

Elective Modules: Analytical Chemistry

The following compulsory modules corresponding to 13 SKS / 19.5 ECTS-Credits must be passed:

2 nd semester	Electives Module: Controlling and Assurance of Analysis Result	SKS	ECTS-Credits
a	Sampling Technique (LO 1 & 2) Urgency of the sampling, factors and kinds of sampling, tools and materials of sampling, sampling preparation, sampling preservatives, River water sampling, reservoir and lake sampling, draw-well water sampling, wastewater sampling, estuarine and sea water sampling, air sampling: ambient, roadside, moving and non-moving emission, soil and plant sampling, preparation technique of biology and organic, technique preparation of water, practice of sampling.	2	2.66
b	Assurance of Analysis Result (LO 5 & 8) System of Standardization Quality, Understanding of SNI ISO/IEC 17025:2017 and implementation, quality assurance management, implementation of TQM: Quality Assurance (QA), Quality Control (QC) of Internal and external, validation and verification of method and uncertainty calculation and the report of result.	2	2.66
Total		4	5.32
	Learning Outcomes LO 1. Students have ability to become professional experts in the industry, academic, and other relevant fields. LO 2. Students have ability to apply scientific methods in chemistry and other fields. LO 5. Student have expertise in practical work in the laboratory, handling general and special chemicals, and implementing work safety and security systems. LO 8. Students have experience, and able to operate common chemical instruments, as well as able to analyze data and information from these instruments.		
	Prerequisites: Basic Chemistry, Basic spectroscopy Analysis, Separation chemistry and chromatography, electrometry and X-Ray Spectroscopy		

3 rd , 4 th & 5 th semester	Electives Module: Instrumentation of Analytical Chemistry	SKS	ECTS-Credits
a	Advance Instrument (LO 6 & 8) Theory and applied of analytical chemistry on material analysis using basically instrumentation of spectroscopy and chromatography technique, also instrumentation using electrochemistry, etc. This subject is based on the mostly paper report and how to transfer it into thesis data. Also, how to correlate the one instrumental data from one to other data.	2	2.66
b	Electrometric Analysis (LO 6 & 8) Design and application of electrometric method including potentiometric, electrogravimetric, coulometry and voltammetry.	2	2.66
Total		4	5.32
Learning Outcomes: LO 6. Students master the theoretical concepts of structure, properties, changes, kinetics, and energetics of molecules and chemical systems, identification, separation, characterization, transformation, synthesis of micro-and micro molecular compound and their application. LO 8. Students have experience, and able to operate common chemical instruments, as well as able to analyze data and information from these instruments.			
Prerequisites: Basic Chemistry, Basic spectroscopy Analysis, electrometric and X- Ray Spectroscopy			

4 th , 5 th , 6 th semester	Electives Module: Industrial Chemistry	SKS	ECTS-Credits
a.	Analysis of Chemical Industry (LO 6) This subject is in correlation with material, production process, analysis and chemical reaction involving into the industries of ceramic, cement, plastic, paints and detergent.	2	2.66
b.	Analysis of Industrial Waste (LO 1 & 3) Analysis of the waste produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories, mills, and	2	2.66

	mining operations. Types of industrial waste include dirt and gravel, masonry and concrete, scrap metal, oil, solvents, chemicals, scrap lumber, even vegetable matter from restaurants. Industrial waste may be solid, semi-solid or liquid in form. It may be hazardous waste (some types of which are toxic) or non-hazardous waste. Industrial waste may pollute the nearby soil or adjacent water bodies, and can contaminate groundwater, lakes, streams, rivers or coastal waters. Industrial waste is often mixed into municipal waste, making accurate assessments difficult. Most countries have enacted legislation to deal with the problem of industrial waste, but strictness and compliance regimes vary. Enforcement is always an issue.		
	Total	4	5.32
	<p>Learning Outcomes:</p> <p>LO 1. Students have ability to become professional experts in the industry, academic, and other relevant fields.</p> <p>LO 3. Students master in theory and working as a researcher in the field of science and technology with the ability to solve community problems with an orientation to sustainable development and to disseminate research results in scientific meetings and scientific publications.</p> <p>LO 6. Students master the theoretical concepts of structure, properties, changes, kinetics, and energetics of molecules and chemical systems, identification, separation, characterization, transformation, synthesis of micro-and micro molecular compound and their application.</p>		
	<p>Prerequisites:</p> <p>Basic Chemistry, Environmental Chemistry</p>		

4 th & 5 th semester	Electives Module: Analysis and Toxicology of Environmental	SKS	ECTS-Credits
a.	<p>Analysis of Ion Speciation</p> <p>Speciation of substances in the air and water, fraction of species occurred and the profile of species of the complex substances of solvent, ligand species, complex substance such arsenic (As) mercury (Hg) in environment and marine biota chrome (Cr) in wastewater, lead (Pb) and copper in sediments, Species of substance in the air of lead (Pb) and other hazards in the air, and paper studies.</p>	2	2.66
b.	<p>Environmental Toxicology</p> <p>Environmental toxicology draws heavily on principles and techniques from other fields, including biochemistry, cell</p>	2	2.66

	biology, developmental biology, and genetics. Among its primary interests are the 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.		
	Total	4	5.32
	<p>Learning Outcomes:</p> <p>LO 6. Students master the theoretical concepts of structure, properties, changes, kinetics, and energetics of molecules and chemical systems, identification, separation, characterization, transformation, synthesis of micro-and micro molecular compound and their application.</p>		
	<p>Prerequisites:</p> <p>Environmental Chemistry, Separation Chemistry and Chromatography</p>		