Program Name: M.Sc./Integrated M.Sc.-PhD Chemistry

PROGRAM OUTCOMES:

1. Building a firm foundation for conceptual, quantitative, and rational thinking that underlies theories and models related to the chemical sciences
2. Students will be able to integrate chemical concepts and ideas learned in lecture courses with skills learned in laboratories to formulate hypotheses, propose and perform experiments, collect data, compile and interpret results and draw reasonable and logical conclusions.
3. Be proficient in the use of both classical and modern tools (e.g., instrumentation, techniques, software) for analysis of chemical systems.
4. Students will be able to identify and solve chemical problems and explore new areas of research.
5. Students will be explored to interdisciplinary and multidisciplinary areas of chemical sciences and their applications.
6. Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals
7. Students will be empowered with excellent critical thinking skills and problem solving abilities and will be able to communicate the results of their work to chemists and non-chemists.
8. Generate awareness of the benefits and impacts of chemistry related to the environment, society, and other disciplines outside the scientific community.

PROGRAM SPECIFIC OUTCOMES:

We offer specialization in Analytical, Organic Chemistry and Materials Chemistry in the second year of the program

In **Analytical chemistry**, we introduce new technologies and methods to students for analyzing organic and inorganic matter. On completing this specialization, the below mentioned outcomes are expected:

1. Students will get advanced knowledge in the area of modern primary characterization techniques in chemistry (and related subject areas);
2. Students will have a thorough theoretical and practical understanding of advanced analytical instruments.
3. Provide students with an opportunity to work with advanced analytical instrumentation in state-of-the-art laboratories dedicated both to education and also to research;
4. Develop knowledge and research skills applicable to a career in modern analytical chemistry,
5. Students will work within a small team to undergo practical-based research, particularly on characterization and analytical instrumentation

In **Organic chemistry**, we offer in-depth knowledge about organic-chemical reactions with a focus on principles for effective synthesis methods, stereoelectivity, catalysis, as well as advanced organic spectroscopy. On completing this specialization, the below mentioned outcomes are expected:

1. Students will have an understanding of chemical and molecular processes in chemical reactions.
2. Students will be empowered with research-based in-depth understanding in the fieldof design and synthesis of complex molecules.
3. Students will be able to use complicated analytical and spectroscopic methods to synthesize and characterize new products.
4. Students will learn about synthetically useful transformations like oxidations, reductions, enolate reactions, percicyclic reactions, organometallic reactions, and reactions of electron deficient species. The emphasis will be on developing a mechanistic understanding of selectivity and synthetic strategy.
5. Develop research oriented skills

We are introducing new specialization – **Materials Chemistry** from 2021. This is an interdisciplinary specialization, designed to provide knowledge about the properties of metallic, semiconducting, biomaterials, polymeric materials and their industrial applications. After completing the course, below mentioned outcomes are expected:

1. Students will develop an understanding of the basic slid state chemistry, material properties, their product design and applications in various fields.
2. Students will learn to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions
3. Students will learn biomaterials classifications, their properties, performance specification and biological applications.
4. Students will also learn about fundamentals of various analytical techniques and the applications of these techniques in characterizing chemical compounds.
5. Students will develop an understanding of the electrochemical methods and industrial electrochemical process.

COURSE OUTCOMES

Sl. No	**Semester**	**Course/module (Code)**	**Expected outcomes**
1	I	Physical Chemistry (101)	1. After completing the course, students will develop an understanding of the chemical kinetics, thermodynamics, basics of quantum chemistry and electrochemistry. 2. Students will also improve skills to present practical reports and awareness of health and safety procedures.

		Inorganic Chemistry (102)	1. After completing the course, students will gain understanding of coordination complexes, alloys, organometallic chemistry and different solid state reactions. 2. Practical component will develop experimental skills of the students and they will learn how to interpret data obtained from a range of physical techniques to characterize inorganic compounds
		Organic Chemistry I (103)	1. At the end of the course, students will gain understanding of quantum chemistry related to organic compounds, nucleophilic substitution reactions, stereochemistry, reaction mechanisms and kinetics. 2. Practical component will develop experimental skills of the students and they will learn how to interpret data obtained from a range of physical techniques to characterize inorganic compounds
		Analytical Chemistry I (104)	1. At the end of the course, the learners should be able to analyze the data obtained from different instruments based on various analytical concepts. 2. Students will learn to quantify analytes with proper data handling and analysis. 3. Practical component will enable students to achieve mastery over industrially important chromatography and spectroscopy experiments.

2	II	Advanced Organic Spectroscopy (201)	1. At the end of the course, the students should be able to apply their knowledge of different spectroscopic techniques in solving structure of organic molecules and in determination of their stereochemistry. 2. Students will be able to interpret the given spectroscopic data of unknown compounds. 3. Students will be able to use these spectroscopic techniques in their future research
		Nanoscience and Nanotechnology (202)	1. Develop understanding into the synthesis of nanomaterials and their characterization with different experimental techniques. 2. Develop the aptitude in translating this knowledge into useful technological applications. 3. Harness extensive analytic and synthetic problem-solving capacities. 4. Enhance the sufficient scientific background to undertake research.
		Environmental and Green Chemistry (203)	1. After completion of the course, students would be able to understand the effect of human activities on the environmental health. 2. With this laboratory practical course work, the students may collect and analyze samples for identification of a contaminator, or help develop remediation programs. 3. The major outcome could be that the students get involved in altering industrial practices so that the end result is a more environment-friendly product. 4. Students who opt to work in the chemical industries, may advise employees on safety and emergency response, or on how to deal with government regulations and compliance issues.

		Research Methodology and IPR (204)	1. The students once they complete their academic projects, they get awareness of acquiring the patent and copyright for their innovative works. 2. Students also get the knowledge of plagiarism in their innovations which can be questioned legally.
3	III (Specialization in Analytical Chemistry)	Analytical Chemistry II (A301)	1. Handle HPLC, Gas chromatography and can able to Interpret MS, NMR, ^{13}C NMR, TGA, DSC data of different chemical compounds.
		Advanced Analytical Techniques (A302)	1. The students will be able to carry out X-Ray Diffraction, Surface analysis, Electroanalytical Measurements and Electrodeposition and Coulometry. 2. Knowledge of these techniques will be useful in research and industries
		Industrial Chemistry (A303)	1. The students will be able to synthesize polymers and catalysts for industrial applications. 2. They will have complete understanding of polymer and catalysts properties and characterization
		Applied Electrochemistry (A304)	1. The students will be able to know about electrochemistry and electrode kinetics, batteries, fuel cells and electrochemical biosensors etc

4	III (Specialization in Organic Chemistry)	Organic Chemistry II (O301)	1. The students will be able to plan a synthetic reaction, name the product and elucidate the mechanism of a particular reaction
		Organic Chemistry III (O302)	1. The students will be able to carry out photochemical reactions, pericyclic reactions and catalytic reactions using organometallic compounds. 2. Students will get a comprehensive account of pericyclic reactions and photochemical reactions
		Organic Chemistry IV (O303)	1. The students will be able to learn the use of Name reactions in various industrial applications. 2. Students will get a comprehensive account of natural products and their chemistry. 3. Students will get an idea about various redox processes that are made use of in industries.
		Medicinal Chemistry (O304)	1. The students will be able to know about different types of drugs, their source, and their way of action.
4	**III (Specialization in Materials Chemistry)**	Introduction to solid state chemistry (M301)	Students will be able to demonstrate an understanding of: 1. basic materials chemistry that reinforces current and emerging technologies as well as some of the novel classes of materials being developed for future applications. 2. molecular, structural, and chemical origins of the physical properties of materials such as metals, semiconductors, biomaterials and polymers.
		Material Characterization and introduction to biomaterials (M302)	Students will be able to: 1. Understand the fundamental principals in biomedical engineering, material science and Chemistry, and how they contribute to biomaterial development and performance. 2. understand thoroughly-Surface analysis, spectroscopy

			microscopy techniques 3. apply this knowledge in research and industries.
		Electrodics of Materials (M303)	1. This course exploring the electrochemical application of materials. 2. After successful completion of this course, students will be able to demonstrate an understanding of electrochemistry of various materials, electrode preparation using polymers, porous materials, construction of small devices etc.
		Design of Experiments (M304)	1. The course objective is to learn to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions. 2. Opportunities to use the principles arise in all phases of new product design and development, process development, and manufacturing process improvement. 3. Computer software packages to implement the methods presented will be illustrated extensively, and students will have opportunities to use it for homework assignments and the term project.
5	IV	Project (6 month)	1. Gain work experience and bridge the gap between academia and industry. 2. Improve your employability prospects. 3. Students will develop skills and advance their professional portfolios while also contributing to the goals and outcomes of their host agency