Fall 2024

ME 430-001, 101: CAD

Swapnil Moon

Mechanical and Industrial Engineering Department
ME430 Introduction to Computer Aided Design **3 Credits**

NJIT New Jersey's Science & Technology University

COURSE OUTLINE

Prerequisites CIS 101, Math 222

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Office Hours Wednesday 2:35 – 4:00 & By Appointment

Textbook **No Textbook. Must purchase Solid Professor.**
Solid Professor Academic Student License
https://www.Solid Professor.com/student-store/school
Instructor's Lecture Notes

Reference Mastering CAD/CAM by I. Zeid, McGraw-Hill, New York, 2005
ISBN 0-07-286845-7

Course Description This is a course introducing basic concepts of CAD (Computer Aided Design) and structural and thermal as applied to Mechanical Engineering design problems. Topics include geometric modeling, computer graphics, projections, database, mechanism design, structure and thermal FEA (Finite Element Analysis), optimization for design models. The laboratory component involves use of current CAD software packages for mechanical design.

Grading Scheme

Lab Work – Assignments	40%
Solid Professor Exercises, Quizzes & Tests	15%
Final Project	20%
Mid-Term Exam/Project	15%
Final Exam	10%
e-Portfolio	2% (Bonus)

Course Policies:

1. 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. **The method of handling late or missed work is determined by the instructor.**
2. **As part of the course students will complete training for the Certified SOLIDWORKS Associate in Mechanical Design Certification Exam (CSWA).**
3. **Missing more than 4 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.
4. **ANY FORM OF CHEATING ON ASSIGNMENTS OR 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.

5. 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. **(visit http://www.njit.edu/academics/honorcode.php).**
6. Weekly assignments are to be turned in by the due date.
7. The **part file** for the assignment is required to be submitted to get credit for the assignment. Non submission of the part file will lead to a loss of grade for the assignment.
8. Weekly assignments are due on the first meeting of the class for the week (Monday or the appropriate first day of class for the section) **BEFORE** the start of Lecture. Assignments turned in after the lecture starts are counted as late.
9. **Assignments that are more than 2 weeks late will not be graded for credit**.
10. Point deduction – Late Assignments: 1-Week-15%, 2-Weeks-25%
11. **At least 60% of the homework must be submitted for a passing grade.**
12. Not submitting the final project will lead to an 'F' in the course.
13. Attendance, attitude, class participation and effort can and will be used to change borderline grades up or down.
14. For special accommodation student must approach the Office of Accessibility Resources and Services (OARS).
15. For issues regarding access to adequate computing equipment, or high-speed internet access, please contact the Office of the Dean of Students.
16. 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.

NJIT Makerspace:

Students will get training in the following Makerspace courses:

Make 101 - Introduction to the Makerspace (This course introduces users to the policies and safety procedures of the space and provides basic training for simple hand tools)

Make 103 - Introduction to 3D Printing (Briefly covers the basics of 3D printing including basic maintenance and operation, model preparation and slicing, starting, monitoring, and removing a print)

Students will perform projects that will involve the use of the Makerspace. The projects will focus on:

- Developing specification of constraints for the design problem giving consideration to scientific principles and other relevant knowledge
- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints
- Develop 3D CAD models and assemblies using CAD tools like Creo Parametric , Solidworks
- Build a prototype using 3D printing and Laser cutting (NJIT Makerspace)
- Evaluation of the prototype to optimize the design solution by identifying the characteristics of the design that performed the best and improve the original design

Tentative Course Outline:

Week#	TOPICS	ASSIGNMENTS
1)	Course Introduction, Product Life Cycle and Roles of CAD in Design Process (Synthesis and Analysis) Introduction to sketching, sketch tools	Solid Professor – Assignment 1
2)	CAD/CAM Software – Database Coordinate Systems and Sketch Planes (Working Coordinate System, Model Coordinate System, and Screen Coordinate System - Projections). Sketched features	**SolidWorks:** Idler Arm, & Split Cotter Pin. Solid Professor – Assignment 2
3)	Model Representation Schemes – Wireframe Modeling, Surface Modeling, and Solid Model Creation Techniques (Constructive Solid Geometry, Boolean Operations, and Parametric Modeling) Applied features, Reference geometry, Patterns and mirroring, Introduction to part modeling	**SolidWorks:** Landing Gear Assembly, Assembly drawing of Landing Gear. Solid Professor – Assignment 3
4)	Dimensioning & Tolerancing Techniques Multi-view Projections & Auxiliary View Type of Sectional Views. Assembly Design Modeling – Assembly Constraints Assembly design, Design tables	**SolidWorks:** Detailed Drawing of Housing Cover Support Bracket – Sheet Metal Solid Professor – Assignment 4
5)	Geometric Dimensioning & Tolerancing CSWA Exam - Introduction	**SolidWorks:** Car Wheel Assembly. Solid Professor – Assignment 5
6)	Additive manufacturing and Prototyping. Using Ultimaker Cura CSWA skills review, Drafting competencies - Drawing views	**SolidWorks:** Predator Drone **Creo Parametric**: Base Support, Card Holder & Helical Extension Spring. Solid Professor – Assignment 6
7)	Threads and fasteners - Thread terminology, Thread callouts, ANSI Metric units/ANSI Unified threads, Internal threads, Thread pitch. **Cams** Interpreting drawings for 3D Modeling	**Creo Parametric**: Cam, Razor Handle Solid Professor – Assignment 7 Make-101/Make-103 Training
8)	**Mid-term – Design project** Basic/Intermediate Part Creation	**Creo Parametric**: Bottle, Pump Housing, Involute Gear. Solid Professor – Assignment 8
9)	Gears – Gear terminology, gear formulas, creating gears using Creo Parametric and Solidworks, keys and gears Practice exam - Intermediate/Advanced Part Creation	**Creo Parametric**: Roller Chain Assembly, Roller Chain Assembly Detailed Drawing & Bicycle Chain Assembly. Solid Professor – Assignment 9

10)	CAD/CAM Software – Matrices of Coordinate Systems Transformation: Homogeneous Coordinate System, and Practice exam - Assembly modeling	**Creo Parametric**: Pinion Gear Shaft Detailed Drawing, Brake Rotor Solid Professor – Assignment 10
11)	Mechanism Design – Kinematics and Dynamics Analyses in CAD. Mechanism Design – Type of Joints and Degree of Freedom in Mechanism Design. Using Solidworks Motion Study	**Creo Mechanism**: Slider Crank Mechanism, Valve Cam Mechanism. **Solidworks Mechanism:** Jansen Mechanism Solid Professor – Assignment 11
12)	FEA – 2-D and 3-D Analysis, Element Types, Singularities Finite Element Analysis (FEA) – P-Method and H-Method, Steps in FEA Modeling, Convergence Techniques. Theory of Failures – von Mises Stress etc.	**Creo Simulate**: Structural Analysis of Guide Block **SolidWorks Simulation**: Static Structural Analysis of Pulley Support Start to create parts for Final Project.
13)	Standards Exchange Between CAD Systems – Direct method and Neutral files (IGES, DXF, and STEP)	**SolidWorks Simulation**: Steady State Thermal Analysis of Heatsink. Continue working on parts for Final Project.
14)		Working on the Final Project.

Homework related to the lectures will be assigned, collected, and graded.

The laboratory will have hands-on sessions to cover the basics and advanced features of Creo Parametric, Creo Simulate, SolidWorks, & Solidworks Simulate .