SEE4204: ENVIRONMENTAL SYSTEMS MODELLING

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Environmental Systems Modelling

Subject Code
SEE - School of Energy and Environment
Course Number
4204

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2181 Mathematical Methods for Engineering;
SEE1002 Introduction to Computing for Energy and Environment; AND
SEE2003 Introduction to Energy and Environmental Data Analysis

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to instruct students to learn how environmental phenomena works as systems and how to use models to better understand the environmental systems and to solve environmental problems. Students will learn basic concepts and strategies for building simple models, designing model experiments, and evaluating model results. Various environmental applications using modelling from a variety of disciplines (e.g. air and water) will also be introduced.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the modelling aspects of environmental systems	10	x		
2	Demonstrate principles and concepts underlying environmental models	40	x		
3	Apply simple model simulations to explain environmental phenomena	20		x	x
4	Design modelling strategies to solve environmental problems	30		x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Students will engage in lectures with discussion to learn key concepts, such as principles related to numerical modelling and environmental systems.	1, 2	3
2	Computational Labs	In computational sessions, students will apply the theories discussed in lecture to build simple models in Python programming language. They will also use these models to solve environmental problems.	2, 3, 4	3 hours/week for 3-4 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignment There will be 5-6 assignments throughout the semester, which includes problem solving and computational lab reports.	1, 2, 3	35	
2	Term Paper Students will write a mini proposal to apply modelling in solving real-world environmental problems.	3, 4	25	

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Additional Information for ATs

Examination duration: 2 hours
Percentage of continuous assessment, examination, etc.: 60% by continuous assessment; 40% by exam

To pass a course, a student must do ALL of the following:
1) obtain at least 30% of the total marks allocated towards continuous assessment (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. Assignment

Criterion

Ability to describe the principles and mechanisms, and solve problems related to environmental systems modelling

Excellent (A+, A, A-)

Excellent problem-solving skills to demonstrate in-depth understanding of environmental modelling principles and applications

Good (B+, B, B-)

Good problem-solving skills to demonstrate significant understanding of environmental modelling principles and applications

Fair (C+, C, C-)

Moderate problem solving skills to demonstrate understanding of environmental modelling principles and applications

Marginal (D)
Basic problem solving skills to demonstrate acceptable understanding of environmental modelling principles and applications

Failure (F)
Poor problem-solving skills that fails to demonstrate understanding of environmental modelling principles and applications

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Assessment Task
2. Term paper

Criterion
Ability to design modelling strategies for a real-world environmental problem

Excellent (A+, A, A-)
Demonstrate excellent ability of self-learning and strategy design on the topics of environmental modelling

Good (B+, B, B-)
Demonstrate good ability of self-learning and strategy design on the topics of environmental modelling

Fair (C+, C, C-)
Demonstrate moderate ability of self-learning and strategy design on the topics of environmental modelling

Marginal (D)
Demonstrate basic ability of self-learning and strategy design on the topics of environmental modelling

Failure (F)
Fail to design acceptable strategy on the topics of environmental modelling

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Assessment Task
3. Final exam

Criterion
Ability to explain concepts and solve problems

Excellent (A+, A, A-)
Demonstrate excellent ability to explain key concepts of numerical modelling and apply them on solving environmental problems

Good (B+, B, B-)
Demonstrate good ability to explain key concepts of numerical modelling and apply them on solving environmental problems

Fair (C+, C, C-)
Demonstrate moderate ability to explain key concepts of numerical modelling and apply them on solving environmental problems

Marginal (D)
Demonstrate basic ability to explain key concepts of numerical modelling and apply them on solving environmental problems

Failure (F)

Fail to explain key concepts of numerical modelling and apply them on solving environmental problems

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Part III Other Information

Keyword Syllabus

Environmental systems

- Systems thinking; Environmental behaviour pattern; Feedback

Model building and equations

- Pollution transport; Continuity equation; Dynamic modelling; Kinetic modelling; Data-based mechanistic modelling; Eulerian model; Lagrangian approaches; Python, R language and/or MATLAB

Strategies for environmental systems modelling

- Model experiment design; Environmental data; Model validation

Application in environmental systems modelling

- Matter cycling; Water quality model; Atmospheric model; Ecosystem model; Case study

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Wainwright, J. (2012). Environmental Modelling: Finding Simplicity in Complexity 2nd Edition. West Sussex, UK: Wiley.
2	Deaton, M. (2000). Dynamic Modelling of Environmental Systems, Springer, 2000.