



Course description
Bachelor of Science Program in Natural Resources and Environmental Management
(International Program)
Faculty of Environment and Resource Studies

1) General Education

1.1 Social Sciences

Credits (lecture - lab/practice – self-study)

ENNM 111 21st Century Skills 3 (3-0-6)

Pre-requisite None

Current workplace demands; technological and cultural effects on skill dynamics; oral and written communication; information technology; professionalism and empathy in the workplace; collaboration; critical thinking and problem solving; creativity and innovation

LALA 280 Philosophy for Today's Life 3 (3-0-6)

Pre-requisite None

Basic concepts of philosophy necessary for today's life; free will; the value of life; happiness; love; living an ethical lifestyle in a global context

1.2 Humanities

ENNM 112 Leadership & Management 3 (3-0-6)

Pre-requisite None

The global workplace; personalized leadership and management skills; project-based leadership and support; traditional and emerging leadership and management styles; empowering and developing others; empathy and effective communication; constructive feedback; reverse planning; setting and supporting SMART goals with PDCA; authentic assessment and KPIs; telecommuting; conflict resolution

1.3 Languages

LAEN 180 English for Academic Purposes I 2 (2-0-4)

Pre-requisite None

Vocabulary, expressions, grammar, and contextualized social language; essential communicative skills in small groups; simulations in various university and academic situations; introduction to academic writing; and reading and listening from various sources

LAEN 181 English for Academic Purposes II 2 (2-0-4)

Pre-requisite LAEN 180

Essential strategies for four language skills: reading and listening from various sources, speaking in academic contexts and essay-writing, including sub-skills i.e., grammar, academic vocabulary, and summary with a focus on academic English and issues that enhance students world knowledge

LAEN 280 Science Fiction and Society 2 (2-0-4)

Pre-requisite None



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A study of literary fiction from detective to cyber punk short stories and novels to augment the awareness of significance and effects of science toward the society that humans live in

LAEN 281	The Science of Speech Sounds	2 (2-0-4)
	Pre-requisite	SCGI 103
	The human speech sounds, including the articulatory, the physiology, the physics, the acoustics, the perception, and the application	
LAEN 282	Multilingualism and Multiculturalism	2 (2-0-4)
	Pre-requisite	LAEN 280
	The concepts of languages and cultures around the World, internationalization, and globalization; the universality and diversity in the multilingual and multicultural globe	
LAEN 380	Academic Presentations in English	2 (2-0-4)
	Pre-requisite	LAEN 181
	Presentation skills in the students' fields of study using appropriate and accurate English; clear delivery of the message; interesting and effective language use; language for statistics description; presentation strategies and research skills that enhance life-long learning	

1.4 Science and Mathematics

SCBE 100	Wonder of Life	3 (3-0-6)
	The origin of life on earth; the composition of life and its organization; cell and its life; from breakfast to ATP; reproduce or die; a chip from the old block; adapt to evolve; we are the world; pollution not in my backyard	

SCGI 103	Physics for future entrepreneurs	3 (3-0-6)
	Working principles of household appliances, cars and advanced technology instruments, physics concepts behind these devices, physics and safety, physics and environmental issues	

ENGE 300	The Earth and Nature	3 (3-0-6)
	Principle of environment, ecosystem, dynamic system, balance of nature in ecology system, natural resource conservation and biodiversity; Human community related to their environment and natural resource. Human activities directly impacts on environment and natural resources: water, soil, minerals, forest, wildlife, energy, air, noise, solid waste, and hazardous waste. Current environmental situation and environmental crisis in our country and others counties; Ways of environmental management as a means for sustainable development	

1.5 Health and Recreation

SPGE 120	Bike for Health and Recreation	2 (1-2-3)
	Pre-requisite	None



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Sport science principles and their application to bike riding; physical and mental fitness preparation for bike riders; bicycle and accessories maintenance, benefits, basic principles, bike skills, safety; rules and regulations and manner in riding in bike lanes, tour around MU by bike for recreation and health

SPGE 121 Body and Mind 2 (1-2-3)

Pre-requisite None

Applied sport science principles, physical and mental fitness preparation for group exercise; benefits and basic principles of group exercise training, skills and safety; group exercise activities such as bosu ball, punch kick, jump, jump rope, boot camp, indoor bike, trampoline and aqua aerobic

SPGE 122 Group Exercise 2 (1-2-3)

Pre-requisite None

Applied sport science principles, physical and mental fitness preparation for group exercise; benefits and basic principles of group exercise training, skills and safety, group exercise activities such as bosu ball, punch kick, jump, jump rope, boot camp, indoor bike, trampoline and aqua aerobic

SPGE 123 Track Athletics 2 (1-2-3)

Pre-requisite None

History, usefulness, applied sport science principles, physical and mental fitness preparation for player, basic skills; steps, set position of start running and movement for various distances of competition; sports facilities, judging, rules, regulations, injuries and safety, equipment and maintenance

SPGE 124 Sepak Takraw 2 (1-2-3)

Pre-requisite None

History, usefulness, applied sport science principles, physical and mental fitness preparation for player, basic skills such as basic movement, variety of kicking, heading, serving, volley, back kick, attack and defense techniques, team playing, rule, regulations, injuries and safety, equipment and maintenance

SPGE 125 Petanque 2 (1-2-3)

Pre-requisite None

History, benefits, applied sport science principles, physical and mental fitness preparation for player; petanque court and equipment; rules and regulation; petanque basic skills such as handing, throwing, standing, balancing, pointing, hitting; individual double and team completion; equipment maintenance and safety

SPGE 126 Synchronized Swimming 2 (1-2-3)

Pre-requisite None



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History, benefits, application of sports science principles in synchronized swimming, physical and mental fitness preparation for synchronised swimmer, safety, rules and regulations, uniforms; basic skill such as floating, breathing, scolling movements, bullet leg, flamingo and eggbeater; synchronized swimming style such as basic routine, team routine

SPGE 127 Aerobic for Health 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to aerobic for health; aerobic exercise significance, benefits and basic principles of aerobic dance training; skills of aerobic dance movements, safety, and aerobic activities such as water aerobics, martial art with music, step aerobic, new body and boot camp

SPGE 128 Yoga for Health 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to Yoga for health; History, meaning, training locations and equipment, and benefits of Yoga; body preparation, joint and muscle stretching, techniques of muscle contraction and relaxation; practice of Asana (body position/posture), breathing control, pranayama, deep relaxation and Yoga training safety

SPGE 129 Tennis 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to lawn tennis; history, benefits, equipment, rules and regulations, physical fitness; basic skills such as forehand, backhand, volley, serve and strategies for singles and doubles; injuries and safety, sports science of tennis

SPGE 130 Soccer 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to soccer; brief history of soccer encompassing; benefit, equipment, rule and regulations, physical fitness; basic skills of kicking, passing, heading, dribbling, throwing and team play, equipment keeping, risks injuries and safety; soccer for exercise, health and recreation

SPGE 131 Swimming 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to swimming, significance, benefits, safety, rules and regulations, uniforms; basic skill such as breathing, floating, leg movements. Styles of swimming such as Freestyle, back stroke and breast stroke

SPGE 132 Basketball 2 (1-2-3)

Pre-requisite None



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Sport science principles and their application to basketball; benefits, rules and regulations, uniforms and safety; basic skills such as foot movement, body position, ball handling, shooting and dribbling; various team tactics and strategies

SPGE 133 Volleyball 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to volleyball; benefits, rules and regulation, uniforms and safety; basic skill such as foot movement, body position, serving, volley, bumping, individual attack and defense techniques; team tactics and strategies

SPGE 134 Social Dance 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to social dance; cultural significance, benefits, rules and regulations, safety and uniforms; Basic skill of waltz, cuban-rumba and Cha Cha and Jive

SPGE 135 Table Tennis 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to table tennis; benefits, rules and regulations, uniforms and safety; basic skills such as foot- work, control, forehand stroke, backhand stroke, service and top spin. competition event in single and doubles in Table tennis

SPGE 136 Arts Self-defense 2 (1-2-3)

Pre-requisite None

Sport science principles and their application to the Art of Self-defense. Usefulness, definition, safety, Basic skills, such as rolls and somersaults kick, punch, immobilization, attacks and self-defense

2) Specific Courses

2.1. Core Courses

2.1.1 Basic Science and Mathematics

Mathematics

Credits (lecture - lab/practice – self-study)

SCMA 101 Mathematics 1 3 (3-0-6)

Pre-requisite None

Functions; limits; continuity; derivatives of algebraic functions; logarithmic functions exponential functions and trigonometric functions; implicit differentiation; higher-order derivatives; differentials; applications of differentiation; indeterminate forms and l' Hospital's rule; functions of several variables and partial derivatives; total differentials and total derivatives; antiderivatives and integration; techniques of integration; applications of integration



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SCMA 102 Mathematics II 3 (3-0-6)

Pre-requisite None

Infinite sequences and series; functions of several variables; limits and continuity of functions of several variables; partial derivatives; first order linear differential equations; first order nonlinear differential equations; higher order linear equations; applications of differential equations; systems of linear equations; linear algebra; applications of linear algebra

Chemistry

SCCH 151 General Chemistry I 3 (3-0-3)

Pre-requisite None

Stoichiometry, atomic structure, chemical bonding theory; representative and transition metal elements, organic chemistry, nuclear chemistry, environmental chemistry

SCCH 152 General chemistry II 3 (3-0-6)

Pre-requisite None

A study of fundamental chemistry in the topics of chemical thermodynamics, chemical kinetics, chemical equilibrium, ionic equilibrium, electrochemistry, gas, liquid, and solid

SCCH 159 General Chemistry Laboratory 1 (0-3-1)

Pre-requisite None

General experimental techniques related to topics in general chemistry; experiments related to qualitative and quantitative analysis

Biology

ENNM 121 Environmental Botany 3 (2-3-5)

Pre-requisite None

Basic concepts, definition and principles of environmental botany and related environmental issues including roles and importance of plants, cell structure, morphology, physiology; mechanisms and processes involved in the responses of plants to their environment; ecology, palynology, basic methods in plant taxonomy and identification of major plant groups for environmental researches; evolution and biodiversity, interdisciplinary study of the relationships between plants and the environment integrated into a global perspective of change, including geological, climatic, and human impacts; methods in environmental botany for the past environmental change analysis

ENNM 221 Zoology 3 (2-3-5)

Pre-requisite ENNM 121

Basic concepts of zoology and environment; origin of animal life; animal reproduction and development; classification of major phyla of animals and the major classes of vertebrates; structure and function of animals, and basic concepts of animal behavior and ecology



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ENNM 222 Microbiology 3 (2-3-5)

Pre-requisite SCBE 100

Concepts, basic principles and laboratory in environmental microbiology including: morphology; physiology; metabolism and the growth of organisms in kingdoms of monera; protista and fungi; methods and factors influencing the microbial control in the environment; types; isolation and determination of microorganisms to the environment; roles of microorganisms related to biodegradation of environmental contaminated substances

Physics

SCPY 111 Basic Physics Laboratory 1 (0-3-1)

Pre-requisite None

Basic physics experiments emphasizing on measurement, data-recording and data-analysis skills in the topics relating to and supporting theoretical study on mechanics, thermodynamics, and electromagnetism

ENNM 214 Environmental Climatology 3 (3-0-6)

Pre-requisite SCGI 103

The world climate system; the atmosphere; ocean; land; cryosphere; the earth's energy balance; atmospheric radiative transfer; the surface energy balance; the hydrologic cycle; atmospheric circulation; the role of the ocean and the cryosphere; oceanic conveyor belt; abrupt change in thermohaline circulation; climate change; natural and anthropogenic; modeling of climate

2.1.2 Specialized Science

Credits (lecture - lab/practice – self-study)

Analytical chemistry

SCCH 262 Fundamental Analytical Chemistry 2 (2-0-4)

Pre-requisite SCCH 151 or equivalence

An Introduction to analytical chemistry, the preparation of reagents and samples; data evaluation, volumetric analysis, titration; an introduction to spectroanalytical chemistry; molecular and atomic absorption; molecular and atomic emission techniques; potentiometry: emphasizing on pH measurement, separation techniques for sample preparation and high performance liquid chromatography

SCCH 268 Analytical Chemistry Laboratory 1 (0-3-1)

Pre-requisite SCCH 159 or equivalence

Elementary skills in analytical chemistry, the correct use glassware, basic statistics in the quantitative analysis, titration methods and quantitative analysis based on calibration concepts (e.g. potentiometric method by pH measurements; an application of Beers law to colorimetric analysis) measurement of absorption spectrum; calculations and practices in the preparation of buffer solutions and buffer solutions with various buffer capacity



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Organic Chemistry

SCCH 172 Organic Chemistry 3 (3-0-6)

Pre-requisite None

Molecular structures and properties of organic compounds; classification and nomenclature of various functional groups; stereochemistry, stereoisomers and their optical activities, synthesis, reactions and identification of alkanes, alkenes, alkynes, aromatic hydrocarbons; halides or organohalogens, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives and amines; molecular structure and properties of biomolecules: carbohydrates, proteins, and lipids

Biochemistry

SCBM 224 Biochemistry 3 (3-0-6)

Pre-requisite SCBE 100

Structures and functions of biomolecules; protein folding; protein structure and functions; biocatalysis; enzyme kinetics; citric acid cycle; electron transport and oxidative phosphorylation; anabolism and catabolism of biomolecules in normal and some important pathological conditions; regulations of metabolic pathways; the flow of genetic information; gene regulation; molecular techniques with medical applications

Statistic

ENNM 311 Environmental Statistics 3 (3-0-6)

Pre-requisite SCMA 101

An Introduction to statistics; descriptive statistics and Inferential statistics; estimation for mean and proportion; hypothesis testing; inferential statistics on the mean and proportion; inferences on comparing two means or several means; inferences on comparing two variances; an analysis of estimating relationships; using the statistical program for statistical analysis and applying for environmental science.

2.2 Specialized Courses

2.2.1 Basic Environment

12 Credits

Credits (lecture - lab/practice – self-study)

ENNM 113 Environmental Geology 3 (2-3-5)

Pre-requisite None

A study of the earth background and an application of geological principles to solve environmental problems, involving the study of the interaction between humans and the geologic environment; an application of geological information to conflict solution; minimizing possible adverse environmental degradation or maximizing possible advantageous conditions resulting from the use of natural and modified environment; studies of geological maps to understand the geological background to solve the nature and human conditions to the environments as well as the geologic disaster breakdown and managements



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ENNM 213 General Ecology 3 (2-3-5)

Pre-requisite ENNM 121

Concepts; theories and definition of ecology; the relationships between organisms and their environment; population ecology; the interactions among individuals of a population; the interactions between population in their abiotic environment; and interactions with other species; Population growth, regulations, diversity, stability, community ecology, factors affecting community-level distribution through time and within a given space; succession, biodiversity, production, equilibrium and non-equilibrium communities, disturbances; primary production, secondary production, and nutrient cycles; the effects of climate on distribution; the ecosystem ecology, food chain and food web; ecological balance; an application of ecology; biodiversity conservation; ecological restoration

ENNM 223 Environmental Soil Science 3 (2-3-5)

Pre-requisite ENNM 113

The significance of soil; the origin of soil; the soil process; components of soil; soil physics chemical and biological properties; water and air in soil; soil colloid; acid soil; alkaline soil; salt affected soil; soil organism; soil organic matter; soil nutrients, fertilizer and fertilizer usage, soil conservation and management; soil types in Thailand, soil pollution and management, soil field study, soil survey and soil samples, an application of soil database of Thailand

ENNM 224 Hydrology 3 (3-0-6)

Pre-requisite ENNM 113

Hydrologic cycle; hydrometeorology; precipitation; surface runoff; groundwater; coastal sea; water quantity estimation; watershed management; water related disasters; principles for water resource management

2.2.2 Environmental Technology 6 Credits

Environmental Pollution and Control

ENNM 225 Environmental Pollution 3 (2-3-5)

Pre-requisite SCCH 151

Categories and harmfulness of environmental pollution; sources of environmental pollution; soil pollution; water pollution; air pollution; solid and hazardous waste; emerging pollutant; effect of environmental pollution to environment and human; environmental pollution risk assessment; solution and management of environmental pollution; laboratories for environmental pollution

Technology

ENNM 312 Air pollution 3 (3-0-6)

Pre-requisite SCCH 151



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Fundamental of air pollution; causes of air quality problems; sources, types of air pollutants, prevention, control, measurement of air pollutants; the effects of air pollution and the health risks of pollution

2.2.3 Environmental Management

27 Credits

ENNM 226 Forest Ecology and Management 3 (2-3-5)

Pre-requisite ENNM 121

Concepts and principles of forest ecology; component and characteristics of forest ecology; factors affecting forest ecology; forest geography; roles and function of forest ecology; energy cycle in the forest ecosystem; plant characteristics analysis; forest types in world and Thailand; principle and theories forest management; forest management in Thailand

ENNM 313 Ecological Economics 3 (3-0-6)

Pre-requisite SCMA 101

A study of the related economic theories of demand; utility; supply; factor input; opportunity cost; market efficiency; market failure; public good; externality; market-based instrument; project analysis; discounting; intergeneration; optimal use of natural resources; sustainability; substitutability of natural stock by man made stock; valuation of the environment and natural resources.

ENNM 314 Geo-Informatics for Natural Resource Management 3 (2-3-5)

Pre-requisite SCMA 101

Principles; theories and, procedures of geo-informatics including remote sensing; the geographic information system (GIS) and the global positioning system (GPS); integrating geo-informatics in the global natural resource management; geo-informatics applications in Thailand within government and non-government organizations

ENNM 321 Environmental and Health Impact Assessment 3 (3-0-6)

Pre-requisite SCMA 101

Environmental changes and its impact on communities; an environmental impact analysis; statement techniques; assessment methodology; tools such as EIA (Environmental Impact Assessment) for environmental planning and decision making

ENNM 322 Environmental Management System Standard 3 (3-0-6)

Pre-requisite SCMA 101

A history the of environmental management system; ISO 14000 environmental management series; the environmental policy set up; environmental aspects identification and evaluation; implementation and operation; internal and external environmental audit including the integration of other management systems such as quality; occupational health and safety and the energy management system

ENNM 323 Environmental Law and Policy 3 (3-0-6)



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Pre-requisite LALA 280

International environmental law and policy; tragedy of the commons, precautionary principles, environmental equity concept and its legal implications; scientific and ethical approaches to global and domestic environmental politics; regimes across the environmental protection agency; protocols and conventions; the future of the international environmental law and policy

ENNM 431 Communication for Natural Resources and Environmental Management 3 (3-0-6)

Pre-requisite LAEN 280

The relationships between the environment and communication; elements of environmental communication; key concepts in environmental communication; environmental campaigns; diffusion and adoption of environmental innovations; communication for low carbon society; climate change communication; communication for water resource management; communication for forest management; biodiversity communication; communication in environmental and natural resource planning; communication in environmental assessments; communication for conflict resolution: environmental and natural resource management; environmental communication research

ENNM 496 Senior Project in Natural Resources and Environmental Management 3 (0-9-3)

Pre-requisite ENNM 314

Small research projects in natural resources and environmental management or related fields under the supervision of a research advisor

2.2.4 Research and Ethics

ENNM 491 Seminar in Natural Resources and Environmental Management 2 (2-0-4)

Pre-requisite ENNM 390

Senior student presentations; discussions of research; and reviews of topics of current interest; staff and invited speakers from Mahidol University and from other universities or other related organizations

ENNM 492 Environmental Research Methodology 2 (2-0-4)

Pre-requisite ENNM 311

Academic proposal writing, research problem conceptualizing, research hypothesis writing, literature review, academic critical thinking, conceptual framework diagramming, research design, statistics, methodology writing, research ethics

2.3 Basic Profession Course Elective 9 Credits

2.3.1 Environmental Management Technology

ENNM 351 Water Resource Management 3 (2-3-5)

Pre-requisite ENNM 213



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The water resource system; principle; appropriate techniques and methods in the water resource management; an evaluation of water demand and supply; flood and drought; planning for the water resource management; public participation; case studies

ENNM 352 Soil Management and Land Use 3 (3-0-6)

Pre-requisite ENNM 223

An introduction to problems of soil resources and land use; soil problem; saline soil; acid sulphate soil; sandy soil; shallow soil; organic soil; slope soil; soil pollution; problems of soil pollution and effective management; land use and management; an application of geographic informatics to soil resource management; sustainable soil resource management

ENNM 353 Environmental Biogeochemistry 3 (3-0-6)

Pre-requisite ENNM 213

Biogeochemical interactions and cycles; the carbon cycle; weathering; aqueous geochemical processes; estuarine and coastal processes; sediment transport; ocean circulation and nutrient cycling; transportation and remediation of contaminants; inorganic contaminants; organic contaminants; emerging contaminants; analytical methodologies; case studies of CO₂ increase; mine drainage; heavy metal contaminants; acid rain; the drinking water system; the waste water treatment systems

ENNM 354 Wetland Ecology and Management 3 (2-3-5)

Pre-requisite ENNM 213

Definitions of wetlands; wetland classifications; wetland hydrology; water quality in wetlands; wetland soils; flora and fauna communities in the wetlands; biogeochemical mechanisms and interactions between key components in wetland ecosystems; Wetland functions; values and importance to communities and society; threats to wetlands; concepts and principles of wetlands management; Indicators of wetland status and monitoring; case studies and examples from Thailand and other countries

ENNM 355 Sustainable Utilization of Microbial Resources 3 (2-3-5)

Pre-requisite ENNM 222

Fundamental knowledge of microbial resources; trends in applied microbiology; the design of industrial microbial processes; bioengineering of diversified microbial metabolisms; bioreactor behavior and microbial kinetics control; industrial microbial processes (fermented foods; single cell and metabolites production; waste biodegradation; vaccine production; microbial pharmaceutical production; etc.); policies and trends in the sustainable use of microbial resources and biological specimen transfers; future directions in the sustainability of microbial utilization; term projects in the sustainable utilization of microbial resources

ENNM 356 Biosafety and Biosecurity of Microbial Resource Management 3 (2-3-5)

Pre-requisite ENNM 222



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Fundamental knowledge of microbial characteristics; trends in biosafety and biosecurity of microbial resources; biological laboratory safety; an introduction of good laboratory practices and laboratory safety; biosafety for engineers and maintenance personnel; biohazard control of biomedical research facilities; blood-borne pathogen standard and exposure control plan; food-borne pathogen standard and the exposure control plan; water-borne pathogen standard and of the exposure control plan; vector-borne pathogen standard and the exposure control plan; the basis of laboratory safety; general laboratory safety; chemical safety; biosafety and biosecurity for research and diagnostic laboratories; biohazardous waste management; biosafety and biosecurity for biosafety level 3 laboratory; policy in biosafety and biosecurity for biological laboratories

ENNM 357 Environmental Measurements 3 (2-3-5)

Pre-requisite ENNM 213

Basic environment measurement techniques with community-based problem-solving tasks using statistical analysis tool, environmental modeling (GIS), mapping, chemical analysis, planning, sampling and preparation, analytical tools; air; water and soil sampling; air quality; water quality and hydrological analysis; soil and a sediment analysis

ENNM 358 Renewable Energy Technology for Environmental and
Resource Management 3 (2-3-5)

Pre-requisite ENNM 213

The world and Thailand energy situations; energy crisis; energy resources; solar energy; wind energy; hydro power; biomass; geothermal; renewable energy technology; energy conversion; energy storage technology; heat application; electricity generation; renewable energy project assessment

ENNM 359 Indoor Air Pollution 3 (3-0-6)

Pre-requisite ENNM 214

Fundamentals of indoor air pollution; causes of indoor air quality problems, sources and types of air pollutants, prevention, control, measurement of indoor air pollutants, human responses and the health risks of the indoor air pollution

ENNM 451 Environmental Chemistry 3 (2-3-5)

Pre-requisite SCCH 151

Sources, reactions, transport, effects, and fates of chemical species in water, soil, and air environments; Characteristics and interactions between the environmental components; representation of environmental cycles Carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulphur cycles; chemical and physical properties associated with water; solutions and solubility, equilibria in solution, acid/base characteristics, oxidation/ reduction processes; water quality and pollutants in water resources; atmospheric chemistry and air pollutants; geosphere and geochemistry; toxicological chemistry



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| ENNM 452 | International Rivers in Southeast Asia | 3 (3-0-6) |
| | Pre-requisite ENNM 224 | |
| | A study of the international rivers in Southeast Asia regarding their emergences; geographical features; river basin limits; peoples; cultural extent; the common use of river resources; river resource developments and development problems. the peoples' participation in the development projects; international organizations' roles toward the river development; lessons and international laws for the river management in Southeast Asia. (Field trip provided) | |
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| ENNM 453 | Stream and Watershed Restoration | 3 (3-0-6) |
| | Pre-requisite ENNM 224 | |
| | Stream and watershed restoration concepts; natural processes of watershed and impacts on watershed: degraded streams due to natural and/or human influences; good decisions to choose appropriate technologies or techniques for restoration. | |
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| ENNM 454 | Physical anthropology | 3 (3-0-6) |
| | Pre-requisite ENNM 221 | |
| | Human origins; biological basis of human culture and societies; primatology; primate evolution; primate behavior; primate sociobiology; primate societies. | |
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| ENNM 455 | Environmental Toxicology and Risk Assessment | 3 (2-3-5) |
| | Pre-requisite ENNM 225 | |
| | The toxicity of toxicants from chemicals organism living and environmental conditions; the process of toxic metabolism such as uptake; distribution; excretion and biotransformation of toxicants Effects and modifying factor of toxic effects; the toxicity and risk assessment on environment and the ecosystem | |
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| ENNM 456 | Green Environment and Energy | 3 (3-0-6) |
| | Pre-requisite ENNM 225 | |
| | Definition and relation of natural resource environment and energy. Energy source and classification of energy. Principle of green growth. Principle and method of technology for sustainable environment and energy. Tools and applications of technologies for sustainable environment and energy. Prevention and conservation of environment and energy. Regulations and policies of environment and energy. Case studies on technology applications for sustainable development of environment and energy. | |
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| ENNM 457 | Remediation Technologies for Contaminated Site Clean-up | 3 (2-3-5) |
| | Pre-requisite ENNM 225 | |
| | Principles and important steps of contaminated site cleanup; Site characterization, Principles of pollution control at the source and the prevention of pollution dispersion, Remediation technologies: physical, chemical, and biological; monitoring the environmental quality after closure | |



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ENNM 458 Sustainable Wastewater Treatment Technologies 3 (2-3-5)

Pre-requisite ENNM 225

Conventional wastewater treatment technologies; the wastewater treatment technology design system; Advanced Wastewater Treatment Technologies; preliminary treatment; primary treatment; secondary Treatment; biological treatment technologies; disinfection technologies; energy wastewater; waste to energy; sustainable wastewater treatment technologies; renewable energy technologies; the natural wastewater treatment system

ENNM 459 Agricultural Innovation Systems 3 (3-0-6)

Pre-requisite ENNM 223

Principles; concepts and techniques of the agricultural innovation systems; the agricultural and food value chain; agribusiness; conservation agriculture; sustainable land use and rural development; climate-Smart agriculture; precision agriculture; carbon and nitrogen cycling in the agroecosystem; environmentally sustainable agri-food production; climate, water scarcity and soil degradation; managing weather and climate risks in agriculture; the agricultural system models; food, energy, and society in agriculture; an innovation in family farming; incentives and resources for innovation

2.3.2 Natural Resource Management

ENNM 360 Coastal and Marine Resources 3 (2-3-5)

Pre-requisite ENNM 213

The components and structure of coastal and marine resources; both of physical and biological structure; marine and coastal ecosystem; activities and the utilization of resources and impacts; policies and regulations for management; an evaluation of developmental projects and an environmental impact assessment

ENNM 361 Tropical Forest Management 3 (2-3-5)

Pre-requisite ENNM 213

Tropical forest ecology; deforestation; forest fragmentation; conservation, the sustainable use of tropical forests; tropical forest management techniques.

ENNM 362 Plant Taxonomy 3 (2-3-5)

Pre-requisite ENNM 121

Principles and methods of plant systematics, the systems of classification, nomenclature and identification of vascular plants, plant specimen collecting and techniques of specimen preservation, family description, origin and distribution, evolutionary history and diversification of plants

ENNM 363 Animal Taxonomy 3 (2-3-5)

Pre-requisite ENNM 221



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Principles and methods of animal systematics; phylogenetics; different types of systematic data; evolutionary history and diversification of animals and environment

ENNM 364 Identification and Preservation of Microbial Specimens 3 (2-3-5)

Pre-requisite ENNM 222

Fundamental information of microbial features; trends in the microbial application and impact; principles of microbial specimen preservation; ISO principles and OECD guidelines for culture collections; Information management and database design; legal management of microbial resources; principles of microbial identification and quality control; classification of bacteria; maldi biotyper for microorganisms; modern techniques for yeast taxonomy; classification and taxonomy of filamentous fungi: barcoding; preservation and management of fungal specimens; preservation and taxonomy of algae; the management system for biological resources using barcode; DNA sequence data processing and interpretation; standard practices on liquid drying and cryo-preservation techniques

ENNM 365 Ornithology 3 (2-3-5)

Pre-requisite ENNM 221

An evolution of birds; systematics and classification; flight and locomotion; geography and environment; the digestive system; the circulatory system; energy balance and thermoregulation; the nervous system; vocal communication; behavior; the mating system; the reproductive system; parental care; the bird conservation

ENNM 366 Mammalogy 3 (2-3-5)

Pre-requisite ENNM 221

An evolution of mammals; systematics and classification; locomotion; geography and environment; the digestive system; the circulatory system; energy balance and thermoregulation; the nervous system; communication; behavior; the mating system; the reproductive system; parental care; mammal conservation

ENNM 367 Wildlife Ecology and Range Management 3 (2-3-5)

Pre-requisite ENNM 221

Concepts and theories of the ecosystems and natural communities related to wildlife and range; basic needs of wildlife; wildlife population ecology; behavior and wildlife management; habitat and range management; hunting and trapping; endangered wildlife management; wildlife management for recreation; wildlife value; wildlife farm management; wildlife disease; exotic wildlife; wildlife law and policy; case studies in wildlife ecology and range management.

ENNM 368 Behavioral Ecology 3 (2-3-5)

Pre-requisite ENNM 221



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Evolution and natural selection of behaviors; evolutionary and ecological pressures on animal behaviors; survival value and fitness of animal behaviors; ethology; sociobiology.

ENNM 462 Biogeography 3 (2-3-5)

Pre-requisite ENNM 221

Climate; topography; ecology; biodiversity; an impact of environmental changes on organism distribution; the effect of human activities on organisms; conservation

ENNM 463 Biodiversity Conservation and Management 3 (2-3-5)

Pre-requisite ENNM 221

Concept of biodiversity conservation; threats to biodiversity; habitat loss by human activities; exotic species; disease; and overharvesting; the value of biodiversity; small population; endangered species; establishing protected areas; designing protected area; protected areas management; conservation outside protected area; ex-situ conservation; biodiversity laws

2.3.3 Economics, Laws and Environmental Management

ENNM 381 Geosystems 3 (2-3-5)

Pre-requisite ENNM 314

Fundamentals of geography; the science of geography; the earth system concepts; location and time on earth; the energy-atmosphere system; solar energy; seasons; and the atmosphere; atmospheric energy and global temperatures; atmospheric and oceanic circulation; water; weather; and the climate system; atmospheric water and weather; the global climate systems; water resources; the earth's changing landscape systems; the dynamic planet; earthquakes and volcanoes; weathering; karst landscapes; and the mass movement; the river systems and geomorphology; wind processes; and geomorphology; the biogeography systems; the geography of soils; the ecosystem and biome; human activities

ENNM 382 Environmental Problem and Environmental Ethics in Southeast Asia 3 (3-0-6)

Pre-requisite ENNM 227

A study of environmental problems and environmental ethics in Southeast Asia; both natural and manmade environmental problems; world order and good governance involving the environment; international laws and agreements on the environment in relation to Southeast Asia. (field trip provided)

ENNM 383 Policy Instruments for Environmental and Natural Resources 3 (3-0-6)

Pre-requisite ENNM 227

A study of environmental and natural resource management problems including air and water pollution; the solid waste management; biodiversity; the ecosystem management; the maintenance of biodiversity; the protection of natural resources; wildlife and endangered



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species; policy instruments based on economic incentives including taxes; charges; permits; labeling; and other information disclosure mechanisms

ENNM 384 Economic Valuation of the Environmental and Natural Resources 3 (3-0-6)

Pre-requisite ENNM 313

Meanings and significance or the economic value assessment of the environment; Categories of the environment economic value; economic welfare theories related to the value assessment techniques; an implementation of welfare; the theoretical framework for the behavioral models; techniques for evaluating the value of revealed satisfaction; techniques for evaluating the value of direct asking satisfaction, techniques for transferring value; the creation of the econometric model for evaluating the economic value

ENNM 479 Global Environmental Change and Food Security 3 (3-0-6)

Pre-requisite ENNM 227

Global food security; the Global food system; changing trends of global food security; optimizing food safety; ensuring proper nutrition; poverty and equity; managing global environmental change; water and food security; soil quality and food security; climate change and food security; climate adaptation; climate mitigation; global food trade; global food supply and demand; Rural food value chains; food security policy analysis; nutrition policy analysis; poverty assessment

ENNM 481 Regional and Urban Economics 3 (3-0-6)

Pre-requisite ENNM 313

A study of related economic theories and an analysis of regional and urban economy; the utilization of natural resources and their returns; the structure, development, planning, problems, and their solutions at the urban level; a study of the growth model; economic policy planning and regional problems

ENNM 482 Urban Environmental Management 3 (3-0-6)

Pre-requisite ENNM 313

Emerging and expansions issues of cities, mega and medium size city, urban city; Ecosystem capitals services; environmental carrying capacity; Sustainable Development Goals (SDGs) and Millennium Development Goals (MDGs); sustainable environment and cities in theory and practice; incorporating climate change adaptation into the environment planning and livable cities; up-scaling Institutions managerial capacity on environmental security and sustainable city; comprehensive city's sustainability domains, e.g., economic, social innovation and technology culture local knowledge and self-sufficiency ideology

ENNM 483 Social Responsibility 3 (3-0-6)

Pre-requisite ENNM 227

Theories and practical guidelines on ethics; building of the management systems, good governance and transparency and corporate responsibility regarding stakeholders'



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relationships within a society; applying the principles of good governance in the management focusing on problems, public mind, and social responsibility in regional and international organizations to enhance social care; actual case studies seminar on organizational ethics and social responsibility

Field Experience

ENNM 390 Internship in Natural Resource and Environmental Management 6 (0-12-6)

Pre-requisite ENNM 227

Natural resource management work-internship program will focus on actual work and on-the-job training in natural resource management.