

## **MAT 424: Materials Selection for Product Design**

**Instructor:** Dr. Ozge Akbulut

**TA:** Ayse Ay

**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.
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:**

Ashby, M. F. Materials Selection in Mechanical Design, Fourth Edition, Butterworth-Heinemann (2010).

### **Suggested reading:**

Charles, J. A., Crane, F. A. A. Selection and Use of Engineering Materials, 2nd edition, Butterworths, (1989).

Norman, D. The Design of Everyday Things: Revised and Expanded Edition, Basic Books (2013).

Norman, D. Emotional Design: Why We Love (or Hate) Everyday Things, Basic Books (2005).

**Class trip to Fark Labs** for entrepreneurship ecosystem in Türkiye

### **Schedule**

#### **Week 1**

Introduction to the concept of design-based doing

<https://uxpodcast.com/125-don-norman-part-1/>

Introduction to the class project

Product design for resource-limited settings

### **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**

Student presentations for the class project

### **Week 4**

Thermal properties and performance

### **Week 5**

Circular economy (Guest lecturer(s) from DCube—<https://www.d-cube.org/>)

“Made to be remade”

### **Week 6**

Materials for additive manufacturing

<https://www.stratasys.com/materials/search>

Term Exam 1

### **Week 7**

Manufacturing processes

Design for manufacturing

### **Week 8**

Multiple objective optimization

### **Week 9**

Student presentations for the class project

### **Week 10**

Materials for biomedical applications

Design of medical devices (based on Biodesign: The process of innovating medical technologies, Paul G. Yock Stefanos Zenios Josh Makower Todd J. Brinton Uday N. Kumar F. T. Jay Watkins (Ed's). Cambridge University Press, 2015.; <http://ebiodesign.org/>)

### **Week 11**

Startup week, guest lecturers, product design experience in selected startups

Duckt, micromobility charging solutions: <https://duckt.app/>

Spirohome: <https://tr.inofab.health/>

### **Week 12**

Machine learning and AI in materials design and selection

### **Week 13**

Term exam 2

Finalizing the product

### **Week 14**

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)