MECH3510 CAD/CAM

Course Code: MECH3510	**Course Title:** CAD/CAM
Required Course Or Elective Course: elective	**Terms Offered (Credits):** Fall or Spring (3 credits)
Faculty In Charge: Yanglong Lu	**Pre/Co-Requisites:**
Course Structure: Lecture: 1 day per week, 1 hour 50 mins; Lab: 1 day per week, 3 hours	

Textbook/Required Material:

(1) Class notes
(2) Principles of CAD/CAM/CAE Systems by Kunwoo Lee (reference)
(3) Mastering CAD/CAM by Ibrahim Zeid (reference)
(4) Geometric modelling by Michael E. Mortenson (reference)
(5) Numerical methods for engineers and scientists by Hoffman, Joe D., and Steven Frankel (reference)
(6) Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2 (reference)

Bulletin Course Description:

This is an elective course for the BEng in Mechanical Engineering with Option in Design, covering topics such as curves and surfaces, geometric modeling basics, data structures in CAD/CAM, finite element analysis, optimization, tool path generation, and machine learning in design. In addition to lectures, intensive labs of ANSYS for finite element analysis and Python programming will be offered.

Course Topics:

1. Basic computer graphics, coordinate systems, homogeneous transformations
2. Geometric modeling algorithms and systems, modeling functions, data structures, Boolean and Euler operations, non-manifold modeling
3. Representation and manipulations of curves: Hermite, Bi-cubic, Beizer, B-spline
4. Representation and manipulation of surfaces: basic terminology of parametric surfaces, bilinear, ruled, Coons, Hermite, Bezier, and Bspline
5. Basics of finite element method
6. Optimization algorithms: single-variable optimization, gradient-based optimization, genetic algorithm and topology optimization
7. Basics of machine learning: classification, regression, and clustering algorithms
8. Meshing algorithms
9. Tool path generation algorithms
10. Numerically controlled manufacturing processes

Course Objectives: (correlated program objectives)	1. To equip the students with fundamental theories and technologies in basic computer graphics, geometric modeling algorithms, curves and surfaces, meshing algorithms, introductory optimization algorithms, and tool path generation algorithms that are the foundation of Today's CAD/CAM/CAE systems (P-O1, P-O3) 2. To introduce basic and entry level theories and terminology of Finite Element Method (P-O3) 3. To introduce basic of machine learning and its application in design (P-O3)

	4. To provide students an extensive and intensive programming training course of Python with ample in-depth projects (P-O1, P-O3)
Course Outcomes: (correlated course objectives and program outcomes)	A. Become an expert user of Python -- the student will be able to efficiently use the language to program and implement efficient algorithms of CAD/CAM from the very early conceptual design till the final machining G-code generation or additive manufacturing operation, in a team-work environment [3] (POC1, POC2, POC3, POC4, POC5, POC6, POC7, POC8) B. The student will have a thorough understanding of the fundamental mathematical theories and computer algorithms underlying CAD/CAM/CAE software tools [1, 2] (POC3, POC6) C. Be able to design and implement a computer program of moderate complexity for CAD/CAM/CAE tasks [3] (POC1, POC2, POC6)
Assessment Tools: (correlated course outcomes)	1. Regular homework problems - 15% [B] 2. Lab projects - 15% [A, C] 3. Mid-term - 35% [B] 4. Final project - 35% [A, C]

BEng in Mechanical Engineering (4-year program)
Program Objectives:

P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,
P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,
P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,
P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,
P-O5. Continuously improve through lifelong learning.

Program Outcomes:

POC1. ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints;
POC2. ability to design and conduct experiments as well as analyze and interpret data;
POC3. ability to apply knowledge of mathematics, science, and engineering for problem solving in mechanical engineering and related sectors or for further education in a research career;
POC4. ability to develop specification and to design system, component, or process to meet needs;
POC5. ability to understand the manufacturability, maintainability, and recyclability of engineering system and components;
POC6. ability to use modern engineering tools, techniques, and skills in engineering practice;
POC7. ability to communicate effectively;
POC8. ability to function in multi-disciplinary teams and provide leadership;
POC9. broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context;
POC10. clear understanding of professional and ethical responsibilities;
POC11. recognition of the need for life-long learning and continuing education;
POC12. international outlook with knowledge of contemporary issues.