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
Instructor	Dr. Swapnil Moon Office: MEC 324 C Phone: 973-596-5670 E-mail: swapnil.moon@njit.edu
Office Hours	Thursday 4:00 – 5:30 & 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 course introduces basic/intermediate-level concepts of CAD (Computer Aided Design), as well as structural and thermal principles, 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 the use of current CAD software packages, SolidWorks and Creo Parametric, for mechanical design. NJIT Makerspace training and prototyping are integrated to connect digital design to physical realization.

Grading Scheme

Lab Work – Assignments	45%
Solid Professor Exercises, Quizzes & Tests	15%
Final Project	15%
Mid-Term Exam/Project	15%
Modeling Exam - CSWA	10%
e-Portfolio	2% (Bonus)

Course Policies:

1. Attending class, completing assignments on time, and keeping up with the class material is vital 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 four 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 the 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. The 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 the 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, students 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 get in touch with the Office of the Dean of Students.
16. For any modifications or deviations from the syllabus throughout the course of the semester, the 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 considering 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 improving 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). CAD Review & intermediate Sketching – Intro to SolidWorks Introduction to sketching, sketch tools	**SolidWorks:** Idler Arm Solid Professor – Assignment 1
2)	CAD/CAM Software – Database Coordinate Systems and Sketch Planes. SolidWorks Design Tables - Design, create, and automate multiple configurations of a part efficiently. Sketched features	**SolidWorks:** Split Cotter Pin. Solid Professor – Assignment 2
3)	Model Representation Schemes – Wireframe Modeling, Surface Modeling, and Solid Model Creation Techniques. SolidWorks - Assembly design. SolidWorks – Sheet Metal. Applied features, Reference geometry, Patterns and mirroring, Introduction to part modeling	**SolidWorks:** Landing Gear Assembly, Assembly drawing of Landing Gear. Support Bracket – Sheet Metal Solid Professor – Assignment 3 Make-101/Make-103 Training
4)	SolidWorks - Assembly design, Advanced part modeling techniques Additive manufacturing and Prototyping. Using Ultimaker Cura Interpreting drawings for 3D Modeling	**SolidWorks:** Predator Drone Detailed Drawing of Housing Cover Solid Professor – Assignment 4
5)	SolidWorks - Assembly design CSWA Exam - Introduction	**SolidWorks:** Car Wheel Assembly. Solid Professor – Assignment 5
6)	Dimensioning & Tolerancing Techniques Multi-view Projections & Auxiliary View. Type of Sectional Views. CSWA skills review, Drafting competencies - Drawing views Midterm project - Initiation	**SolidWorks:** Detailed Drawing of Housing Cover Solid Professor – Assignment 6
7)	Mechanism Design – Kinematics and Dynamics Analyses in CAD. Type of Joints and Degree of Freedom in Mechanism Design. SolidWorks Motion Study Midterm project - Modeling	**SolidWorks Mechanism:** Jansen Mechanism Solid Professor – Assignment 7
8)	Threads and fasteners - Thread terminology, Thread callouts, ANSI Metric units/ANSI Unified threads, Internal threads, Thread pitch. Cams Creo Parametric – Introduction. Basic Sketching, Feature creation CSWA – Basic part modeling, Mock test Midterm project - Modeling/ Manufacturing	**Creo Parametric**: Base Support, Card Holder & Helical Extension Spring. Solid Professor – Assignment 8

9)	Creo Parametric – Introduction. Basic Sketching, Feature creation. Introduction to CAM design using Creo Parametric CSWA – Basic part modeling, Practice test Midterm project - Modeling/ Manufacturing	**Creo Parametric**: Cam, Razor Handle Solid Professor – Assignment 9
10)	Creo Parametric – Introduction. Basic Sketching, Feature creation. Introduction to Surfacing CSWA –Basic/Intermediate Part Creation, Practice test	**Creo Parametric**: Bottle, Pump Housing, Involute Gear. Solid Professor – Assignment 10
11)	Gears – Gear terminology, gear formulas, creating gears using Creo Parametric and SolidWorks, keys and gears. Assembly modeling. Multi-view Projections & Auxiliary View. Type of Sectional Views. CSWA skills review, Drafting competencies - Drawing views Practice exam - Intermediate/Advanced Part Creation	**Creo Parametric**: Detailed Drawings Pinion Gear Shaft Solid Professor – Assignment 11
12)	Creo Parametric - Assembly modeling Standards Exchange Between CAD Systems – Direct method and Neutral files (IGES, DXF, and STEP) Practice exam - Assembly modeling	**Creo Parametric**: Roller Chain Assembly, Roller Chain Assembly Detailed Drawing & Bicycle Chain Assembly. Brake Rotor Solid Professor – Assignment 12
13)	Mechanism Design – Kinematics and Dynamics Analyses in CAD. Type of Joints and Degree of Freedom in Mechanism Design. Using Creo Mechanism	**Creo Mechanism**: Slider Crank Mechanism, Valve Cam Mechanism. Solid Professor – Assignment 11 **SolidWorks Simulation**: Static Structural Analysis of Pulley Support Begin creating parts for the Final Project.
14)	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.	**SolidWorks Simulation**: Steady State Thermal Analysis of Heatsink. Working on the Final Project.
	Final Exam - CSWA	

Course Learning Outcomes:

1. **Relate** and identify the role of CAD to speed up and optimize the design process.
2. **Develop** performance criteria of a mechanism or system to meet specific needs. Design the system or mechanism to meet these performance criteria.
3. **Manufacture** a prototype using 3D printing technologies on campus.
4. **Test** the prototype to evaluate the extent to which the device or system meets the performance criteria. Work effectively in a team to complete a comprehensive CAD-based design project.
5. **Generate** basic and advanced 3D solid models of mechanical parts based on the interpretation of various types of drawing views and understanding of various types of drawing annotations.

6. **Creating** and modifying assemblies using part files
7. **Generate** a logical and concise report on the design process, manufacturing, and testing of the prototype, and results.
8. **Generate**, compute mass properties of parts, and create an assembly and check interference, etc., using CAD software.
9. **Solve** problems related to motion analysis of mechanisms, optimization, FEA structural and thermal analyses.
10. **Use** of commercial software for structure, thermal type problems, and standard exchange data between CAD Systems
11. **Generate** detailed drawings, production drawings, with Bill of Materials of an assembly.

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 Simulation.