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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
ISBN 978-1-58503-433-8
- 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
ISBN 0-521-59416-2

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>.
- 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

Week Number:	TOPICS
1	<p>Software package: AutoCAD</p> <p>Introduction to 2-D drawings, template file, and dimensioning:</p> <ul style="list-style-type: none">• 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. <p>Assignments:</p> <ul style="list-style-type: none">• 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
2	Software package: AutoCAD

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.**

3 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**

4 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**

- **Periodic Flow and Heat Transfer in Tube Bank.**
- **Two Branches Channel Manifold**

13 Software packages: **GAMBIT and FLUENT**

- **Turbine Cascade**
- **NACA Airfoil Project – Turbulent flow analysis around airfoil with pressure far field boundary condition.**

14 Software packages: **GAMBIT and FLUENT**

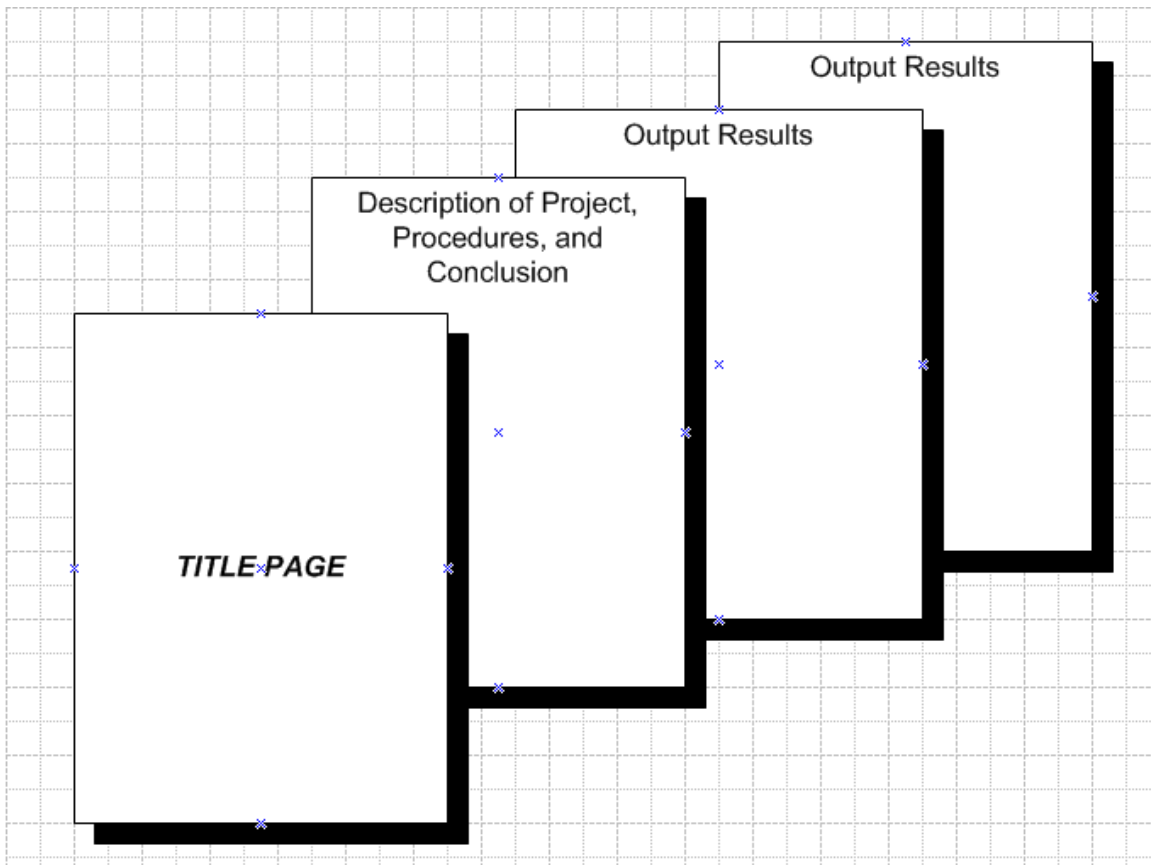
- **Review and completing projects.**
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Homework related to the lectures will be assigned, collected and graded.

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:

Lab Works - Assignments	30%
Projects	40%
Final Exam	30%
Total	100%