MNE3010: MECHANICAL DESIGN

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Mechanical Design

Subject Code
MNE - Mechanical Engineering
Course Number
3010

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
MNE2109/BME2109 Engineering Mechanics OR
MNE3118 Mechanics of Materials

Precursors
Ideally, both MNE2109 and MNE3118 are required for the course MNE3010 to ensure successful learning experience. Please feel free to consult the course examiner if you have any questions.

Equivalent Courses
Nil

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

This course aims to provide students with knowledge and skills in applying elementary design analysis principles, basic design procedures, and design data from standards and catalogues generally provided by manufacturers, for the design of mechanical elements commonly used in mechanical devices as well as power and motion transmission systems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify the working principles of various kinds of commonly used mechanical components.		x	x	
2	Apply suitable theories and basic engineering principles and procedures to perform mechanical design calculations with due consideration to the choice of appropriate materials and their mechanical strengths.			x	
3	Assess the appropriateness of engineering design data from standards and catalogues for standard components (such as bearings, springs and mechanical fasteners), which are provided by manufacturers.			x	
4	Solve real problems in power and motion transmission systems, such as a shaft carrying gears, pulleys, cams, clutches and mounted on bearings with spring supports, with constraints in environmental temperature, or availability of space, or static and dynamic loading conditions, and materials etc.			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	It takes place in a classroom setting, which consists of lectures and student activities such as quizzes in between.	1, 2, 3, 4	3 hrs/week

2	Mechanical Design Project	Students will work in small groups to design and fabricate a specific mechanical component (for example: a turbine blade), which will be evaluated within a given context.	1, 2, 3, 4	3 hrs laboratory session x 3

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Quizzes and Mid-term Test	1, 2, 3, 4	30	
2	Mechanical Design Project	1, 2, 3, 4	30	Conducted over the entire semester

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2.5

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

Quizzes and Mid-term Test

Criterion

Describe the mechanical design concepts and principles and provide solution to related design problems.

Excellent (A+, A, A-)

75%-100%

Good (B+, B, B-)

60%-74%

Fair (C+, C, C-)

45%-59%

Marginal (D)

40%-44%

Failure (F)

<40%

Assessment Task

Mechanical Design Project

Criterion

Apply learnt mechanical engineering principles to solve real problems in power and motion transmission systems, such as a shaft carrying gears, pulleys, cams, clutches and mounted on bearings with spring supports, with constraints in environmental temperature, or availability of space, or static and dynamic loading conditions, and materials etc.

Excellent (A+, A, A-)

Strong evidence of critical thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge of the design project matters concerned.

Good (B+, B, B-)

Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with the project matters.

Fair (C+, C, C-)

Student who is profiting from the design project experiences; understanding of the subject; ability to develop solutions to concerning the project requirements.

Marginal (D)

Demonstrate just sufficient understanding of the design project content to enable the student to move onto other projects.

Failure (F)

Little evidence of understanding and solution implementation of the design project matters; weakness in critical and analytic skills; limited, or irrelevant use of data.

Assessment Task

Examination

Criterion

Explain the fundamental concepts and working principles, select proper machine elements and solve problems in the mechanical design process.

Excellent (A+, A, A-)

Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

Good (B+, B, B-)

Significant evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with course matter.

Fair (C+, C, C-)

Student is profiting from the university experience; understanding of the mechanics; ability to develop solutions to simple problems in the course.

Marginal (D)

Basic familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; very limited demonstration of correct use knowledge in the course.

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

- Mechanical properties of materials: Stress and strain. Principle stress. True Stress and true strain. Hardness. Impact properties. Stress concentration. Yield. Fracture and Fatigue. Toughness. Viscoelastic behaviour.
- Design of shafts for power transmission: Combined bending, torsion and axial loading. Critical speed. Critical diameter.
- Design of keys and keyways, and couplings: Bending, torsion and combined loads, stresses in keyed shafts; rigid and flexible couplings.
- Design of brakes and clutches: Plate and cone clutches. Block and band brakes.
- Design of pulleys and belts: Flat-belt and V-belt drives. Centrifugal tension
- Design of gears and gear trains: Involute tooth profile. Epicyclic gear train. Spur and helical gears.
- Design of bearings: Journal bearings. Anti-friction bearings. Bearing life prediction. Selection of ball bearings and roller bearings.
- Design of spring: Types of springs. Analysis of stiffness. Spring wire size, number of coils, pitch, overall dimensions etc.
- Design of cams and cam followers: Displacement curves and cam profiles.
- Design of mechanical fasteners: Threaded fasteners. Power screws for motion and power transmissions.

Reading List

Compulsory Readings

	Title
1	Richard Budynas and Keith Nisbett, Shigley's Mechanical Engineering Design (McGraw-Hill Series in Mechanical Engineering), 10th Edition, McGraw Hill, 2014.
2	Steven R. Schmid, Bernard J. Hamrock and Bo. O. Jacobson, Fundamentals of Machine Elements, Prentice-Hall International, 2013.

Additional Readings

	Title
1	Robert L. Mott, Machine Elements in Mechanical Design, 5th Edition, Prentice Hall, 2013.