The Hong Kong University of Science and Technology

Course Title: Computer-Aided Design and Manufacturing

Course Code: MECH3510

Credits: 3 credits

Pre/Co-Requisites: MECH2520

Instructor: Prof. Yanglong Lu (maeylu@ust.hk)

Teaching Assistants: Tong Zhu (tzhuaf@connect.ust.hk)

Zipu Yan (zyanbn@connect.ust.hk)

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, labs of ANSYS for finite element analysis and Python programming will be offered.

Course 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.
B. The student will have a thorough understanding of the fundamental mathematical theories and computer algorithms underlying CAD/CAM/CAE software tools.
C. Be able to design and implement a computer program of moderate complexity for CAD/CAM/CAE tasks.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)
Mid-Term	35%
Regular homework problems	15%
Lab projects	15%
Final project	35%

Required Texts and Materials

(1) Class notes

[Optional] Additional Resources

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

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