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Web Page: web.njit.edu/~surjan
Office Hours: will be announced in class and posted in instructor’s website – see Instructor Schedule Grid

Textbooks and Notes:

- 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 modeling, importing various CAD model formats, assembly and animation of the results of analysis, 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. Pro/ENGINEER and Pro/MECHANICA by PTC Inc.
2. ANSYS by ANSYS Inc.
3. Fluent and Gambit by Fluent Inc.

Prerequisites: ME-635 or department approval.

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**

<table>
<thead>
<tr>
<th>Week Number</th>
<th>TOPICS</th>
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| 1           | Software package: **Pro/ENGINEER** and **Pro/MECHANICA**  
Introduction to the course - Computer Aided Engineering.  
  - *Rectangular Plate with Circular Hole*  
  - *Large deflection analysis - nonlinear analysis of plate.*  
  - *Torsion analysis - U-joint under torsion load.* |
| 2           | Software package: **Pro/ENGINEER** and **Pro/MECHANICA**  
  - *Structural static analysis with design sensitivity studies and optimization - bracket.*  
  - *Tractor Suspension* |
| 3           | Software package: **Pro/ENGINEER** and **Pro/MECHANICA**  
  - *A Steel Cooling Spine*  
  - *Transient and steady state thermal analysis - heatsink.*  
  - *Modal Analysis of Tuning Fork* |
| 4           | Software package: **Pro/ENGINEER** and **Pro/MECHANICA**  
  - *3D contact analysis - latch mechanism.*  
  - *Symmetric constraints, bearing loads in structure analysis - mill bearing.* |
| 5           | Software packages: **Pro/ENGINEER** and **Pro/MECHANICA**  
  - *Chip Steady State and Transient Thermal Analysis, also Static Analysis*  
  - *Buckling of a Circular Arch*  
  - *Buckling analysis - plate with ribs as stiffeners.* |
| 6           | Software packages: **Pro/ENGINEER** and **Pro/MECHANICA**, **ANSYS Classic**  
  - Modeling, adding element type, material properties, constraints, symmetry boundary conditions, pressure loads, solve, post process of the results using ANSYS.  
  - Data exchange between CAD systems (e.g. IGES).  
  - Import IGES assembly model. |
- Fatigue analysis - Helicopter blade rotor.
- Belt Clip Optimization Project
- Nonlinear Analysis of a plate – ANSYS Classic.

7 Software packages: **Pro/ENGINEER and Pro/MECHANICA, ANSYS Workbench**

- Fatigue Analysis of Piston – Pro/MECHANICA
- Structural Static and Modal Analysis of Hood Latch – Ansys Workbench
- Press Fit Contact Analysis – Ansys Workbench

8 Software packages: **ANSYS Workbench and Classic**

- Coupled-Field Multiphysics Analysis of a MEMS Thermal Actuator Under Interaction Between Thermal, Electric, and Structure Fields
- Impact Analysis – Deformation of Copper Cylinder Projectile.
- Motor Base Support Assembly Project

9 Software packages: **ANSYS Workbench and Classic**

- Elasto-Plastic of C-Clamp – Ansys Classic
- Pipe Junction Steady-State Analysis – Ansys Classic
- Bike Frame Analysis – Ansys Workbench

10 Software packages: **ANSYS Workbench and Classic**

- Rotating Gear – Ansys Classic
- Steady, Transient and Thermal Stress Analysis of Circuit Board – Ansys Workbench
- Suspension Bracket Project

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

- Import geometry from other CAD system.
- Create 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 turbulent forced convection problem.
- Calculate a solution using the segregated solver.
• Mixing Elbow Analysis
• Converging – Diverging Nozzle Analysis
• Periodic flow and heat transfer.

12 Software packages: GAMBIT, and FLUENT
  • External Compressible Flow Over Bullet
  • Turbulent Flow in Wavy Channel Project
  • Turbine Cascade

13 Software packages: GAMBIT, and FLUENT
  • Turbulent Fluid Flow and Heat Transfer in 3-D Mixing Junction
  • NACA Airfoil Project
  • Centrifugal Blower Project

14 Software packages: GAMBIT, and FLUENT
  • Wind Tunnel Simulation of a Sport Car

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>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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