Mechanical and Industrial Engineering Department
ME635 Computer Aided Design   **3 Credits**

COURSE OUTLINE

Prerequisites	ME-616 and ME-622 or department approval.
Instructor	Dr. Swapnil Moon Office: MEC 324 C
	Phone: 973-596-5670 E-mail: swapnil.moon@njit.edu
Office Hours	Monday 4:00 – 5:30 pm & By Appointment
Textbook	Creo Parametric 9.0 Advanced Tutorial By Roger Toogood, SDC Publications, 2022
	ISBN: 978-1-63057-461-1
Reference	Mastering CAD/CAM by I. Zeid, McGraw-Hill, New York, 2005
	ISBN 0-07-286845-7
Course Description	This is a course introducing various concepts of CAD (Computer Aided Design), CAE (Computer Aided Engineering) and CAM (Computer Aided Manufacturing) as applied to Mechanical Engineering design problems. Topics include solid modeling, assembly, creating detailed drawing of solid models and production drawings, Finite element analysis, manufacturing models and generating cutter location data (CL Data) in Numerical Control machining such as turning and milling machines for design models. The laboratory component involves use of current CAD/CAM/CAE software packages.

Grading Scheme & Policies:		
	Homework and Design challenges	55%
	Lab work & Cart Project	20%
	Mid-Term & Final Exam	10%
	Projects	15%
	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. **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. **Attending progress meetings scheduled throughout the semester is mandatory**

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 particular 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 accepted**.

10. Point deduction – Late Assignments: 1-Week-20%, 2-Weeks-25%

11. **At least 60% of the homework has to be submitted for a passing grade.**

12. Not submitting the Cart project and the final projects 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.

<u>ACADEMIC INTEGRITY</u>

"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

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"

Administration of Exams

- Exams will be administered using either a combination of Respondus + Lockdown Browser and Webex or through ProctorU Review+.
- Students need to have access to a laptop to be able to take the exam using the above mentioned tools.
- NJIT honor code will be strictly adhered to, any violations will be processed through the office of Dean of students.

NJIT Makerspace:

As a part of this course students will be completing the 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)

Tentative Course Outline:

Week 1:
Introduction course overview

Introduction to Creo Parametric and Solidworks; Basics of Solid modeling. Design Intent, Cart Project Introduction
Softwares - Creo Parametric; Solidworks
Assignments: Creo Cart Project parts:

- Handle_pin;
- Front_spr_plate;
- Arm_vbrack;
- Arm_brack;
- Front_spring.

Week 2:
Part modeling: Sketching, Sketched Features, Applied Features, Design Strategies
Chapter 1 & 2
Softwares - Creo Parametric; Solidworks
Assignments - Creo Cart Project parts:

- Arm_upper;
- Arm_lower;
- Fram_low_rgt;
- Fram_upp_rgt;
- Hub_cap; Lugnut.

Week 3:
Geometric modeling – Parametric curves: Straight lines, Quadratic curves, Cubic curves, continuities
Part modeling: Applied Features, Reference Geometry, Patterned Geometry
Lesson 4 – Patterns and Family Tables
Softwares - Creo Parametric; Solidworks; MatLAB
Assignments - Creo Cart Project parts:

- Cargo;
- Spring;
- Tubing;
- Wheel;
- Hex_bolt; Handle.

Week 4:
Geometric modeling – Parametric curves: B-Spline curves, NURB curves. Parametric surfaces:
Parametric representation, B-spline surface
Lesson 5 - User Defined Features
Softwares - Creo Parametric; Solidworks; MatLAB
Assignments - Creo Cart Project parts:

- Wheel;
- Hex_bolt;
- Handle;
- Mount;

- Wheel_axle

Week 5:
Geometric transformations: Homogeneour coordinates, Scaling, Translation, Rotations
Chapter 5: Geometric Modeling Systems – Wireframe, Surface, and Solid Modeling Systems.
Assembly modeling
Softwares - Creo Parametric; Solidworks; MatLAB
Assignments - Creo Cart Project parts:
- Front_pillar;
- Frame_front.prt;
- Frame_right.prt from
- frame_right.asm;
- Right_side.asm.

Week 6:
Geometric Modeling Systems – Nonmanifold, Assembly and Web Based Modeling Systems.
Design for additive manufacturing – Design for additive manufacturing using 3D scan data and Meshmixer
Orthographic projections. Drawings. Detailed drawing and dimensioning using ASME standards.
Softwares - Creo Parametric; Solidworks, Meshmixer
Assignments - Creo Cart Project parts:
- Front Wheel Assembly with BOM (Bill of Materials);
- Detailed drawing of front_spr_plate;
- Detailed drawing of Front_wheel_brack.

Week 7:
Additive Manufacturing – Design for additive manufacturing
ANSYS Mechanical Topology Optimization – Optimization work flow in ANSYS Workbench. Complete end to end procedure from original CAD file to the final calculation on the optimized shape. Optimization methods and general theory.
Creo Parametric – Generative design: Producing a generative engine algorithm-based manufacture-ready design based on requirements and goals.
Surface modeling
Softwares - Creo MANUFACTURE; Solidworks Surfacing; Ultimaker CURA, ANSYS
Assignments –
- Solidworks Surfacing
- Adv. Surface, Lofted Surface, Freeform Surface
- Solidworks Simulation - Static Analysis

Week 8: Midterm Exam
Cart Project Due
ANSYS Mechanical Topology Optimzation – Optimization methods and general theory. Basic and advanced definitions of optimization for static applications. Geometry tools used in Spaceclaim to prepare and repair STL files.

Solidworks Topology Optimization – Optimal design based on design and manufacturing constraints using Topology Optimization tool in SOLIDWORKS Simulation
Additive Manufacturing – Design for additive manufacturing

Week 9:
Computer Aided Manufacturing: Fundamental principles, CNC turning
Finite element analysis: Fundamental principles, Solidworks Simulate
Softwares - Creo MANUFACTURE; Solidworks Surfacing; Solidworks Simulate

Assignments –
- Solidworks Surfacing
- Solidworks Simulation - Static Analysis
- Creo Manufacture - Basic Turning

Week 10:
Computer Aided Manufacturing: Fundamental principles, CNC turning
Finite element analysis: Fundamental principles, Solidworks Simulate
Softwares - Creo MANUFACTURE; Solidworks Simulate, ANSYS
Assignments –
- Solidworks Simulation:
- Static analysis, Thermal analysis, Buckling analysis
- ANSYS Workbench Static Structural Analysis
- Comparison between ANSYS and Solidworks Simulate
- Creo MANUFACTURE
- Thread and Groove turning; Profile, Face, Surface and Hole Making Milling

Week 11:
Computer Aided Manufacturing: CNC milling
Finite element analysis: Advanced techniques, Solidworks Simulate
Softwares - Creo MANUFACTURE; Solidworks Simulate
Assignments -
- Solidworks Simulation:
- Large deformation, Modal analysis
- Creo MANUFACTURE
- Milling sequence
Working on Projects

Week 12:
Computer Aided Manufacturing: CNC milling using Mill window and Mill volume
Softwares - Creo MANUFACTURE
Assignments - Expert Machinist, Mill Volume Sequence; Mill Window Sequence.
Working on Projects

Week 13:
Finite element analysis: Transient thermal analysis, Solidworks Simulate

Week 14:
Standards Exchange Between CAD Systems – Direct method and Neutral files (IGES, DXF, and STEP)   Creo MANUFACTURE
Working on Projects

Week 15:
Final Exam and Projects Due

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

The laboratory will be in MEC-219, and will have hands-on sessions to cover the basics and advanced features of Creo Parametric, Creo Simulate, SolidWorks, Solidworks Simulate and ANSYS, Meshmixer.