For students enrolled since the second semester 2025 academic years and onward

Department of Basic Science and Physical Education

Applied Chemical Technology

Program Master of Science Program in Applied Chemical Technology

Degree Master of Science (Applied Chemical Technology)
M.S. (Applied Chemical Technology)

Plan 1 Option A 1:

Total credits required: minimum 36 credits

(1) Major courses: minimum 2 credits (audit)

- Seminar: 2 credits (audit)

03652597	Seminar	1,1

(2) Thesis: minimum 36 credits

03652599	Thesis	1-36

Plan 1 Option A 2:

Total credits required: minimum 36 credits

(1) Major courses: minimum 15 credits

- Seminar: 2 credits

03652597	Seminar	1,1

- Major requirements: 1 credit

03652591	Research Methods in Applied Chemical Technology	1(1-0-2)

- Major electives: minimum 12 credits

Students are required to choose courses from the list below.

03652521	Lignocellulosic Chemistry	3(3-0-6)
03652522	Strategies in Organic Synthesis and Structure Modification of Natural Products	3(3-0-6)
03652523	Cosmetic Products and Development	3(3-0-6)
03652524	Advanced Spectroscopy for Organic Compounds	3(3-0-6)
03652531	Chemistry of Macro Biomolecules	3(3-0-6)
03652532	Drug Design for Future	3(3-0-6)
03652541	Computer Applications in Chemistry	3(3-0-6)
03652542	Advanced Computational Chemistry	3(2-3-6)
03652543	Molecular Modeling in Chemistry	3(2-3-6)
03652544	Chemical Process Simulation	3(3-0-6)
03652545	Machine Learning for Computational Chemistry	3(3-0-6)
03652551	Advanced Coordination Chemistry and Identification	3(3-0-6)
03652552	Frontiers Inorganic Chemistry	3(3-0-6)
03652561	Advanced Composites Materials	3(3-0-6)
03652562	Polymer Analysis and Characterization	3(3-0-6)
03652563	Polymer Physics	3(3-0-6)

03652564	Polymer Rheology	3(3-0-6)
03652571	Advanced Dyes and Functional Materials	3(3-0-6)
03652572	Chemical Catalysis Technology	3(3-0-6)
03652573	Semiconductor in Photocatalyst	3(3-0-6)
03652574	Materials for Green Chemistry and Carbon Neutrality	3(3-0-6)
03652596	Selected Topics in Applied Chemical Technology	1-3
03652598	Special Problems	1-3

(2) Thesis: minimum 21 credits

03652599	Thesis	1-21

Plan 2:

Total credits required: minimum 36 credits

(1) Major courses: minimum 30 credits

- Seminar: 2 credits

03652597	Seminar	1,1

- Major requirements: 7 credits

03652511	Industrial Standards-Based Laboratory Quality System Development	3(3-0-6)
03652512	Resource Management in Chemical Industries	3(3-0-6)
03652591	Research Methods in Applied Chemical Technology	1(1-0-2)

- Major electives: minimum 21 credits

Students are required to choose courses from the list below.

03652521	Lignocellulosic Chemistry	3(3-0-6)
03652522	Strategies in Organic Synthesis and Structure Modification of Natural Products	3(3-0-6)
03652523	Cosmetic Products and Development	3(3-0-6)
03652524	Advanced Spectroscopy for Organic Compounds	3(3-0-6)
03652531	Chemistry of Macro Biomolecules	3(3-0-6)
03652532	Drug Design for Future	3(3-0-6)
03652541	Computer Applications in Chemistry	3(3-0-6)
03652542	Advanced Computational Chemistry	3(2-3-6)
03652543	Molecular Modeling in Chemistry	3(2-3-6)
03652544	Chemical Process Simulation	3(3-0-6)
03652545	Machine Learning for Computational Chemistry	3(3-0-6)
03652551	Advanced Coordination Chemistry and Identification	3(3-0-6)
03652552	Frontiers Inorganic Chemistry	3(3-0-6)
03652561	Advanced Composites Materials	3(3-0-6)
03652562	Polymer Analysis and Characterization	3(3-0-6)
03652563	Polymer Physics	3(3-0-6)
03652564	Polymer Rheology	3(3-0-6)
03652571	Advanced Dyes and Functional Materials	3(3-0-6)
03652572	Chemical Catalysis Technology	3(3-0-6)
03652573	Semiconductor in Photocatalyst	3(3-0-6)
03652574	Materials for Green Chemistry and Carbon Neutrality	3(3-0-6)
03652596	Selected Topics in Applied Chemical Technology	1-3

03652598 Special Problems 1-3

(2) Independent Study: 6 credits

03652595 Independent Study 1-21

Course Description

Courses in the field

03652511 Industrial Standards-Based Laboratory Quality System Development 3(3-0-6)

Scope and components of ISO/IEC 17025 quality management system and safety standards for chemical management. Defining scope of laboratory, identifying customer requirements, and setting objectives. Document control, record control, sample management, conducting tests and calibrations, internal audits, external audits, uncertainty measurement, data analysis, corrective actions, and preventive actions. Knowledge, skills, and responsibilities of personnel in the quality system. Calibration, maintenance, and control of equipment. Analysis of internal and external audit results. Laboratory chemical safety management system and safety measures for chemical management.

03652512 Resource Management in Chemical Industries 3(3-0-6)

Interest rate. Capital cost. Operating cost. Time value of money. Discount cash flow analysis. Internal rate of return. Economic evaluation.

03652521 Lignocellulosic Chemistry 3(3-0-6)

Cellulose. Hemicellulose. Lignin and extractives. Pretreatments of lignocellulose. Conversion of lignocellulosic derivatives for product formation. Utilization of lignocellulose for fuels and chemicals production.

03652522 Strategies in Organic Synthesis and Structure Modification of Natural Products 3(3-0-6)

Key reactions used in organic synthesis. Concepts in designing of organic compound synthesis. Retrosynthesis. Synthesis of complex molecules. Synthesis of natural products from simple and commercially available precursors. Methods for chemical modification of natural products to enhance biological activities. Modern organic reactions presenting in current chemistry journals.

03652523 Cosmetic Products and Development 3(3-0-6)

Important ingredients in cosmetics for cleaning, skin treatment, hair and nails treatment, and makeup. Important ingredients in perfume, aromatic compounds, and spa products. Cosmeceuticals. Good manufacturing practices (GMP) for cosmetic products. Advancement in cosmetic development in current chemistry journals.

03652524 Advanced Spectroscopy for Organic Compounds 3(3-0-6)

Basic spectroscopy for structural analysis. Mass spectrometry for identification of organic compounds. One-dimensional (1D) and two-dimensional (2D) nuclear magnetic resonance spectroscopy for structural determination. Structural elucidation of natural organic compounds by all spectroscopic techniques.

03652531 Chemistry of Macro Biomolecules **3(3-0-6)**

Chemical structure and properties of nucleic acids. Biological and biochemical mechanisms of DNA replication and transcription. Synthesis of nucleosides as drugs. Automated solid-phase DNA synthesis using phosphoramidite chemistry. Structure of peptides and proteins. Mechanism of serine proteases. Mechanism of methyltransferases. Enzyme kinetics according to Michaelis-Menten equation. Chemical reactions of glycolysis. Chemistry of protein biosynthesis.

03652532 Drug Design for Future **3(3-0-6)**

Analysis of drug design and action through study of drug–target interactions. Structural biology, databases and applying artificial intelligence to design drugs. Pharmacokinetics and inhibitor design. Data retrieval. Analysis of 3D structure models. Comparison of molecular models. Visualization using PyMOL. Inhibitory concentration. Dose responses. Animal models and novel drugs testing. Medicinal application. Proposing design and optimization of inhibitors compatible with structure of active site. Good manufacturing practice (GMP) for pharmaceutical facility.

03652541 Computer Applications in Chemistry **3(3-0-6)**

Knowledge of computers and computer applications. Formulas and functions in mathematics. Chemical calculations. Drawing chemical structures and chemical reactions. Designing experimental diagram. Machine learning for chemistry. Searching database and chemical research by applying computer programs.

03652542 Advanced Computational Chemistry **3(2-3-6)**

Knowledge of computational chemistry. Concept of potential energy surface. Quantum mechanics. Ab-initio calculations. Semi-empirical calculations. Density functional theory calculations. Computational chemistry software and practical computing.

03652543 Molecular Modeling in Chemistry **3(2-3-6)**

Introduction to molecular modeling. Protein databank and database of biomolecules. Homology modeling. Analysis of 3D structural properties using graphical visualization program. Drug design techniques using computational methods. Molecular dynamics simulations. Laboratory in molecular modeling in chemistry.

03652544 Chemical Process Simulation **3(3-0-6)**

Chemical process simulation using computer software. Simulation of unit operations. Process analysis to study effect of parameters on chemical process and to identify method to enhance process efficiency.

03652545 Machine Learning for Computational Chemistry **3(3-0-6)**

Machine learning. Supervised learning. Deep learning. Model selection and customization. Unsupervised learning. Electronic properties of molecules. Feature of atoms and molecules. Chemical dataset. Predicting molecular properties. Machine learning models. Machine learning libraries. Case study.

03652551 Advanced Coordination Chemistry and Identification **3(3-0-6)**

Theories of bonding in coordination compounds. Stereochemistry. Kinetics and thermodynamics. Inorganic reactions and mechanisms. Coordination chemistry of biomolecules. Identification of inorganic compounds using nuclear magnetic resonance spectroscopy. Electron spin resonance. Infrared spectroscopy. Cyclic voltammetry and X-ray techniques.

03652552 Frontiers Inorganic Chemistry **3(3-0-6)**

Main group element compounds. Lanthanides and actinides elements. Organometallic chemistry. Bioinorganic chemistry. Metal clusters and metal-metal bonds. Solid state inorganic chemistry. Supramolecular chemistry. Inorganic reaction mechanisms. Green inorganic syntheses.

03652561 Advanced Composites Materials **3(3-0-6)**

Advanced composite synthesis and basic principle of composite. Composition of composite materials. Metal-based composite, polymer-based composite, and ceramic-based composite. Structure and properties analysis of composite. Rule of mixing. Processing of composite. Applications of multifunctional composite, biocomposite, and nanocomposite.

03652562 Polymer Analysis and Characterization **3(3-0-6)**

Principles of polymers analysis and characterization techniques. Chemical analysis by infrared spectrophotometer, nuclear magnetic resonance spectrophotometer, and X-ray diffraction. Surface analysis by scanning and transmission electron microscopy and atomic force microscopy. Elemental composition analysis by X-ray photoelectron spectroscope. Molecular weight analysis by viscometer and gel permeation chromatography. Thermal analysis by thermal gravity analysis, differential scanning calorimeter, and dynamic mechanical thermal analysis.

03652563 Polymer Physics **3(3-0-6)**

Linear viscoelasticity of polymers. Physics of amorphous and crystalline polymers. Transition temperature and free volume of polymers. Elastic properties of rubber materials. Glass-rubber transition behavior and organized states of polymers. Dynamic response properties on stress and strain. Failure behavior and mechanical behavior of polymers.

03652564 Polymer Rheology **3(3-0-6)**

Newtonian and non-Newtonian fluids. Flow properties of polymers. Relationship between flow behavior and shear and tension forces. Viscoelastic properties. Flow index of melted polymers. Factors influencing flow of polymers. Relationship between the molecular structure of polymers and flow properties. Instrument and method for measurement of flow properties. Flow behavior and polymers processing.

03652571 Advanced Dyes and Functional Materials **3(3-0-6)**

Dyes. Pigments. Commercial dyes. Synthesis of azo dyes and cyanines. Photochemistry of dyes and pigments. Organic semiconductors. Organic electronic materials. Nanoparticles. Quantum dots. Dye-sensitised solar cells. Perovskite solar cells.

03652572 Chemical Catalysis Technology **3(3-0-6)**

Catalysis in industry and scientific research. Fundamental principles of catalysis. Synthesis and design of catalysts. Techniques for analyzing chemical and physical properties of catalysts. Applications of catalysis technology in various industries. Enhancing the efficiency of catalytic processes. Experimental design and mathematical analysis. Development of catalytic materials and new innovations.

03652573 Semiconductor in Photocatalyst **3(3-0-6)**

Properties of semiconductors. Photocatalytic applications. Photocatalytic reactions and mechanisms. Chemical kinetics of photocatalysis. Synthesis and development of photocatalysts. Photocatalytic reactor design. Characterization of photocatalyst semiconductors and solving research problems concerning photocatalysis.

03652574 Materials for Green Chemistry and Carbon Neutrality **3(3-0-6)**

Overview of green chemistry and sustainability. Renewable starting materials. Reagent and organic solvent replacement. Catalysis in a green chemistry context. Alternative methods to power reactions. Renewable energy sources and energy saving. Materials for green chemistry. Materials promoting carbon neutrality. Application.

03652591 Research Methods in Applied Chemical Technology **1(1-0-2)**

Concepts, methodologies, and research processes in applied chemical technology. Problem analysis and research problem identification. Quantitative and qualitative research. Mixed-method research. Research tools. Data collection. Applying statistics and interpretation of quantitative data. Principles of qualitative research result analysis. Research analysis, result explanation and discussion, report writing, presentation and preparation for publication.

03652595 Independent Study **3**

Independent study on interesting topic at the master's degree level and compile into a written report.

03652596 Selected Topics in Applied Chemical Technology **1-3**

Selected Topics in applied chemical technology at the master's degree level. Topics are subject to change each semester.

03652597 Seminar **1**

Presentation and discussion on current interesting topics in applied chemical technology at the master's degree level.

03652598 Special Problems **1-3**

Study and research applied chemical technology at the master's degree level and compile into a written report.

03652599 Thesis **1-36**

Research at the master's degree level and compile into a thesis.