Spring 2021

ME 430-102: Introductory Computer Aided Design

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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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Textbook **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 & Policies:

Lab Work – Assignments	35%
Project	20%
Mid-Term Exam	20%
Final Exam	25%

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. Examples of legitimate reasons are: illness, death in family, etc. **The method of handling late or missed work is determined by the instructor.**
2. **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.
3. 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.
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. 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: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.
7. 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.
8. Weekly assignments are to be turned in by the due date and must include the statement "This assignment represents my work and is not the result of copying or using any other persons work." The statement must be signed by the student submitting the work.
9. 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.
10. Weekly assignments are due on the first meeting of the class for the week (Monday or the appropriate first day of class for the particular section) **BEFORE** the start of Lecture. Assignments turned in after the lecture starts are counted as late.
11. **Assignments that are more than 2 weeks late will not be accepted**.
12. Point deduction – Late Assignments: 1-Week-20%, 2-Weeks-30%
13. **At least 60% of the homework has to be submitted for a passing grade.**
14. Not submitting the final project will lead to an 'F' in the course.
15. **For using your smart phone devices during the lecture you are requested to please step out of the class, otherwise you would be asked to leave for the day.**
16. Attendance, attitude, class participation and effort can and will be used to change borderline grades up or down.

17. For special allowances associated with disabilities student must approach the Disability Resource Center.
18. 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 Number:	TOPICS	ASSIGNMENTS
1)	Course Introduction, Product Life Cycle and Roles of CAD in Design Process (Synthesis and Analysis) Structure of Software GUI and Basic & Advanced Types of Protrusion	**Creo Parametric**: Base Support, Card Holder & Helical Extension Spring.
2)	CAD/CAM Hardware – CAD/CAM Systems – Hardware Configurations (Mainframe, Workstation and PC Configurations). Graphics Displays hardware in Computer Graphics	**Creo Parametric**: Hammer Handle, Cam, Razor Handle & Clip.
3)	CAD/CAM Hardware – Hardware Integration and Networking. CAD/CAM Software – Database Coordinate Systems and Sketch Planes (Working Coordinate System, Model Coordinate System, and Screen Coordinate System - Projections).	**Creo Parametric**: Bottle, Pump Housing, Basket Ball Rim & Involute Gear.

4)	Model Representation Schemes – Wireframe Modeling, Surface Modeling, and Solid Model Creation Techniques (Constructive Solid Geometry, Boolean Operations, and Parametric Modeling)	**Creo Parametric**: Pinion Gear Shaft Detailed Drawing, Aux. View of Control Bracket Detailed Drawing & Brake Rotor.
5)	Dimensioning & Tolerancing Techniques Multi-view Projections & Auxiliary View Type of Sectional Views Assembly Design Modeling – Assembly Constraints	**Creo Parametric**: Roller Chain Assembly, Roller Chain Assembly Detailed Drawing & Bicycle Chain Assembly. Make-101/Make-103 Training
6)	CAD/CAM Software – Matrices of Coordinate Systems Transformation: Homogeneous Coordinate System, and Mathematical Development of Working, Model & Screen Coord. Systems Relationships.	**SolidWorks:** Idler Arm, Shaft Hanger, Drill Press Bracket & Split Cotter Pin.
7)	Optimization Mechanism Design – Kinematics and Dynamics Analyses in CAD.	**SolidWorks:** Landing Gear Assembly, Detailed Drawing of Housing Cover & Assembly drawing of Landing Gear.
8)	**Mid-term Exam I** **Curves Representation – Analytical and Free Form Curves: Bezier, B-Spline & NURBS**	**SolidWorks:** Support Bracket – Sheet Metal
9)	Mechanism Design – Type of Joints and Degree of Freedom in Mechanism Design	**SolidWork:** Car Wheel Assembly. **Creo Parametric**: Crankshaft Balancing and Optimization.
10)	Introduction to Plastic Injection Machines. Theory of Failures – von Mises Stress etc. Finite Element Analysis (FEA) – P-Method and H-Method, Steps in FEA Modeling, Convergence Techniques	**Creo Parametric**: Slider Crank Mechanism, Eccentric Mechanism & Valve Cam Mechanism.
11)	FEA – 2-D and 3-D Analysis, Element Types, Singularities	**Creo Parametric & Simulate**: Structural Analysis of Guide Block & Thermal Analysis of Computer Chip Assembly. **SolidWorks Simulation**: Static Structural Analysis Of Pulley Support
12)	Matrices of Geometric Transformation – Translation, Scaling, Reflection & Rotation	**Creo Parametric & Simulate**: Static Structural Analysis of Spider Assembly. **SolidWorks Simulation**: Steady State Thermal Analysis Of Heatsink. **Creo MANUFACTURE:** Plate Milling and Drilling Using Expert Machinist.

		Start to create parts for Final Project
13)	Standards Exchange Between CAD Systems – Direct method and Neutral files (IGES, DXF, and STEP)	Working on Final Project.

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