CHEMISTRY

Course Outcome

Semester I

Major Course: MJC-1(T) - Inorganic Chemistry: Atomic Structure, Chemical Bonding and Fundamentals of Organic Chemistry

Course Outcomes:

- Understand the model of an atom and related principles.
- Understand bonding principles, shapes, and structures of covalent molecules.
- Begin research in organic chemistry, including detection, separation, and purification of organic compounds.

Practical: MJC-1(P) - Inorganic and Organic Chemistry Practical

Course Outcomes:

- Prepare solutions and perform titrations.
- Understand steps in organic chemistry like detection and purification.

Semester II

Major Course: MJC-2(T) - Physical Chemistry: States of Matter and Ionic Equilibrium

Course Outcomes:

- Understand gas, liquid, and solid states and related mathematical expressions.
- Analyze crystal structures.
- Grasp ionization concepts and equilibria involving weak acids, bases, and buffers.

Practical: MJC-2(P) - Physical Chemistry Practical

Course Outcomes:

- Determine viscosity and surface tension.
- Calculate molecular weights.
- Prepare buffer solutions and conduct pH-metric titrations.

Semester III

Major Course: MJC-3(T) - Organic Chemistry: Cyclic Hydrocarbons and Their Halogen Derivatives

Course Outcomes:

- Understand aromaticity and reactivity of hydrocarbons.
- Design organic syntheses using halogen derivatives.

Major Course: MJC-4(T) - Physical Chemistry: Chemical Thermodynamics and Applications

Course Outcomes:

- Learn thermodynamic principles and enthalpy changes.
- Understand entropy, free energy, and the laws of thermodynamics.

Practical: MJC-4(P)

Course Outcomes:

- Determine enthalpy changes and heat capacities.
- Measure solubility and heats of hydration.

Semester IV

Major Course: MJC-5(T) - Inorganic Chemistry: s-, p-, d-, and f-block Elements

Course Outcomes:

- Understand periodic properties and bonding.
- Study transition metal chemistry, including oxidation states and coordination behavior.

Practical: MJC-5(P)

Course Outcomes:

- Identify basic and acid radicals in salt mixtures.

Major Course: MJC-6(T) - Organic Chemistry: Compounds with Oxygen-Containing Functional Groups

Course Outcomes:

- Understand reactions of alcohols, phenols, aldehydes, ketones, and acids.
- Draw mechanisms and apply green chemistry principles.

Practical: MJC-6(P)

Course Outcomes:

- Perform organic synthesis and functional group tests.

Major Course: MJC-7(T) - Physical Chemistry: Phase Equilibria, Conductance and Electrochemical Cells

Course Outcomes:

- Understand phase diagrams and conductance.
- Analyze electrochemical cells and perform potentiometric titrations.

Semester V

Major Course: MJC-8(T) - Coordination Chemistry

Course Outcomes:

- Analyze coordination compounds using VBT and CFT.
- Understand magnetic properties and electronic spectra of complexes.

Practical: MJC-8(P)

Course Outcomes:

- Prepare coordination compounds.
- Perform complexometric and colorimetric analysis.

Major Course: MJC-9(T) - Organic Chemistry: Polynuclear Hydrocarbons, Nitrogen Compounds, Heterocycles, Alkaloids, Terpenoids

Course Outcomes:

- Study aromatic systems, nitrogen compounds, and natural products.

Semester VI

Major Course: MJC-10(T) - Colligative Properties, Kinetics, Photochemistry

Course Outcomes:

- Understand colligative properties, rate laws, and photochemical reactions.

Practical: MJC-10(P)

Course Outcomes:

- Determine molecular masses and reaction rates.

Major Course: MJC-11(T) - Organic Chemistry: Biomolecules

Course Outcomes:

- Understand amino acids, proteins, nucleic acids, enzymes, and lipids.

Practical: MJC-11(P)

Course Outcomes:

- Conduct biochemical tests and synthesize simple pharmaceuticals.

Semester VII

MJC-13 (T): Inorganic Chemistry - Organometallic Chemistry, Symmetry and Group Theory

Course Outcomes:

- CO1: Understand nomenclature and classification of organometallic compounds.
- CO2: Analyze properties and structures of metal carbonyls.
- CO3: Learn preparation methods of organometallics.
- CO4: Grasp symmetry concepts and group theory fundamentals.

MJC-15 (T): Organic Chemistry - Spectroscopy

Course Outcomes:

- CO1: Understand types of electronic transitions in organic molecules.
- CO2: Learn principles of ultraviolet spectroscopy.
- CO3: Understand molecular vibrations and IR spectroscopy principles.
- CO4: Grasp nuclear spin and NMR spectroscopy fundamentals.
- CO5: Learn the principles of ESR spectroscopy.

Semester VIII

MJC-16 (T): Analytical Methods in Chemistry

Course Outcomes:

- CO1: Understand accuracy and precision in chemical analysis.
- CO2: Independently develop analytical methods for various samples.
- CO3: Test contaminated water samples.
- CO4: Understand instruments like Flame Photometer and UV-Vis Spectrophotometer.
- CO5: Learn chromatographic separation techniques.
- CO6: Apply knowledge of geometrical isomers and keto-enol tautomers.
- CO7: Determine soil composition.
- CO8: Estimate macronutrients using flame photometry

Programme Outcome (PO) for B.Sc. (Hons.) in Chemistry (Four-Year Undergraduate Programme)

Upon successful completion of the Chemistry Honours program, graduates will be able to:

PO1: In-depth Knowledge of Chemistry

Acquire comprehensive and systematic understanding of the fundamental concepts across the three main branches of Chemistry—Inorganic, Organic, and Physical Chemistry—as well as specialized areas such as Analytical Chemistry, Spectroscopy, Biomolecules, Organometallic Chemistry, and Coordination Chemistry.

PO2: Laboratory and Technical Skills

Develop strong experimental skills and technical competencies through well-structured laboratory courses. This includes quantitative and qualitative analysis, organic synthesis, physical measurements, titrations, spectroscopy, and chromatographic techniques.

PO3: Critical Thinking and Analytical Reasoning

Apply principles of Chemistry to identify, formulate, and solve scientific problems. Analyze data, interpret results, and draw valid conclusions using mathematical, logical, and analytical tools.

PO4: Research Orientation and Innovation

Demonstrate the ability to engage in initial research, including literature survey, problem formulation, experimental design, data collection, and result interpretation—especially emphasized through courses like Research Methodology and specialized electives.

PO5: Scientific Communication

Communicate scientific concepts and results effectively through written reports, presentations, and discussions. Use proper scientific language and data visualization to convey findings.

PO6: Interdisciplinary Approach

Understand the interdisciplinary applications of chemistry in fields like biology, medicine, environmental science, material science, and industrial processes. Recognize the role of chemistry in real-world and societal contexts.

PO7: Ethical Practices and Sustainability

Apply ethical principles in chemical research and laboratory practice. Understand the environmental implications of chemical processes and promote green chemistry and sustainable development.

PO8: Problem-Solving Using Modern Tools

Utilize modern scientific instruments, software, and analytical techniques for solving chemical problems. Demonstrate competency in using digital tools for simulations, chemical structure analysis, and spectroscopic interpretation.

PO9: Readiness for Higher Studies and Careers

Be prepared for competitive exams and further academic pursuits (postgraduate, research). Possess the foundational knowledge and skills for employment in chemical industries, pharmaceuticals, quality control labs, teaching, and allied scientific fields.

PO10: Lifelong Learning and Professional Development

Foster a mindset of continuous learning through emerging trends in chemistry, workshops, journals, and participation in scientific forums. Cultivate adaptability and professionalism required for diverse career paths.

Cross-Cutting Issues in Chemistry Curriculum

1. Professional Ethics

Relevant Curriculum Topics:

- **Laboratory Practices:** Emphasizing accuracy, honesty, and integrity in data recording, interpretation, and reporting (Practicals: MJC-1(P), MJC-2(P), MJC-4(P), MJC-6(P), MJC-8(P), etc.).
- **Research Methodology (MJC-14):** Encourages ethical conduct in research, avoiding plagiarism, respecting intellectual property, and following scientific honesty.
- **Spectroscopy and Analysis (MJC-15, MJC-16):** Emphasizes ethical handling of instrumentation, sample authenticity, and transparency in results.

Values Promoted:

- Scientific integrity
- Accountability
- Respect for intellectual work

2. Gender Sensitization

Relevant Curriculum Integration:

- **Inclusive Teaching Approach:** Using examples and case studies that showcase contributions of both male and female scientists (e.g., Marie Curie in radioactivity, Rosalind Franklin in DNA structure).
- **Classroom Discussions:** Encouraging equal participation in practical work, group discussions, and seminars to promote gender equity.

Values Promoted:

- Gender equality
- Mutual respect
- Equal opportunity in STEM education

3. Human Values

Relevant Curriculum Touchpoints:

- **History and Philosophy of Science:** Through discussion of scientific revolutions and societal impact of chemical discoveries.
- **Collaborative Projects/Practical Work:** Promote cooperation, patience, empathy, and teamwork.
- **Pharmaceutical Chemistry (MJC-11, MJC-16):** Reflects on chemistry's role in alleviating human suffering, healthcare, and disease prevention.

Values Promoted:

- Empathy
- Compassion
- Respect for life and well-being

4. Environment and Sustainability

Embedded in Curriculum Topics:

- **Green Chemistry (MJC-6, MJC-11):** Use of environmentally friendly chemical practices and solvents; promotes reduction of chemical waste.
- **Environmental Chemistry & Analysis (MJC-16):** Monitoring pollutants, soil testing, water quality analysis.
- **Physical Chemistry and Thermodynamics (MJC-4, MJC-10):** Understanding energy efficiency and sustainable processes.
- **Organic Synthesis Practicals:** Encouraging green methods (e.g., microwave/solvent-free synthesis).

Values Promoted:

- Environmental consciousness
- Resource conservation
- Sustainable development mindset

5. Health and Safety Awareness

Practicals Across All Semesters:

- Safe handling of chemicals
- Proper waste disposal
- Use of personal protective equipment (PPE)
- First aid and emergency procedures in labs

Values Promoted:

- Self-care and peer safety
- Awareness of chemical hazards
- Precautionary practices in workspaces

Suggested Co-curricular Activities to Reinforce These Themes:

- **Workshops on Scientific Ethics and Plagiarism**
- **Debates on Gender Roles in STEM**
- **Outreach Programs on Green Chemistry**
- **Student-led Environment Monitoring Projects**
- **Celebration of Women in Science Days**