MAT 424: Materials Selection for Product Design
Instructor: Dr. Ozge Akbulut
TA: ...

Course meeting times: ----. There are no recitations for this class, but you are encouraged to make use of the Instructor's office hours for assistance.

Scope: The course focuses on materials selection for mechanical and everyday design of objects. It offers hands on experience in product design through a class project that includes prototyping, testing of the prototype and iterations in the product. It aims to acquaint students with a systematic materials selection procedure for product design based on properties, cost, availability, and processability of materials for product design.

Learning outcomes:

1. To establish a quantitative and qualitative understanding between design parameters and materials properties
2. To optimize performance of materials (thus products) for engineering applications
3. To comprehend the importance of sustainability and environment with respect to energy consumption and recyclability of engineering components in selection of materials and fabrication process, and carry out life-cycle analysis for quantification.
4. To utilize available tools (e.g., computer programs) in materials selection

Note: We may have to revise the course plan according to the countrywide reassessment to be made regarding higher education. This is expected to happen at the beginning of April. The content to be delivered is certain but the method of course delivery, the number and dates of exams, and some other details are subject to change.

Grading:
Class project (40%)
Students will be given a predetermined problem that can be solved with a tool or a device or through an improvement of an available tool or device. They are expected to present at the stages of i) idea, ii) prototype, iii) testing of the prototype, and iv) final product.

Written assignments (20%) on soft robotics, life-cycle analysis etc.
Term exams (40%), no final.

Required reading:

Suggested reading:

Class trip to Fark Labs for entrepreneurship ecosystem in Turkiye
Schedule

**Week 1** (GOAL 9: Industry, Innovation and Infrastructure; GOAL 12: Responsible Consumption and Production)
- Introduction to the concept of design-based doing
  [https://uxpodcast.com/125-don-norman-part-1/](https://uxpodcast.com/125-don-norman-part-1/)
- Introduction to the class project
- Product design for resource-limited settings
- Sustainability as a design parameter

**Week 2**
- Mechanical performance: stiffness, lightness etc. of beams and panels under tension and torsion, pressure vessel (common types of loading)
- Performance index (materials index), Ashby Plot
- Identification of design requirements
- Molecular origins of density and stiffness
- Individual project group meetings with the instructor, with appointment.

**Week 3** (GOAL 9: Industry, Innovation and Infrastructure; GOAL 12: Responsible Consumption and Production)
- How to specify the “need” for a product/How to make a problem statement
- Student presentations for the class project

**Week 4**
- Thermal properties and performance

**Week 5** (GOAL 9: Industry, Innovation and Infrastructure; GOAL 11: Sustainable Cities and Communities; GOAL 12: Responsible Consumption and Production; GOAL 13: Climate Action; GOAL 17: Partnerships to achieve the Goal)
- Circular economy (Guest lecturer(s) from DCube—[https://www.d-cube.org/](https://www.d-cube.org/))
  “Made to be remade”

**Week 6**
- Materials for additive manufacturing
  [https://www.stratasys.com/materials/search](https://www.stratasys.com/materials/search)
- Term Exam 1

**Week 7** (GOAL 9: Industry, Innovation and Infrastructure; GOAL 12: Responsible Consumption and Production)
- Manufacturing processes
- Design for manufacturing

**Week 8** (GOAL 9: Industry, Innovation and Infrastructure; GOAL 11: Sustainable Cities and Communities; GOAL 12: Responsible Consumption and Production; GOAL 13: Climate Action)
- Multiple objective optimization
**Week 9** (GOAL 9: Industry, Innovation and Infrastructure; GOAL 12: Responsible Consumption and Production)
Student presentations for the class project

**Week 10**
Materials for biomedical applications

**Week 11**
Startup week, guest lecturers, product design experience in selected startups
Duckt, micromobility charging solutions: [https://duckt.app/](https://duckt.app/)
Spirohome: [https://tr.inofab.health/](https://tr.inofab.health/)

**Week 12**
Machine learning and AI in materials design and selection

**Week 13** (GOAL 9: Industry, Innovation and Infrastructure; GOAL 12: Responsible Consumption and Production)
Term exam 2
Finalizing the product

**Week 14** (GOAL 9: Industry, Innovation and Infrastructure; GOAL 12: Responsible Consumption and Production)
Student presentations for the class project

**Related classes:**
1. Economic & Environmental Issues in Materials Selection (MIT, Mat. Sci. & Eng.)
2. Emergent Materials (MIT, Architecture)
3. Materials Selection and Performance (UC Merced)