MTEN 449 –Materials Engineering Design I (Fall 2025)

Otto H. York Department of Chemical and Materials Engineering
New Jersey Institute of Technology

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Office Hours: Monday (Time TBD)

Date, Time, and Location: Class will meet twice a week, once for a lecture (2 hours/week) and once for a hands-on laboratory (2 hours/week).

Tuesdays 1:00pm to 3:05pm / Fridays 1:00pm to 5:20pm
Location: Tiernan 411B

Tuesday sessions will consist of a lecture and in-class discussion time, while Friday sessions will consist of hands-on activities involving materials selection and shorter lectures.

Learning Materials:
Primary Textbooks:
1. Materials Selection in Mechanical Design, 4th Edition, Michael F. Ashby, BH/Elsevier.
2. Materials and the Environment, 3rd Edition, BH/Elsevier, 2021.

Recommended Additional Reading:
1. Michael F. Ashby, et al, Materials Engineering, Science, Processing and Design, 2nd Edition, BH/Elsevier, 2009.

Hardware: A working computer is required.
Software: Ansys Granta EduPack

Course Description: **MTEN 449 – Materials Engineering Design I (2:4:0), 4 credits.** This course covers the processing/structure/property/performance relations of a wide range of materials, including metals, ceramics, polymers, and their composites. Students will learn about the relationship between engineering design parameters and material properties and use a materials selection software package to develop their own understanding of this link. Case studies in material selection, rational design, optimizing selection with multiple constraints, and applications will be presented and discussed. The design challenges will include computational and/or experimental studies based on open-ended projects with realistic constraints associated with environmental protection, material degradation and failure, cost, health/safety concerns, etc. Design challenges will be carried out in teams in collaboration with faculty and/or industry mentors/sponsors.

Prerequisites: MATH 333, MTEN 311, MTEN 395

Course Objectives: At the end of this course, students will be able to:
(1) describe the relationship between structure, processing, properties, and performance in materials
(2) the fundamental link between material properties and engineering design parameters
(3) apply property/performance relations to materials selection
(4) apply engineering constraints to materials selection problems
(5) select the best processing method to get the desired properties
(6) make informed judgments by recognizing economic, environmental, societal, and ethical responsibilities in materials design and selection

(7) use materials selection software and prior knowledge to solve materials design and selection problems across a variety of disciplines
(8) work effectively in a team to solve materials engineering design and selection problems, including active participation in establishing goals, developing a work plan, and contributing to achieving team objectives
(9) communicate effectively, through both oral presentations and written reports, to explain and justify materials design and selection decisions
(10) demonstrate the ability to acquire and apply new knowledge about materials selection and the design process by effectively using appropriate learning strategies (including internet resources, online databases, and the NJIT library)

Detailed Schedule:

Week	Date	Topics	Assignment
1	Spt. 2	Course Overview & Introduction	
	Spt. 5		
2	Spt. 9	The Design Process	
	Spt. 12	Ethics Workshop	
3	Spt. 16	Engineering Materials and Their Properties	HW 1 due
	Spt. 19	Engineering Materials and Their Properties: Part II	
4	Spt. 23	Material Property Charts	
	Spt. 26	Intro to EduPak Software	HW 2 due
5	Spt. 30	Materials Selection Process	
	Oct. 3	Case Studies – Materials Selection ***Final Project Topic due (including work plan)***	HW 3 due
6	Oct. 7	Multiple Constraints and Conflicting Objectives	
	Oc. 10	Case Studies: Multiple Constraints and Conflicting Objectives	HW 4 due
7	Oct. 14	Selection of Materials and Shape	
	Oct. 17	Case Studies: Materials and Shape	HW 5 due
8	Oct. 21	Hybrid Materials	
	Oct. 24	Case Studies – Hybrid Materials	HW 6 due
9	Oct. 28	Materials and the Environment	
	Oct. 31	Applying Environmental Impact to Materials Selection: Part I	HW 7 due
10	Nov. 4	*No class. Dr. Guvendiren travelling to AIChE Meeting in Boston (will reschedule)*	
	Nov. 7	***Interim Report – Due Nov 7 by 11:59PM***	
11	Nov. 11	Materials and Sustainable Development	
	Nov. 14	Applying Environmental Impact to Materials Selection: Part II	HW 8 due
12	Nov. 18	Materials and Big Issues	
	Nov. 21	Case Studies	HW 9 due
13	Nov. 25	Final Project Review	
	Nov. 28	*No class. Thanksgiving Recess*	
14	Dec. 2	*No class. Dr. Guvendiren travelling to MRS Meeting in Boston (will reschedule)*	
	Dec. 5	Final Project Review	

15	Dec. 9	Final Project Presentation	
***Final Report Write Up* – Due Dec 14 by 11:59PM**			

Academic Integrity: 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.

Use of Generative AI (e.g., ChatGPT):
Students are not allowed to use any generative AI technologies to directly solve the homework problems or to prepare the final report. As noted above, submitted assignments must reflect the student's own work, and must not simply be copied from a tool such as ChatGPT. Students may use AI technologies to answer general questions about topics in the class, for instance, by asking similar questions as they would to a TA during office hours to clarify topics from lecture. The homework assignments are excellent practice for the final project, and as such, the greatest educational benefit can be obtained by first working independently to solve the problems.

Attendance:
All students are expected to attend and participate in lectures in person. Students are responsible for the content of missed classes.

Grading:
All assignments must be submitted on Canvas by 11:59 PM on the due date. Homework will be posted on Canvas at least one week prior to the assigned due date. All handwritten answers must be written neatly. Illegible answers will not be graded. Students must clearly show how the answer was obtained, for instance, through a verbal explanation and/or showing detailed calculations and derivations as appropriate. A correct answer without a detailed working procedure/equations/data sheet will not be awarded full points. Working with your peers on these problems is allowed and encouraged. HOWEVER, you should acknowledge your collaborators when submitting your assignments AND each student must provide their own solutions to problems and submit their own assignment. It is not acceptable (and a violation of course policies) to use the same written answers as your collaborators.

Assignments will contribute to the final grade as follows:

Homework Assignments / Lab Reports	50%
Interim Report	10%
Final Oral Presentation	20%
Final Written Report	20%

Grades will be assigned with the following rubric:

90% and above	A
85-89%	B+
80-84%	B
75-79%	C+
70-74%	C

60-69%	D
Below 60%	F

Late homework/lab report policy:
Unexcused late submissions will result in deduction of 25% of possible credit for each additional day late.

Design Project:
For the final project, each group (up to two students) will choose a materials selection topic, prepare and deliver an approximately 20-minute talk on the chosen topic, and submit a written report on that same topic. Projects can be completed either individually or as a group. If working in a group, the presentation is completed together, with all students presenting, while the written reports are submitted individually, with the report reflecting a single student's written product.