MNE8112: CAD/CAM/CAE INTEGRATION

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
CAD/CAM/CAE Integration

Subject Code
MNE - Mechanical Engineering
Course Number
8112

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
MNE6001 CAD/CAM Integration

Exclusive Courses
Nil

Part II Course Details

Abstract

The aim of this course is to develop a comprehensive understanding of technology underlying Computer Aided Design and Manufacture and Computer Aided Engineering solutions. Students will learn how to apply CAD/CAM/CAE technology to solve integrated design/analysis/manufacturing problems with a significant geometric component.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	describe the mathematical basis for the representation of geometric entities including parametric curves and free-form surfaces.		x	x	
2	describe the basic theories and algorithms for solid modelling and other advanced representation schemes.		x	x	
3	elaborate the general methodology for integrated CAD/CAE solutions and apply the method for typical applications.		x	x	
4	describe the techniques in CNC toolpath computation for 3-axis and multi-axis machining with selected topics in advanced CAD/CAM applications.		x	x	
5	interpret a design/analysis/manufacturing problem with a significant geometric component, translate it into an algorithmic problem, and apply relevant techniques to solve it.			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	Lectures covering four major areas on CAD modelling, integrated CAD/CAE solutions, CAM processing, and 3D printing.	1, 2, 3, 4, 5	2 hrs/week

2	Tutorial	Tutorials on CAD modelling, including spline-based modelling, subdivision-based modelling and solid modelling.	1, 2, 5	1 hr/week for 8 weeks
3	Mini-project	Mini-projects covering various topics on integrated CAD/CAE solutions, CAM, 3D printing and other closely related topics.	3, 4, 5	1 hr/week for 5 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignment / Test	1, 2, 5	15	
2	Mini-project	3, 4, 5	25	
3	Examination	1, 2, 3, 4, 5		

Continuous Assessment (%)

40

Examination (%)

60

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 and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Through examination, the students will be evaluated on the knowledge in the fields of CAD/CAM/CAE integration.

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
Assignment/ Test (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Tutorials mainly covering various topics of lectures on CAD modelling and processing.

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
Mini-project (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Mini-projects mainly covering topics on integrated CAD/CAE solutions, CAM processing, 3D printing, and other closely related topics.

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 (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Through examination, the students will be evaluated on the knowledge in the fields of CAD/CAM/CAE integration.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Assignment/ Test (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Tutorials mainly covering various topics of lectures on CAD modelling and processing.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Mini-project (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Mini-projects mainly covering topics on integrated CAD/CAE solutions, CAM processing, 3D printing, and other closely related topics.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

CAD/CAM systems, Bezier, B-spline and NURBS for curve and surface modelling, subdivision-based modelling, CSG and B-Rep for solid modelling, algorithms for curve/curve intersection, curve/surface intersection and surface/surface intersection, isogeometric analysis for integrated CAD/CAE solutions with typical applications in computational mechanics and thermal analysis, algorithms for 3-axis and multi-axis toolpath extraction, data processing for 3D printing.

Reading List

Compulsory Readings

	Title
1	N.A.

Additional Readings

	Title
1	Les Piegl and Wayne Tiller, "The NURBS Book", Springer-Verlag Berlin, Heidelberg, 1997.
2	David F. Rogers, “An Introduction to NURBS : with Historical Perspectives”, Academic Press, San Francisco, 2001.
3	I. Zeid, “Mastering CAD/CAM with Engineering Subscription Card”, McGraw-Hill, 2004.
4	J. Austin Cottrell, Thomas J. R. Hughes, Yuri Bazilevs, "Isogeometric Analysis: Toward Integration of CAD and FEA", John Wiley & Sons, 2009.
5	Christopher G. Provatidis, “Precursors of Isogeometric Analysis: Finite Elements, Boundary Elements, and Collocation Methods”, Springer, 2019.
6	I. Gibson, D. Rosen and B. Stucker, "Additive Manufacturing Technologies - 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer-Verlag New York, 2015.
7	Computer Methods in Applied Mechanics and Engineering, Elsevier Science.
8	Computer-Aided Design Journal, Elsevier Science.