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Office Hours: will be announced in class and posted in instructor’s website – see **Instructor Schedule Grid**

**Textbooks and Notes:**

- AutoCAD 2009 Tutorial First Level: 2D Fundamentals by Randy H. Shih, SDC Publications, 2009  
- Instructor’s Lecture Notes

**References:**

- User’s Guide of software packages used in the course  
- Computational Fluid Dynamics by T.J. Chung, Cambridge University Press, 2002  

**Course Description:**

This is a course introducing various concepts of CAD (Computer Aided Design) and CAE (Computer Aided Engineering) as applied to Mechanical Engineering design problems. Topics include 2-D drawings, geometric dimensioning and tolerancing (GDT), modeling, assembly and animation, static modal, nonlinear, contact, impact, failure, thermal, and multi-physics analyses, and computational fluid dynamics for design. The laboratory component involves use of current CAD/CAE software packages.

**Software Packages:**

1. AutoCAD by Autodesk Inc.  
2. Pro/ENGINEER and AutobuildZ by PTC Inc.  
3. ANSYS by ANSYS Inc.  
4. Fluent and Gambit by ANSYS Fluent Inc.

**Prerequisites:** ME-425, ME-430 or consent of the instructor.
**Miscellaneous:**

- NJIT Academic Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students – visit [http://www.njit.edu/academics/honorcode.php](http://www.njit.edu/academics/honorcode.php).
- For any modifications or deviations from the syllabus throughout the course of the semester, instructor will consult with students and the students must agree to.

**Course Outline: Lectures**

<table>
<thead>
<tr>
<th>Week Number</th>
<th>TOPICS</th>
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<tbody>
<tr>
<td>1</td>
<td>Software package: <strong>AutoCAD</strong></td>
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Introduction to 2-D drawings, template file, and dimensioning:

- Start a new drawing; change the UNITS, LIMITS, SNAP, and GRID.
- Setup/add layers and set their colors. Load and use linetypes with layers using Layer Properties Manager.
- Use absolute, relative, and polar coordinate entry methods.
- Use ZOOM to adjust the view.
- Use ONSNAP to accurately place points.
- Use CONSTRUCTION LINE, LINE, ARC, CIRCLE, and FILLET to create a drawing.
- Select objects in a variety of ways.
- Use MOVE, ROTATE, and STRETCH to edit objects.
- Use the MIRROR and OFFSET commands.
- Edit objects with the TRIM, BREAK, and EXTEND commands.
- Make multiple copies in standard patterns with the ARRAY command.
- Add dimensions in linear, radial, or angular fashion.
- Adjust the dimension variables to fit the object being dimensioned.
- Edit the dimensions.
- Use TEXT and DTEXT.
- Model and Paper Space (Layout1, Layout2) – adding border and title block in the layout.
- Plot and Save a drawing.

**Assignments:**

- Create an Imperial Inches Border and Title Block as shown in AutoCAD book page 7-10
- Chapter 2 Exercise 1 page 2-30 with Title Block page 7-10
- Custom A4 Border and Title Block posted in the web
- Chapter 2 Exercise 3 page 2-31 with Metric Title Block A4
More drawing, editing, and dimensioning commands:

- Use a template file.
- More on ONSNAP, POLAR, OTRACK, LWT, and MODEL options.
- Use COPY, ROTATE, OFFSET, GRIP, and EXPLODE to edit objects.
- Edit the PLOT STYLE table.
- Create an Auxiliary View.
- Create a sectional view with HATCH.

Assignments:

- Locator drawing (Chapter 5) complete with dimensions, border and title block – use Inches ACAD-H-Title
- Geneva Cam drawing complete with dimensions, border and title block – see AutoCAD book Chapter 7.
- Pipe Hanger – see website.
- V-Block drawing complete with dimensions, border and title block – see AutoCAD book Chapter 8.

Software package: **AutoCAD**

Assembly Drawings:

- Using AutoCAD with Internet.
- Loading multiple drawings.
- Defining a BLOCK.
- Copying and pasting with Windows clipboard.
- Create the assembly drawing.

Assignments:

- Cylinder Support Auxiliary View – see website.
- Bearing – Sectional view Chapter 9.
- Sprocket – posted in website.
- Shaft Support Assembly drawing – Chapter 10. Be sure to create BOM (Bill of Material) as shown in Chapter 10

Software package: **AutoCAD**

**GEOMETRIC DIMENSIONING AND TOLERANCING (GDT)**

- Positive and negative tolerances for specific dimensions.
- Use the geometric tolerance feature to dimension mechanical parts.

Assignments:

- Slider – dimensioning and tolerancing (posted in website).
- Retaining Plate Project
- Flange – Metric GDT (posted in website).
- Flange – Inches GDT Project.

5  Software packages: AutoCAD, AutobuildZ, and Pro/ENGINEER

- Data exchange between CAD systems (e.g. DWG, DXF, IGES, STEP, SAT, PARASOLID formats etc).
- Create 3-D geometry from 2-D drawings.

Parametric modeling of solid geometry.

Software packages: Pro/ENGINEER, ANSYS Workbench

- Modeling, adding element type, material properties, constraints, symmetry boundary conditions, pressure loads, solve, post process of the results using ANSYS.
- Linear and Nonlinear Analysis of a plate.
- Data exchange between CAD systems (e.g. IGES, STEP).
- Import IGES or STEP model.

Assignments:

- Cutter – 3D Model from 2D Drawing using AutobuildZ.
- Retaining Plate – Creating 3D Model from a 2D AutoCAD
- Geneva Cam Project – Using AutobuildZ (posted in website)
- Rectangular Plate with Hole Subjected to Tensile Loading – ANSYS Workbench. The assignment is located in the last page of tutorial.

6  Software packages: Pro/ENGINEER, ANSYS Workbench

- Large Deflection of a Circular Plate with Uniform Pressure.
- Heat Transfer in a Composite Wall.
- Stresses Due to Shrink Fit Between Two Cylinder (Contact Analysis) – interference fit stresses.
- Buckling of Circular Arc

7  Software packages: ANSYS Workbench

- Structural Static and Modal Analysis of Hood Latch.
- Heat Loss through an Insulated Steam Pipe Project
- Anchor Plate Project
- MEMS Thermal Actuator Analysis

8  Software packages: ANSYS Workbench and Classic

- Modal Analysis of Crankshaft Project.
- Fatigue Analysis of Rectangular Plate Subjected to End Moment.
- Trailer Hitch Structural Analysis with Contact Project
- Modal and Harmonic Analyses of SDOF

9 Software packages: **ANSYS Workbench**

- Bike Frame Static Analysis.
- Structural Static Analysis of Spindle.
- Thermal Analysis of Computer Chips
- Bi-Metal Strips Structural Thermal Project

10 Software packages: **Pro/ENGINEER, ANSYS Workbench CFX – COMPUTATIONAL FLUID DYNAMICS**

- Create a geometry and structured mesh on faces.
- Set boundary types, and prepare the mesh to be read into CFD package.
- Export a mesh for CFD analysis.
- Read an existing grid file into CFD package.
- Set material/fluid properties and boundary conditions for laminar problem.
- Calculate a solution using the segregated solver.

Assignments:

- **Simulating Flow in a Static Mixer – SEE ASSIGNMENT AT THE END OF TUTORIAL**
- **Flow Analysis in a 3-D Duct – SEE ASSIGNMENT AT THE END OF TUTORIAL**

11 Software packages: **Pro/ENGINEER, ANSYS Workbench CFX, GAMBIT and FLUENT – COMPUTATIONAL FLUID DYNAMICS**

Import geometry from other CAD system.

- **Laminar Flow in 3D Backward Step Project – 3 dimensional model geometry**
- **Simulating Flow in a Ball Valve Assembly**
- **Converging – Diverging Nozzle Analysis.**

12 Software packages: **Excel, GAMBIT and FLUENT**

Generate the computational domain in Excel and read it into CFD pre-processor Gambit.

- **Laminar Flow in a Pipe**
Homework related to the lectures will be assigned, collected and graded.

The laboratory will be in the ME Computer Lab MEC-219, and will have hands-on sessions to cover the topics of the course.

**SUBMITTED ASSIGNMENT FORMAT:**

Projects / assignments should be submitted according to the following format:
Grading Scheme:

The grade will be based on the following:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Lab Works - Assignments</td>
<td>30%</td>
</tr>
<tr>
<td>Projects</td>
<td>40%</td>
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<tr>
<td>Final Exam</td>
<td>30%</td>
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<tr>
<td>Total</td>
<td>100%</td>
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