MNE4010: DYNAMICS AND VIBRATIONS

Effective Term
Semester B 2023/24

Part I Course Overview

Course Title
Dynamics and Vibrations

Subject Code
MNE - Mechanical Engineering
Course Number
4010

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
MBE2109/BME2109/MNE2109 Engineering Mechanics

Precursors
MBE3049/MNE3049 Control Principles

Equivalent Courses
MBE4010/BME4010 Dynamics and Control

Exclusive Courses
Nil

Additional Information
#Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

Vector description of force, position, velocity and acceleration in fixed and moving reference frames; Newtonian dynamics of particles and rigid bodies; Newton-Euler and Lagrangian formulations for rigid bodies; the simple oscillator and its applications; free and forced vibration of linearly damped models of mechanical systems; application of MATLAB to solve equations of motion and optimize engineering designs; applications to engineering systems involving vibration isolation and absorption.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Comprehend fundamental concepts of particle kinematics and kinetics, rigid body dynamics, and mechanical vibrations.		x		x
2	Create mathematical models of simple mechanical systems through analysis of displacement, velocity and acceleration.			x	
3	Analyse idealized dynamics and vibrations problems.			x	
4	Formulate Newton-Euler and Lagrangian based equations of motion for rigid bodies to simplify dynamical system analyses.		x	x	x
5	Evaluate the overall mechanical system performance via integrated modelling through simulations.		x	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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Explain the key concepts and approaches to model and solve mechanical dynamics and vibrations problems. Requires students to formulate the equations of motion governing simple dynamical systems. Some additional work is given to the students to perform at their own pace.	1, 2, 3, 4, 5	3 hrs/week
2	Computer Laboratory Activities	Work in a team to get hands on experience on using MATLAB for modelling and analysis of dynamical systems.	1, 2, 3, 4, 5	2 hrs/week for 3 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Homework Assignment	1, 2, 3, 4, 5	20	Approximately 5 homework assignments.
2	Mid-term Quiz	1, 2, 3	30	A 2-hours quiz on Week #7 or 8.
3	Group Report and Presentation	1, 2, 3, 4, 5	15	A group assignment requiring work of over 9 weeks.

Continuous Assessment (%)

65

Examination (%)

35

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework (the total of the "Continuous Assessment" score) and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

Homework Assignment

Criterion

Ability to develop models to analyse simplified dynamical and vibratory mechanical systems; ability to explain in detail of the methodologies and procedures in analyzing these systems.

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
Mid-term Quiz

Criterion
Ability to develop models to analyse simplified kinematic and rigid body mechanical systems for practical engineering situations; ability to explain the concepts of generalized coordinates and holonomic constraints; ability to explain in detail of the methodologies and procedures related to analyzing dynamical system.

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
Group Report and Presentation

Criterion
Ability to explain in detail of observations and evaluate the system performance of the team's proposed topic.

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 model, analyse and control simplified dynamical and vibratory mechanical systems.

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
For a student to pass the course, at least 30% of the maximum mark for both coursework (the total of the "Continuous Assessment" score) and examination should be obtained.

Part III Other Information

Keyword Syllabus
Force, work, energy and power; kinetics and kinematics of particles, systems of particles, and rigid bodies; Newton-Euler equations of motion; generalized coordinates and Lagrange’ s equations of motion; simple harmonic motions; vibrations of single and multi-degrees-of-freedom systems, steady-state and transient response; mathematical modeling; differential equations.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Ferdinand Beer, E. Johnston, David Mazurek, Phillip Cornwell, and Brian Self, Vector Mechanics for Engineers: Dynamics, McGraw Hill; 12th edition (January 29, 2018), ISBN-10:1259977307.