MECH410/520 Computer Aided Design (CAD)

Spring 2010

Course Description (see UVic Calendar)

The course consists of the following components:

1) Computer Graphics Theory (Geometric Representation, Projection, Transformations, Solid and Surface Models of CAD Systems)
2) Advanced CAD/CAE/CAM Systems, Pro/ENGINEER®, and Its Applications
3) Virtual Prototyping of Mechanical Components and Devices
4) Design Optimization Using Computer Virtual Prototypes
5) Interactive Graphical Programming

Course Information

Instructors: Armando Tura
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Course Homepage: http://www.me.uvic.ca/~mech410/

Section Number: Lecture: S01, Lab.: LS01 (open lab). Credits: 1 1/2
Lecture Schedule: Tuesday, Wedsdays and Fridays 11:30 am -12:30 pm
Lecture Place: CORB 143
Office Hours: Tuesday: 1:30-3:30 p.m. ELW A254 (or by appointment)
Lab. Schedule: Computational Design Lab. ELW B228 (Open 7x24, first lab: Jan 13)
Lab. Consultant: Tuesdays 1:30 - 4:30 p.m. (Mr. Minh Ly, Lab: ELW B228 and Office: ELW A214)
References: • Lee, K. Principles *of CAD/CAM/CAE Systems,* Addison Wesley, 1999.
• MECH410/520 Web Page at http://www.me.uvic.ca/~mech410/
• Roger Toogood, *Pro/ENGINEER Wildfire 4.0 Tutorial,* SDC.

Pro/ENGINEER Laboratory		MECH410 (Group of 2)	MECH520 (Individual)
Laboratory 1 (Start on Jan 15)	Design Modeling - User Interface; 2D Sketching; 3D Modeling; and Engineering Drawing Generation (10 days)	7 %	7 %
Laboratory 2	Mechanical Assembly – Modeling of Assembly and Mechanism; and Motion Animation (10 days)	7 %	7 %
Laboratory 3	Static Structural (and Thermal) Analysis (1 wk)	5 %	5 %
Laboratory 4	Sensitivity Analysis and Design Optimization (1 wk)	5 %	5 %
Laboratory 5	Automated CNC Tool Path Generation & Machining (1wk)	6 %	6 %
Final Project* Project Presentation (March 30, Tue) and Report (3-4 wks) - An Application of CAD/CAE/CAM System (Your Choice) Using Pro/ENGINEER; or Unigraphics NX; or SolidWorks		35 %	40 %
Assignments	To be assigned in class	0 %	0 %
Quiz 1	(1 lecture time, Sections 1,2,3,4,5,7,8) Feb 24	17.5 %	15 %
Quiz 2	(1 lecture time, Sections 8-13) Mar 31	17.5 %	15 %

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* "Satisfactory" work can earn 80 percent of the grade. The rest 20 percent of the grade will be rewarded to creative work.

Course Outline

1. Introduction to CAD/CAE/CAM and Technology Review
2. Computer Hardware and Software for A CAD System
3. Graphical Coordinate Systems
   Model (or World, Database) Coordinate System (MCS); Working Coordinate System (WCS); Screen Coordinate System (SCS); Viewing Coordinate System (VCS)

4. Reviews on Geometric Transformations and Projections
   a) 2D and 3D Transformations
   b) Parallel Projections

5. An Introduction to the Pro/ENGINEER Design Modeling System
   a) Foundation of the Pro/ENGINEER and Feature-based Solid Modeling CAD Systems
   b) Function Modules of a CAD/CAE/CAM System
   c) Pro/E User Interface and Part/Assembly Model Generation
   d) Engineering Drawings and Documentation, File Conversion
   e) Motion Simulation

6. An An Overview of Unigraphics NX CAD/CAM/CAE System

7. Computer Modeling Techniques
   a) Wireframe Model
   b) Solid Model: Boundary Representation; Sweeping; Construction Solid Geometry
   c) Feature-based Modeling and Parametric Modeling
   d) Computer Model for Scanned Data and Reverse Engineering

8. An Introduction to Design Optimization
   a) Formulation of a Design Optimization Problem
   b) Search Schemes of Commonly Used Optimization Methods
   c) Important Issues in Design Optimization
   d) Virtual Prototyping Based Design Optimization

9. Advanced Applications of Pro/ENGINEER (Integrated CAD/CAE/CAM): Structural/Thermal Analysis, Parameter Design Optimization, Automated CNC Tool Path Generation and Animation, and Freeform Surface Design

10. Representation of Curves
    a) Parametric Curve Representation
    b) Cubic spline, Bezier curves, B-spline curves and NURB

11. Representation of Surfaces
    a) Plane; Bilinear, Ruled, Bezier and NURB Surfaces
    b) Visualizing Surfaces; Surface Mesh and Surface Machining
    c) Surface Modeling in Pro/ENGINEER

12. Interactive Computer Graphical Programming
    a) Introduction and Background Review
    b) Programming in CAD Systems (Menu, Macro and High-level Programming – AutoCAD & Pro/E)

13. Data Organization in CAD
    a) Data Structure and Database
    b) Graphical Standard and CAD/CAM Data Exchange

14. Advanced CAD Systems and Their Industrial Applications
    a) CAD/CAM Integration and Concurrent Engineering
    b) Virtual-prototyping in Product Development

    (An Overview of SolidWorks and COSMOS Works)