3:

Hydrogen – Hydrides - Ionic, Covalent, Metallic and polynuclear hydrides, $LiAlH_4$ and $NaBH_4$. Hydrogen peroxide - preparation, reactions and estimation.

Water - hardness of water, water softening processes, ion-exchange & reverse osmosis process, preparation, properties & uses of heavy water.

Oxygen – Oxides, classification of oxide.

Ozone -preparation, properties (oxidation and ozonolysis).

Unit IV **(18 hours)**

Metallurgy: Metallurgy - definition of metallurgy, minerals, and ores, grinding, pulverizing, ore dressing - gravity separation, hydraulic washing, froth floatation, magnetic separation and chemical separation, roasting, and calcination, reduction of minerals to metal - Carbon, Hydrogen, amalgamation process, refining of metals - Electrolytic refining, chromatography, Ion exchange method.

IA Group Elements- general properties, diagonal relationship of Li with Mg, comparison with other members of family, extraction, properties, and uses of Li.

Unit V **(18 hours)**

Principles of Volumetric: Principles of volumetric analysis - Definition of molarity, molality, equivalent weight, normality and mole fraction; definition and examples for Principles of **Qualitative analysis** - inorganic semi-micro Analysis, semi-micro techniques, principles involved in Sodium Carbonate Extract preparation, Common Ion Effect and Solubility Product and their applications in Qualitative Analysis.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Outline the understanding of chemistry behind the metallurgical process for hydrogen and Group IA group elements

CO2: Identify trends observed along period and group-based periodic properties of elements in the periodic table

CO3: Explain the principles of volumetric & qualitative analysis to find molarity, molality,and normality of given solutions

CO4: Evaluate the MO and VSEPR theory understand nature of the chemical bonding andgeometry in the organic and inorganic compounds

CO5: Adapt the correct method for preparation, of hydrogen, hydrogen peroxide, water, oxygen, ozone

Text Books:

1. Joseph William Mellor, *Modern Inorganic Chemistry***,** Palala Press, 2015.
2. B.R. Puri, L.R. Sharma and K.C. Kalia**,** *Principle of Inorganic Chemistry***,** VishalPublication Co., 2020.

Reference Books:

1. P.L. Soni and Mohan Katyal, *Text Book of Inorganic Chemistry*, Sultan Chand & Sons,New Delhi, 2017.
2. A.I.Vogel, *Text Book of Qualitative Inorganic Analysis*, ELBS Longman,

London, 2012.
3. F. Albert Cotton, Geoffrey Wilkinson, A. Murillo Carlos & Manfred Bochmann, *Advanced Inorganic Chemistry***,** A Wiley Interscience Publication, New York, 2021.
4. James E. Huheey, Ellen A. Keiter, L. Keiter Richard and K. Medhi Okhil, *Inorganic Chemistry*, Pearson India, 2019.

Journals:

1. Inorganic Chemistry Frontiers
2. Journal of Inorganic chemistry
3. Journal of Chemistry Education

E-Resources:

1. Concise-Inorganic-Chemistry-5th-Edition-pdf.pdf
2. H1-chemical-bonding -Hybridisation.pdf
3. Hydrogen, D_2O, H_2O_2, Water.pdf
4. Ozone preparation.pdf
5. Metallurgy.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	3	**39**
CO2	9	3	9	3	3	9	3	**39**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	3	**39**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**45**	**15**	**15**	**45**	**27**	**207**

Low -1 Medium-3 High-9

Skill Enhancement Course - I
Preparation of Industrial Products and Applied Chemistry Practical

(For Students Admitted from 2025-26)

Semester: I **Hours/Week: 2**
Subject Code: JBCHS15P **Credit: 1**

Course objectives:

1. To impart practical knowledge of preparing commonly used industrial and laboratory chemical products through standard procedures.
2. To develop applied skills in chemistry by engaging students in hands-on experiments that demonstrate industrial relevance and safety protocols.

List of Experiments **(30 hours)**

I. Preparation of Industrial Products

1. Preparation of White Phenyl and Black Phenyl
2. Preparation of Detergent Powder and Vessel Cleaning powder

3. Preparation of Detergent Cake
4. Preparation of Candles
5. Preparation of Ink and Talcum Powder
6. Preparation of Chalk and Nail Polish.
7. Preparation of Toothpaste or Toothpowder.
8. Preparation of lip palm.

II. Applied Chemistry Practical

1. Effect of inhibitors and protective coating on corrosion rate using weight loss method.
2. Determination of TDS in given water sample.
3. Determination of pH and conductivity of regional beverages.
4. Organic spotting by using Micro scale techniques.

Evaluation Scheme: At the end of the semester, a practical examination for two hours will be conducted for 50 marks.
Distribution of external marks:50 (Record- 10, Procedure – 10, Experimental and result- 30)

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Demonstrate the preparation of key industrial products such as soaps, detergents, dyes, paints, and pharmaceuticals using lab-scale techniques.
CO2: Understand and follow standard operating procedures (SOPs) in chemical manufacturing and laboratory environments.
CO3: Apply knowledge of chemical reactions and properties to synthesize and analyze products with industrial relevance.
CO4: Handle chemicals and equipment safely, demonstrating awareness of environmental, health, and safety standards in chemical practice.
CO5: Analyze and interpret experimental results, preparing technical reports that reflect process efficiency and product quality.

Text Book:

1. John Kenkel, *Chemistry An Industry-Based Laboratory*, Taylor & Francis Publisher, 2020

Reference Books:

1. Ranjan Kumar Mohapatra, *Engineering Chemistry with Laboratory Experiments*, PHILearning, 2015.
2. Shashi Chawla, *Textbook of Engineering Chemistry with Lab Manual Of Chemistry & Environmental Studies*, Publisher, Dhanpat Rai & Co., 2017.
3. Manoj Kumar Solanki, *Engineering Chemistry Laboratory Manual*, Edu creationPublishing, 2019.

Journals:

1. African Journal of Educational Studies in Mathematics and Sciences
2. Journal of Chemistry Education
3. Journal of cosmetic dermatology

E- Resources:

1. https://www.google.com/url?sa=t&source=web&rct=j&url=https://www.aphis.usda.gov/animal_health/emergency_management/downloads/sop/sop_cd.pdf&ved=2ahUKEwjZrvTEvpzxAhWRA3I

KHfZxDYcQFjAAegQIAxAC&usg=AOvVaw3hU7e5hL-hJz6Vu0-SkhYC
2. https://www.google.com/url?sa=t&source=web&rct=j&url=https://www.naturesgardencandles.com/mas_assets/media/pdf/manual.pdf&ved=2ahUKEwiZ2pOYv5zxAhW_yzgGHfDmA64QFjAAegQIAxAC&usg=AOvVaw1hwVIp0-YTGIwl7LdraOJp
3. https://www.google.com/url?sa=t&source=web&rct=j&url=https://chem.ku.edu/sites/chem HaFyCMcQFjAMegQIGRAC&usg=AOvVaw0wveersqP8h_7GlKwGUQqS
4. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/cosmeticsfornail.pdf
5. https://www.allaboutchemistry.net/preparation-soaps-nail-polish-boot-polish-varnish-nail-remover -shampoo-perfumes-isc-chemistry-project/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	3	9	**39**
CO2	9	3	9	9	3	9	9	**51**
CO3	9	3	9	9	3	9	9	**51**
CO4	9	3	9	9	3	9	9	**51**
CO5	9	3	9	9	3	9	9	**51**
Total	**45**	**15**	**45**	**39**	**15**	**39**	**45**	**243**

Low-1 Medium-3 High-9

Core-III - Physical Chemistry–I

(For Students Admitted from 2025-26)

Semester: II **Hours/Week: 5**
Subject Code: JBCHC21 **Credit: 5**

Course objectives:
1. To gain basic knowledge on laws those govern thermodynamics.
2. To understand the fundamental concepts in quantum chemistry, gaseous state, adsorption and phase rule

Unit I **(15 hours)**

Quantum Chemistry: Quantum theory of radiation, The Sommerfield extension of Bohr theory, Planck's theory, Photoelectric effect, Compton effect, Wave mechanical concept of the Atom, De-Broglie's Relationship, Davisson and Germer Experiment, wave nature of electron, Heisenberg's Uncertainty Principle, Schrodinger Wave Equation (Without Derivation), Significance of Wave Functions, ψ^1 and ψ^2, Probability distribution of electrons, radial probability distribution curves. **Gaseous state–** Kinetic gas equation, derivation, gas laws from the kinetic gas equation, kinds of velocities - Mean, RMS, Most probable velocities, calculation of molecular velocities, Maxwell's distribution of molecular velocities (no derivation).

Unit II **(15 hours)**

Second Law of Thermodynamics: Second Law of Thermodynamics-need for the II law, Spontaneous process, criteria of spontaneity, different forms of statements of the second law, cyclic process, Heat Engines, Carnot's cycle, Efficiency - Carnot's theorem (statement only), Concept of entropy- definition and mathematical statement, randomness, and entropy; standard entropy - derivation of entropy from Carnot cycle, entropy change of an ideal gas during isothermal process, entropy changes in cyclic - reversible and irreversible processes, entropy changes in physical transformations, calculation of entropy changes with changes in T, V and P, entropy of mixing of ideal gases; free energy and work function, Gibbs free energy Carnot, Helmholtz work function-their variations with temperature, pressure, and volume, criteria for spontaneity, Gibbs-Helmholtz equations - derivation and applications.

Unit III **(15 hours)**

Third Law of Thermodynamics & Liquid Crystals: Third law of thermodynamics - entropy at Absolute zero, Planck's formulation of third law, Nernst heat theorem, statement of III law of thermodynamics, evaluation of absolute entropy from heat capacity measurements, exceptions to III law, application of III law; partial molar properties, chemical potential, Gibbs-Duhem Equation, effect of temperature and pressure on chemical potential. liquid crystals - classification and molecular arrangements, liquid state, density, diffusion, viscosity, evaporation; surface tension, effect of temperature on surface tension, parachor - definition and applications only, coefficient of viscosity-effect of temperature and effect of pressure.

Unit IV **(15 hours)**

Colligative Properties & Adsorption: Colligative Properties - lowering of vapour pressure, osmosis, and osmotic pressure, relation between osmotic pressure and vapour pressure of an ideal solution, reverse osmosis; elevation of boiling point and depression of freezing point - derivations and determinations, Vant Hoff Factor . Adsorption - distinction between chemical and physical adsorption, adsorption isotherms, Freundlich adsorption isotherm, Langmuir adsorption isotherm - derivation, Brunauer Emmett Teller (BET) - measurement of surface area.

Unit V **(15 hours)**

Phase Rule: Definition – phase, number of components and number of degrees of freedom, Gibbs phase rule (derivation). One component system - water system, two-component system - reduced phase rule, simple eutectic systems - Pb-Ag system. Systems involving compound formation - congruent and incongruent melting points-Zn-Mg system and dehydration of $CuSO_4.5H_2O$. Distribution law - statement, conditions for the validity of distribution law, thermodynamic derivation, applications of the distribution law.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall the meaning of various terms involved in quantum chemistry and relates the physical phenomena

CO2: Apply the concepts of thermodynamics & gaseous state to find thermodynamic parameters

CO3: Assume the concepts of liquid Crystals to derive physical parameters

CO4: Interpret the knowledge about colligative properties & adsorption

CO5: Construct the phase diagram by applying phase rule

Text Books:

1. B.R. Puri, L.R. Sharma and S. Pathania, *Principles of Physical Chemistry*, VishalPublishing Co, New Delhi, 2018.
2. Peter Atkins, *Atkins Physical Chemistry*, Oxford University Press, New York, 11thEdition, 2018.

Reference Books:

1. A. S. Nagi and S.C. Anand, *A Text Book of Physical Chemistry*, New age internationalprivate Ltd, New Delhi, 2016
2. Donald A. Macquarie, *Quantum Chemistry*, 2016.
3. K. L. Kapoor, *A Textbook of physical chemistry-Quantum Chemistry*, 2020

Journals:

1. Journal of Physical Chemistry A
2. Russian Journal of Applied Chemistry
3. Journal of chemistry Education

E-Resources:

1. DARIN J ULNESS -Physical-Chemistry-Quantum-Chemistry.pdf
2. Gurtu-J-N-Khera-H-C-Physical-chemistry-Vol-III-Pragati-Prakashan-2009-pdf.pdf
3. THERMODYNAMICS-pdf.pdf
4. DARIN J ULNESS -Physical-Chemistry-Quantum-Chemistry.pdf
5. https://chem.libretexts.org/Courses/Pacific_Union_College/Quantum_Chemistry

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	3	**39**
CO2	9	3	9	3	3	9	3	**39**
CO3	9	3	9	3	3	9	3	**39**
CO4	9	3	9	3	3	9	3	**39**
CO5	9	3	9	3	3	9	3	**39**
Total	**45**	**15**	**45**	**15**	**15**	**45**	**15**	**195**

Low-1 Medium-3 High-9

Core-VI - Inorganic Qualitative Analysis and Volumetric Analysis Practical

(For Students Admitted from 2025-26)

Semester: II **Hours/Week: 5**
Subject Code: JBCHC22P **Credit: 3**

Course objectives:

1. To gain practical skills in handling apparatus to minimize errors
2. To apply principles of qualitative and quantitative analysis in identify and quantify salt in solution.

List of Experiments

1. Inorganic Qualitative Analysis: (30 hours)

Mixtures containing two cations and two anions (one interfering ion).

Cations: Lead, Bismuth, Copper, Cadmium, Arsenic, Antimony, Iron (II and III), Aluminium, Chromium, Zinc, Manganese, Cobalt, Nickel, Barium, Strontium, Calcium, Magnesium and Ammonium.

Anions: Carbonate, Sulphide, Nitrate, Sulphate, Bromide, Iodide, Arsenate and Chromate.

Interfering ions: Fluoride, Oxalate, Borate and Phosphate.

2. Volumetric Analysis: (45 hours)

a. Acid – Base:

1. Estimation of Sodium Hydroxide or Potassium Hydroxide (Standard AR SodiumCarbonate)
2. Estimation of Hydrochloric acid or Sulphuric acid (Standard AR Oxalic acid)
3. Estimation of a mixture of Sodium Hydroxide and Sodium Carbonate

b. Permanganometry:

1. Estimation of Ferrous ion
2. Estimation of Calcium (direct Method)
3. Estimation of Hydrogen Peroxide

c. Dichrometry:

1. Estimation of Ferrous ion
2. Estimation of Ferric ion using external indicator (demonstration only)

d. Iodometry and Iodimetry:

1. Estimation of Potassium dichromate
2. Estimation of Potassium permanganate
3. Estimation of Copper

e. Argentimetry:

1. Estimation of Potassium Chloride (standard AR Sodium Chloride) - demonstration only

Evaluation Scheme: 3 hrs. for volumetric analysis and 3hrs. for qualitative analysis.
Distribution of external marks - 75
Record - 5 marks

volumetric analysis - 35

a) Procedure – 10
b) Estimation – 25 (> 1 % error – 25, 1-2 % - 20, 2-3 % -15, 3-4 %- 10, < 4% - 5)

qualitative analysis - 35

a) Anion analysis with procedure – 15 (6 marks for each anion and 3 marks for elimination of interfering radicals)
b) Cation analysis with procedure – 20 (group separation -8, for each cation with group analysis procedure – 6,

Course Outcomes:

After successful completion of this course, student will be able to

CO1: List the principle behind qualitative of inorganic compounds and understand the nature of interfering ions

CO2: Illustrate the volumetric law to quantify the solute in solutions.

CO3: Examine the inorganic salt mixture for their cations and anions
CO4: Compare the volumetric analysis based on the type of reaction and identify indicator requirements
CO5: Design the volumetric procedure based on the nature of the solution

Reference Books:
a. V. Venkateswaran, R. Veeraswamy & A. R. Kulandaivelu, *Basic Principles of Practical Chemistry*, Sultan Chand & Sons Publications, New Delhi, 2017.
b. Y. Shi**,** *Text Book of Quantitative Chemical Analysis*- Auris Publishing**,** 2017.
Journals:
1. African Journal of Educational Studies in Mathematics and Sciences
2. Journal of chemistry Education
3. International Journal of Science and Qualitative Analysis

E-Resource:
1. http://www.rbmcollege.ac.in/sites/default/files/files/reading%20material/inorganic- qualitative-analysis.pdf
2. https://www.sciencedirect.com/topics/chemistry/volumetric-analysis
3. https://www.pharmaguideline.com/2021/10/cerimetry-iodimetry-iodometry-bromometry-dichrometry.html
4. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Qualitative_Analysis
5. https://pubs.acs.org/doi/10.1021/ed081p725

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	3	**39**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**45**	**15**	**15**	**45**	**39**	**219**

Low-1 Medium-3 High-9

Skill Enhancement Course II - Fundamentals of Applied Chemistry

(For Students Admitted from 2025-26)

Semester: II **Hours/Week: 2**
Subject Code: JBCHS25 **Credit: 1**

Course objectives:
1. To gain basic knowledge on cement and fuels
2. To understand the reason behind corrosion, importance of alloys, paints and composite materials

Unit I **(6 hours)**

Fuels: Definition, types of fuels, characteristics, properties, solid fuels (wood and coal) liquid fuels, disadvantages of solid fuels over liquid and gaseous fuels, nuclear fuels, difference between nuclear and chemical fuels.

Unit II **(6 hours)**

Alloys: Introduction, physical and chemical properties of alloys, purpose of making alloys, types of alloys, Ferrous alloys, Copper alloys, Nickel alloys, Nickel-Iron alloys, super alloys, hard alloys, preparation of Alloys.

Unit III **(6 hours)**

Cement: Cement - Manufacture - wet process and dry process, types, analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India.

Composite Materials – Constitution -Matrix, dispersed phase, classification, composite manufacturing methods.

Unit IV **(6 hours)**

Paints & Pigments: Introduction, white pigments, manufacture, characteristic of pigments, Lithopone, physical properties of pigments, uses. Paints-classification, constitution and its manufacturing process.

Unit V **(6 hours)**

Corrosion: Introduction, disadvantages of corrosion, Types of corrosion-Galvanic, pitting, stress and erosion; corrosion fatigue, corrosive agents, prevention of corrosion-cathodic and anodic protection, surface coating and inhibitors and corrosion rate measurement-polarization techniques.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall properties of fuels, alloys, paints & pigments to explain their applications

CO2: Identify the choice of materials based on the composition

CO3: Classify the cement and composite material based on the method of preparation

CO4: Evaluate the environmental effect of fuels

CO5: Predict the effective corrosion minimization method

Text Books:

1. P.C Jain and Monica Jain**,** *Engineering Chemistry*, Dhanpat Rai Publishing CompanyLtd., New Delhi, 17th Edition, 2019

2. B.K. Sharma, *Industrial Chemistry* Part 1&2 ,2020

Reference Books:

1. Edwin. E. Slosson, *Chemistry for chemical Industries***,** Medtech publisher, 2017.

2. Shasi chawla, *A Text Book Of Engineering Chemistry*, 2017.

3. B.N.Srinivas, *Engineering chemistry*, Laxmi publication, First Edition, 2016.

Journals:

1. Journal of Applied Chemistry springer
2. Annual review of physical Chemistry
3. Journal of chemistry Education

E-Resource:

1. https://www.slideshare.net/mschumann/applied-chemistry-powerpoint
2. https://chem.libretexts.org/Bookshelves/General_Chemistry/Chemistry_(OpenSTAX)/17%3A_Electrochemistry/17.6%3A_Corrosion
3. https://nzic.org.nz/app/uploads/2017/10/10D.pdf
4. https://www.icevirtuallibrary.com/isbn/9780727739452
5. https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Inorganic_Chemistry/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	3	9	**39**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	9	3	9	9	**51**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**45**	**21**	**15**	**39**	**45**	**225**

Low-1 **Medium-3** **High-9**

Extra Credit-I - Industrial Visit Report

(For Students Admitted from 2025-26)

Semester: II
Subject Code: JBCHX2P **Credit: 2**

Course Objectives:

1. To provide students with practical exposure to industrial operations and professional environments.
2. To connect theoretical learning with real-world applications in the industry.

The students should undergo industrial visit in any of chemical, textile, clinical or pharmaceutical industry. They have to prepare the report with the guidance of the course teacher. Necessary documents and the evidence to be enclosed in the report.

Evaluation Scheme:75 marks will be given for the documentation of the report and 15 marks for the presentation and 10 marks for the viva voce.

Course Outcomes:

After successful completion of this course, student will be able to
CO1: Understand and explain key industrial processes and technologies.
CO2: Relate academic concepts to industry practices and operations.

CO3: Observe and report on organizational structure and workflow.
CO4: Recognize industry standards for safety, quality, and efficiency.
CO5: Prepare and present a comprehensive report reflecting on the visit experience.

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	3	9	9	45
CO2	9	9	9	3	9	9	9	57
CO3	9	9	9	3	9	9	9	57
CO4	9	3	9	3	3	9	9	45
CO5	9	3	9	9	3	9	9	51
Total	45	27	45	21	27	45	45	255

Low-1 Medium-3 High-9

Core-V - Organic Chemistry–I

(For Students Admitted from 2025-26)

Semester: III **Hours/Week: 4**
Subject Code: JBCHC31 **Credit: 4**

Course Objectives:

1. To provide an in-depth understanding of the structure, properties, reactions, and preparation methods of aliphatic hydrocarbons, polynuclear aromatic hydrocarbons, hydrogen, halogenated compounds, and organometallic compounds.
2. To develop the ability to apply organic and inorganic chemical principles to predict reaction mechanisms and understand their industrial and laboratory applications.

Unit I **(12 hours)**

Aliphatic Hydrocarbons: Aliphatic Saturated Hydrocarbons - General methods of preparation, properties and reactions of alkanes; free radical substitution, halogenation of methane and ethane, petroleum products, cracking, octane number, and flashpoint.

Aliphatic unsaturated hydrocarbons-General methods of preparation, properties and reactions of alkenes, ethylene and propene, Markovnikoff‟s rule and peroxide effect, mechanism of addition to carbon, carbon double bond; alkynes -preparation, properties, and reactions of acetylene. Alkadienes - isolated, conjugated and cumulated double bond systems with examples - Thiele‟s theory of partial valency.

Unit II **(12 hours)**

Cycloalkanes and Aromatic Hydrocarbons: **Cycloalkanes** -nomenclature, general methods of preparation and reactions of cycloalkanes, Baeyer's strain theory and its modifications, conformational analysis of cyclohexane.

Conformational analysis - introduction of terms, conformers, dihedral angle, torsional strain,

conformational analysis of ethane and n-butane including energy diagrams, conformers of cyclohexane (chair, boat and skew boat forms) including energy diagram, axial and equatorial bonds, ring flipping showing axial equatorial interconversions.

Benzene - preparation, reactions, and structure of benzene, aromaticity and Huckel"s (4n+2) rule, aromatic substitution -orientation in benzene ring, Relative and absolute method, mechanism of aromatic electrophilic mono-substitution- i) halogenation ii) Friedel-Crafts reactions iii) Nitration iv) Sulphonation, Di-substitution – effect of substituent on di substation – directive and activation effect. Aromatic nucleophilic substitution - unimolecular and bimolecular substitution.

Unit III **(12 hours)**

Polynuclear Hydrocarbons, Oils, Fats and Dyes: Polynuclear Hydrocarbons - Preparation, Properties, Structure and Uses of Naphthalene, Anthracene and Phenanthrene. Preparation and Uses of Naphthylamine, Naphthols, Naphthaquinone and Anthraquinone. Preparation of Biphenyl, Benzidine and Stilbene. Oils and Fats- Definition, Determination and Application. Dyes - Definition, Otto-Witt theory of color and constitution, Classification of dyes according to structure and applications, Preparation and uses of following dyes - Methyl orange, Malachite green, Phenolphthalein, Indigo and Alizarin.

Unit IV **(12 hours)**

Halogen Compounds: Nomenclature of alkyl and aryl halides, preparation of alkyl halides, from alcohols and alkenes, radical halogenation, alkylic bromination of alkenes, preparation of aryl halides. reactions of alkyl halides-substitution reactions, S_N1 & S_N2, mechanism, kinetics, andenergy profile diagram & stereochemistry. Reactions of vinyl and allyl halides-elimination of alkyl halides, E_1 & E_2 mechanism, Saytzeff rule. Reactions of aryl halides-nucleophilic aromatic substitution reaction with mechanism, bimolecular displacement mechanism, elimination- addition mechanism, and addition-elimination mechanism, benzyne intermediate; electrophilic addition reaction -mechanism of addition of hydrogen halides and halogen to alkenes, Markovnikoff's rule, peroxide effect mechanisms.

Unit V **(12 hours)**

Organometallic Compounds and Alcohols: Organometallic compounds - preparation of grignard reagent, organolithium compounds, organozinc compounds, organocopper compounds- Reformatsky reaction, synthesis of organic compounds using Grignard reagent and alkyl lithium. Alcohols - nomenclature, preparation of alcohols, by reduction of carbonyl compounds, reaction of carbonyl compounds with Grignard reagent, properties of alcohol, hydrogen bonding, reactions of alcohols, dehydration, conversion to Tosylates-oxidation. aliphatic alcohol -General methods of preparation, properties, and reactions of monohydric Alcohol. Unsaturated alcohol - allyl alcohol. Polyhydric alcohol – Glycol, Glycerol, and Nitro-glycerin, Estimation of hydroxy groups

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Classify and explain the chemistry of aliphatic hydrocarbons (alkanes, alkenes, and alkynes), including their preparation, properties, and typical reactions.

CO2: Understand the structure and reactivity of polynuclear hydrocarbons (like naphthalene, anthracene, phenanthrene) and their uses in industrial and pharmaceutical fields.

CO3: Describe the properties and applications of hydrogen and its isotopes, including hydrides and

hydrogenation processes.

CO4: Explain the synthesis, physical and chemical properties of halogenated organic compounds, and evaluate their environmental and biological significance.

CO5: Understand the structure, bonding, and reactivity of organometallic compounds, especially their role in catalysis and industrial organic synthesis.

Text Book:

1. Arun Bahl & Bahl , *A Text Book of Organic Chemistry*, S. Chand & Company, 2016.

Reference Books:

1. P.L. Soni and H. M. Chalwa, *Text Book of Organic Chemistry*, 29th Edition, Sultan Chand & Sons, New Delhi, 2019.
2. M. K. Jain and S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co, NewDelhi, 2020.
3. Robert Thorhton, Morrison Robert and Robert Neilson Boyd, *Organic Chemistry*, Pearson India, Sixth Edition, 2016.
4. Michael B. Smith, *Jerry March's Advanced Organic Chemistry (Reactions, Mechanisms and Structure)*, Eighth Edition, Wiley Eastern Limited, New Delhi, 2020.

Journals:

1. The Journal of Organic Chemistry
2. European Journal of Organic Chemistry.
3. Asian Journal of Organic Chemistry

E-Resources:

1. https://www.researchgate.net/profile/Dr_Sumanta_Mondal/publication/329415872_UNI-
2. https://www.allamaiqbalcollege.edu.in/uploads/download_2004191004.pdf
3. https://www.allamaiqbalcollege.edu.in/uploads/download_2004191004.pdf
4. https://crab.rutgers.edu/~alroche/Ch14.pdf
5. https://chem.libretexts.org/Courses/Sacramento_City_College/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	3	3	3	**31**
CO2	9	3	9	3	3	3	3	**33**
CO3	9	3	9	3	3	9	3	**39**
CO4	9	3	9	3	3	9	3	**39**
CO5	9	3	9	3	3	9	3	**39**
Total	**45**	**15**	**45**	**13**	**15**	**33**	**15**	**181**

Low-1 Medium-3 High-9

Core-VI - Organic Analysis and Organic Estimation Practical

(For Students Admitted from 2025-26)

Semester: III **Hours/Week: 4**

Subject Code: JBCHC32P **Credit: 3**

Course Objectives:

1. To develop skills in testing and analyzing of organic compounds

2. To build skills required in chemistry such as the proper handling of apparatus and chemicalsof organic compounds

List of Experiments

1. Organic Analysis: (30 hours)

Analysis of following functional groups (anyone), organic substance (Aliphatic or Aromatic) stating saturation or unsaturation and confirmation by the preparation of a solid derivation. Acids (monocarboxylic and dicarboxylic), Phenols (monohydric and polyhydric) , Aldehydes, Ketones, Esters, Nitro Compounds, Amines, (Primary, Secondary and tertiary), Amides (monoamide and diamide), Anilides, Halogenated Hydrocarbons (side chain and nuclear) and carbohydrates. Determination of Melting point (using Melting point instrument) and boiling points.

2. Organic Estimation: (30 hours)

1. Estimation of Phenol
2. Estimation of Aniline
3. Estimation of Glucose (Bertrand‟s Method)

Evaluation Scheme: 3 hours for Organic Analysis and 3 hours for Organic Estimation.
Distribution of external marks - 75
Record - 10 marks
Organic analysis - 35
Aromatic / Aliphatic – 5
Saturated / unsaturated – 5
Elements present – 5
Functional group present – 10
Derivation – 10
Organic preparation - 30
Procedure – 10
Crude sample - 15
Recrystallization sample - 5

Course Outcomes:

After successful completion of this course, student will be able to
CO1: List the basic principles of organic chemistry to comprehend functional group
CO2: Build skills in preparing derivate of organic compounds
CO3: Analyze the organic compounds for aromatic/aliphatic/saturation/unsaturation
CO4: Determine the physical properties of organic compounds
CO5: Estimate the phenol, aniline, and glucose content of organic compounds

Textbook:

1. V. Venkateswaran, R. Veeraswamy and A. R. Kulandaivelu, *Basic Principles of Practical*

Chemistry, New Delhi, Sulthan Chand & Sons Publications, 2017.

Reference Books:

1. K.K. Rehani, N.K. Verma, B.K. Vermani, *Comprehensive Practical Chemistry* Laxmi Publications, First Edition, 2019.
2. Furniss and Brian S and Hannaford and Antony J, *Vogels* Textbook Of Practical Organic Chemistry, 5th Edition by, Pearson India, 2016.
3. A. I. Vogel, *Text Book of Practical Organic Chemistry*, ELBS, London, 5th Edition, 2010.

Journals:

1. Journal of Organic Chemistry
2. Organic letter
3. Trace Organic Analysis Journal

E-Resources:

1. https://drive.google.com/file/d/1BtYs8N32iUeifkHLCkeBQpdqYwUIWuQI/view?usp=sha ring
2. https://drive.google.com/file/d/1EEPKWIkHIhB5PkgOhiav4Cq2ZlW2ADW3/view?usp=s haring
3. https://drive.google.com/file/d/1hemR8ajU0JR_SGkSJzBxYZ4l3qgehyNy/view?usp=shari ng
4. https://www.csub.edu/chemistry/organic/manual/Lab14_QualitativeAnalysis.pdf
5. http://wwwchem.uwimona.edu.jm/lab_manuals/c10expt25.html

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	3	9	3	**37**
CO2	9	3	9	1	3	9	9	**43**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**45**	**11**	**15**	**45**	**39**	**215**

Low-1 Medium-3 High-9

Ability Enhancement Compulsory Course - I-Pharmaceutical Chemistry – I

(For Students Admitted from 2025-26)

Semester: III **Hours/Week: 4**
Subject Code: JBCHA33 **Credit: 4**

Course Objectives:

1. To enable the students to understand the concepts in pharmaceutical chemistry and drugsdesign
2. To gain knowledge on analytical separation, assay of drugs and metabolism of drugs

Unit I **(12 hours)**

Introduction to pharmaceutical chemistry, classification, and nomenclature of drugs: Pharmaceutical chemistry - definition, important aspects of pharmaceutical chemistry, role of chemistry in pharmacy, pharmacopoeia; terms used in chemistry of drugs-classification of drugs based on chemical structure and therapeutic actions, nomenclature, IUPAC naming of simple

heterocyclics, stereo chemical notations.

Unit II **(12 hours)**

Theories of drug action and factors affecting drug action: Biological defenses, chemical defenses, isosterism in drugs; drug receptors - nature, isolation, modification and localization of receptors; theories of drug Action - nature of pharmacological action, occupancy theory, rate theory, induced fit theory; mechanism of drug action, action of drugs on enzymes, drugs acting on biological membranes, factors affecting drug action, nonspecific action of drugs and pharmacogenomics - personalized medicine.

Unit III **(12 hours)**

Assay of Drugs and Metabolism of Drugs: Chemical assay, biological assay, immunological assay; metabolism of drugs– factors affecting metabolism, phases of metabolism, phase-I reactions– microsomal reductions, non-microsomal metabolism, hydrolysis, phase-II reactions–major path way of metabolism.

Unit IV **(12 hours)**

Quantitative Structure-Activity Relationship: Quantitative structure-activity relationship between chemical structure and pharmacological activity, effects of unsaturation, chain length, isomerism, halogens, Amino group Nitro and Nitrite Compound, Nitrile group, Acidic group, Hydroxyl group, Alkyl groups, Hansh Equation, Craig plot, Topliss scheme, achievements of QSAR-limitations of QSAR.

Unit V **(12 hours)**

Analytical Separation: Analytical Separation methods - liquid-liquid extraction, distribution coefficient, and distribution ratio, factors influencing solvent extraction, elementary idea on chromatography – TLC, HPLC, and GC and applications.

Drug Design -introduction, methods of lead discovery, application of bioisosterism in drug design, prodrug design and computer-aided drug design

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall the basic concepts of pharmaceutical chemistry

CO2: Apply appropriate chromatography techniques in TLC, HPLC, and GC in isolation ofdrugs

CO3: Analyze the assay and metabolism of drugs to find the major pathway

CO4: Determine the application of pharmaceutical chemistry is concerned with the drug designand synthesis of biologically active molecules

CO5: Design potential candidate for drug molecule using the QSAR analysis

Text Books:

1. Ashutosh Kar, *Medicinal Chemistry*, New Age International Publishers, 2018.
2. V.K. Ahluwalia, and Madhu Chopra, *Textbook of Medicinal Chemistry*, 1st Edition, AnneBook‟s Pvt. Ltd., New Delhi, 2015.

Reference Books:

1. R.P. Budhiraja, *Separation Chemistry*, Newage International Ltd, New Delhi, 2016.
2. G.R. Chatwal, *Organic Pharmaceutical Chemistry*, New Delhi, Himalaya PublishingHouse,

2016.

Journals:

1. Pharmaceutical Chemistry Journal
2. Journal of Pharmaceutical Chemistry and Chemical Science
3. The Pharmaceutical and Chemical Journal

E-Resource:

1. https://www.slideshare.net/RupalAgarwal5/pharmaceutical-chemistry-72953136
2. https://www.sciencedirect.com/topics/medicine-and-dentistry/drug-metabolism-assay
3. https://www.researchgate.net/profile/Chanin-Nantasenamat-/publication/28358424_A_Practical_Overview_of_Quantitative_Structure-Activity_Relationship/links/00463534b9ff4d92a3000000/A-Practical-Overview-of- Quantitative-Structure-Activity-Relationship.pdf
4. https://analyticalsciencejournals.onlinelibrary.wiley.com/doi/abs/10.1002/jssc.201900656
5. https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/drug-nomenclature

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	3	3	**33**
CO2	9	3	9	3	3	9	3	**39**
CO3	9	3	9	3	3	9	3	**39**
CO4	9	3	9	3	3	9	3	**39**
CO5	3	3	9	3	3	9	9	**39**
Total	**39**	**15**	**45**	**15**	**15**	**39**	**21**	**189**

Low-1 Medium-3 High-9

Skill Enhancement Course - III - Introduction to Marine Chemistry

(For Students Admitted from 2025-26)

Semester: III **Hours/Week: 2**
Subject Code: JBCHS34 **Credit: 1**

Course Objectives:

1. To gain knowledge on basic understanding on marine science and chemical equilibrium
2. To enable students to know the importance of seaweeds and sea water battery

Unit - I **(6 hours)**

Introduction: Introduction- chemical oceanography, ocean basins; properties of fresh water and seawater, temperature, salinity, density, micro & macro nutrient analysis of sea water, life in the oceans and the chemical connection.

Unit - II **(6 hours)**

Chemical Equilibrium: Chemical equilibrium - ion complexes, acid-base reactions, carbonate

chemistry (Alkalinity, DIC), redox chemistry, seawater composition changes, marine sediments, radioactive tracers, and stable isotopes.

Unit - III **(6 hours)**

Salinity: The Salts -The ocean salinity and dissolved salts, sources of salts & salt balance, resistance time, The gases-types, depth distribution, CO_2 as buffer, carbon cycle and other substances.

Unit - IV **(6 hours)**

Heavy Metals in Sea Water, Cement, Soil, Sea Water: Heavy metals contribution in seawater, Cement and soil. Sediments and their intoxication oil slick, suitable adsorbents for oil slick; Sea water- marine corrosion and anti-corrosion coating material.

Battery - types of battery, mechanism and applications, energy storage, Basic principles of super capacitors.

Unit - V **(6 hours)**

Seaweeds: Classification, uses of seaweeds in various fields, biofuels, nutritional and medicinal value of sea weeds, humans and the sea and the impacts of humans on the marine environment

Course Outcomes:

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

CO1: Recall the characteristics of seawater and understand the sea battery
CO2: Classify the acid-base reaction and stable isotopes
CO3: Analyze the micro and macronutrient in seawater
CO4: Compare carbon cycle and chemical equilibria in marine chemistry
CO5: Test the seaweed cultivation with knowledge acquired

Text Book:

1. Frank J. Millero, *Chemical Oceanography*, CRC Press, Fourth Edition, 2016.

Reference Books:

1. Jean-Pierre Gattuso and Lina Hansson Ocean acidification OUP Oxford, 2011.
2. The Open University *Seawater: Its Composition, Properties and Behaviour*,Oceanography Series, Pergamon, 2nd Edition, 1995.
3. J.K. Grasshoff, K.Kremling, M.Ehrhardt, *Methods of Seawater Analysis*, 3 completelyrevised and extended Edition, Wiley-VCH, 1999.

Journals:

1. Marine Chemistry - Journals
2. Journal of Marine Science Research and Oceanography
3. International Journal of Research in Marine Sciences

E- Resources:

1. https://www.soest.hawaii.edu/oceanography/courses/OCN623/Spring%202015/Salinity2015web.pdf
2. https://www.ocean.washington.edu/courses/oc400/Lecture_Notes/CHPT5.pdf
3. https://www.slideshare.net/norolaynsaid/heavy-metals-66977026
4. https://www.newworldencyclopedia.org/entry/Seaweed

5. https://nsidc.org/cryosphere/seaice/characteristics/brine_salinity.html

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	9	3	**45**
CO2	9	9	3	3	3	3	3	**33**
CO3	9	9	9	3	3	9	9	**51**
CO4	9	9	3	3	3	9	3	**39**
CO5	9	9	9	3	3	9	9	**51**
Total	**45**	**45**	**33**	**15**	**15**	**39**	**27**	**219**

Low-1 Medium-3 High-9

Multi- Disciplinary I - Chemistry of Cosmetics and Perfume

(For Students Admitted from 2025-26)

Semester: III **Hours/Week: 2**
Subject Code: JBMD31CH **Credit: 1**

Course objectives:

1. The objective of this course is to make students aware of the contents of personal care products, uses, harmful effects, caution about overuse and chemistry behind the 'Cosmetics'.
2. To gain knowledge about formulations of various types of cosmetics and their significance

Unit I **(6 hours)**

Introduction to Cosmetics: Introduction, history of cosmetics, product types - aerosol, emulsion, gel, non-aerosol, solution and stick. Quality control. Testing-clinical testing, consumer testing, Draize test, efficacy testing, RIPT, salon testing. Herbal cosmetics - herbs used in cosmetics, hazardous chemicals in cosmetics. Cosmetic packaging and labeling, How to read PCP (Personal Care Product) label, **cosmetic regulations and laws** -Food, Drug and Cosmetic Act (FD&C Act), Fair Packaging and Labeling Act (FPLA). Cosmetic industry - a boon for Indian economy.

Unit II **(6 hours)**

Skin care Products: Skin care basics and routine- acne on skin, prevention and remedies -skin cleansers -face wash – classifications- toners – cold cream – cleansing milk – moisturizers – hand and body lotions - skin tan – sun screen lotions – constituents, exfoliants, tattoos and tattoo ink - How safe are they

Unit III **(6 hours)**

Hair care products: Hair care and nutrition, shampoos – principal constituents – thickeners and foam stabilizers – perfumes – preservatives - conditioning agents – anti-dandruff shampoos. Hair cream – composition – hair gels - hair dyes – types – constituents - dye removals

Unit IV **(6 hours)**

Perfumes: Types of perfumes, raw materials in perfumery, production of natural perfumes, flower perfumes. Deodorants, anti-perspirants.).

cosmetics: Eye shadows, under-eye concealers, eye-liners, mascaras, artificial eyelashes, and eyebrow pencils, eye makeup removers, Lipsticks and nail polish.

Dental care: Tooth pastes – ingredients – mouth wash

Unit V **(6 hours)**

Beauty treatments Facials: types – advantages – disadvantages; face masks – types; bleach - types – advantages– disadvantages; shaping the brows; eyelash tinting; perming – types; hair colouring and dyeing; permanent waving – hair straightening; wax types – waxing; pedicure, manicure - advantages – disadvantages

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Know about the composition of various cosmetic products.

CO2: Understand chemical aspects and applications of hair care and dental care and skin care products.

CO3: Understand chemical aspects and applications of perfumes and skin care products.

CO4: To understand the methods of beauty treatments their advantages and disadvantage.

CO5: Understand the hazards of cosmetic products.

Text Books:

1. Thankamma Jacob, (1997) Foods, drugs and cometics – A consumer guide, Macmillan publication, London.

Reference Books:

1. Modern Technology of Cosmetics, Asia Pacific Press Inc, New Delhi, 2004.
2. E. Stocchi: Industrial Chemistry, Vol 1, Ellis Horwood Ltd. UK, 1990.
3. P.C Jain, M. Jain: Engineering Chemistry, 16th edition, Dhanpat Rai & Sons, Delhi, 2015.
4. Sharma B.K & Gaur H, Industrial Chemistry, Goel Publishing House, Meerut (1996).

Journals:

1. Flavour and Fragrance Journal

E-Resources:

1. http://www.khake.com/page75.html
2. Net.foxsm/list/284

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	3	9	9	45
CO2	9	3	9	3	3	9	9	45
CO3	9	3	9	9	3	9	9	51
CO4	9	3	9	3	3	9	9	45
CO5	9	3	9	3	3	9	9	45
Total	45	15	45	21	15	45	45	231

Low-1 Medium-3 High-9

Extra Credit-II – Industrial Training Report

(For Students Admitted from 2025-26)

Semester: III
Subject Code: JBCHX3P **Credit: 2**

Course Objectives:

1. To provide hands-on experience in an industrial or professional environment related to the student's field of study.
2. To develop technical, managerial, and communication skills through real-time projects and tasks

The students should undergo industrial training in any of chemical, textile, clinical or pharmaceutical industry for ten days. They have to prepare the report with the guidance of the course teacher. Necessary documents and the evidence to be enclosed in the report.

Evaluation Scheme: 75 marks will be given for the documentation of the report and 15 marks for the presentation and 10 marks for the viva voce.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Apply theoretical knowledge to solve practical problems in an industrial setting.
CO2: Demonstrate proficiency in industry-relevant tools, techniques, and technologies.
CO3: Analyze the workflow, management structure, and operational strategies of the organization.
CO4: Communicate effectively through professional documentation and presentations.
CO5: Reflect on their personal and professional growth during the training period.

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	9	3	**33**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**39**	**15**	**21**	**45**	**39**	**219**

Low-1 **Medium-3** **High-9**

Core-VII - Inorganic Chemistry – II

(For Students Admitted from 2025-26)

Semester: IV **Hours/Week: 5**
Subject Code: JBCHC41 **Credit: 5**

Course Objectives:

1. To understand the principles and process of metals and non-metals isolation
2. To understand the properties and uses of group IB, IIA, IIIA, IV, V & VI elements

Unit I **(15 hours)**

I B Group Elements: I B Group- extraction, properties, and uses of Cu, alloys of Cu and their application- Estimation of copper in the coordination compounds.

II A Group Elements - diagonal relationship of Be with Al, comparison of Be with Mg, extraction, properties, and uses of Be

III A Group Elements - general characteristics, extraction of aluminium, anhydrous aluminium trichloride, boranes, diborane - preparation, properties, and structure.

Unit II **(15 hours)**

Dipole Moment : Dipole moment - definition, experimental determination, calculation of percentage ionic character of HF and HCl, dipole moment and molecular structure - CO_2, H_2O, NH_3, and CH_4. **Magneto chemistry -** introduction (magnetic field, magnetic pole, intensity of magnetization). Magnetic induction, permeability, intensity of magnetism, magnetic susceptibility, molar magnetic susceptibility. Magnetic behaviour - diamagnetism, paramagnetism, ferromagnetism and antiferromagnetism, effect of temperature on magnetic behaviour of substances, determination of magnetic susceptibility by Gouy‟s method. Applications of magnetic susceptibilities - number of unpaired electrons in a molecule, structure of Coordination compounds, and formation of free radicals.

Unit III **(15 hours)**

IV Group Elements: Group IV - metallurgy of lead, allotropy of carbon, carbides, silicates, silicones, permonocarbonic acid, perdicarbonic acid.

V Group Elements - Nitrogen, active Nitrogen, Hydrides of Nitrogen, ammonia - manufacture, properties and uses, Oxides of Nitrogen, Fixation of Nitrogen, manufacture of Nitric and Arsenic acid, distinction between Arsenite and Arsenate, Antimony trioxide, tartar emetic, and sodium bismuthate.

VI Group Elements - Oxides, Oxyacids and Oxyhalides of Sulphur, Permonosulphuric acid, Perdisulphuric acid & Potassiumpersulphate.

Unit IV **(15 hours)**

Halogens: Halogens - isolation of Fluorine, Moissan‟s method and Denis method, distinction of Fluorine from other elements, manufacture & properties of Chlorine, Bromine and Iodine, manufacture of bleaching powder by Bachmann method, structure & properties of bleaching powder. Interhalogen compounds - Naming of the compounds, types, preparation, properties, structure and uses of ICl, BrF_3, IF_5, IF_7. Basic properties of Iodine. Pseudohalogens - definition, similarities and dissimilarities between Halogen, Pseudohalogen and Cyanogen. Thiocyanogen- preparation, properties and uses.

Noble gases - isolation, general properties, clathrates, Fluorides, Oxides and Oxyfluorides of Xenon.

Unit V **(15 hours)**

Transition Elements and Group Study: Transition elements - Position in the periodic table,

general characteristics of d-block elements, occurrence, extraction, and uses of Titanium, Vanadium, Molybdenum, and Tungsten, chemistry of Titanium Dioxide, Titanium Tetrachloride, Vanadium Pentaoxide, ammonium Molybdate, Zirconium halide, Molybdenum Blue, Tungstic Oxide, Tungsten Bronze and Chloroplatnic acid, group study of Ti, V, Cr groups, comparative study of Fe, Co, Ni, preparation, properties, and uses of Potassium Ferricyanide, Potassium Ferrocyanide, Cobaltous Nitrate and Nickel (II) Chloride.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall the mineral source and understand the chemistry behind extraction of group IB, IIA, IIIA, IV, V & VI elements.

CO2: Identify the periodic trend observed in IB, IIA, IIIA, IV, V & VI group elements.

CO3: Classify the inorganic compounds based on the bonding property.

CO4: Compare the periodic property to understand the chemical reactivity of halogens and noble gases.

CO5: Elaborate the periodic properties of transition element to account for catalytic property

Text Book:

1. R.D. Madan, *Modern Inorganic Chemistry*, S. Chand and Company Private Limited,New Delhi, 2019.

Reference Books:

1. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principle of Inorganic Chemistry*, VishalPublishing Co., New Delhi, 2020.
2. E. James Huheey, A. Keiter Ellen, L. Keiter Richard and Okhil K. Medhi, *InorganicChemistry Principles of Structure and Reactivity*, Pearson India, 2019.
3. Mark Weller, Tina Overton, Jonathan Rourke and Fraser Armstrong, *InorganicChemistry*, Oxford University Press, 2018.
4. Alan Weller, *Inorganic Chemistry*, Oxford University Press, 2018.

Journals:

1. Inorganic - Chemical Communications
2. European Journal of Inorganic Chemistry
3. Coordination Chemistry Review

E-Resources:

1. http://www.digimat.in/nptel/courses/video/104101090/L44.html compounds -solvent treatment process. Petroleum chemical product - DMT, MMA and
2. http://www.digimat.in/nptel/courses/video/104101090/L43.html
3. https://onlinecourses.nptel.ac.in/noc20_cy19/preview
4. https://digimat.in/nptel/courses/video/104101090/L02.html
5. https://www.digimat.in/nptel/courses/video/104101090/L01.html

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	3	3	**27**
CO2	9	3	9	3	3	9	3	**39**

CO3	9	3	9	3	3	9	3	**39**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**39**	**15**	**21**	**39**	**27**	**201**

Low-1 Medium-3 High-9

Core-VIII - Organic Chemistry –II

(For Students Admitted from 2025-26)

Semester: IV **Hours/Week: 4**
Subject Code: JBCHC42 **Credit: 4**

Course Objectives:

1. To provide comprehensive knowledge on the structure, preparation, properties, and reactions of alcohols, phenols, acid derivatives, and heterocyclic compounds.
2. To introduce the concept of stereochemistry, focusing on optical isomerism and its significance in organic reactions and pharmaceuticals.

Unit I **(12 hours)**

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, preparation -oxidation of alcohols, Ozonolysis, reactions- oxidation (with CrO_3, Ag_2O, and $KMnO_4$), reduction – Wolff- addition, HCN addition) Hemiacetal and acetal formation, Carbonyl alpha substitution reaction - Keto-Enol Tautomerism, Enolate ion formation, Haloform reaction, carbonyl condensation reaction, Perkin reaction, Schmidt Reaction, Stobbe Condensation, study ofname reactions with mechanisms - Aldol Condensation, Cannizaro Reaction, Claisen Condensation, Benzoin, and Beckmann rearrangement, synthesis of Caprolactum, preparation of Vanillin and Acrolein, general methods of preparation, properties and reactions of formaldehyde and acetone. The distinction between aldehydes and ketones.

Unit II **(12 hours)**

Carboxylic acids and acids derivatives: Nomenclature, effect of substituent on acidity of aliphatic and aromatic carboxylic acids, preparation of monocarboxylic acids - oxidative cleavage of alkenes hydrolysis of nitriles, carboxylation with Grignard reagent, Side chain oxidation of alkyl benzenes, and reaction of carboxylic acids, preparation and reactions of acid derivatives - acid chlorides, esters, amides and anhydrides, dicarboxylic acids - preparation and reactions of Malonic acid, Adipic acid, Phthalic acid, and Citric acid.

Unit III **(12 hours)**

Phenols: Phenols - preparation (from Cumene, Aromatic Sulphonic Acid, Chlorobenzene), properties - acidity of phenol, uses, reactions (oxidation) to quinines, Riemer-Tiemann reaction, Bromination, Nitration, Liebermann‟s Nitroso reaction, preparation of phenolphthalein, Kolbe's reaction, Pinacol-Pinacolone rearrangement.

Ethers- Nomenclature, preparation (from Williamsons synthesis and alkoxy mercuration of alkenes), reactions of ethers, acidic cleavage, Claisen rearrangement, Zeisel's method of

estimation of methoxy groups, crown ether structure, and importance in organic synthesis.
Epoxides - nomenclature, preparation from alkenes and halohydrins, reactions, ring opening reactions, acid catalyzed and base catalysed reactions.

Unit IV **(12 hours)**

Heterocyclic Compounds: Heterocyclic compounds - general classification, aromatic and non-aromatic heterocyclic, preparation, properties and uses of Furan,pyrrole & thiophene, synthesis, and reactions of Pyridine, comparative study of basicity of pyrrole, pyridine with amines. Preparation of indole, quinoline, isoquinoline & indigotin. The relative basic character of aromatic amines - derivatives of aniline, preparation and uses of acetanilide, sulphanilic acid and sulphanilamide. Benzene diazonium chloride -synthetic and applications of benzene diazonium chloride.
Aromatic nitro compounds - conversion of nitrobenzene into o-, p- and m-dinitro benzenes, reduction reactions of nitrobenzene in neutral, acidic, and basic media, preparation and uses of TNT and Amatol.

Unit V **(12 hours)**

Optical Isomerism: Definition - Classification. Optical isomerism - Optical activity, Optical, and Specific rotations, Conditions for optical activity, Asymmetric centre, Chirality, Achiral molecules-Meaning of (+) and (-) and D and L notations; Elements of symmetry -Projection formulae, Fischer, and Newman projection formulae, Notation of Optical isomers, Cahn- Ingold - Prelog rules, R-S; notations for optical isomers with one and two asymmetric Carbon atoms, Erythro and Threo representations; meso compounds, racemic mixtures and resolution, optical isomerism of compounds without asymmetric Carbon atoms, allenes and biphenyls, asymmetric synthesis.
Geometrical isomerism-Cis-Trans, Syn-Anti, and E-Z Notations, geometrical isomerism in Maleic and Fumaric acids and unsymmetricalKishner, Clemenson reduction, Metal hydride reduction, Nucleophilic addition (Hydration, bisulfite ketoximes, methods of distinguishing geometrical isomers using melting point, dipole moment, Dehydration, Cyclization and Heat of Hydrogenation.

Course Outcomes:

After successful completion of this course, student will be able to
CO1: Describe the structure, nomenclature, and reactions of alcohols and phenols, including their industrial and laboratory applications.
CO2: Explain the preparation and reactivity of acid derivatives, such as acid chlorides, esters, amides, and anhydrides.
CO3: Understand the concept of chirality and optical isomerism, and distinguish between enantiomers and diastereomers using appropriate notation (R/S, D/L).
CO4: Interpret the significance of stereochemistry in biological systems and drug design.
CO5: Identify and explain the chemistry of common heterocyclic compounds, such as pyrrole, furan, thiophene, and their derivatives, including aromaticity and electrophilic substitution reactions

Text Book:

1. M. K. Jain, and S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., NewDelhi, 2020.

Reference Books:

1. Michaei B. Smith, *Marchs Advanced Organic Chemistry Reactions Mechanisms and Structure*, John Wiley Limited, New Delhi, 2020.

2. O.P. Agarwal, *Organic Chemistry Natural Products (Volume II),* Krishna Prakashanmedia Pvt. Ltd, India, 2015.
3. Jagdamba singh and Jaya singh, *Photochemistry and Pericyclic Reactions*, New Age International Publishers Fourth Edition, 2019.

Journals:

1. Asian Journal of Organic Chemistry
2. European Journal of Organic Chemistry
3. Russian Journal of Organic Chemistry

E-Resources:

1. ORGANIC CHEMISTRY - CUM INORGANIC CHEMISTRY.pdf
2. Morris-David-Morris-Stereochemistry-Tutorial-C-B-ok-xyz.pdf
3. Finar-OrganicChemistryVol1-Text.pdf
4. Aldehydes-Ketones-.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	3	3	**27**
CO2	9	3	9	3	3	3	3	**33**
CO3	9	3	9	3	3	9	3	**39**
CO4	9	3	9	3	3	9	3	**39**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**39**	**15**	**15**	**33**	**21**	**183**

Low-1 Medium-3 High-9

Ability Enhancement Compulsory Course II - Pharmaceutical Chemistry– II

(For Students Admitted from 2025-26)

Semester: IV **Hours/Week: 4**
Subject Code: JBCHA43 **Credit: 4**

Course Objectives:

1. To understand the various diseases in human beings and their treatment methods
2. To widen the knowledge on antiseptics, disinfectants, cancer, antineoplastic and antibiotics

Unit I **(15 hours)**

Organic Pharmaceutical Aids: Organic pharmaceutical aids– preservatives, anti-oxidants, sequestrants, emulsifying agents, colouring, flavouring, sweetening, stabilizing and suspending agents, ointment bases and related agents

organic diagnostic agents–drugs used as X-ray contrast media, drugs used to organ function, drugs used to determine blood volume and hematopoietic function, drugs used for miscellaneous diagnostic tests.

Unit II **(15 hours)**

Analgesics, antipyretics, anti-inflammatory agents: Analgesics, antipyretics and anti-inflammatory agents - Narcotic analgesics- methadone and morphine, Non-narcotic analgesics- salicylic acid derivatives, para amino phenol derivatives, Pyrazole derivative, indolyl, and aryl acetic derivatives

Anesthetics - general anaesthetics - ether chloroform, halothane, trichloroethylene, ethyl chloride, Nitrous oxide, and cyclopropane, intravenous anaesthetics- thiopental sodium methohexitone, local anaesthetics-esters, amides.

Unit III **(15 hours)**

Antiseptics and disinfectants - distinction between antiseptics and disinfectants, standardizations of disinfectants and antiseptics- examples of phenol, halogen compounds, dyes, organic mercurial, formaldehyde and its derivatives and cationic surface-active agents.

Antibiotics -classification, structure, properties and uses of chloramphenicol, penicillin, streptomycin, tetracycline, and erythromycin.

Unit IV **(15 hours)**

Cancer, antineoplastic and cardiovascular drugs: Cancer and antineoplastic drugs - malignant and non-malignant tumour- causes, treatment, antineoplastic drugs- alkylating or cytotoxic agents, antimetabolites - plant products, hormones, adrenocorticosteroids

Diabetes and hypoglycemic drugs–diabetes, types, insulin and hypoglycemic agents. Cardiovascular drugs -cardiac glycosides, antiarrhythmic drugs, quinidine, procainamide, propanol hydrochloride, cholinergic drugs, antihypertensive agents, alpha methyldopa and reserpine.

Unit V **(15 hours)**

Aids: AIDS-HIV, symptoms, and treatment of AIDS.

Anticonvulsant drugs - barbiturates, hydantoin, oxazolidine diones, acetyl urea derivative and succinimides.

Medicinally important inorganic compounds - Compounds of Aluminium- Alum, Aluminium Hydroxide Gel, Bentonite, and Aluminium Monostearate; Compounds of phosphorus - phosphoric acid and hypophosphoric acid; Compounds of Iron–Ferrous Fumarate, Ferrous Gluconate, Ferrous Sulphate, and Ferric Ammonium Citrate; compounds of Mercury- Mercuric Oxide, Oleated Mercury, Mercurous Chloride, Mercury Amido Chloride and Mercury with Chalk.

Course Outcomes (CO):

After successful completion of this course, student will be able to

CO1: Label the common drugs and interpret the basic concepts of organic pharmaceutical aids.
CO2: Identify the general antipyretics, anti-inflammatory, and anaesthetics agents.
CO3: Analyze the various diseases in human beings and their treatment methods.
CO4: Evaluate importance of the Indian medicinal plants.
CO5: Predict antiseptics, disinfectants, cancer, antineoplastic and antibiotics drugs.

Text Book:

1. Jeyashree Gosh, *Text Book of Pharmaceutical Chemistry*, S. Chand and company, New Delhi, 2017.

Reference Books:

1. R. Chatwal, *Organic Pharmaceutical Chemistry*, Himalaya Publishing House, New Delhi,2018.
2. V. Rajasekaran, *Text Book of Pharmaceutical Inorganic Chemistry Theory & Practical*,Sun Publications, 2019.
3. David Plummer, *Practical Biochemistry*, Tata McGraw-Hills Publishing Company, NewDelhi, 2017.

Journals:

1. Pharmaceutical and Chemical Journal
2. Journal of Medicinal Chemistry
3. Journal of Pharmaceutical science

E-Resources:

1. https://drive.google.com/file/d/12mV2qvVBajGNF1RdhWGrtZ4SfjGbLaCV/view?usp=sharing
2. https://drive.google.com/file/d/1f_SygAkoMXSEoQfVnyn4PIzDkPnQpRTV/view?usp=shari ng
3 https://drive.google.com/file/d/1BvmelseOclJLJhLolSOy71joYH5DsAN4/view?usp=sharing
4. https://onlinelibrary.wiley.com/doi/abs/10.1002/0471238961.0114011214210705.a01
5.https://books.google.co.in/books/about/A_Textbook_of_Pharmaceutical_Chemistry.html?id=QwobEAAAQBAJ&redir_esc=y

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	9	3	**33**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**39**	**15**	**21**	**45**	**39**	**219**

Low-1 Medium-3 High-9

Skill Enhancement Course - IV - Industrial Chemistry Practical

(For Students Admitted from 2025-26)

Semester: IV **Hours/Week: 2**
Subject Code: JBCHS44P **Credit: 1**

Course Objectives:

1. Be acquainted with current development in the field of Industrial Chemistry
2. To acquire knowledge of analysis-water samples, essential oils, food samples, soap, cement, pigment, adulterants, natural coloring and flavoring agent (flowers and fruits)

List of Experiments **(30 hours)**

1) Analysis of heavy metals in marine water.
2) Analysis of heavy metals in cement sample.
3) Analysis of heavy metals in soil sample.
4) Estimation of copper in coordination complex.
5) Determination of Alkalinity in Water Samples.

6) Separation of Essential Oils by Soxhlet Extractor.
7) Testing adulterants in milk (turmeric powder and edible oil).
8) Estimation of Glucose in Food Samples.
9) Extraction of Natural coloring Agents in Flowers and Fruits.
10) Estimation of Available Oxygen in Hydrogen Peroxide.
11) Estimation of Amino acid (Alanine).

Evaluation scheme: At the end of the semester, a practical examination for two hours will be conducted for 50marks.
Distribution of external marks- 50 (Record- 10, Procedure – 10, Experimental and result- 30)

Course Outcomes:
After successful completion of this course, student will be able to
CO1: List the types of alkalinity in water samples, and demonstrate separation of essential oils, and testing of adulterants
CO2: Identify extractable coloring and flavoring agents from flowers and fruits
CO3: Compare the estimation of hydrogen peroxide and amino acid
CO4: Deduce the amount of glucose in food samples
CO5: Adapt the novelty in soap preparation by changing additives

Text Book:
1. O.P. Vermani, *Applied Chemistry: Theory and Practice*, New Age International Private Limited, 2017.
Reference Books:
1. John Kenkel, *Chemistry An Industry-Based Laboratory*, Taylor & Francis Publisher,2020
2. Ranjan Kumar Mohapatra, *Engineering Chemistry with Laboratory Experiments*, PHI Learning, 2015.
3. Manoj Kumar Solanki, *Engineering Chemistry Laboratory Manual*, Edu creationPublishing, 2019.
Journals:
1. Journal of the Society of Chemical Industry
2. International Journal of Industrial Chemistry
3. Journal of Chemical Education
E-Resources:
1. https://images.app.goo.gl/n6FkKJZJwN1QumnT9
2. https://images.app.goo.gl/5GM819F1YZXXhBkW8
3. https://images.app.goo.gl/zxCvxZEqBWU8tkDh9
4. https://gmcsurat.edu.in/lib/exe/fetch.php?media=biochemistry:g-
5. https://web.iitd.ac.in/~arunku/files/CEL212_2012/CEL%20212%20Lab%202%20Alkalinity%20and%20Acidity.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	9	3	9	9	**51**
CO2	9	3	9	3	3	9	9	**45**

CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**45**	**21**	**15**	**45**	**45**	**231**

Low-1 Medium-3 High-9

Multi- Disciplinary II – Preparation of Personal Care Products Practical

(For Students Admitted from 2025-26)

Semester: III **Hours/Week: 2**
Subject Code: JBMD41CHP **Credit: 1**

Course objectives:

1. To equip students with practical knowledge and technical skills required to formulate and evaluate personal care products.
2. To familiarize students with the selection of raw materials, formulation processes, and quality assessment parameters.

List of Experiments: **(30 hours)**

1. Preparation of Liquid Shampoo.
2. Preparation of Tooth Paste.
3. Preparation of Hair Dye.
4. Preparation of Talcum Powder.
5. Preparation of Face Cream.
6. Preparation of Herbal Soap.
7. Preparation of Papaya face pack.
8. Preparation of Herbal Kajal.
9. Preparation of Body Lotion.
10. Extraction of Rose Oil from Rose Petals.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Gain knowledge of ingredients and formulation techniques used in personal care products like creams, shampoos, lotions, etc.

CO2: Acquire hands-on experience in preparing various personal care products in a laboratory setting.

CO3: Learn to apply quality control and safety standards during formulation and testing.

CO4: Understand basic regulatory and labeling requirements related to cosmetic and personal care products.

CO5: Cultivate innovation and problem-solving skills in product development and customization.

Text Books:

1. Himadri Panda, Herbal cosmetics Handbook .3rd revised edition Jeyashree Gosh, *Text Book of Pharmaceutical Chemistry*, S. Chand and company, NewDelhi, September 2017.

Reference Books:

1. Handbook on herbal products.(Vol.1 and 2)NIIR Board of Technologists,Delhi.
2. Barel, A.O.; Paye, M.; Maibach, H.I.(2014),Handbook of Cosmetic Science and Technology, CRC Press.
3. Garud, A.; Sharma, P.K.; Garud, N. (2012),Text Book of Cosmetics, Pragati Prakashan

Journals:

1. Journal of Surfactants and Detergents
2. Journal of Food Chemistry and Nutrition
3. Infectious Diseases in Clinical Practice

E- Resources:

1. https://xavierscollegegoa.ac.in/wp-content/uploads/2024/12/Lab_Manual_Chemistry.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	9	9	**39**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**39**	**15**	**15**	**45**	**45**	**219**

Low-1 Medium-3 High-9

Extra Credit-III – Internship Report on Soil Testing or Food Quality Testing

(For Students Admitted from 2025-26)

Semester: IV
Subject Code: JBCHX4P **Credit: 2**

Course Objectives:

1. To gain practical knowledge and hands-on experience in soil or food sample testing using standard laboratory procedures.
2. To understand the importance of quality control, safety standards, and regulatory compliance in soil or food testing laboratories.

The students should undergo internship in soil testing center or food quality testing center for ten days. They have to prepare the report with the guidance of the course teacher. Necessary documents and the evidence to be enclosed in the report.

Evaluation Scheme:75 marks will be given for the documentation of the report and 15 marks for the presentation and 10 marks for the viva voce.

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Perform basic laboratory tests to assess soil or food quality using appropriate instruments and techniques.
CO2: Interpret test results and evaluate their relevance in agricultural or food safety contexts.
CO3: Understand and apply standard operating procedures (SOPs), quality assurance, and safety measures.
CO4: Prepare accurate lab reports and maintain records in accordance with industry norms.
CO5: Demonstrate professional behavior, teamwork, and communication skills in a lab or industrial environment.

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	9	3	**33**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**39**	**15**	**21**	**45**	**39**	**219**

Low-1 Medium-3 High-9

Core-IX - Physical Chemistry–II

(For Students Admitted from 2025-26

Semester: V **Hours/Week: 6**
Subject Code: JBCHC51 **Credit: 6**

Course Objectives:
1. To build a strong conceptual foundation in the principles governing reaction rates, chemical equilibrium, solution behavior, and electrochemical processes.
2. To equip students with analytical skills to solve numerical and conceptual problems related to kinetics, equilibrium, colligative properties, and electrochemical cells.

Unit I **(18 hours)**

Chemical Equilibrium: Chemical Equilibrium - Law of Mass Action, Law of Chemical Equilibrium, Thermodynamic Derivation of Chemical Equilibrium, Vant Hoff Reaction Isotherm, Standard Free Energy Change, Temperature Dependence of Equilibrium Constant, Vant Hoff Isochore, Le Chatelier Principle and its Applications. Enzyme Catalysis - Mechanism and Kinetics of Enzyme Catalysis, Michaelis Menton Equation, Effect of Temperature on Enzyme Catalysis.

Unit II **(18 hours)**

Solutions: Solutions -Raoult‟s Law, Ideal Solution, Henry‟s Law, Temperature Composition Diagrams, Ideal Liquid Mixture (Toluene - Benzene), Non Ideal Mixture (Water- Ethanol and Water - Hydrogen Chloride), Azeotropic Mixtures, Distillation of Immiscible Liquids; Partially Miscible Liquids (Phenol - Water and Triethylamine - Water systems), Nernst Distribution Law, Thermodynamic Derivation, Limitations, Applications of Nernst Distribution Law, Solvent Extraction and Determination of Hydrolysis Constant.

Unit III **(18 hours)**

Group Theory: Group Theory - Molecular Symmetry Elements and Symmetry Operations, Products of Symmetry Operations, Properties of a Group, Classes and Sub Groups, Group Multiplication Table (C_2V, C_3V Table only), Point Groups, Classification of Molecules into Point Groups, Vector and Matrix Algebra, Symmetry Operations and Transformation Matrices, Inverse Matrices. Matrix representation, reducible and irreducible representation, direct product representation, the great orthogonality theorem (only theorem)

Unit IV **(18 hours)**

Chemical Kinetics: Rate of Reactions - Rate Constant, Order and Molecularity of Reactions, First Order and Pseudo Unimolecular Reactions (Definition and Examples) - Derivation of RateConstant for the Inversion of Cane Sugar. Second Order Reactions - Definition and examples, Derivation of Rate Constant (Same Concentration and Different Concentration) and Half Life Period, Application to Saponification of Ester. Third Order Reactions - Definition and examples, Application to the Reaction between $FeCl_3$ and $SnCl_2$, Methods of Determination of Order of Reactions. Zero Order Reactions - Definition and examples, Derivation of Rate Constant. Theory of Reaction Rates - Collision Theory of Bimolecular Reactions, Unimolecular Reactions, Lindemann's Hypothesis, Theory of Absolute Reaction Rates.

Unit V **(18 hours)**

Electrochemistry–I: Conduction in Metals and in Electrolyte Solutions, Specific Conductance and Equivalent Conductance, Measurement of Equivalent Conductance, Variation of Equivalent and Specific Conductance with Dilution, Ostwald‟s Dilution Law, Debye Huckel Theory of Strong Electrolytes, Onsagar Equation (no derivation) - Significance and Limitations, Kohlrausch‟s Law and its Applications, Migration of Ions, Ionic Mobility, Transport Number and its Determination, Hittorff Method and Moving Boundary Method, Abnormal Transport Number, Applications of Conductometric Measurements, Determination of Degree of Dissociation of Weak Electrolytes, Ionic Product of Water, Solubility Product of a Sparingly Soluble Salt, Conductometric Titrations, pH Concept, Buffer Solutions, Buffer Activity- Henderson Equation, Applications of Buffer Solutions.

Course Outcomes:

After successful completion of this course, student will be able to

CO1:Explain the factors affecting reaction rates and derive rate laws using integrated and differential methods in chemical kinetics.

CO2: Understand and apply Le Chatelier's principle and equilibrium constants to predict the direction and extent of chemical reactions.

CO3: Classify and analyze different types of solutions, calculate concentration terms, and understand colligative properties and their deviations.
CO4: Explain the principles of electrochemistry, including redox reactions, electrode potentials, and the construction of electrochemical cells.
CO5: Solve numerical problems related to Nernst equation, electrolysis, and conductance, and understand their practical applications in industries and laboratories.

Text Book:
1. B. R. Puri, Madan S. Pathania and L. R. Sharma, *Principles of Physical Chemistry*,Vishal Publishing Co, New Delhi, 2020.

Reference Books:
1. Peter Atkins, and Julio de Paula, Atkins *Physical Chemistry*, Oxford University PressYMCA Library Building, New Delhi, 2014.
2. F. Albert Cotton, *Chemical Applications of Group Theory*, An Indian Adaptation, WileyEastern Ltd., New Delhi, New York, 2020.

Journals:
1. Journal of Applied Electrochemistry
2. Journal of Physical Chemistry A
3. Physical Chemistry Chemical Physics

E-Resources:
1. https://www.chem1.com/acad/pdf/solut.pdf
2. http://www.lcwu.edu.pk/ocd/cfiles/Chemistry/Min%20/%20Chem-102/Solutions.pdf
3. https://www.slideshare.net/nnhsuk/chapter-03grouptheory-1
4. https://images.app.goo.gl/tJELwrSu3moSTTdVA
5. http://web.iyte.edu.tr/~serifeyalcin/lectures/chem306/cn_1.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	3	**39**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	9	9	9	**51**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**45**	**15**	**27**	**45**	**39**	**231**

Low-1 Medium-3 High-9

Core-X - Organic Chemistry–III

(For Students Admitted from 2025-26)

Semester: V **Hours/Week: 6**
Subject Code: JBCHC52 **Credit: 6**

Course Objectives:

1. To provide an in-depth understanding of the structure, classification, and functions of biomolecules (amino acids, proteins, carbohydrates, vitamins).
2. To develop knowledge of advanced organic reaction mechanisms, including pericyclic reactions, photochemical processes, and molecular rearrangements.

Unit I **(18 hours)**

Aromatic Sulphonic Acids: Preparation, Properties and Uses of Benzene Sulphonic Acid, Preparation and Uses of Saccharin, Chloramine-T and Dichloramine- T.

Alkaloids - Classification, Isolation, General Methods of Determination of Structure of Alkaloids, Synthesis and Structural Elucidation of Piperine, Atropine, and Nicotine.

Terpenoids - Classification, Isolation, Isoprene rule, Synthesis and Structural Elucidation of Citral, Geraniol and Alpha-Pinene.

Unit II **(18 hours)**

Amino Acids and Proteins: Definition, Classification, Preparation of Alpha Amino Acids - Glycine, Alanine and Tryptophan, General Properties of Amino Acids - Zwitter ions, Isoelectric Point, Peptides - Bergmann Method, Structure Determination of Polypeptides, End Group Analysis.

Proteins – Definition, Classification Based on Physical and Chemical Properties, Primary and Secondary structure of Proteins - Helical and Sheet Structures (Elementary Treatment Only). Nucleic acid – Nucleoside, Nucleotide, R.N.A, and D.N.A. (General Structure).

Unit III **(18 hours)**

Carbohydrates- Classification, Glucose and Fructose - Osazone formation, Configuration - Open Chain Structureand Ring Structure, Conformation - Haworth,,s Projection Formulae, Epimerisation -Conversion of Aldose to Ketose and Vice Versa, Disaccharides - Structural Elucidation of Sucrose, Polysaccharides - Structure of Cellulose (no Structural Elucidation).

Vitamins - Definition and Classification, Structural Elucidation of Ascorbic Acid.

Unit IV **(18 hours)**

P**ericyclic reactions**: Pericyclic reactions -features, MOs of conjugated p systems, FMOS, electrocyclic reaction, mode of rotations, analysis of odd and even number of electron pair(s) systems with FMO method, cycloaddition reaction, modes of addition, Diels-Alder reaction, analysis with FMO method, sigmatropic rearrangement, [1,3] and [1,5] rearrangements, Cope and Claisen rearrangements-mechanisms

Organic photochemistry - types of photochemical reactions, photodissociation, gas-phase photolysis, isomerisation, cyclisation, dimerisation, and oxetane formation. Norrish- type I and type II reactions. Barton reaction, Photo-Fries rearrangement photochemical formation of smog, photochemistry of vision.

Unit V **(18 hours)**

Molecular Rearrangements: Molecular Rearrangements - Classification as Anionotropic, Cationotropic, Intermolecular and Intramolecular, Mechanisms - Pinacol -Pinacolone, Beckmann, Benzidine, Hofmann, Curtius, Lossen, Schmidt.

Tautomerism - Definition, Prototropy, and Anionotropy, Detailed Study of the Following- Types of Tautomerism, Keto-Enol Tautomerism, Nitro – aci-nitro Tautomerism, Lactam-Lactim Tautomerism.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Describe the structure, classification, and functions of amino acids and proteins, including peptide bond formation and protein folding.

CO2: Understand the chemistry and biological role of carbohydrates and vitamins, and distinguish between different types based on their structures and functions.

CO3: Explain the mechanism and stereochemistry of pericyclic reactions, including electrocyclic reactions, cycloadditions, and sigmatropic rearrangements, using the Woodward–Hoffmann rules.

CO4: Analyze the principles of organic photochemistry, including excited-state reactions such as Norrish and Paternò–Büchi reactions.

CO5: Identify and explain various molecular rearrangements (e.g., Beckmann, Hofmann, Curtius, Pinacol–Pinacolone), and apply them to synthetic organic transformations.

Text Book:

1. M. K. Jain, and S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co., New Delhi, 2020.

Reference Books:

1. Robert Thorhton Morrison and Robert Neilson Boyd, *Organic Chemistry*, Pearson India Private Limited, New Delhi, 2016.
2. Michaei B. Smith, *Marchs Advanced Organic Chemistry Reactions Mechanisms and Structure*, John Wiley Limited, New Delhi, 2020.
3. O.P. Agarwal, *Organic Chemistry Natural Products* (Volume II), Krishna Prakashan Media Pvt. Ltd, India, 2015.

Journals:

1. Current Organic Chemistry
2. Journal of Natural Products
3. Organic and Biomolecular Chemistry

E-Resources:

1. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi5qPbXsZLxAhVN4zgGHbgSDPoQFnoECBEQAA&url=https%3A%2F%2Fworldwidescience.org%2Ftopicpages%2Fb%2Fbenzene%2Bnaphthalene%2Bphenanthrene.html&usg=AOvVaw0dmGbA1QMoKwKnBEJeAT6w
2. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwijYedtpLxAhWJ63MBHa4XCTUQFnoECBYQAA&url=https%3A%2F%2Fcourses.lumenlearning.com%2Fwm-biology1%2Fchapter%2Freading-types-of carbohydrate s%2F&usg=A OvVaw1T1kJrScwn6oEUdC0yf6T8
3. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi3z4SAt5LxAhUl8HMBHWXLBckQFnoECBIQAA&url=https%3A

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	3	**39**
CO2	9	3	9	3	3	9	3	**39**
CO3	9	3	9	3	3	9	3	**39**

CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**45**	**15**	**21**	**45**	**27**	**213**

Low-1 **Medium-3** **High-9**

Core-XI – Advanced Physical Chemistry Practical

(For Students Admitted from 2025-26)

Semester: V **Hours/Week: 6**
Subject Code: JBCHC53P **Credit: 4**

Course Objectives:

1. To gain hands on experience in handling of conductometric titration, potentiometric titration, phase diagram, pH, partition coefficient experiments, viscosity and critical solution temperature
2. To understand the basic principles of lab techniques adopted in physical chemistrylaboratories

List of Experiments: **(90 Hours)**

I. Kinetics

1. Determination of rate constant of acid catalyzed hydrolysis of an ester
2. Determination of relative strength of acid by acid catalyzed hydrolysis of ester
3. Determination of order of a reaction between iodine and persulphate (initial rate method)

II. Phase diagram

1. Phase diagram involving (a) Simple Eutectic and (b) Compound Formation
2. Determination of upper CST of phenol water system.
3. Effect of NaCl on CST of phenol water system and estimation of NaCl solution of unknown concentration using CST
4. Determination of transition temperature of a salt hydrate.

III. Distribution law

1. Determination of the distribution coefficient of iodine between carbon tetrachloride and water.
2. Determination of equilibrium constant of the reaction $KI + I_2 \longrightarrow KI_3$

IV. Electrochemistry

1. Determination of cell constant by conductance measurements.
2. Determination of molar conductance of strong electrolyte.
3. Determination of dissociation constant of acetic acid.
4. Conductometric titration of HCl vs NaOH
5. Potentiometric titration of HCl vs NaOH
6. Conductometric titration of ferrous ion vs $K_2Cr_2O_7$ using quinhydrone electrode.

V. Colligative property

1. Determination of molecular eight by rast method (Camphor andNaphthalene).
2. Determination of molecular weight of unknown polymeric material.

Evaluation Scheme: 3 hrs for Physical Chemistry Experiments and 3hrs for Industrial Chemistry Experiments for 30 marks each.
Distribution of external marks:75
Record – 10
Viva- 15
Physical Chemistry Experiment- 50

Procedure- 10
Experiment and result – 40

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Perform advanced physical chemistry experiments involving kinetics, conductometry, potentiometry, and calorimetry with precision.
CO2: Analyze phase diagrams and equilibrium data, and interpret results in the context of themodynamic principles.
CO3: Use instruments such as pH meters, potentiometers, and conductivity meters effectively and calibrate them for experimental use.
CO4: Calculate thermodynamic parameters such as enthalpy, entropy, and Gibbs free energy from experimental data.
CO5: Calculate thermodynamic parameters such as enthalpy, entropy, and Gibbs free energy from experimental data.

Text Book:
1. J. B. Yadav, *Advanced Practical Physical Chemistry*, Krishna Prakashan Media Limited,2016.
Reference Books:
2. Kamala Rani Bhattacharyya, *Physical Chemistry Practical*, New Academic Publications,2016.
3. A.R. Kulandaivelu, V. Venkateswaran & R. Veeraswamy, *Basic Principles of Practical Chemistry*, Sultan Chand and Sons, New Delhi, 2017.
4. B. Viswanathan, & P. S. Raghavan, *Practical Physical Chemistry*, New Delhi, Viva Book Private Limited, 2014.
5. J. B. Yadav, *Advanced Practical Physical Chemistry*, Krishna Prakashan Media Limited,2016.
6. Determination of Rf. Values and Identification of Organic Compounds by Thin LayerJournals:
E-Resource:
1. http://rbvrrwomenscollege.net/wpcontent/uploads/2018/06/physical_Chemistry_manual.pdf
2. https://www.colby.edu/chemistry/CH142/lab/CH142Exp8Electroplating.pdf
3. https://diyhpl.us/~nmz787/pdf/DFT_flavor_of_coordination_chemistry.pdf

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	3	9	9	45
CO2	9	3	9	3	3	9	9	45
CO3	9	3	9	3	3	9	9	45
CO4	9	3	9	3	9	9	9	51
CO5	9	3	9	3	3	9	9	45
Total	45	15	45	15	21	45	45	231

Low-1 Medium-3 High-9

Multi-Disciplinary III (A) - Industrial Chemistry

(For Students Admitted from 2025-26)

Semester: V **Hours/Week: 4**

Subject Code: JBMD51CHA **Credit: 3**

Course Objectives:

1. To acquire knowledge on fermentation, pulp and paper industries
2. To understand the concepts in silicate, rubber, fertilizers, soaps and detergents industry

Unit I **(12 hours)**

Pulp & Paper Industry: Raw materials for Pulp & Paper (Fibrous &Non-Fibrous raw materials). Pulping -Definition, Uses of Pulp, Pulping Methods for Paper Manufacture: (1)Mechanical or Ground Wood Process - Chemical Nature of Wood-Wood Pulping - Object and Use - Ground Wood Process - Improvements (2) Chemical Processes- (a) Kraft or Alkaline Sulphate Process in detail including Recovery of Chemicals, (b) Acid Sulphite Process in detail(3)Semi-Chemical Process - Short Time (NSSC) Process Comparison of Kraft, Sulphite & NSSC Pulping Processes, Stock Preparation, Furnishing, Beating, Bleaching, Sizing, Fillers and Colouring; Paper Making Processes - Fourdrinier Machine in detail with flow chart - Cylinder Machine – Short account with advantages & disadvantages.

Unit II **(12 hours)**

Fermentation Industries: Introduction, Definition, Factors Influencing Fermentation Reactions, Types of Fermentation Process -Aerobic and Anaerobic processes (Microorganisms), Microbial Nutrients, Merits of Fermentation Process and Fermentation Products; Fermentation Industries -

Manufacture of Ethyl Alcohol with flow sheet - Manufacture of Butyl Alcohol - Manufacture of Vinegar - Manufacture of Lactic acid - Manufacture of Citric Acid.

Unit III **(12 hours)**

Silicate and Rubber Industry: Cement - Manufacture of Cement, Setting & Curing, RCC and Cement Industries in India; Glass -Types of Glasses, Manufacture of Optical Glass, Borosilicate Glass, Coloured Glass, Glass Wool & Applications; Rubber - Natural and Synthetic rubber, Manufacture and Applications of SBR, Neoprene, PUF and Silicone rubber.

Unit IV **(12 hours)**

Fertilizers: Introduction, Classification of Soil Nutrients - Micronurtients and Macronutrients, Fundamentals of N, P and K, Role of Primary and Secondary Nutrients in Plant Growth, Natural and Chemical Fertilizers, Manufacture of Ammonium Sulphate, Calcium Cyanamide, Urea, Calcium Super Phosphate, DAP and Potassium Nitrate, Mixed Fertilizers, Fertilizer Industry in India.

Unit V **(12 hours)**

Soaps and Detergents: Introduction, Classification of Soaps, Raw Materials Required, Manufacture of Soaps, Cleansing Action of Soaps; Detergents - Principal Groups of Synthetic Detergents, Classification of Detergents, Anionic Surfactants, Cationic, and Ampholytic Surfactants, Non-Ionic Surfactants, Detergent Builders and Additives-Sludge Regulators, Principle of Cleansing Action of Detergents or Detergency, Comparison of Soaps and Detergents.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall the raw materials for commercial materials and understand the chemical processes
CO2: Identify the type of fermentation based on composition of products
CO3: Classify the paper, cement, fertilizers, glass, rubber, soaps, and detergents
CO4: Explain the cleaning action of soaps and detergents
CO5: Modify pulping methods for paper manufacture

Text Book:

1. B.K. Sharma, *Industrial Chemistry*, Krishna Prakashan Media Pvt. Ltd., Meerut, 2016.

Reference books

1. Edwin E. Slosson, *Chemistry for Chemical Industries*, Medtech Private Limited, 2017.
2. O.P. Veramani, *Applied Chemistry*: *Theory and Practice*, New Age International Private Limited, New Delhi, 2017.
3. Jaya Shree Anireddy, *Textbook of Engineering Chemistry*, Wiley Pvt. Ltd., New Delhi,2018.

Journals:

1. Journal of Industrial and Engineering Chemistry
2. International Journal of Industrial Chemistry
3. American Journal of Applied and Industrial Chemistry

E-Resources:

1. https://www.researchgate.net/publication/282709774_Pulp_and_Paper_Industry_Chemic als
2. https://www.researchgate.net/publication/281716235_Industrial_fermentation
3. https://www.slideshare.net/AttittudeBlogger/amal-ppt-41637599
4. https://www.researchgate.net/publication/331132826_The_Impact_of_Chemical_Fertilizers_on_our_Environment_and_Ecosystem
5. https://nzic.org.nz2017/10PDF Soap and Detergent Manufacture - NZ Institute ofChemistry

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	9	**45**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**45**	**15**	**15**	**45**	**45**	**225**

Low-1 Medium-3 High-9

Multi-Disciplinary III (B) - Biological Chemistry

(For Students Admitted from 2025-26)

Semester: V **Hours/Week: 4**
Subject Code: JBMD51CHB **Credit: 3**

Course Objectives:

1. To learn about various methods of treatment and analysis of blood, nutrients digestion, hormones and enzymes
2. To acquire knowledge on biological functions of micro-minerals and vitamins

Unit I **(12 hours)**

Blood: Blood-Composition, Plasma Proteins, RBCs, Blood Groups, The Rh Factors, Blood Transfusions, Blood Pressure, Hypertension, Hypotension.

Unit II **(12 hours)**

Nutrients Digestion and Absorption: Introduction, Digestion, Absorption, Process of Digestion, Digestion in the Oral Cavity, Digestion in the Stomach, Digestion in the Small Intestine, Absorption and Digestion of Carbohydrates, Fatty acids, Amino acids, and Proteins.

Unit III **(12 hours)**

Hormones and their Physiological Effects: Introduction, Preparation, and Functions of Hormones, Chemical Nature of Hormones, Structure a Physiological Function of Some Hormones, Adrenaline, Thyroxine, Oxytocin, Insulin and The Sex Hormones (Androgens and Oestrogens).

Unit IV **(12 hours)**

Micronutrients and their Biological Role: Introduction, Biological Function of Some Micro Minerals, Iron, Copper, Fluorine and Zinc and Iodine, etc.; Vitamins - Water Soluble Vitamins, Lipid Soluble Vitamins - a detailed study.

Unit V **(12 hours)**

Enzymes: Introduction, Properties, Nomenclature, Classification, Chemical Nature of Enzyme, Co Factors, and Co-Enzymes, Mechanism of Enzyme Catalysis, Factors Affecting - Enzyme Activity, Enzyme Action, Regulation of Enzyme Activity, Inhibitors -Reversible and IrreversibleInhibitors.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: List the biochemical changes during digestion and understand absorption of nutrients
CO2: Apply the possible physiological effects to hormone functional changes
CO3: Analyse the biological role of micronutrients
CO4: Classify the vitamins, hormones & enzymes
CO5: Design the function mimics inhibitors

Text Books:

1. Jeyashree Gosh, *Text Book of Pharmaceutical Chemistry*, S. Chand and company, NewDelhi, 2017
2. Robert Thorhton Morrison and Robert Neilson Boyd, *Organic Chemistry*, Pearson IndiaPrivate Limited., New Delhi, 2016.

Reference Books:

1. Michael L. Bishop, Edward P. Fody and Larry. E. Schoeff, *Clinical Chemistry*, Wolters Kluwer, 2017.
2. K.V. Krishna Das, *Textbooks of medicine*, Jaypee Brothers Medical Publication, NewDelhi, 2017.
3. Jayashree Ghosh, *Fundamental Concepts of Applied Chemistry*, S. Chand & CompanyLtd.New Delhi, 2010.

Journals:

1. Journal of Biological Chemistry:
2. ACS Chemical Biology

3. Chemical Biology & Drug Design

E-Resources:

1. https://drive.google.com/file/d/13yrniBSZiXZthg-zB2tPoEp-v5mssG0w/view?usp=sharing
2. https://drive.google.com/file/d/14cFrFUenz231C_xxhij1Guop4lxXw7hc/view?usp=shari ng
3. https://med.libretexts.org/Courses/Manchester_Community_College_(MCC)/Manchester
4. Introduction_to_Nutrition/03%3A_Digestion_Absorption_and_Transport_of_Nutrients https://www.researchgate.net/publication/335222483_Plant_Hormones_and_Their_Physiological_Effects
5. https://bio.libretexts.org/Bookshelves/Human_Biology/Book%3A_Human_Biology_(Wakim_and_Grewal)/04%3A_Nutrition/4.2%3A_Nutrients

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	9	**45**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**45**	**15**	**21**	**45**	**45**	**231**

Low-1 Medium-3 High-9

Multi-Disciplinary IV (A)- Textile Chemistry

(For Students Admitted from 2025-26)

Semester: V **Hours/Week: 4**
Subject Code: JBMD52CHA **Credit: 3**

Course Objectives:

1. To acquire knowledge on textile fibres, operation of singeing and dyes
2. To understand chemistry behind dyeing and printing and their applications

Unit I **(12 hours)**

Textile Fibres : Definition and Classification of Textile Fibres according to their Nature and Origin, Essential and Desirable Properties of Textile Fibres; Cotton Fibres- Chemical Composition and Morphology; Bast Fibres - Jute, Hemp, Ramie and Linin (Flax); Regenerated Fibres - Viscose Rayon; Protein Fibres – Silk and Wool, Sericulture and Reeling of Silk, Grading of Wool, Morphology of Wool Fibre, Regenerated Protein Fibres - Soyabean, Ardile, Casein, Vicara and Mineral Fibres (Asbestos).

Unit II **(12 hours)**

Operation of Singeing: Study of the Operation of Singeing, Various Method of Singeing Suchas Plate, Gas and Rotary Cylinder Machines, Precautionary Measures to be taken during Singeing Operation, Study of Operations of Desizing using Hydrolytic and Oxidative Method (Any Two Methods) Scouring Method using Vertical Kier, General methods of Bleaching using Sodium Chlorite, Bromite, Hypochlorites, and Hydrogen Peroxide

Unit III **(12 hours)**

Dyes: Colour and Chemical Constitution, Chromosphere, Auxochrome, Theories, History of Natural and Synthetic Dye, Classification of Dyes based on Chemical Constitution and Methodof Application. Application of Direct, Reactive, Acid and Basic. Vat Dyes on Cotton and Protein Fibres.

Unit IV **(12 hours)**

Dyeing and Printing: Definition, Difference between Dyeing and Printing, Block Printing, Batik Printing, Screen Printing, Roller Printing, Direct Printing Styles, Printing with Vat Dyes, Azoic Dyes, and Modern colors; Finishing Processes - Purpose, Classification, Brief Detail Finishing Operations, Straightening, Sanforizing, Stiffening, Mercerizing in Detail, Calendering, Water Proofing, Mildew Proofing, Fire Proofing, and Moth Proofing.

Unit V **(12 hours)**

Printing of Synthetic Fibres: Development in Printing of Synthetic Fibres and their Blends. Bubble Dyeing, Foam Technology, Transfer Printing, Capsule/Speckle Printing; Aqueous Pigment Printing-Dylan and Celestron Dyes; Foam - Discharge Style, Burnt -Out Style, etc.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall the principle that involve in dying and understand morphology of fibers
CO2: Choose the methods in operation of singeing
CO3: Classify application of textile fibers, operation for singeing and dyes
CO4: Compare dyeing and printing with its applications
CO5: Design the printing of synthetic fibres for their applications

Text Books:

1. Tyronel L. Vigo, *Textile Processing & Properties*, Elsevier Publishing Company, Netherland, 2002.
2. Rastogi Deepali, and Chopra Sheetal, *Textile Science*, Orient Blackswan Private Limited, 2017.

Reference books:

1. K. Hunger, *Industrial Dyes: Chemistry, Properties, Applications*, Wiley-VCH. New Delhi, 2003.
2. R. Nietzki, *Chemistry of Organic Dyestuffs*. Gurney & Jackson, University of Michigan. 2019.
3. Georg Von Georgievics, *The Chemical Technology Of Textile Fibres - Their Origin Structure Preparation Washing Bleaching Dyeing Printing And Dressing*, Read Books Publisher, 2008.

Journals:

1. International Journal of Textile Science
2. Journal of Modern Textile Science and Engineering
3. Journal of Textile science and technology

E-Resources:

1. https://textechdip.wordpress.com/contents/textile-fiber/
2. https://www.slideshare.net/parmeetkaur17/singeing-process
3. http://www.meerutcollege.org/mcm_admin/upload/1586585321.pdf
4. https://vdocuments.mx/defects-in-dyeing-and-printing.html
5. https://www.textileebook.com/2019/09/synthetic-fibres-nylon-polyester-acrylic- polyolefin-edited-by-j-e-mcintyre.html

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	**Total**
CO1	9	3	9	3	3	9	9	**45**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	9	9	9	**51**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**45**	**15**	**27**	**45**	**45**	**237**

Low-1 Medium-3 High-9

Multi-Disciplinary IV (B) - Analytical Methods

(For Students Admitted from 2025-26)

Semester: V **Hours/Week: 4**
Subject Code: JBMD2CHBI **Credit: 3**

Course Objectives:

1. To understand concepts on the principle and instrumentation of TGA, DTA, DSC, TMA, DMA and gas chromatography
2. To acquire basics on principle, and instrumentation of atomic absorption, flame emission, X - ray emission, ultraviolet and visible and infrared spectroscopy

Unit I **(12 hours)**

Introduction of Analytical Chemistry: The Scope of Analytical Chemistry, Functions and Applications of Analytical Chemistry, Definition and Basic Concepts of Mean, Median, Degree of Freedom, Deviation, Standard Deviation Variance, Q-Test, T-Test, Accuracy, Absolute Method and Comparative Method, Precision, Errors, Classification of Errors – Methods of Minimizing Errors, Significant Figures and Computative Rules.

Unit II **(12 hours)**

Thermal Techniques: Thermogravimetry-Principle, Instrumentation, Application of TGA, Differential Thermal Analysis (DTA) -Principle, Instrumentation, and application of DTA. Differential Scanning Calorimetry-Principle, Instrumentation, Applications of DSC, Thermo Mechanical Analysis (TMA) and Dynamic Mechanical Analysis (DMA) - Principle, Instrumentation, and Applications of TMA and DMA; Pyrolysis-gas chromatography, Principle, Instrumentation.

Unit III **(12 hours)**

Atomic Spectrometry: Atomic Absorption Spectrometry-Absorption of Characteristic Radiation Instrumentation, Sample Vaporization, Quantitative Measurements, and Interferences and Applications. Flame emission spectrometry-Principle, Instrumentation, Flame characteristics Flame Process, Emission Spectra, Quantitative Measurements, and Interferences and Applications. X-Ray

Emission Spectrometry-X-Ray Process, Instrumentation, and Applications.

Unit IV **(12 hours)**

Ultraviolet and Visible Spectroscopy: Introduction, Absorption laws, Formation of Absorption bands, Theory of Electronic Spectroscopy, Types of Electronic Transitions, Transition Probability, Chromophore, Auxochrome, Absorption, and Intensity Shifts, Types of Absorption Bands, Solvent Effects, Conjugated Diene, Woodward-Fieser rules for Calculating Wavelength Maxima in Diene, Distortion of the Chromophore-Polyenes and Polyenes, Benzene and its Derivatives, Absorption Spectra of Condensed Ring Systems, Steric Hindrance, and Coplanarity, Fluorescence and Phosphorescence – Applications.

Unit V **(12 hours)**

Infrared Spectroscopy: Introduction, Theory of Molecular Vibrations, Vibrational Frequency, Number of Fundamental Vibrations, Factors Influencing Vibrational Frequencies, Fingerprint Region, Application of IR Spectroscopy, Detection of Alkanes, Alkenes, Alkynes, Cycloalkanes, Aromatic Hydrocarbon, Phenols and Alcohols, Ethers, Carbonyl Compounds, Aldehydes and Ketones, Esters Lactones, Carboxylic Acid, Acid Halides, Acid Anhydrides, Amides, Amino Acid, Amines, and Nitro Compounds.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: List the sources for atomic spectroscopy and understand inference from quantitative measurements

CO2: Apply the instrumentation knowledge in handling spectral, chromatography techniques with precautions

CO3: Classify the molecular transition in various spectral techniques.

CO4: Evaluate the Woodward-Fieser rules and understand λ_{max} observed in UV-Vis spectra

CO5: Suggest the application of chromatography and spectral technique for the identifying and isolating compounds.

Text Books:

1. A. Skoog Douglas, F. James Holler and R. Crouch Stanley, *Principles of Instrumental Analysis*, Cengage Learning India Pvt. Ltd., 2020.
2. D. K. Sarkar, *Fundamentals of Analytical Chemistry*, Pharma Med Press / BSP Books,2021.

Reference books:

1. F.W. Fifield, and D. Kealey, *Principle and Practice of Analytical Chemistry*, Blackwell Science Ltd., New Delhi, 5th Edition, 2004.
2. G. R. Chatwal and Sham Anand, *Instrumental Methods of Chemical Analysis*, New Delhi, Himalaya Publishing House, 2011.
3. Miguel Valcarcel, *Principles of Analytical Chemistry*, Springer Publisher, 2014

Journals:

1. Journal of Analytical methods in Chemistry
2. Analytical methods Journal
3. Analytical Methods

E-Resources:

1. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=

2ahUKEwi7svXOvJLxAhWB7XMBHVwuDIYQFnoECBQQAA&url=http%3A%2F%2Finstrument-specialists.com%2Fthermal-analysis-applications%2Fdifferential-scanning-calorimetrydsc%2F&usg=AOvVaw3TWPWEBp4JyudIycwcOpK2

2. https://onlinecourses.nptel.ac.in/noc19_cy18/preview
3. https://www.digimat.in/nptel/courses/video/104105084/L51.html

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	3	9	9	45
CO2	9	3	9	3	3	9	9	45
CO3	9	3	9	3	3	9	9	45
CO4	9	3	9	3	9	9	9	51
CO5	9	3	9	3	3	9	9	45
Total	45	15	45	15	21	45	45	231

Low-1 Medium-3 High-9

Skill Enhancement Course V- Selected Topics in Applied Chemistry

(For Students Admitted from 2025-26)

Semester: V **Hours/Week: 2**
Subject Code: IBCHS541 **Credit: 1**

Course Objectives:

1. To widen the knowledge in leather, dairy and polymer chemistry
2. To impart knowledge on organophosphorus, carbamates, organochlorine and vermiculture

Unit I **(6 hours)**

Leather Chemistry: Introduction, Chief Processes Used in Leather Manufacture-Before Tannage, After Tannage, Composition of a Hide, Preparing Skins and Hides-Cleaning and Soaking, Liming and Degreasing and Fleshing and Shaving. Tanning Process-Tannage Materials, Vegetable Tanning.

Unit II **(6 hours)**

Dairy Chemistry: Milk – Composition of Milk, Physical Properties of milk, Effect of Heat on Milk, Coagulation by Heat, Effect of Heat on Fat, Sugar Protein Mixture, Acidity, Viscosity, Minerals, Colour, Flavour & Digestibility, Microorganism, Screen Formation and Scorching of Milk, Pasteurization, Homogenization.

Unit III **(6 hours)**

Polymer Chemistry: Introduction, Classification of Polymer-Natural & Synthetic, Thermoplastic & Thermosetting, Plastics, Elastomers, Fibers & Liquid resins, Homopolymer & Co-Polymers (Definition & Examples only). Polymerization: Definition, Types of Polymerization, Addition & Condensation Polymerization, Examples –Polyethylene, Polyvinyl Chloride, Terylene and Nylon 6, 6. Natural Rubber– Synthetic Rubber, Buna N and Buna S Rubber.

Unit IV **(6 hours)**

Organophosphorus, Carbamates and Organochlorine Compounds: Pesticides-Classification-Insecticides, Fungicides and Herbicides-General Methods of Application, Safety Measures, Preservation of seeds and Toxicity. CIB Quality requirements. Natural Insecticide-Nicotine, Pyrethrin, Inorganic pesticides – Borates and Organic pesticides - D.D.T. and BHC. Fungicide-Dithiocarbamates, Copper Compounds and Bordeaux mixture. Herbicides, Acaricides, Rodenticides. Attractants – Repellents.

Unit V **(6 hours)**

Vermiculture: Introduction, definition, classification, physico- chemical parameters of vermicompost, Different Methods: Bed method, Pit method, Conventional commercial composting. Harvesting, packaging, transport and storage of Vermicompost. FCO quality requirements.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: List the various insecticides, herbicides, fungicides and understand safety measures
CO2: Select the suitable method for vermiculture
CO3: Analyse dairy products based on properties
CO4: Classify the natural & synthetic polymer
CO5: Develop practical skills to the new materials with acquired knowledge on leather

Text Books:

1. Jeyashree Gosh, *Text Book of Pharmaceutical Chemistry*, S. Chand and company, New Delhi, 2017.
2. B.K. Sharma, *Industrial Chemistry*-I, Anu Books, New Delhi, 2020.

Reference Books:

1. K. Bagavathi Sundari, *Applied Chemistry*, MJP publications. New Delhi, 2019.
2. A. Ravikrishnan, *Engineering Chemistry*, Sir Krishna publication, Chennai, 2021.
3. B.K. Sharma, *Industrial Chemistry-II*, Anu Books, New Delhi, 2020.

Journals:

1. International Journal of Applied Chemistry
2. Russian Journal of Applied Chemistry
3. American Journal of Applied Chemistry

E-Resource:

1. https://books.google.co.in/books?id=MGG0ZcHXUuQC&pg=PA28&source=gbs_selected_pages&cad=3#v=onepage&q&f=false
2. http://wwwchem.uwimona.edu.jm/courses/CHEM2402/Textiles/Leather.html
3. https://pubmed.ncbi.nlm.nih.gov/21071550/
4. http://agri.and.nic.in/vermi_culture.htm

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	3	9	9	45
CO2	9	3	9	9	3	9	9	51

CO3	**9**	**3**	**9**	**3**	**3**	**9**	**9**	**45**
CO4	**9**	**3**	**9**	**3**	**3**	**9**	**9**	**45**
CO5	**9**	**3**	**9**	**9**	**3**	**9**	**9**	**51**
Total	**45**	**15**	**45**	**27**	**15**	**45**	**45**	**237**

Low-1 Medium-3 High-9

Core-XII - Inorganic Chemistry–III

(For Students Admitted from 2025-26)

Semester: VI **Hours/Week: 6**
Subject Code: JBCHC61 **Credits: 6**

Course Objectives:

1. To acquaint with the importance of inner transition elements - Lanthanides and Actinide
2. To understand the concept of co-ordination chemistry, organometallic compounds, solidsbio-inorganic compounds and inorganic polymers

Unit I **(15 hours)**

Lanthanides and Actinides: **Lanthanides-**Position in the Periodic Table, General Characteristic of Lanthanides, Lanthanide Contraction and its Consequences, Isolation of Lanthanides from Monazite and separation techniques (precipitation, ion-exchange, solvent-extraction and selective reduction and oxidation)

Actinides - Position in the Periodic Table, General Characteristic of Actinides, Occurrence, Separation of Actinide, Synthesis of Trans uranium elements. Comparison of Lanthanides and Actinides, Comparison of d- and f- block elements.

Unit II **(15 hours)**

Coordination Chemistry- I: Introduction-Definition and Terminology, Ligands, Monodentate and Polydentate Ligands, Coordination Number, Chelation, Nomenclature of Coordination Compounds, Structural & Stereo Isomerism, Werner‟s Co-Ordination Theory, Sidgwick's Electronic Concept, EAN Rule, Metal Carbonyl Complexes, Bonding in Carbonyls-Mono and Binuclear Carbonyls of Ni, Fe, Cr, Co and Mn–Hybridisation and Structure, VB theory, Shortcomings of Valence Bond theory.

Unit III **(15 hours)**

Coordination Chemistry- II: Crystal Field Theory-Crystal Field Splitting of Energy Levels, Crystal Field Splitting of Octahedral and Tetrahedral Complexes, Crystal Field Stabilization Energy, Crystal Field Splitting in Tetragonal and Square Planar Complexes, Factors Affecting the Magnitude of Crystal Field Splitting, Magnetic Properties of Complexes, Ligand Field Theory, Evidence of Covalent Bonding in Metal-Ligand Bonding, Molecular orbital theory of Complexes.

Unit IV **(15 hours)**

Bioinorganic Chemistry and Solids: Bioinorganic Chemistry-Essential and Trace Elements in Biological processes - Biological role of Haemoglobin, Myoglobin, Metalloprophyrins and Chlorophyll (Elementary idea of Structure and Mechanism of their Action), Biological Functions and Toxicity of Some Elements, Biological Fixation of Nitrogen. Solids-Band Theory of

Conductors, Semiconductors and Insulators. Imperfections in a Crystal-Outline of SchottkyDefects, Frenkel defects, Metal Excess and Metal Deficiency Defects and Line Defects. Nanomaterials - an Elementary Study.

Unit V **(15 hours)**

Organometallic Compounds and Inorganic Polymers: Organometallic Compounds- Definition, Classification-Ionic, σ-bonded and π-bonded Organometallic compounds, Preparation, properties and uses of Organometallic compounds, Olefin Complexes-Synthesis and Structure of Zeisels salt, Cyclopentadienyl Complexes - Preparation, properties, structure and uses of Ferrocene. Inorganic Polymers-Introduction, Classification, Preparation of Borazine, Substituted Borazine, Poly-Phosphonitritic Chloride, Poly-phosphoric acid, Borophosphate glasses, Tetrasulphur Tetranitride, Trithiazyl trifluoride, Imides of Sulphur.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall the periodic property of lanthanides and actinides and understand the general characteristics of inner transition elements

CO2: Utilize the Valence Bond theory, Crystal Field theory & Molecular orbital theory to arrive geometry and structure of coordination compounds

CO3: Categorize the solid-state crystal based on imperfections observed in light of band theory

CO4: Compare the stability of coordination complexes with organometallic compounds

CO5: Develop the basic understanding on the biological role of hemoglobin, myoglobin, metalloporphyrins, and chlorophyll

Text Book:

1. R.D. Madan, *Modern Inorganic Chemistry*, S. Chand and Company Private Limited,New Delhi, 2019.

Reference Books:

1. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principle of Inorganic Chemistry*, VishalPublishing Co, New Delhi, 2020.
2. R. Methrotra and A. Singh, *Organometallic Chemistry*, New Age International Pvt. Ltd. Publishers, New Delhi, 2020.
3. James E. Huheey, Ellen A. Keiter, L. Keiter Richard & Okhil K. Medhi, *Inorganic*
4. *Chemistry Principles of Structure and Reactivity*, Pearson India, 2019.

Journals:

1. Journal of Coordination Chemistry
2. Journal of Inorganic Biochemistry
3. Journal of Organometallic Chemistry

E-Resources:

1. https://www.alchemyst.co.uk/pdf/Inorganic/lanthanides_and_actinides.pdf
2. https://ncerthelp.com/cbse%20notes/class%2012/chemistry/Chemistry%20Notes%20for%20class%2012%20Chapter%209%20Coordination%20Compounds%20.pdf
3. https://chem.libretexts.org/Courses/Saint_Marys_College_Notre_Dame_IN/CHEM_342%3A_Bio-inorganic_Chemistry/Readings/Week_4%3A_Ligand_Field_Theory_(Octahedral_Compl

exes)/4.1%3A_Ligand_Field_Theory_(LFT)_and_Crystal_Field_Theory_(CFT)_of_Octahedral_Complexes

4. https://www.slideshare.net/mobile/Vishali29/structure-of-chlorophyll-haemoglobin

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	3	**39**
CO2	9	3	9	3	9	9	3	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	3	**39**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**45**	**15**	**21**	**45**	**27**	**213**

Low-1 Medium-3 High-9

Core-XIII - Physical Chemistry–III

(For Students Admitted from 2025-26)

Semester: VI **Hours/Week: 6**
Subject Code: JBCHC62 **Credit: 6**

Course Objectives:

1. To gain knowledge about of photochemistry, electrochemistry and colloidal state
2. To widen knowledge about spectroscopy – IR, UV, Raman, Electronic spectra & NMR

Unit I **(18 hours)**

Photochemistry: Photochemistry - Interaction of Radiation with Matter, Differences between Thermal and Photochemical processes, Laws of Photochemistry - Grothus-Draper Law, Stark-Einstein Law; Jablonski Diagram Depicting Various Processes Occurring in the Excited State (Internal Conversion, Intersystem Crossing) Qualitative Description of Fluorescence, Phosphorescence, Chemiluminescence, Quantum Yield, Photosensitized Reactions. Kinetics of Photochemical Combinations - H_2-Cl_2 and H_2-Br_2 reactions.

Unit II **(18 hours)**

Electrochemistry – II: Electromotive Force, Electrolytic and Galvanic Cells, Daniel Cell, Standard Weston Cadmium Cell, Reversible and Irreversible Cells, Conventional Representation of Electrochemical Cells, EMF of a Cell and its Measurement, Computation of Cell EMF, Nernst Equation, Types of Reversible electrodes –Single Electrode Potential, Standard Hydrogen Electrode, Reference Electrodes, and Standard Electrode Potential, Fuel Cells (H_2-O_2 Cell), Lead Storage Battery. Statistical Thermodynamics– Postulates of Macroscopic Thermodynamics, Maxwell‟s Derivation of the Molecular Velocity Distribution, Maxwell-Boltzmann Statistics.

Unit III **(18 hours)**

The Colloidal State: Introduction, Classification of Colloidal Solutions, Characteristics of Hydrophilic and Hydrophobic Sols, Preparation of Colloidal Solution, Lyophilic & Lyophobic Solution, Preparation methods, Condensation Methods such as by Double Decomposition,

Hydrolysis, Reduction, Oxidation, Exchange of Solvent, Controlled Condensation, Change of Physical State, in Short, Dispersion Methods such as Bredig‟s Method, by Grinding, Peptization,in Short, Purification of Colloidal Solution – Dialysis, Ultrafiltration, Ultra centrifuging, Properties of Colloidal Solutions, Optical Properties such as Tyndall Effect, Brownian Effect, Color, Electrical Properties such as Electrical Charge, Electrical double layer & Zeta Potential, Cataphoresis, Electro-Osmosis. The Protective Colloid (Gold Number), Application of Colloidal State.

Unit IV **(18 hours)**

Solid state: Definition of space lattice and unit cell, laws of crystallography-Law of constancyof interfacial angle, Law of rational indices, Law of symmetry.Symmetry elements of a Crystal.Lattice sites and coordination number. X-ray diffraction of crystals- Bragg‟s equation, Rotating crystal method Powder Method. Structure of crystal system NaCl, KCl and CsCl. Born Haber cycle-Lattice energy.

Unit V **(18 hours)**

Spectroscopy: Raman Spectra-Raman Effect, Stokes and Anti Stokes Lines, Basic ideas of IR and Raman spectra. Electronic spectra-Franck-Condon Principle. NMR Spectroscopy- Introduction, Spinning of Proton in a Magnetic field, Various aspects of NMR Spectrum, Position of Signals and Chemical Shift, Factors Affecting Chemical Shift, Number of Peaks in the NMR Spectra, Equivalent and Non-Equivalent Protons, Peak Area and Proton Counting, Splitting of Signals, Interpretation of the NMR Spectrum of Ethanol, Acetaldehyde.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: List the basic principle and laws applied in photochemistry, electrochemistry, statistical thermodynamics, colloidal state, and spectroscopy

CO2: Compare the photophysical and photochemical processes of photochemistry

CO3: Classify the characteristics, preparations and purification of colloidal matter

CO4: Evaluate the structure of the crystal system.

CO5: Solve transition assignment correspond to IR, Raman, NMR and UV spectral peaks

Text Books:

1. B.R. Puri, L.R. Sharma, and S. Pathania, *Principles of Physical Chemistry*, VishalPublishing Co., New Delhi, 2016.
2. B.S. Bahl, G.D. Tuli and Arun Bahl, *Essentials of Physical Chemistry*, Schamd, 2020.

Reference Books:

1. P.L. Soni, *Text Book of Physical Chemistry*, New Delhi, Sultan Chand & Co., 2014.
2. C.N. Banwell, & E.M. McCash, *Fundamentals of Molecular Spectroscopy*, McGraw Hill Education, New Delhi, 2017.
3. Robert M. Silverstein, Francis X. Webster, David J. Kiemle and David L. Bryce, *Spectrometric Identification of Organic Compounds*, Wiley Pvt. Ltd., 2014.

Journals:

1. Journal of Photochemistry
2. Journal of Applied Electrochemistry
3. Journal of Applied Spectroscopy

E-Resources:

1. https://www.google.com/search?q=photochemistry+pdf&oq=photochemistry+pdf&aqs=c

hrome..69i57j0l4.10270j0j7&client=ms-android-vivo&sourceid=chrome- mobile&ie=UTF-8
2. https://www.lkouniv.ac.insite PDF Web results B. Sc. II-Sem Colloidal state (1) The foundation of colloidal chemistry
3. https://nptel.ac.in pdf mod2PDF Module 2 Spectroscopic techniques Lecture 3 Basics of ... – NPTEL
4. https://www.fulviofrisone.com ...PDF Introductory Raman Spectroscopy - Fulvio Frisone

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	3	9	9	45
CO2	9	3	9	3	3	9	9	45
CO3	9	3	9	3	3	9	9	45
CO4	9	3	9	3	3	9	9	45
CO5	9	3	9	3	9	9	9	51
Total	45	15	45	15	21	45	45	231

Low-1 Medium-3 High-9

Core-XIV - Gravimetric Analysis and Organic Preparation Practical

(For Students Admitted from 2025-26)

Semester: VI **Hours/Week: 5**
Subject Code: JBCHC63P **Credit: 3**

Course Objectives:
1. To learn methods and principles of gravimetric analysis
2. To gain skills relating to the preparation of organic compounds

List of Experiments

1. Gravimetric Analysis: **(45 hours)**

i. Estimation of Lead as Lead Chromate
ii. Estimation of Barium as Barium Chromate
iii. Estimation of Calcium as Calcium Oxalate Mono Hydrateiv.
iv. Estimation of Copper as Cuprous Thiocyanate
v. Estimation of Nickel as DMG Complex
vi. Estimation of Chloride as Silver Chloride (demonstration only)

2. Preparation of Organic compounds **(45 hours)**

a. Nitration:
i. Meta Dinitrobenzene from Nitrobenzene
ii. Picric Acid from Phenol

b. Bromination:
i. Para Bromo Acetanilide from Acetanilide

c. Hydrolysis:
i. Salicylic Acid from Methyl Salicylate

ii. Benzoic Acid from Benzamide

d. Oxidation:

i. Benzoic Acid from Benzaldehyde

e. Condensation:

i. Glucosazone from Glucose

f. Benzoylation:

i. Benzoylation of Amines / Phenols

g. Green synthesis of organic compounds by microwave and water as solvent.

Evaluation Scheme: 4 hrs for Gravimetric Analysis and 2hrs for Organic Preparation
Distribution of external marks- 75
Record- 10
Viva – 5
Gravimetric Analysis - 35
Procedure – 10
Error (< 2 % - 25, 3% - 20, 4% - 15, > 4% - 10)
preparation of organic compounds - 25
Procedure – 5
Crude sample – 15
Recrystallization - 5

Course Outcomes:

After successful completion of this course, student will be able to

CO1: List the principles and find procedures involved in gravimetric analysis and organic preparation

CO2: Apply gravimetric analysis to estimate lead, barium, calcium, copper, nickel and chloride

CO3: Analyze the preparation of organic compound using nitration, bromination, hydrolysis, oxidation, condensation, and benzoylation

CO4: Evaluate the skills acquired in proper handling of apparatus and chemicals of organic compounds

CO5: Develop practical skills in testing and analyzing organic compounds

Text Books:

1. A.R. Kulandaivelu, V. Venkateswaran and R. Veeraswamy, *Basic Principles of Practical Chemistry*, Sultan Chand and Sons, New Delhi, 2017.

Reference Books:

1. F.G. Mann and B.C. Saunders, *Practical Organic Chemistry*, Pearson India, 2011.
2. O. P. Pandey, D. N. Bajpai and S. Giri, *Practical Chemistry*, S. Chand, New Delhi, 2010.
3. Sonia Ratnani, Swati Agrawal and Sujeet Kumar Mishra, *Practical Chemistry*, McGrawHill Education, New Delhi, 2020.
4. N.S. Gnanpragasam, and G. Ramamurthy, *Organic Chemistry: Lab Manual*, S.Viswanathan, Printers & Publishers Pvt Ltd, 2009.

Journals:

1. Journals on Titration | Gravimetric Analysis
2. Gravimetric Analysis
3. RSC Advance

E-Resource:

1. https://srcollege.edu.in/temp/lms/Manuals/UGOrganicAnalysis.pdf
2. https://edu.rsc.org/practical/gravimetric-analysis-practical-videos-16-18- students/4012297.article
3. https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/27%3A_Reactions_of_Organic_Compounds/27.09%3A_Synthesis_of_Organic_Compounds
4. dhttps://egyankosh.ac.in/bitstream/123456789/15906/1/Experiment-17.pdf
5. https://vlab.amrita.edu/index.php?sub=2&brch=193&sim=348&cnt=1

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	9	**45**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**15**	**45**	**15**	**15**	**45**	**45**	**225**

Low-1 Medium-3 High-9

Core –XV: Project

(For Students Admitted from 2025-26)

Semester: VI **Hours/Week: 6**
Subject Code: JBCHC64PW **Credit: 5**

Course Objectives:

1. To understand the practical skill of chemistry project
2. To learn principles and procedures employed in thesis writing of Chemistry

(90 hours)

Project work to be done by a group of five students in collaboration with central/state institute/R&D laboratory. The Project work should help the students to create a research attitude and apply the theory they have learnt throughout the course.

Evaluation Scheme: Project internal is evaluated based on the presentation of the project - 15 marks, background knowledge - 20 marks, and 5marks for attendance. The external 75 marks are distributed as follows, for dissertation 25 marks, for presentation 15 marks, and viva- voce10 marks.

Course Outcomes (CO):

After successful completion of this course, student will be able to

CO1: Choose and discuss the basic concepts in the chemistry project
CO2: Illustrate the principles and procedures employed in thesis writing of chemistry
CO3: Examine the skillsets required of chemistry project

CO4: Choose the appropriate procedures in handling of apparatus and chemicals
CO5: Formulate the designer materials with ecofriendly starting materials

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	3	9	9	45
CO2	9	3	9	3	9	9	9	51
CO3	9	9	9	3	9	9	9	57
CO4	9	3	9	3	3	9	9	45
CO5	9	3	9	9	3	9	9	51
Total	45	21	45	21	27	45	45	249

Low-1 Medium-3 High-9

Multi-Disciplinary V (A) - Introduction to Green Chemistry

(For Students Admitted from 2025-26)

Semester: VI **Hours/Week: 4**
Subject Code: JBMD61CHA **Credit: 3**

Course Objectives:
1. To know the basics principle of green chemistry and its developments
2. To know the basic ideas of synthesis, purification, properties and application of green chemistry

Unit I **(12 hours)**

Introduction to Green Chemistry: Introduction, Basic Principles of Green Chemistry with Explanation and Examples, Green Chemistry in Day to Day Life, Dry Cleaning of Clothes, Versatile Bleaching Agent, green solution for industrial production of petroleum and petrochemicals. Green solutions for industrial production of surfactants, organic and inorganic chemicals.

Unit II **(12 hours)**

Synthesis and Reactions involving Basic Principles of Green Chemistry: Introduction, Green Synthesis of the Following Compounds Advantages Over the Conventional Methods-Styrene, Adipic Acid, Urethane, 4-Aminodiphenylamine and Acetaldehyde, Alkylation of Active Methylene Group, Free Radical Bromination of Toluene, Preparation of Furfural from Biomass, Synthesis of Paracetamol and Citral, Use of Molting Accelerators in Place of Insecticides, Environmentally Safe Marine Antifoulant.

Unit III **(12 hours)**

Green Reagent and Green Catalysts: Dimethyl Carbonate for Methylation of Active Methylene Compounds, Green Catalysts-Definition of Titanium Silicate as Catalyst for Hydroxylation of Phenol, Microencapsulated Scandium Trifluoro Methane Sulphonate as Catalyst for Friedel Crafts Acylation, Phase Transfer Catalyst-Application of PTC in Synthesisof Nitrile from Alkyl Halides, Saponification by Crown Ethers, Aqueous Phase Reactions-AldolCondensation, Strecker Synthesis-

Organic Synthesis in Solid State, Claisen Rearrangement of Allyl Phenyl Ether to O-Allylphenol

Unit IV **(12 hours)**

Green chemical strategies for sustainable development: Areas of green chemistry, Reaction mass balance- Ato economy, evaluation for chemical reaction efficiency, green solvents- supercritical CO_2, H_2O, Ionic solvent / reaction media, catalysis and bio catalysis. microwave oven as a reactor, theory of microwave heating.

Unit V **(12 hours)**

Photochemical Degradation: An Eco-friendly Approach of Waste Treatment Photochemical Principles, Heterogeneous Photo-catalysis, Homogeneous Photo-degradation, photo oxidation, Direct Photo-degradation, Gas phase Detoxification, Equipments and application, Certain Class of Nanoparticles and their Application**.**

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall the basic principle of green chemistry and understand the green chemistry observedin everyday life

CO2: Apply the appropriate synthesis, purification methods for nanoparticles

CO3: Compare the green reagent and green catalysts synthesis

CO4: Explain the green chemical strategies for sustainable developement

CO5: Develop practical skills for preparing compounds by green synthesis method

Text Book:

1. A. Ravikrishnan, *Engineering Chemistry*, Sir Krishna Hitech Publishing Company Pvt.Ltd., Chennai, 2021.

Reference Books:

1. V. Kumar, *An introduction to green chemistry*, Vishal Publishing Co., 2013.
2. Tarun Kumar Upadhyay and Sushil Kumar Sharma, *A Textbook on Geoinformatics, Nanotechnology and Precision Farming*, New Delhi Publishers, 2020.

Journals:

1. Green Chemistry
2. Green Chemistry Letters and Reviews

E-Resources:

1. https://www.asdlib.org/onlineArticles/ecourseware/Manahan/GreenChem-2.pdf
2. https://application.wiley-vch.de/books/sample/352730715X_c01.pdf
3. https://www.sciencedirect.com/science/article/pii/S1878535217300990

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	9	3	3	9	**39**
CO2	9	3	9	9	3	9	9	**51**
CO3	9	3	9	9	3	9	9	**51**
CO4	9	3	9	9	3	9	9	**51**

CO5	9	3	9	9	3	9	9	**51**
Total	**45**	**15**	**39**	**45**	**15**	**39**	**45**	**243**

Low-1 Medium-3 High-9

Multi-Disciplinary V (B) – Introduction to Nanochemistry

(For Students Admitted from 2025-26)

Semester: VI **Hours/Week: 4**
Subject Code: JBMD61CHB **Credit:3**

Course Objectives:

1. To widen knowledge about fundamentals, type, constituents, synthesis and uses of nanomaterials.
2. To acquire knowledge on classification, characterization and applications of nanomaterials.

Unit I **(12 hours)**

Fundamentals of nanotechnology: Introduction to Nanoscience and Nanotechnology, Nanoscale material, implications for Physics, Chemistry, Engineering & Biology, and Motivation for Nanotechnology study. History &development of Nanoscience and Nanotechnology with the emphasis on history of Nano-metals, Chalcogenides and Boron Nitrite and Carbon Nanomaterial**s.**

Unit II **(12 hours)**

Structures and Classification of Nanomaterials: Nano-structures: various types of nano-structures and nano-crystals. Classification: of bulk Nano-structured materials, OD, 1D, 2D structures. Size Effects, Fraction of Surfaces, Surface Energy and Surface Stress, Effect on the Lattice Parameter, Phonon Density of States, Nano-particles, Quantum dots, Nano-wires, Ultra-thin films, Multi-layered materials.

Unit III **(12 hours)**

Nano Particles Synthesis and Characterization: Introduction, General Method of Synthesis– Top-Down Method, Bottom-Up Method, Chemical Synthesis - Reduction of Metal Atoms,Thermal Decomposition Methods, Photolysis, Radiolysis, Laser Vaporization, etc., General Properties of Nanoparticles, Methods of Characterizing Nanoparticle: SEM, TEM, STEM, Scanning Probe Microscope, Scanning Tunneling Microscope (STM) and Atomic Force Microscope (AFM).

Unit IV **(12 hours)**

Nano Composites: Nano Composites and their Applications, Metal-Metal nanocomposites for nuclear energy applications, Magnetic nanocomposites for Spintronics application, Ceramic nanocomposites for high temperature applications.

Nano ceramics: Dielectrics, ferroelectrics and magneto ceramics, Nanopolymers: Preparation and characterization of diblock Copolymer based nanocomposites, Nanoparticles polymer ensembles;

Applications of Nanopolymers in Catalysis.

Unit V **(12 hours)**

Certain class of nanoparticles and application: Synthesis, Purification, Properties and Application of Fullerenes, Carbon Nanotubes, Au and Ag Nanoparticles. Sensors-Chemical Sensors, Biosensors and Optical Sensors-Synthesis, Characterization and their Use. Application of Nanoparticles-Biology and Medicine, Core-Shell Nanoparticles, Catalysis, Sensing, Chemical Reactivity and Targeted Drug Delivery. Particle Size Analysis and Surface Area Measurements of Nanoparticles.

Text Book:

1. A. Ravikrishnan, *Engineering Chemistry*, Sir Krishna Hitech Publishing Company Pvt.Ltd., Chennai, 2021.

Reference Books:

1. S. Shanmugam, *Nanotechnology*, MJP Publishers, Chennai, 2019.
2. Robert W. Kelsall, Ian. W. Hanley & Mark Geoghegan, *Nano Scale Science, `Technology*, John Wiley & Sons Ltd., USA, 2007.
3. Subbiah Balaji, *Nanobiotechnology*, MJP Publishers, Chennai, 2019.

Journals:

1. Journal of Nanostructure in Chemistry

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	3	3	**27**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	9	3	9	9	**51**
Total	**45**	**15**	**39**	**21**	**15**	**39**	**39**	**213**

Low-1 Medium-3 High-9

Skill Enhancement Course –VI- Analytical Chemistry Practical

(For Students Admitted from 2025-26)

Semester: VI **Hours/Week: 2**
Subject Code: JBCHS65P **Credit: 1**

Course Objectives:

1. Be acquainted with current development in the field of Analytical Chemistry and apply the methods in various fields.
2. To learn principles and procedures employed in determination of Rf. Values, Dyes from waste effluent and Electrochemical Systems, separation of components from binary mixture and extractionof natural products.

List of Experiments **(30 hours)**

1. Determination of Nitrogen in soil sample.
2. Analysis of Electrochemical Systems - Copper Electroplating
3. Separation of Dyes from waste effluent.
4. Estimate the purity of organic compound by melting point, boiling point and chromotograpy
5. Separation of a Mixture of Potassium Permanganate and Potassium Dichromate usingColumn Chromatography
6. Determination of Rf. Values and Identification of Organic Compounds by Thin Layer Chromatography (TLC)
7. Separation of Components of a Binary mixture - Benzoic acid andNaphthalene/Toluene.
8. Separation of Components of a Binary mixture - ortho and para aniline.
9. Isolation of Lactose from Milk,
10. Isolation of Caffeinefrom Tea.
11. Isolation of Citric acid from Lemon.
12. Preparation of Inorganic Complexes and Identification of Counter Ion usingconductometric Titration.
13. Simulation of Electronic Structure for Inorganic Complexes using DFT Methods.

Evaluation scheme: At the end of the semester, a practical examination for two hours will be conducted for 50marks.
Distribution of external marks- 50 (Record- 10, Procedure – 10, Experimental and result- 30)

Course Outcomes:
After successful completion of this course, student will be able to
CO1: List the types of alkalinity in water samples, and demonstrate separation of essential oils, and testing of adulterants
CO2: Identify extractable coloring and flavoring agents from flowers and fruits
CO3: Compare the estimation of hydrogen peroxide and amino acid
CO4: Deduce the amount of glucose in food samples
CO5: Adapt the novelty in soap preparation by changing additives

Text Book:
1. O.P. Vermani, *Applied Chemistry: Theory and Practice*, New Age International Private Limited, 2017.
Reference Books:
1. John Kenkel, *Chemistry An Industry-Based Laboratory*, Taylor & Francis Publisher,2020
2. Ranjan Kumar Mohapatra, *Engineering Chemistry with Laboratory Experiments*, PHI Learning, 2015.
3. Manoj Kumar Solanki, *Engineering Chemistry Laboratory Manual*, Edu creationPublishing, 2019.
Journals:
1. Journal of the Society of Chemical Industry
2. International Journal of Industrial Chemistry
3. Journal of Chemical Education

E-Resources:
1. https://images.app.goo.gl/n6FkKJZJwN1QumnT9

2. https://images.app.goo.gl/5GM819F1YZXXhBkW8
3. https://images.app.goo.gl/zxCvxZEqBWU8tkDh9
4. https://gmcsurat.edu.in/lib/exe/fetch.php?media=biochemistry:g-_group_various_method_of_glucose_estimation_gtt_and_carbohydrate_chemistry.pdf
5. https://web.iitd.ac.in/~arunku/files/CEL212_2012/CEL%20212%20Lab%202%20Alkalinity%20and%20Acidity.pdf

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	9	3	9	9	51
CO2	9	3	9	3	3	9	9	45
CO3	9	3	9	3	3	9	9	45
CO4	9	3	9	3	3	9	9	45
CO5	9	3	9	3	3	9	9	45
Total	45	15	45	21	15	45	45	231

Low-1 **Medium-3** **High-9**

Extra Credit-III – Internship Report on Clinical sample testing or Forensic Analysis

(For Students Admitted from 2025-26)

Semester: VI
Subject Code: JBCHX6I **Credit: 2**

Course Objectives:

1.To gain practical knowledge and hands-on experience in clinical or forensic sample testing using standard laboratory procedures.
2. To understand the importance of quality control, safety standards, and regulatory compliance in clinical or forensic laboratories.

The students should undergo internship in clinical or forensic laboratories for ten days. They have to prepare the report with the guidance of the course teacher. Necessary documents and the evidence to be enclosed in the report.

Evaluation Scheme:75 marks will be given for the documentation of the report and 15 marks for the presentation and 10 marks for the viva voce.

Course Outcomes:

After successful completion of this course, student will be able to
CO1: Perform basic laboratory tests to assess clinical or forensic sample using appropriate instruments and techniques.
CO2: Interpret test results and evaluate their relevance in clinical or forensic contexts.
CO3: Understand and apply standard operating procedures (SOPs), quality assurance, and safety measures.

CO4: Prepare accurate lab reports and maintain records in accordance with industry norms.
CO5: Demonstrate professional behavior, teamwork, and communication skills in a lab or industrial environment.

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	3	9	3	**33**
CO2	9	3	9	3	3	9	9	**45**
CO3	9	3	9	3	3	9	9	**45**
CO4	9	3	9	3	3	9	9	**45**
CO5	9	3	9	3	9	9	9	**51**
Total	**45**	**15**	**39**	**15**	**21**	**45**	**39**	**219**

Ability Enhancement Compulsory Course For B. Sc Home Science
Basic Chemistry

(For Students Admitted from 2024-25)

Semester: I **Hours/Week: 4**
Subject Code: JBNDA13 **Credit: 4**

Course Objectives:
1. To acquire basics on oil, fats, vitamins and food additives.
2. To widen knowledge about Lubricants, Dyes, Fertilizer, Insecticides, Herbicides, fungicides.

Unit I **(15 hours)**

Oils, Fats and Food Additives: Oils and Fats-Classification of Oils, Fat Splitting, Distillation of Completely Miscible and Non-Miscible Oils, Hydrogenation of Oils, Rancidity, Saponification Value, Iodine number, Acid Value. Soap and Synthetic Detergent-Preparation of Soap and Detergent, Different types of Soap and their Composition, Surfactants (LAS, ABS, LABS), Detergent binders and builders. Food Additives-A general study of Food Flavours, Colours and Preservatives, Artificial Sweeteners.

Unit II **(15 hours)**

Water, Ozone, and H_2O_2: Water-Types of Water, Types of Hardness, Removal of Hardness by Reverse Osmosis and Ion Exchange Method, Estimation of Hardness by EDTA Method, Degrees of Hardness. Ozone-Manufacture, Composition, Structure and Properties & Uses.
H_2O_2-Manufacture, Structure, Uses of Hydrogen Peroxide and Estimation of Hydrogen Peroxide by Permanganometry.

Unit III **(15 hours)**

Fertilizer, Insecticides, Herbicides and Fungicides: Introduction, Requisites of a Good Fertilizer and Classification of Fertilizer, Nitrogen Fertilizers-Ammonium Sulphate, Calcium Ammonium Nitrate, Calcium Cyanamide and Urea; Phosphate Fertilizers and Phosphate slag; Potash Fertilizers: Potassium Chloride, Potassium Sulphate and Potassium Nitrate, Effects of Fertilizers. Classification

of Insecticides, as Organic and Inorganic-General Methods of Application and Toxicity. Safety Measures when using Insecticides-Plant Products - Nicotine, Pyrethrin,

Unit IV **(15 hours)**

Carbohydrates, Vitamins, and Dyes: Carbohydrates-Classification and Examples of Carbohydrates, Structure of Glucose, Fructose, Sucrose (Structure only). Vitamins-Definition, Classification, Sources, Deficiency Diseases of Vitamins. Dyes-Definition, Theory of Colour and Constitution, Classification of Dyes, Preparation of Methyl Orange, Congo Red and Malachite Green, Crystal Violet, Phenolphthalein, Fluorescein, Eosin, and Indigo.

Unit V **(15 hours)**

Lubricants, Cement, and Corrosion: Lubricants-Classification of Lubricants, Lubricating Oils (Conducting and Non-Conducting) Solid and Semisolid Lubricants, Synthetic Lubricants
Glass-Glassy State and its Properties, Classification (Silicate and Non-Silicate Glasses), Manufacture and Processing of Glass. Cement-Classification of *cement*, ingredients and their role, Manufacture of cement and the setting process, quick-setting cement.
Corrosion and Passivity-Rusting of Iron, Preventive Methods from Rusting, Cathodic Protection, Galvanization, Use of Inhibitors.

Course Outcomes:

After successful completion of this course, student will be able to
CO1: Recall the structure of vitamines, carbohydrates, dyes and understand the reason for colours observed in dyes
CO2: Appreciate the quality of oil, fat-based saponification, acid values and iodine number
CO3: Analyse the water resources to find suitable softening technique
CO4: Compare natural source for vitamins, carbohydrates and dye materials
CO5: Formulate the novel lubricants for special requirement, and mechanism behind rusting of Iron material

Text Books:

1. T. Coultate, *Food Chemistry*, C Publishing House, New Delhi, 2015.
2. B.K. Sharma, *Industrial Chemistry*, Krishna Prakashan media Pvt Ltd. Publishing, Uttar Pradesh, 2016.

Reference Books:

1. Shashi Chawla, *A Text Book of Engineering Chemistry*, Dhanpat Rai & Co. (P) Limited,2017.
2. Arun Bahl, B.S. Bahl, *Textbook of Organic Chemistry*, Sultan Chand & Sons, CompanyLtd, 2019.
3. Sathya Prakash, G.D. Tuli, S.K. Basu, & R.D. Madan, *Advanced Inorganic Chemistry*, Sultan Chand & Sons Company Ltd, 2016.

Journals:

1. Lubrication Science
2. International Journal of Fuels and Lubricants
3. Nutrition Journal

E-Resources:

1. https://www.sciencedirect.com/science/article/pii/B9780123815040000135?via%3Dihub
2. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=

8&ved=2ahUKEwjF5N2cg5TxAhU1zzgGHVDeCTIQFnoECBAQAA&url=http%3A%2F%2Fwww.dmce.ac.in%2Fnewdmcewebsite%2Fothers%2Fresource%2FHumanities%2FAPLLIED%2520CHEMISTRY%25201.pdf&usg=AOvVaw1RnGsVIE- pz39bbhR03IPT.
3. https://library.e.abb.com/public/34d5b70e18f7d6c8c1257be500438ac3/Oil%20and%20gas%20production%20handbook%20ed3x0_web.pdf
4. https://www.tandfonline.com/doi/full/10.1080/19440049.2015.1069407
5. https://pubs.acs.org/doi/10.1021/es00104a009

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	**3**	**3**	**3**	**1**	**3**	**9**	**3**	**25**
CO2	**9**	**3**	**9**	**3**	**3**	**9**	**9**	**45**
CO3	**9**	**3**	**9**	**3**	**3**	**9**	**9**	**45**
CO4	**9**	**3**	**9**	**3**	**3**	**9**	**9**	**45**
CO5	**9**	**3**	**9**	**3**	**3**	**9**	**9**	**45**
Total	**39**	**15**	**39**	**13**	**15**	**45**	**39**	**205**

Low-1 Medium-3 High-9

VALUE ADDED PROGRAMME

(For Students Admitted from 2025-26)

PREAMBLE

1. Title of the paper- Preparative Lab for Cosmetics and Personal Care Products was changed into Preparation of Cosmetics and Services in Aromatherapy.
2. Preparation of chemical soap experiment was removed in the course of Preparation of Cosmetics and Services in Aromatherapy.
3. In experiment No.1,the word of hair oil was added instead of hair growth oil.

PROGRAMME STRUCTURE 2025-2026

S. No	Programme	Subject Code	Subject	Total Contact Hours	Credits	ESE	Total
1.	Value added programme in water and waste water treatment	JCWT1P	Water and Waste Water Treatment Practical	**50**	**5**	**100**	**100**
2.	Value added programme in	JCDC1P	Dairy Chemistry	**50**	**5**	**100**	**100**

	dairy chemistry		Practical				
3.	Value added programme in aromatherapy and cosmetics	JCAT1P	Preparation of Cosmetics and Services in Aromatherapy Practical.	**50**	**5**	**100**	**100**
			Total	**150**	**15**	**300**	**300**

Water and Waste Water Treatment Practical

(For Students Admitted from 2025-26**)**

Subject Code: JCWT1P **Hours/Week: 5**
Credit: 5

Course Objectives

1. To build practical skills to analyses water samples
2. To understand instrumental errors and precisions

List of Experiments for water samples analysis **(50 hours)**

1. Determination of Acidity.
2. Determination of Alkalinity.
3. Determination of Chloride.
4. Determination of Total Hardness.
5. Determination of Salinity.
6. Determination of Chemical Oxygen Demand.
7. Determination of Biological Oxygen Demand.
8. Determination of Total Dissolved Solids.
9. Determination of Mixed Liquid Suspended Solids.
10. Determination of Dissolved Oxygen.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Recall the methods of waste water treatment and demonstrate the current development in the field

CO2: Apply the practical skill for purification of water

CO3: Analyze the water and waste water samples for acidity, alkalinity, pH, chloride, sulphate, salinity, calcium, COD, BOD, TDS, MLSS and dissolved oxygen

CO4: Compare the various industrial processes of water

CO5: Adapt the better treatment methods for unknown water samples

Textbook

1. V. Veeraiyan and L. Devaraj Stephen, *Engineering Chemistry Laboratory*, VRB Publishers Pvt. Ltd., Chennai, 2017.

Reference Books:

1. A.R. Kulandaivelu, V. Venkateswaran and R. Veeraswamy, *Basic Principles of Practical Chemistry*, Sultan Chand and Sons, New Delhi, 2017.
2. Manoj Kumar Solanki, *Engineering Chemistry Laboratory Manual*, Edu creation Publishing, 2019.

Journals:

1. Environmental Science: Water Research & Technology
2. Journal of Water Process Engineering

E- Resource:

1. https://drive.google.com/file/d/1_AWwqxmCesBZ3WgH8LCBR1r2P60u_sEg/view?usp=sharing
2. https://publishing.energyinst.org/topics/fuel-quality-and-control/ip-test-methods/ip-1
3. https://www.canterbury.ac.nz/media/documents/science-outreach/chloride_volhard.pdf
4. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/ 755569/COD-215nov.pdf
5. http://www.water-chemistry.in/2008/10/determination-of-mixed-liquor-suspended-solids/

Dairy Chemistry Practical

(For students admitted from 2025-26)

Subject Code: JCDC1P **Hours/Week: 5**
Credit: 5

Course Objectives

1. To acquaint with techniques, associate with dairy quality assessment
2. To understand the chemistry behind treatment methods for dairy products analysis

List of Experiments **(50 hours)**

1. Determination of boiling point and freezing point in various milk.
2. Determination of Total Solid (TS) and Solid Not Fat (SNF) by Lactometer and Gravimetric metric method.
3. Determination of fat in milk and selected dairy products.
4. Determination of viscosity in various milk samples.
5. Detection and quantification of starch in milk.
6. Determination of pH in various milk samples.
7. Detection of cellulose in milk sample.
8. Chemical analysis of butter milk.
9. Detection of adulterants and preservatives in milk.
10. Detection of ammonium sulphate in milk.
11. Isolation of lactose from milk.
12. Isolation of casein from milk.
13. Manufacture of homemade and commercial ice cream.
14. Detect the quality and adulterants in ghee.

15. Preparation of dairy products (milk powder and milk khoa).

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Understand the current development in the field of dairy chemistry and illustrate thevarious industrial processes of milk

CO2: Apply the determination of viscosity and pH of milk

CO3: Isolate the lactose and casein from milk

CO4: Explain the various analysis for checking quality of milk

CO5: Develop the eco-viable process for home- made and commercial ice cream,ghee,creams, butter, milk powder, palkova.etc

Reference Books:

1. Jagdish Prasad, Dairy Products Manufacturing Technology, Kalyani Publishers, 2020.
2. Richmond Henry Droop, Dairy Chemistry a Practical Handbook for Dairy Chemists and others having Control of Dairies, Nabu Press, 2010.
3. K. P. S. Sangwan, Technology of Dairy Plant Operation, 2008.

E- Resource:

1. https://old.fssai.gov.in/Portals/0/Pdf/Draft_Manuals/MILK_AND_MILK_PRODUCTS.pdf
2. http://allpedia.dkart.in/health/adulterants-in-the-foods/4866-detection-of-cellulose-in-milk.html#:~:text=Cellulose%20in%20milk%20gives%20blue,until%20iodine%20begins%20to%20precipitate.
3. http://www.madehow.com/Volume-3/Ice-Cream.html
4. https://patents.google.com/patent/CN105410885A/en#:~:text=The%20method%20comprises%20steps%20as,first%20permeate%20after%20the%20whey
5. https://vlab.amrita.edu/?sub=3&brch=63&sim=1091&cnt=1

Preparation of Cosmetics and Services in Aromatherapy Practical

(For students admitted from 2025-26)

Subject Code: JCAT1P **Hours/Week: 5**
Credit: 5

Course Objectives

1. To strengthen the students to get practical experience on aromatherapy-using oil for skin care, hair care, full body massage and reflexology

2. It enables the students to apply the beauty treatment confidently and helps to improve the particular functioning of systems through body massage

List of Experiments: **(50 hours)**

1. Preparation of various types of Hair Oil.
2. Preparation of hair cream, hair pack, hair gel and hair lotion (mix and match).
3. Preparation of glow gel, anti-acne cream, anti-aging cream and pigmentation gel.
4. Preparation of various types of serum for hair and face.
5. Preparation of various types of face washes-lemon, neem and chemical face wash.

6. Preparation of cold process soap-coconut oil soap, almond oil soap.
7. Preparation of melt and pour soap-papaya soap, charcoal soap, carrot soap.
8. Preparation of shikakai paste, bath powder and hair wash powder.
9. Preparation of various types of face packs, scrubs, massage cream and lotions.
10. Various methods of massage-face massage-body massage-foot massage.
11. Aroma facial recipe (for massage only).

Course Outcomes

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

CO1: Study the pressure points in the body

CO2: Demonstrate the methods to prepare aroma oil to control hair fall and to treat skin and hair related problems

CO3: Preparation of aroma oil for head, hand, foot, face and body massage

CO4: Classify the essential oil and carrier oil

CO5: Understand the preparatory methods and application of cosmetics

Text Books:

1. Valerie Ann Worwood, *Aromatherapy in Everyday life*, V&S Publishers, 5th Edition 1991.
2. Marta Tuchowska, *Aromatherapy and Essential Oils for Beginners: Discover the Phenomenal Powers of Essential Oils to Relax, Revitalize, and Revolutionize Your Health*, *Create Space Independent* Publishing Platform, 2nd Edition (December 17, 2015).

Reference Books:

1. Amanda Gail Aaron, "*The complete guide to natural soap making",* Althea Pr,2019.
2. Ace McCloud, "*Massage therapy: Trigger point therapy: Acupressure therapy: Learn the best techniques for optimum pain relief and relaxation",* Pro Mastery Publishing, 2017.

Journals:

1. Environmental Science and Technology
2. Journal of Industrial and Engineering Chemistry
3. Journal of Natural Products

E-Resources:

1.https://www.pdfdrive.com/essential-oils-aromatherapy-an-introductory-guide-more-than-300-

2.https://www.pdfdrive.com/365-days-of-diy-skin-care-hacks-essential-oils- natural- soaps- homemade-face-masks-diy-natural-beauty-recipes-e199756635.html

3.https://www.pdfdrive.com/the-complete-guide-to-creating-oils-soaps-creams-and-herbal- gels- for-your-mind-and-body-101-natural-body-care-recipes e199756901.html

4.https://www.pdfdrive.com/search?q=8.%09Preparation+of+chemical+soap&pagecount=&pubyear=&searchin=&em=&more=true

5.https://www.pdfdrive.com/search?q=11.%09Various+methods+of+MassageFace+massage Body+massageFoot+ massage&pagecount= &pubyear= &searchin =&em