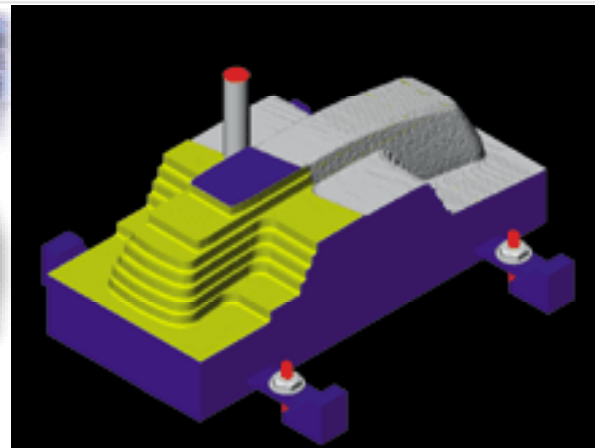
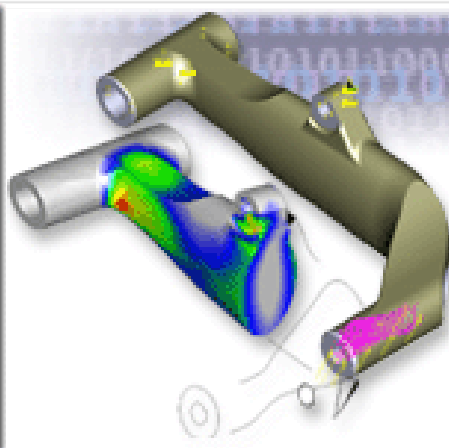


MECH410/520 Computer Aided Design



MECH410/520 Computer Aided Design

- ❑ Instructors: Armando Tura & Dr. Zuomin Dong
- ❑ Office: ELW B126; Phone: 721-7295;
E-mail: atura@uvic.ca
- ❑ Course Homepage:
<http://www.me.uvic.ca/~mech410/>
Course materials are posted at this web site
and updated constantly.
- ❑ Lecture: S01,
- ❑ Lab.: LS01 or LS02 (24 hrs open lab)

Course Contents

- ❑ Computer Graphics Theory (Geometric Representation, Projection, Transformations, Solid and Surface Models of CAD Systems)
- ❑ Advanced CAD/CAE/CAM Systems, Pro/ENGINEER® (Unigraphics NX) and Applications
- ❑ Virtual Prototyping of Mechanical Components and Devices
- ❑ Design Optimization Using Computer Virtual Prototypes
- ❑ Interactive Graphical Programming

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 Office: ELW B126; Phone: 721-7295; E-mail: atura@uvic.ca Dr. Zuomin Dong Office: EOW 548/551; Phone: 721-8900; E-mail: zdong@uvic.ca Course Homepage: http://www.me.uvic.ca/~mech410/
Section Number:	Lecture: S01, Lab.: LS01 (open lab). Credits: 1 1/2
Lecture Schedule:	Tuesday, Wednesdays 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:	<ul style="list-style-type: none">• Lee, K. <i>Principles of CAD/CAM/CAE Systems</i>, Addison Wesley, 1999.• MECH410/520 Web Page at http://www.me.uvic.ca/~mech410/• Roger Toogood, <i>Pro/ENGINEER Wildfire 4.0 Tutorial</i>, SDC.

Laboratory, Project and Quiz

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 1-7) Feb 26	17.5 %	15 %
Quiz 2	(1 lecture time, Sections 8-13) Mar 31	17.5 %	15 %

- "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

Course Outline

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)



MECH 410 and MECH520

Computer Aided Design

Course Homepage: <http://www.me.uvic.ca/~mech410/>

Mr. Armando Tura

Office: ELW B126, Phone: (250) 721-7295, E-mail: atura@uvic.ca

Dr. Zuomin Dong

Office: EOW 548/551, Phone: (250) 721-8900 (or 721-8693), E-mail: zdong@uvic.ca

Research Interests: <http://www.me.uvic.ca/~zdong/>

(This website will be continuously updated and activated.)

Course Outline

Lab, Project and Time Schedule

Laboratory Information and Report Formats

Lecture Notes

- [Course Outline and Background Information \(condensed slides\)](#)
- [Introduction to CAD/CAE/CAM and Technology Review](#) □(condensed slides)
- [Computer Hardware for CAD \(condensed slides\)](#)
 - ✧ [Technical References on 3D Scanning and Computer Model Generation](#)
- [An Introduction to the Pro/ENGINEER Design Modeling System \(Linked to Pro/E Tutorials and Lecture Notes\)](#)
 - [An Overview of Pro/ENGINEER \(condensed slides\)](#)
 - [About Pro/ENGINEER Tutorials \(condensed slides\)](#)
 - [Assembly Modeling and Motion Animation](#) □(condensed slides)
- [Graphical Coordinate Systems and Basic Geometric Transformations \(condensed slides\)](#)
- [Rotation about an Arbitrary Axis \(condensed slides\)](#)
- [Geometric Projections \(condensed slides\) \(notes in Word\)](#)
- [Computer Modeling Techniques \(condensed slides\) \(notes in Word\)](#)
- [An Introduction of Design Modeling Using Unigraphics NX \(condensed slide\)](#)
- **Advanced Applications of Pro/ENGINEER**
 - ✧ [An Over View of Pro/MECHANICA and Applications of Pro/M Structure \(condensed slides\)](#)
 - ✧ [A Review of Finite Element Analysis Method \(condensed slides\)](#)
 - ✧ [Design of Sculptured Part Using Pro/ENGINEER \(condensed slides\)](#)
 - ✧ [CNC Tool Path Generation and Simulation Using Pro/ENGINEER \(condensed slides\) \(5-axis machining video\)](#)

- [Geometric Projections \(condensed slides\) \(notes in Word\)](#)
- [Computer Modeling Techniques \(condensed slides\) \(notes in Word\)](#)
- [An Introduction of Design Modeling Using Unigraphics NX \(condensed slide\)](#)
- [Advanced Applications of Pro/ENGINEER](#)
 - [An Over View of Pro/MECHANICA and Applications of Pro/Model Structure \(condensed slides\)](#)
 - [A Review of Finite Element Analysis Method \(condensed slides\)](#)
 - [Design of Sculptured Part Using Pro/ENGINEER \(condensed slides\)](#)
 - [CNC Tool Path Generation and Simulation Using Pro/ENGINEER \(condensed slides\) \(5-axis machining video\)](#)
- [An Introduction to Design Optimization \(condensed slides\)](#)
 - [An Article on Multiphysics CAD-Based Design Optimization](#)
- [Example Problems for Quiz I](#)
- [Example Quiz I and Solutions](#)
- [Representation of Curves \(condensed slides\)](#)
- [Representation of Surfaces \(condensed slides\)](#)
 - [Generation of Free-form Surface in Pro/ENGINEER \(condensed slides\)](#)
- [Interactive Computer Graphical Programming \(condensed slides\)](#)
- [Data Organization in CAD □ □\(condensed slides\)](#)
 - [Integrating Pro/E with ANSYS \(ANSYS Connection Users Guide R9 2004\)](#)
- [An Overview of SolidWorks, COSMOSWorks, COSMOSXpress and COSMOSMotion](#)
- [Example Problems for Quiz II](#)
- [Research on Virtual Prototyping, Design Optimization, RP and Fuel Cell Vehicle Systems](#)

[Pro/ENGINEER Tutorials and Related Documents](#)

[Unigraphics NX Tutorials and Related Documents](#)

Laboratory Assignments and Project

- [Laboratory 1 Design Modeling](#) (11 days) Jan 15 □ Jan 26 (First Lab on Jan. 20)
 - [Laboratory 2 Mechanical Assembly](#) (1wk) Jan 26 □ Feb 2
 - [Laboratory 3 Static Structural Analysis](#) (1 wk) Feb 2 □ Feb 9
 - [Change of Default Unit System in Pro/E](#)
 - [Laboratory 4 Sensitivity Analysis and Design Optimization](#) (1 wk, reading break) Feb 9 □ Feb 23
 - [Laboratory 5a Automated CNC Tool Path Generation & Machining](#) (1wk) Feb 23 □ Mar 5), OR
 - [Laboratory 5b Design Modeling Using Unigraphics NX](#) (1wk) Feb 23 □ Mar 5)
- 7 [Final Project: Application of Integrated CAD/CAE/CAM System for Optimal Design, Design Improvement or Soft-prototyping](#) (3-4 wks) Mar 5 □ Mar 31
Project Presentation on Tuesday, March 31, 1:30 □ 4:30 pm; Project Report, Due April 3, 2009
[Example Projects and CAD/CAE/CAM Applications](#)

Additional References

- 2D Drawing Generation and 3D Modeling Using AutoCAD (see [Introduction to AutoCAD](#))
- Introduction to C programming (see [A Quick Start on C Programming](#))
- [Introduction to AutoCAD \(Homepage of AutoDesk\)](#)
- [A Quick Start on C Programming](#)
- [Programming in AutoCAD \(ADS Tutorials and Lecture Notes, ARX References\)](#)
- [Other Programming Issues in AutoCAD \(Script File and Menus\)](#)

News

The reference books are available at the Reserved Desk in the Library.

Notes: The documents provided here are presented using either the standard HTML or the Adobe Acrobat format. To read these documents in your browser you may need to download the [Adobe Acrobat Reader](#) from the net.
Last Modified: Jan 14, 2009.

General Laboratory Information

Format of the Laboratory Report (Electronic Submission)

Title of the Assignment

Names and Student Numbers

1. Objective
2. Description of the Assignment
3. Your Experience and Suggestions
4. Illustrations (Images and Drawings from Pro/E)
5. New Procedures Developed (if there is any)

Email the following documents to: mech410@me.uvic.ca

- Lab report in *MS Word* named as: LastName1_LastName2 (.doc)
- The Pro/E Model File with the same name as above (different extension name).

Format of the Project Report (Electronic Submission)

Title of the Project

Names and Student Numbers

Abstract (50 – 100 words)

Table of Contents

1. Introduction (Description of the Project, Problem Definition, Theory or Algorithm)
2. Implementations
3. Technical Challenges
4. Special Features and Highlights
5. Summary (Experience and Suggestions)

References

Appendix

- A. Important figures, drawings, calculations, etc.
- B. Electronic copy of all related and necessary Pro/E files and other source codes.

Email the following documents to: mech410@me.uvic.ca

- A Microsoft PowerPoint Presentation (4-6 slides)
- Project report in *MS Word* named as: `LastName1_LastName2 (.doc)`
- The Pro/E model files with the same name as above (different extension name).

Laboratory Consultant:

Mr. Minh Ly (Sen. Sci) Office: ELW A214, Local: 8893, and Email: mly@me.uvic.ca
TBA (TA) Office: TBA Tel: TBA; Email: [TBA](#)

Computing Facilities and Software:

- Department Computational Design Lab (ELW-B228):
Pro/ENGINEER Wildfire 4.0, ANSYS, MATLAB, SolidWorks, Unigraphics NX
Autodesk Inventor 10 and Mechanical Desktop 2006 (5 seats)
- Engineering Undergraduate Lab: AutoCAD Lt