MNE3126: METHODOLOGIES FOR SOLVING COMPLEX ENGINEERING PROBLEMS

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Methodologies for Solving Complex Engineering Problems

Subject Code
MNE - Mechanical Engineering
Course Number
3126

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MNE2036 Engineering Computing

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to facilitate students with essential skills and tools to solve complex engineering problems. The introduced techniques will be used in a number of industrial sectors such as manufacturing processes monitoring, heat treatment, thermodynamics, thermal engineering, heat and mass transfer, uncertainty modeling, risk management, nonlinear dynamics, mass balance, and vibrations. After this course, students will be able to apply handy tools to solve practical problems encountered in mechanical engineering. The introduced methodologies for tackling these engineering problems will benefit students' future work as mechanical engineers.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Formulate the fundamental principles of complex engineering problems.		x		
2	Apply knowledge of various mathematical analysis techniques to understand the underlying engineering problems.			x	x
3	Employ practice computing skills to solve related engineering problems.				x
4	Implement analytical or numerical algorithm in program languages for finding solutions for a given engineering problem.			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	Lectures will introduce fundamental principles behind different engineering problems, as well as the mechanistic ways to understand, analyze, and solve the problem.	1, 2, 3	2 hrs/week
2	Laboratory Work	Lab projects will be designed to help students to apply computing skills from lectures to solve real practical engineering problems.	2, 3, 4	1 hr/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3	10	
2	Project Reports	2, 3, 4	50	3 reports to be submitted

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

3

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

Assignments

Criterion

Ability to explain the fundamental principle of engineering problems, formulate the problem and solve it based on learned skills.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Project Reports

Criterion

Ability to solve complex engineering problems using practical computing skills and tools by implementing numerical algorithms.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Examination

Criterion
Ability to analyze, formulate and solve engineering problems by either analytical or numerical methods.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Additional Information for AR

Note: For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Part III Other Information

Keyword Syllabus

The touched topics in this course will be a selection from the below keywords depending on the schedule and arrangement of instructors:

Heat flow calculation; Single variable and multivariable differentiation and integration; Numerical integration; Dynamics and kinematics; Vibrations; Linear algebra equation systems; Higher-order ordinary differential equations; Kinematic Analysis and Synthesis; Heat transfer and mass transfer equation; Initial and boundary value problems; Partial differential equations; Elliptic equations and applications; Parabolic equations and applications; Numerical & Statistical Methods; Risk measurement process; Risk factors and uncertainty; Portfolio risk measures (standard deviation, value at risk, safety margin, etc.); Probabilistic analysis; first-order and second-order reliability methods; optimization design.

Reading List

Compulsory Readings

	Title
1	Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, 2011, Wiley publisher, ISBN: 9780471154969.

Additional Readings

	Title
1	Curtis F. Gerald, Patrick O. Wheatley, Applied Numerical Analysis, 7th edition, Pearson/Addison-Wesley publisher, ISBN: 0321133048.
2	R. W. Hamming, Numerical Methods for Scientists and Engineers (Dover Books on Mathematics) 2nd Revised ed. Edition, Dover Publications, ISBN-10: 0486652416.
3	Mitzenmacher, M. and Upfal, E., Probability and Computing: Randomization and Probabilistic Techniques in Algorithms and Data Analysis, Cambridge University Press, 2017, ISBN: 9781107154889.