UNDERGRADUATE MODULES

ESE1001 Environmental Engineering Fundamentals
Modular Credits: 4
Workload: 3-1-0-2-4
Prerequisite(s): H2 Mathematics and H2 Chemistry
Preclusion(s): Nil
Cross-listing(s): Nil
This introductory module aims to familiarize students with a broad range of environmental engineering topics. Topics to be covered include historical perspective on environmental engineering; interactions of humans and the environment; environmental regulations; ecology and the environment; fundamental chemical kinetics; chemistry of solutions; overview of biology/microbiology organisms and processes; application of physical, chemical and biological parameters to environmental quality; engineering decision analyses.

ESE2001 Environmental Processes
Modular Credits: 4
Workload: 3-1-0-0.5-5.5
Prerequisite(s): H1 Mathematics and H2 Physics or Chemistry
Preclusion(s): Nil
Cross-listing(s): Nil
Contaminant transport in environmental fluids can be influenced by a number of physical processes. A comprehensive understanding of the movement of contaminants between environmental fluids and within each fluid is necessary to solve complex environmental problems. This module provides insights into transport processes in the multimedia environment. Topics include advection, diffusion, dispersion, settling, interphase mass transfer, reaction kinetics, equilibrium partition processes, and their applications in natural and engineered environments.

ESE2401 Water Science & Technology
Modular Credits: 4
Workload: 3-0.5-0.5-0-6
Prerequisite(s): H1 Mathematics and H2 Physics or Chemistry
Preclusion(s): Nil
Cross-listing(s): Nil
This module provides students with the fundamental aspects of water science and technology in water and wastewater treatment. Applied chemistry, microbiology and biology in fresh water, marine water, drinking water and wastewater will be covered. This module will enable students to understand the global cycle, possible contamination and threats to water in nature. Students also learn how to integrate engineering systems to purify natural water for human uses, and recycle water back to the global water cycle through the practice of environmental science and technologies.

ESE3001 Water Quality Engineering
Modular Credits: 4
Workload: 3-1-0.5-0.5-5
Prerequisite(s): Nil
Preclusion(s): ESE2401 & ESE3401
Cross-listing(s): Nil
Topics covered in this module include water and wastewater sources, characteristics of water and wastewater (physical, chemical, and biological parameters), principles of physical, chemical, and biological processes for water and wastewater treatment, and water reclamation. Applications of fundamental principles for process analysis and design will be discussed with a focus on commonalities in applications across industry. Laboratory experiments relevant to water quality assessment and engineering are also included in the module.

ESE3101 Solid and Hazardous Waste Management
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE2 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This course provides students with a working knowledge of solid and hazardous waste management and cleanup processes used around the world. The topics covered include a historical perspective; regulations pertaining to solid and hazardous wastes; waste characterisation and risk assessment; waste handling, collection and transport; waste treatment and disposal methods, including biological and chemical treatment, incineration, pyrolysis, landfill, and site remediation. Waste minimisation and cost analysis are also discussed. The course is targeted at level 3 environmental engineering students.

ESE3201 Air Quality Management
Modular Credits: 4
Workload: 3-1-0.5-0.5-5
Prerequisite(s): EVE2 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This module equips students with fundamental knowledge in atmospheric air quality, covering regional and global issues. It provides basic knowledge and training in formulating and evaluating air pollution problems, predicting the effects of airborne pollutants, and offers engineering solutions. The topics covered include effects of emission sources and pollutants, importance
and application of air pollution models, as well as air pollution control strategies and devices. The composition and impact of atmospheric system, chemical reactions of stratospheric ozone, and global climate forcing are also included.

ESE3301 Environmental Microbiological Principles
Modular Credits: 4
Workload: 3-1-1-0-5
Prerequisite(s): EVE2 standing or equivalent
Preclusion(s): Nil
Cross-listing(s): Nil
The module provides students with a strong foundation in environmental microbiology and its application to pollution control systems. It provides an introduction to the principles of microbiology in environmental engineering. After an overview of microbial classification and the applications of environmental microbiology, the course addresses aspects of microbial ecology and population dynamics. Microbial characteristics of the terrestrial and aquatic environment are covered, as well as aspects of indoor air pollution control. Microbial biogeochemical cycling of elements is examined with respect to nitrogen, carbon and sulphur. Aspects of genetic engineering in environmental microbiology are introduced with regard to applied biotechnologies.

ESE3401 Water & Wastewater Engineering 1
Modular Credits: 4
Workload: 3-0-0.5-0.5-6
Prerequisite(s): ESE2401
Preclusion(s): Nil
Cross-listing(s): Nil
This module introduces students to the unit operations and processes application for domestic water supply and wastewater treatment. Integration of physical, chemical and biological processes is the basis of current water and wastewater design practice. This module will enable students to understand the main treatment processes and engineering concerns of water and wastewater treatment systems. Students learn to identify the appropriate treatment system to address water and wastewater treatment needs and design basic processes of water and wastewater treatment systems.

ESE4301 Wastewater Biotechnology
Modular Credits: 4
Workload: 3-0-1-1-5
Prerequisite(s): ESE3301
Preclusion(s): Nil
Cross-listing(s): Nil
This course introduces students to the biological aspects of wastewater biotechnology. These include process metabolism, biology and functions in activated sludge, anaerobic digestion, nutrients removal and biofilms processes. This course will enable students to expand their background of environmental technology in the biological aspects of wastewater treatment processes, and to integrate the biological aspects of wastewater treatment into the physical and chemical aspects previously learned. The students will also learn how to identify solutions for operational problems associated with wastewater treatment processes through the microscopic observations.

ESE4401 Water & Wastewater Engineering 2
Modular Credits: 4
Workload: 3-0-5-0.5-6
Prerequisite(s): ESE2401 & ESE3401
Preclusion(s): Nil
Cross-listing(s): Nil
This module provides the information regarding application of advanced unit operations and processes for enhancing the quality of treated effluent and rendering the product water suitable for reuse applications. The module will enable students to understand the fundamental principles of advanced wastewater treatment. Students are taught to identify and design the appropriate advanced treatment system to enhance the quality of the treated effluent and exploit the option of reuse application.

ESE4402 Treatment Plant Hydraulics
Modular Credits: 4
Workload: 3-0-0.5-1.6
Prerequisite(s): ESE2401
Preclusion(s): Nil
Cross-listing(s): Nil
Hydraulics plays an important role in elevating treatment efficiency and reducing the operating costs of a treatment plant. This module is offered to students who are interested in the application of hydraulics to the design of water and wastewater treatment plants. Hydraulic devices such as pipes, open channels, pumps, and multiport diffuser outfalls will be introduced in terms of their hydraulic properties in relation to the operating efficiency of a treatment plant. The students will be given a design project for an actual treatment plant. By doing the project, the students can enhance their design skills with the theory learned.

ESE4403 Membrane Tech in Env. Applications
Modular Credits: 4
Workload: 3-0-0-1.6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
The module is designed to provide senior undergraduate students with basic knowledge of membrane technology and its applications in environmental fields. This module introduces the basic concepts and knowledge of membrane processes. Students will learn membrane classification, module types, and process configuration, and separation mechanisms. Topics cover the applications of membrane processes in the treatment of surface water, groundwater, seawater, and wastewater. The fundamental principles for design and operation of membrane processes will also be addressed.

**ESE4404 Bioenergy**
Modular Credits: 4  
Workload: 3-1-0-3-3  
Prerequisite(s): EVE3 standing or equivalent with background in fluid mechanics  
Preclusion(s): Nil  
Cross-listing(s): Nil

Sustainability is the key to economic growth in the twenty-first century. With increasing global demand for energy, growing energy insecurity, and adverse impact of fossil fuel consumption on climate change, it is necessary to focus efforts toward bioenergy production from renewable, low-cost and locally available feedstock such as biomass and biowastes. This course introduces the various theories and technologies for production of bioenergy from various feedstocks. Topics include anaerobic technology for production of methane, bioethanol, methanol, hydrogen and biodiesel from biowastes and biomass, and microbial fuel cell for direct electricity production. Other processes such as pyrolysis of biomass shall also be introduced. Students will gain a comprehensive knowledge on the various options and challenges facing the production of bioenergy.

**ESE4405 Urban Water Engineering & Management** Modular Credits: 4  
Workload: 3-1-0-3-3  
Prerequisite(s): ESE3401 or ESE3001  
Preclusion(s): Nil  
Cross-listing(s): Nil

Topics covered in this module include urban water supply and demand, urban water management, identification of urban water quality systems, management strategies, environmental economics, technological and social considerations, capacity planning and management, modeling of water quality enhancement systems, impacts of design and operating protocols, and retrofitting and upgrading considerations. Application of fundamental principles for planning, analysis and design of various types of urban water quality enhancement systems will be addressed.

**ESE4406 Energy and the Environment**
Modular Credits: 4  
Workload: 3-1-0-3-3  
Prerequisite(s): ESE3101 and ESE 3201  
Preclusion(s): CN4248  
Cross-listing(s): Nil

This module describes the technology and scientific understanding by which the world's nations could ameliorate the growing urban, regional, and global environmental problems associated with energy use while still providing sufficient energy to meet the needs of populations for a human existence. Topics include a general introduction to the subject of energy, its use and its environmental effects; the world's energy reserves and resources; electrical energy generation, transmission and storage; fossil fuelled and nuclear fuelled power plants; environmental effects of fossil and nuclear fuel use; renewable energy; transportation.

**ESE4407 Environmental Forensics**
Modular Credits: 4  
Workload: 3-1-0-3-3  
Prerequisite(s): ESE3101, ESE3201 and ESE3401  
Preclusion(s): Nil  
Cross-listing(s): Nil

This module examines the theory and practical application of environmental chemistry and biology for the purpose of identifying contamination sources and forecasting environmental fate and exposure in organisms. The module provides an overview of the emerging field of environmental forensics, which is gaining prominence within government agencies, industry and environmental consulting firms. An interdisciplinary approach is used, introducing the students to fundamental concepts and methodologies from a variety of scientific sub-disciplines including analytical chemistry, molecular biology, ecology, simulation modelling and ecological risk assessment, as well as an awareness of legal and regulatory frameworks related to environmental protection and toxic substance management. The students will learn essential skills to understand technical and legal aspects of complex environmental contamination problems.

**ESE4408 Environmental Impact Assessment**
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): ESE3101, ESE3201, ESE3301 and ESE3401 standing or equivalent with background in fluid mechanics  
Preclusion(s): Nil  
Cross-listing(s): Nil

Environmental Impact Assessment (EIA) is the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made. The objective of EIA is to ensure that decision-makers consider environmental impacts before deciding whether to proceed with new projects. Participants are introduced to the concept of EIA, its historical evolution and the terminologies that are used worldwide. Lectures will cover the organizational aspects of EIA, the EIA framework and the procedural methods to conduct an EIA, with special emphasis on water and water related issues. Participants will carry out a mini EIA study using the various approaches covered in the module.
ESE4409 Environmental Applications of Adsorption
Modular Credits: 4
Workload: 3-0-4-3
Prerequisite(s): ESE 3201 and ESE3401
Preclusion(s): CN3132
Cross-listing(s): Nil
Adsorption is one of the most fundamental processes in many environmental, chemical and biological processes. It can be used for purification of water and gases. This module begins with an overview of historical and natural/industrialized cases. Various theories on adsorption will be presented in detail. Mathematical modeling tools will be taught. A series of case studies will be presented. Students after learning this module will be able to design various adsorption treatment systems and understand adsorption processes in natural/engineered systems.

ESE4501 Design Project
Modular Credits: 4
Workload: 1-0-4-5
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
The students are assigned a design project involving various environmental considerations. The module provides the opportunity for students to work as a team on an environmental project integrating knowledge they have gained from modules they have taken in earlier years. The module will also enhance their interpersonal, communication and leadership skills through group projects, report writing and a few oral presentations.

ESE4502 B.Eng. Dissertation
Modular Credits: 12
Workload: 0-18-0-12
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
Each student is assigned a research project in environmental science and engineering. This module provides the opportunity for students to outsource for relevant information, design the experiments, analyse critically the data obtained and sharpen their communication skills through report writings and oral presentations.

GRADUATE MODULES

ESE5001 Environmental Engineering Principles
Modular Credits: 4
Workload: 3-0-4-3
Pre-requisite: Graduate student standing
This module covers a wide range of topics including physical, chemical and biological principles in Environmental Science & Engineering and qualitative & quantitative analysis of environmental problems. Concepts of contaminant cycling through air, water and soil systems, air and water chemistry, transport & transformation models for contaminants, and physical, chemical and biological treatment processes are also included. Students will learn the essential principles used in Environmental Engineering and understand important issues.

ESE5002 Physical and Process Principles
Modular Credits: 4
Workload: 3-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This module introduces students to the fundamentals of process and physical principles in environmental engineering and discusses how these principles can be used in the analysis and modelling of environmental engineering processes. The contents will include material balances, mass transfer, reaction rate and kinetics, typical ideal and non-ideal reactors as well as tracer study. The course prepares the student in understanding why physical processes are expected to function in certain ways.

ESE5003 Environmental Chemical Principles
Modular Credits: 4
Workload: 3-0-1-6
Prerequisite(s): EVE4 standing Preclusion(s): Nil
Cross-listing(s): Nil
This module is designed to equip post-graduate students with fundamental principles of chemical equilibria and environmental organic chemistry with emphasis on chemical speciation in both natural and engineered systems. It begins with an overview of historical and industrialized water pollution issues. Topics include chemical background, properties of soils, chemical equilibrium and thermodynamics, acid/base reaction, CO₂ system, coordination chemistry, metal-ligand interaction, precipitation, adsorption, ion exchange, colloid, and organic geochemistry. MINEQL, chemical equilibrium software, will be taught in this module. Upon the completion, students will be better equipped to quantitatively understand and solve various environmental problems.
ESE5201 Combustion Pollution Control
Modular Credits: 4
Workload: 3-0-0-1-5.5
Prerequisite(s): EVE4 standing Preclusion(s): Nil
Cross-listing(s): Nil
This module will examine how pollutants are formed during the combustion process, and how they can be diminished by combustion modifications and technologies. Combustion sources ranging from utility boilers to IC engines will be considered. Mechanisms of formation of the oxides of N and S will be covered, as well as technologies for post-combustion control. There will also be an introduction to Health Effects Engineering.

ESE5202 Air Pollution Control Technology
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This module covers several topics in air pollution control including the nature and sources of air pollutants in the indoor and outdoor environments, air pollution models, regulations, technical methods and measures to remove/suppress the emissions of air pollutants. The physical, chemical, and physico-chemical characteristics of pollutants in the atmosphere are described. The principal industrial sources of atmospheric pollution and the technological conditions for the formation of solid and gaseous substances in emissions are defined. Technical principles, basic processes, and equipment employed to limit and eliminate particulates, volatile organic compounds, sulphur oxides, and nitrogen oxides are discussed in detail.

ESE5203 Aerosol Science and Technology
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE 4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
Aerosol science deals with the behaviour of very fine particles in fluid media which finds important health and industrial applications in many areas such as biosolid management, air pollution control, ultra-cleaning manufacturing technology, and advanced materials. In this module, the basic principles of aerosol science and the corresponding industrial applications will be covered. Topics include physics of aerosols, size distributions, mechanics and transport of particles, aerosol dynamics, nanoparticle synthesis, combustion aerosols, and pharmaceutical aerosols.

ESE5204 Toxic & Hazardous Waste Management
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing Preclusion(s): Nil
Cross-listing(s): Nil
This course introduces the advanced concepts of toxic and hazardous waste management issues. Major issues are quantification and characterisation, toxicity, impact on human health, state-of-the-art reduction technologies and ultimate disposal. This course will expose students to the risks faced by urban environmental ecosystems and human beings exposed to toxic and hazardous wastes generated through various human activities and the selection of treatment and disposal facilities, their design, construction, operation and maintenance principles.

ESE5205 Sludge and Solid Waste Management
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This course introduces the advanced concept of sludge and solid waste management. It covers collection, quantification, characterisation, processing, treatment, disposal and resource recovery in relation to sludge and solid waste. It will equip students with in-depth knowledge on principles of design, construction, operation and maintenance of various treatment and disposal facilities along with engineering, institutional, legal and financial infrastructures.

ESE5301 Environmental Biological Principles
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing Preclusion(s): Nil
Cross-listing(s): Nil
This module provides students with a strong foundation in biological principles for environmental engineering, with primary focus on natural biological processes. After an overview of biological principles and classification, the module reviews metabolic adaptations to various natural environments, including extreme habitats. Aspects of genetic adaptation and tolerance to environmental contamination are covered, together with the manipulation of biological processes to degrade and stabilise contaminants. Emphasis is placed on biodegradation of organic pollutants and their bioremediation. Aspects of organic waste stabilisation and remediation of inorganic wastes are included. Lastly, the use of macrophytes for phyto remediation of contaminated soils is examined.
ESE5401 Water Quality Management
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): Graduate-standing (preferred)
Preclusion(s): Nil
Cross-listing(s): Nil
This module introduces students to the fundamental principles of environmental modelling, i.e. mass balance, reaction kinetics, and transfer mechanisms. Mathematical models are used to deal with water quality problems in natural and man-made systems. These include eutrophication, dissolved oxygen imbalance, the fate and transport of contaminants, and treatment system capacity planning. The module will enable students to appreciate the problems associated with water quality and provide them with the basic skills to predict impacts associated with the pollution of the environment. In this way, students can assess the feasibility of projects which are potential sources of contaminants to the environment.

ESE5402 Industrial Wastewater Control
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This module introduces students to the theories and processes commonly used in industrial wastewater control. Topics covered in this course include characteristics of industrial wastewater, control theories and methods, and treatment of specific industrial wastewaters. The module will enable students to understand the particular problems associated with industrial wastewater control. The students will also gain the knowledge that is required for the design of treatment processes to effectively solve environmental problems relating to industrial wastewater discharge.

ESE5403 Water Reclamation & Reuse
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This module provides students with the insight of water reclamation and reuse from technology, quality and regulation aspects. Planning, health effect, reclamation systems and relevant practice will be covered. The module will enable students to understand the contaminants in reuse systems and treatment technologies for water reclamation. Health risks assessment in wastewater reuse practices is also highlighted. Students will learn the technological and social considerations in relation to water reclamation and reuse for different purposes with the health effect and regulation aspects properly addressed.

ESE5404 Biological Treatment Processes
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This module introduces the theories as well as practices of biological wastewater treatment processes. Students will learn to understand the fundamental principles of biological treatment systems. The applications of biological treatment systems will also be addressed. This course will facilitate students to acquire in-depth knowledge of biological treatment systems in wastewater treatment.

ESE5405 Water Treatment Processes
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This module introduces the fundamental principles of water treatment processes. Students will be able to understand water treatment in relation to chemical equilibrium and kinetics, unit processes and their integration. The applications of these fundamental principles for formulating design and operation for water treatment systems will also be addressed. This course will facilitate students to acquire in-depth knowledge of water treatment systems.

ESE5406 Membrane Treatment Processes and Modelling
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
Membrane technology is an emerging field in water and wastewater engineering. This module offers students the fundamental principles and practical applications of membrane processes as an advanced measure for water and wastewater treatment. The topics covered in this module are membrane transport, concentration polarisation, and membrane fouling in relation to water and wastewater engineering. The module will also deal with fouling characterisation of feed water, membrane fouling modelling and methods for fouling prevention and mitigation. Applications of MF, UF, and RO membranes in various water and wastewater treatment problems will also be discussed.
ESE5407 Membrane Technology for Water Management
Modular Credits: 4
Workload: 3-0-0-4-3
Prerequisite(s): ESE4403 Membrane Technology in Environmental Application, or ESE5406 Membrane Treatment Processes and Modeling, or Graduate-standing
Preclusion(s): Nil
Cross-listing(s): Nil
Membrane technology has been widely adopted for water reclamation and seawater desalination. It shall continue to be a key technology for resolving the problem of water scarcity in the near future. This module shall focus on the design and operational consideration of membrane processes for water reclamation and seawater desalination. Topics covered in this module include water quality standards relevant to reclaimed and desalinated water, filtrate quality consideration, membrane filtration system, design and operation of MF/UF filtration system, membrane bioreactor, nanofiltration and reverse osmosis system, examples of commercial plants and economics of membrane system.

ESE5601 Environmental Risk Assessment
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
The objective of this module is to examine the fundamental principles governing toxic contaminant exposure and risk to humans and ecosystems. The course will cover necessary aspects of probability and statistics, physical and chemical behaviour of key priority pollutants, mass transfer and exposure pathways of the contaminants, human and environmental toxicology, and methodologies for risk assessment. The course will also involve several case studies of remediation technology applications with a focus on understanding how human and environmental risk is managed in a real life situation.

ESE5602 Environmental Management Systems
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This module covers historical perspective of environmental management and the basics of environmental management systems (EMS), including an introduction to environmental management, EMS models and key elements, environmental review, environmental policy, identifying and evaluating environmental aspects and impacts, legal requirements, objectives, targets and management programmes, implementation of EMS requirements, monitoring and measurement, EMS audits, management review and continual improvement. Practical sessions will be included, covering, identifying, and evaluating environmental aspects and impacts.

ESE5603 Pollution Minimisation and Prevention
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): EVE4 standing Preclusion(s): Nil
Cross-listing(s): Nil
This module introduces to the students key concepts related to industrial pollution prevention and sustainable development, and their applications to specific industries and processes. Pollution prevention refers to the design of new processes or modification of existing processes to eliminate the creation of pollutants and wastes at the source. This module covers technical aspects of pollution prevention, engineering methods for source reduction, reduction and elimination of waste streams, waste management through energy conservation, health and safety management, green chemistry, and life-cycle analysis. Case studies are presented to show how pollution prevention can be achieved in specific industries and processes.

ESE5604 Process Engineering Design Principles
Modular Credits: 4
Workload: 3-0-0-2-5
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Introduction and classification of processes, including steps in process design. Material balance involving phase equilibria, chemical reactions and recycling of materials. Design of simple stepwise processes, energy balance estimations and use of flowsheeting packages.

ESE5607 Green Catalysis
Modular Credits: 4
Workload: 3-1-0-0-6
Prerequisite(s): EVE4 standing
Preclusion(s): Nil
Cross-listing(s): Nil
This course covers the recent applications of environmentally friendly catalysis for pollutant detoxification, such as indoor air pollutant degradation, water pollutant degradation and self cleaning surfaces. The course also covers examples of catalytical reactions in industry that are environmentally sustainable and produce the least amount of toxic by-products or processes that use advanced, novel processes to reduce unwanted products. The course will briefly review catalysis principles, then follows up
by discussing the industrial limitations of using catalysts, slurry systems vs. catalyst immobilisation, catalyst deactivation and their minimisation, mass transfer limitations, water vs. solvent based catalysts, etc.

**ESE608 Heavy Metals in the Environment**
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): EVE4 standing  
Preclusion(s): Nil  
Cross-listing(s): Nil  
Toxic metal ions have posted a great challenge to environmental engineers and scientists as they cause many serious pollution problems in water, soil and air. The module begins with an overview of historical and industrialised water pollution issues. The metal ion chemistry will be taught. A series of mathematical models aiming at description of metal ion distribution in various natural systems will be presented. Students will learn important treatment technologies such as precipitation, ion exchange and adsorption. Finally, case studies will be presented. This module is targeted at level 4 environmental engineering students and post-graduate students. It is expected that students after learning this module, will be able to design treatment systems for metal waste streams as well as understand toxic metal transportation in natural surface and subsurface systems.

**ESE6001 Environmental Fate of Organic Contaminants**
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): Graduate student standing  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This module examines fundamental principles that govern transformation and fate of organic contaminants in natural and engineered systems. Thermodynamic principles and molecular properties are used throughout the module to develop predictive relationships for the solubility of organic contaminants, partitioning between environmental phases, sorption to solid surfaces, and transformation processes.

**ESE6301 Topics in Environmental Biotechnology**
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): ESE5301 or approval of CEE  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This course aims to introduce students the essential tool for understanding and designing microbiological processes used for environmental protection and improvement. This course will enable students to expand their background of environmental biotechnology, and to integrate these aspects into the physical and chemical aspects of environmental technology previously learned. The major topics include aspects on foundation in microbiology and engineering principles, major environmental biological applications, quantitative analysis of biotechnology, detoxification of hazardous chemicals, clean technology, and resource biorecovery in environmental monitoring.

**ESE6401 Advanced Biological Treatment Processes**
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): ESE5301, ESE5404 or approval of CEE  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This module introduces the fundamental theories of biological wastewater treatment processes. Students will learn to understand the fundamental principles of biological treatment systems and the formulation of mathematical models to describe performance of suspended growth and attached growth systems. The applications of these mathematical models for formulating design and operating protocols for biological treatment systems will also be addressed. This course will facilitate the acquisition of in-depth knowledge of biological treatment systems through projects and homework assignments.

**ESE6402 Advanced Water Treatment Processes**
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): Graduate student standing  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This module introduces the fundamental principles of water treatment processes. Students will learn to understand water treatment in relation to chemical equilibrium and kinetics, coagulation and flocculation, filtration, adsorption, and disinfection. The applications of these fundamental principles for formulating design and operating protocols for water treatment systems will also be addressed. This course will facilitate the acquisition of in-depth knowledge of water treatment systems through projects and homework assignment.

**ESE6403 Topics in Membrane Purification**
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): Graduate student standing  
Preclusion(s): Nil
Cross-listing(s): Nil
This module introduces the fundamental theories on membrane separation, concentration polarisation in pressure-driven membranes, fouling mechanisms and characterisation. The applications of these fundamental theories for designing and operating advanced water quality enhancement systems will also be addressed. This course will facilitate the acquisition of in-depth knowledge of membrane technology through projects and homework assignment.

ESE6404 Advanced Contaminant Transport
Modular Credits: 4
Workload: 3-0-0-1-6
Prerequisite(s): Graduate student standing
Preclusion(s): Nil
Cross-listing(s): Nil

This module introduces the mechanisms of transport, convective-dispersion of contaminants, contaminant transport in rivers and in porous media. The applications of these fundamental theories for modelling fate of contaminants in environment will also be addressed. This course will facilitate the acquisition of in-depth knowledge of movement and fate of contaminants in water environment through projects and homework assignment.

*Information is correct as @21 March 2012. CEE reserved the right to change with short notice.*