

# **MAT630 Nanotechnology**

## **Course description:**

The main objective of this course is to underly the principles and applications of the emerging field of Nanotechnology and Nanoscience from materials science and engineering perspectives and connect the nanotechnology with the industrial revolution. With this course, accumulated materials science and engineering knowledge will be integrated to novel nanotechnological solutions towards building beyond state of art nano-scale focused methodologies. This course establishes a bridge between nano-world and macro-world, and brings specific examples from an industrial view and discusses current and future nanotechnological applications in the fields of engineering, materials, physics, chemistry, biology, electronics, and energy in multi-disciplinary environment. In addition, with this course, recycling and upcycling processes merge with the reuse and synthesis of nanomaterials for value-added applications.

## **Tentative outline**

### **Week 1**

Introduction to nanotechnology-general overview:

- Nanotechnological advancements
- Applications of nanomaterials and technologies

### **Week 2-3**

Carbon technology and carbon nanomaterials and other nanostructures:

- Carbon nanotubes and nanofibers, and their synthesis, application areas
- Graphene and its synthesis, its forms (films, spheres and foam) and modification, application areas
- Aerogels
- Top-down and bottom-up approaches

### **Week 4-5**

Energy at nanoscale

Flexible electronics, piezoelectric systems, supercapacitors, li-ion batteries, hydrogen storage, renewable energy

### **Week 6-7**

Nanocomposites and industrial applications (aerospace, automotive, white-house appliances, defence)

- Nano-integrated thermoset composite systems: Design, development and processing
- Nano-integrated thermoplastic composites: Design, development and processing

### **Week 8**

Natural nanomaterials

### **Week 9-10**

Characterization tools: – Spectroscopic, nanomechanical methods

**Week 11-12**

Recycling and Upcycling nanomaterials, and circular economy

**Week 13**

Commercialization and nanofuture

**Week 14** Final presentations

*There will be 3-4 invited speakers from industry and the speakers will be announced during the term.*

**Textbook and Reference Materials**

I will use my own lecture notes compiled from different resources.

There are numerous review articles on nanoscience and nanotechnology.

Textbook:

Nanotechnology, Janet Slingerland author. 2016 (online available)

Nanotechnology I: Fundamentals of Nanotechnology, Nanotechnology II: Characterization and Applications Editors: Prof. Dr. Mustafa Ersöz et. al. (Uploaded in SuCourse)

**Grading Policy**

Project-1 20 %

Project-2 20 %

Assignments 25%

Final Exam 35 %

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