

Fall 2024

## ME 441-101: Comp Sim & Aanly Mech Engr

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**Textbooks and Notes:**

- AutoCAD 2022 Tutorial First Level: 2D Fundamentals by Randy H. Shih, SDC Publications  
ISBN: 9781630574383
- Instructor's Lecture Notes

**References:**

- 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 (GD&T), 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. Creo Parametric and AutobuildZ by PTC Inc.
3. ANSYS Workbench & AIM by ANSYS Inc.
4. CFX and Fluent by ANSYS Fluent Inc.
5. SolidWorks by Dassault Systèmes SolidWorks Corp.

**Prerequisites:** ME-430

**Grading Scheme:** The grade will be based on the following:

Lab Work - Assignments	30%
Projects	25%
Midterm Exam	20%
Final Exam	25%
ePortfolio (Bonus)	5%
Total	100%

**Ground Rules:**

- Attending class, completing assignments on time, and keeping up with the class material is important for success in this course and in college. Generally, late or missed assignments **will not be accepted** except for legitimate (**pre-approved** when possible) reasons as determined by the instructor. Examples of legitimate reasons are: illness, death in family, etc. The method of handling late or missed work is determined by the instructor.
- **Missing more than 2 classes will lead to an 'F' grade** in the course. Exceptions will only be made for cases of excused absences supported by relevant documentation submitted to and verified by the office of Dean of Students.
- The class time is 6:00 to 8:50 pm, leaving early will be marked as an absence, if due to any issues you are not able to attend the listed class duration please register for a different section.
- **ANY FORM OF CHEATING ON EXAMS WILL RESULT IN AN "F" FOR THE COURSE.** This includes looking at another person's exam or copying another person's work for exams or assignments.
- NJIT honor code will be used for all situations that involve cheating, copying, misrepresentation of student work, and misrepresentation of student information and any violations will be brought to the immediate attention of the Dean of Students (<https://www5.njit.edu/policies/sites/policies/files/NJIT-University-Policy-on-Academic-Integrity.pdf>).
- "Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <https://www5.njit.edu/policies/sites/policies/files/NJIT-University-Policy-on-Academic-Integrity.pdf>
- Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu"
- The student who compromised as well as the student who allowed will **BOTH** be awarded the **SAME** penalty.
- Homework is due **BEFORE** the start of Lecture. Assignments turned in after the lecture starts will be counted as **LATE**.

- All files (part and analysis) for the assignment are required to be submitted to get credit for the assignment.
- While the professor is discussing the lecture, all monitors should be turned off. If anyone caught typing or browsing internet, the student will be asked to leave the class for the day and this will count as an absence.
- **Cell Phone use or Texting** during class is **NOT** allowed.
- **Assignments that are more than 2 weeks late will not be accepted.**
- Point deduction – Late Assignments: 1 week late-20%, 2 weeks late-30%
- At least 60% of the homework assignments and projects have to be submitted for a passing grade.
- Taking the Mid Term and Final Exam is mandatory to receive a final grade in the course.
- Attendance, attitude, class participation and effort can and will be used to change borderline grades up or down.
- For your submissions, **you must use the same units** that were required in the assignment.
- The student must ask the instructor for special allowances associated with disabilities.

### ***Using Respondus LockDown Browser and a Webcam for Online Exams***

Respondus LockDown Browser is a locked browser for taking assessments or quizzes in Canvas. It prevents you from printing, copying, going to another URL, or accessing other applications during a quiz. If a Canvas quiz requires that LockDown Browser be used, you will not be able to take the assessment or quiz with a standard web browser. You may be required to use LockDown Browser with a webcam (Respondus Monitor), which will record you during an online exam.

**This course might require the use of Respondus LockDown Browser and/or Respondus Monitor with a webcam for online exams.** The webcam can be built into your computer or can be the type that plugs in with a USB cable. Watch this [short video](#) to get a basic understanding of LockDown Browser and the webcam feature. A student [Quick Start Guide \(PDF\)](#) is also available.

1. Download and install LockDown Browser from this link:  
<http://www.respondus.com/lockdown/download.php?id=264548414>
2. Once your download has finished, locate the “LockDown Browser” shortcut on the desktop and double-click it. (For Mac users, launch “LockDown Browser” from the Applications folder.)
3. You will be brought to the Canvas login page within the LockDown Browser, click “Login with your UCID” to log in with your NJIT UCID and password and then click Login.
4. Select the course in which you have to take the exam that requires the LockDown Browser.
5. After you enter the course, find the exam and click on it.
6. A confirmation prompt will appear, click the “Start attempt” button. Once a quiz has been started with LockDown Browser, you cannot exit until the Submit all and finish button is clicked.
7. If you are required to use a webcam (Respondus Monitor), you will be prompted to complete a Webcam Check and other Startup Sequence steps.

## Course Outline:

Week Number:	TOPICS
1	<p>Software package: <b>AutoCAD</b></p> <p>Introduction to 2-D drawings, template file, and dimensioning:</p> <p>Assignments:</p> <ul style="list-style-type: none"><li>• Imperial Title Block: Create an Imperial Inches Border and Title Block as shown in AutoCAD book</li><li>• Adjustable Support : Chapter 2 Exercise 1 page 2-31 with Title Block</li><li>• Metric Title Block: Custom A4 Border and Title Block posted in the web</li></ul>
2	<p>Software package: <b>AutoCAD</b></p> <p>More drawings, editing, and dimensioning commands:</p> <p>Assignments:</p> <ul style="list-style-type: none"><li>• Swivel Base: Chapter 2 Exercise 3 page 2-32 with Metric Title Block A4</li><li>• Locator drawing (Chapter 5) complete with dimensions, border and title block – use Inches ACAD-H-Title</li><li>• Geneva Cam drawing complete with dimensions, border and title block – see AutoCAD book Chapter 7.</li><li>• Pipe Hanger – see Canvas.</li></ul>
3	<p>Software package: <b>AutoCAD</b></p> <p>Assignments:</p> <ul style="list-style-type: none"><li>• V-Block drawing complete with dimensions, border and title block – see AutoCAD book Chapter 9.</li><li>• Bearing – Sectional view Chapter 10.</li><li>• Slider – dimensioning and tolerancing (posted on Canvas).</li><li>• Sprocket – posted on Canvas.</li></ul>
4	<p>Software package: <b>AutoCAD</b></p> <p><b>GEOMETRIC DIMENSIONING AND TOLERANCING (GDT), Assembly Drawings</b></p> <p>Assignments:</p> <ul style="list-style-type: none"><li>• Cylinder Support Auxiliary View – see Canvas.</li><li>• Shaft Support Assembly drawing – Chapter 11. Be sure to create BOM (Bill of Material) as shown in Chapter 11</li><li>• <b>PROJECT:</b> Retaining Plate</li><li>• Flange – Metric GDT (posted on Canvas).</li></ul>

5	<p>Software packages: <b>AutoCAD, AutobuildZ, and Creo Parametric</b></p> <ul style="list-style-type: none"> <li>• Data exchange between CAD systems (e.g. DWG, DXF, IGES, STEP, SAT, PARASOLID formats etc).</li> <li>• Create 3-D geometry from 2-D drawings.</li> </ul> <p>Assignments:</p> <ul style="list-style-type: none"> <li>• Cutter – 3D Model from 2D Drawing using AutobuildZ.</li> <li>• Retaining Plate – Creating 3D Creo Parametric Model from a 2D AutoCAD</li> <li>• Retaining Plate – Creating 3D SolidWorks Model from a 2D AutoCAD</li> <li>• <b>PROJECT:</b> Geneva Cam – Using AutobuildZ (posted on Canvas)</li> </ul>
6	<p>Software packages: <b>Creo Parametric, ANSYS Workbench Static Structural &amp; Thermal Analysis</b></p> <ul style="list-style-type: none"> <li>• Rectangular Plate with Hole Subjected to Tensile Loading – ANSYS Workbench. The assignment is located on the last page of tutorial.</li> <li>• Large Deflection of a Circular Plate with Uniform Pressure.</li> <li>• Heat Transfer in a Composite Wall.</li> </ul>
7	MIDTERM
8	<p>Software packages: <b>ANSYS Workbench Static Structural &amp; Thermal Analyses &amp; Multi-Physics ANSYS APDL</b></p> <ul style="list-style-type: none"> <li>• Stresses Due to Shrink Fit between Two Cylinder (Contact Analysis) – interference fit stresses.</li> <li>• Buckling of a Circular Arch</li> <li>• Structural Static and Modal Analysis of Hood Latch.</li> </ul>
9	<p>Software packages: <b>ANSYS Workbench Static Structural</b></p> <ul style="list-style-type: none"> <li>• <b>PROJECT:</b> Heat Loss through an Insulated Steam Pipe</li> <li>• <b>PROJECT:</b> Trailer Hitch Structural Analysis with Contact</li> <li>• <b>PROJECT:</b> Fatigue Analysis of a Ride-On Suspension</li> <li>• Bike Frame Static Analysis</li> </ul>
10	<p>Software packages: <b>ANSYS Workbench Static Structural &amp; Thermal Analyses</b></p> <ul style="list-style-type: none"> <li>• Creo Simulate Assignment</li> <li>• <b>PROJECT:</b> Thermal Stress Analysis of Pump Housing</li> <li>• Spur Gear Tooth Strength Analysis</li> <li>• <b>PROJECT:</b> Static Structural and Modal Analysis of Rotating Saw Blade.</li> <li>• <b>PROJECT:</b> Thermal Stress Analysis of Computer Chips</li> </ul>

- 11 Software packages: **Creo Parametric, ANSYS Workbench Static Structural & CFX – COMPUTATIONAL FLUID DYNAMICS**
- Modal and Harmonic Analyses of SDOF
  - Impact of an Aluminum Bar on a Steel Plate
  - **PROJECT:** Bullet Casing High-Speed Impact – Explicit Dynamics.
  - **PROJECT:** HYPER-ELASTIC MATERIAL: Non-linear Contact Analysis of a Rubber O-Ring
- 12 Software packages: **Creo Parametric, ANSYS Workbench CFX, FLUENT – COMPUTATIONAL FLUID DYNAMICS**
- Simulating Flow in a Static Mixer - see assignment at the end of tutorial
  - **PROJECT:** Flow in a Ball Valve Assembly With Y-Connector
  - Flow Analysis in a 3-D Duct - see assignment at the end of tutorial
- 13 Software packages: **Excel, FLUENT**
- Generate data points of computational domain in Excel, read it into Design Modeler and generate the computational domain for CFD analysis.
- Optimization of Support Bracket
  - **Project:** Optimization of Tri Plate
  - Ansys DesignXplorer Assignment
  - One-Way Fluid Structure Interaction for Flow Over a Probe
- 14 Software packages: **FLUENT**
- 2D Flow Over Automobile
  - Vortex Shedding of Flow over a Cylinder