Example form for Module Handbook (Đề cương tổng quát môn học)

A **Module Handbook or collection of module descriptions that is also available for students to consult** should contain the following information about the individual modules:

Module designation (Tên môn học)	*ENVIRONMENTAL SYSTEMS ANALYSIS*
Semester(s) in which the module is taught (Học kỳ giảng dạy)	*HK 211*
Person responsible for the module (	*Dr. Nguyen Hoang Anh*
Language (ngôn ngữ)	*Vietnamese, English*
Relation to curriculum (Các môn học liên quan)	*Environmental Engineering*
Teaching methods (Phương pháp giảng dạy)	*Lectures: theories and methods, projects, seminars*
Workload (incl. contact hours, self-study hours) (Thời lượng làm việc)	*(Estimated) Total workload:* *Contact hours (lectures: 1350 hours, exercises and seminars : 675 hours)* *Private study including examination preparation, specified in hours[1]: 50 hours*
Credit points (số tín chỉ)	*3*
Required and recommended prerequisites for joining the module (những yêu cầu kiến thức trước khi học)	*- Algebra, statistics* *- Existing competencies in understanding environmental problems*
Module objectives/intended learning outcomes (Mục tiêu môn học, yêu cầu CĐR)	***Aims of this course:*** *The purpose of this course is to train students on concrete and rigorous problem-solving tools that provide a mathematical basis for decision-making. By the end of the course, students will be able to define systems and their boundaries, optimize systems for a set of constraints and objectives, determine the sensitivity of decisions and optimal solutions based on changes in constraints, translate complex problems into networks, and define appropriate sets of solutions when there are multiple, competing objectives. Example problems span natural resource management, traditional environmental engineering processes, and issues in green design and environmental policy.* ***Course Learning Outcomes*** - *Skills of thinking and problem solving* - *Knowledge gain by practice and discovery* - *Skill of system thinking* - *Personal skills and characteristics* - *Professional skills and characteristics* - *Performing ideas on technical and management systems* - *Building project/program/policy* - *Applying project/program/policy to practice*

[1] When calculating contact time, each contact hour is counted as a full hour because the organisation of the schedule, moving from room to room, and individual questions to lecturers after the class, all mean that about 60 minutes should be counted.

Content (Nội dung)	***Introduction of the course*** - *Information about instructor* - *Information about course* - *Ways of teaching & learning* - *Introduction of references* ***Introduction to Systems Theory*** *Types of systems* *• Isolated* *• Closed* *• Open* *Properties of sytems* *• Feedback* *• Complexity* *• Self-organization* *• Self-regulation* *• Emergence* *• System hierarchy* *Complex system behavior* *• Exponential growth* *• Logistic growth* *• Overshoot and oscillation* *• Overshoot and collapse* *System Analysis* *• Methodology* *• System thinking* *• Techniques for system analysis* ***Methods for System Analysis*** *Statistical analysis* *Introduction to environmental statistics* *Statistics fundamental: Data types, Random variation and distribution, Sampling* *Sample moments* *Exploratory data analysis (EDA)* *Statistical Hypothesis Testing: T-test, one/multi-way ANOVA* *Get familiar with Jamovi - a user-friendly statistical software* ***Methods for System Analysis (cont.)*** - *Techniques of Graphical Analysis of the environmental systems* - *Construct model from the analysis of a system: Compartment model* ***Qualitative Analysis*** - *Multi-criteria Analysis* - *The weighting methods* - *Matrix Method for generating scores and weights* - *Simple Additive Weighting Method (SAW)* - *Simple Multi-Attribute Rating Technique (SMART)* - *Cause and effect analysis* - *Group-based weighting decisions - Delphi method.* ***Decision Analysis*** - *Multi-criteria Decision Analysis (MCDA)* - *The concept of decision-support analysis*

	- *Solutions Using Alternate Objectives* - *Defining non-inferior sets (Pareto optimality)* ***Decision Analysis (cont.)*** - *Pareto optimality and tradeoff analysis* - *Trade-off Evaluation (Environmental, Economic, Social Criteria)* - *Cost-Benefit Analysis* - *Utility Scoring* - *Analytical Hierarchy Process (AHP)* ***Quantitative Analysis*** - *Establishing Objectives, Decision Variables, and Constraints* - *Exploring Different Types and Scales of Systems* - *Graphing Decision Space and Objective Functions* ***Quantitative Analysis (cont.)*** - *Tragedy of the Commons as an Optimization Problem* - *Problems with Many Decision Variables* - *Network Analysis and Dynamic Modelling – Solving Multi-Stage/MultiDecision Environmental Problems* ***Environmental Systems Analysis Tools*** - *Selecting questions and tools* - *Why these tools?* - *Key to the questions* - *Environmental Impact Assessment (EIA)* - *Strategic Environmental Assessment (SEA)* - *Life Cycle Assessment (LCA)* - *Environmental Risk Assessment (ERA)*
Exams and assessment formats (Hình thức kiểm tra và thi)	- *Exercises in class* - *Project and seminars* - *Final examination (written)*
Study and examination requirements (Tỉ lệ đánh giá học tập)	• *Forms of evaluation: Scale of mark: 10; under mark 5 .5 is not met; presentation and submit group assignment.* - *Exercise: 20%* - *Project and seminars: 30%* - *Final examination: 50%*
Reading list (Tài liệu)	• *Meadows (2008) Thinking in Systems, System lens & The basics* • *Matthews et al. (2015) Life Cycle Assessment* • *Practical Optimization: A Gentle Introduction*