

MODELING AND SIMULATION OF ADVANCED MANUFACTURING PROCESSES

MECENG 150

3 Units

Mechanical Engineering

Course Modality

- In-Person
- Course Type: Lecture
- Lectures will be course captured

Course Restrictions

Students will receive no credit for MECENG 150 after taking MECENG 150 (this course is not repeatable).

Semesters This Course Will Be Offered

Fall and Spring

Duration of the Course

15 weeks

Estimated Number of Hours Per Week

9-12

Crosslisting Information, if Applicable

None

Instructor Information

Prof. Tarek Zohdi, 6117 Etcheverry Hall, zohdi@berkeley.edu

Prerequisites

N/A

Course Description (750 Characters or Less for the Berkeley Guide)

This course teaches students modern modeling and simulation methods that are geared towards the analysis and optimization of advanced manufacturing processes, in a systematic and scientific manner, with special emphasis on physical modeling, simulation and machine-learning. Examples are motivated by real-world phenomena that students are likely to encounter in their careers, involving a number of topics in advanced manufacturing, including dynamics, controls, structural analysis, materials engineering, robotics, heat-transfer, etc. There are several major applications, which are selected for their current societal and industrial relevance.

Course Description Expanded

This course teaches students modern modeling and simulation methods that are geared towards the analysis and optimization of advanced manufacturing processes, in a systematic and scientific manner, with special emphasis on physical modeling, simulation and machine-learning. Examples are motivated by real-world phenomena that students are likely to encounter in their careers, involving a number of topics in advanced manufacturing, including dynamics, controls, structural analysis, materials engineering, robotics, heat-transfer, etc. There are several major applications, which are selected for their current societal and industrial relevance.

Course Objectives

To enable students to model and simulate modern advanced manufacturing processes.

ABET Course Objectives and/or ABET Program Outcomes (If Applicable)

N/A

Required Texts/Readings

- Free course reader
- Daily Course Packets (preloaded into bcourses)
- Free advanced reference text: UCB Link:
<https://rd.springer.com/book/10.1007/978-3-319-70079-3>
 - FOR UC STUDENTS, FACULTY AND STAFF:
 - Step 1: Go to <https://www.lib.berkeley.edu>
 - Step 2: Click “My Library”
 - Step 3: Click “UC Berkeley CalNet Login”
 - Step 4: Sign in using your UCB credentials
 - Step 5: Start a new search using the top menu. For example, search for “zohdi Modeling and Simulation of Functionalized Materials for Additive Manufacturing and 3D printing: Continuous and Discrete media”
 - Step 6: Click on the title of interest
 - Step 7: Under “View Online” click on the “SpringerLinks Books Engineering” (you may have to log in through CalNet again)
 - Step 8: Download .pdf file
- Undergraduate refresher book

Weekly Schedule of Readings, Assignments, and Course Topics

TOPICS COVERED:

- WEEK 1 TOPIC: MOTIVATION-OVERVIEW OF SIMULATION FIELD -THE CONCEPT OF A DIGITAL TWIN
- WEEK 2 TOPIC: MACHINE LEARNING AND OPTIMIZATION TOOLS
- WEEK 3 TOPIC: MODELING AND SIMULATION OF ROBOTIC SYSTEM OPTIMIZATION
- WEEK 4 TOPIC: THEORY-CONTINUUM MECHANICS- DEFORMATION, STRESS, THERMODYNAMICS
- WEEK 5 TOPIC: THEORY-MATERIAL BEHAVIOR
- WEEK 6 TOPIC: THEORY-ELECTROMAGNETISM
- WEEK 7 TOPIC: MODELING AND SIMULATION OF INDUSTRIAL PROCESSING OF MATERIALS
- WEEK 8 TOPIC: MODELING AND SIMULATION TOOLS: FINITE DIFFERENCE TIME DOMAIN METHOD (FDTD)
- WEEK 9 TOPIC: MODELING AND SIMULATION OF LASER PROCESSING OF MATERIALS
- WEEK 10 TOPIC: MODELING AND SIMULATION OF CHEMICAL VAPOR DEPOSITION (CVD)
- WEEK 11 TOPIC: MODELING AND SIMULATION OF NEW INDUSTRIAL MATERIAL DESIGN
- WEEK 12 TOPIC: MODELING AND SIMULATION OF USEFUL MATERIAL LIFE
- WEEK 13 ADVANCED TOPIC: MODELING AND SIMULATION OF ENERGY SYSTEMS

- WEEK 14 ADVANCED TOPIC: MODELING AND SIMULATION OF INFECTIOUS DISEASE PROPAGATION

PROJECTS (must complete 6 of 8):

- PROJECT 1: BASICS OF OPTIMIZATION AND MACHINE-LEARNING
- PROJECT 2: MODELING AND SIMULATION OF DEFORMATION OF MATERIALS
- PROJECT 3: MODELING AND SIMULATION OF THERMOMECHANICS OF MATERIALS
- PROJECT 4: MODELING AND SIMULATION OF INDUSTRIAL PROCESSING OF MATERIALS
- PROJECT 5: MODELING AND SIMULATION OF JOULE HEATING WITH FDTD
- PROJECT 6: MODELING AND SIMULATION OF LASER AND CVD PROCESSING OF MATERIALS
- PROJECT 7: MODELING AND SIMULATION OF NEW INDUSTRIAL MATERIAL DESIGN
- PROJECT 8: MODELING AND SIMULATION OF ADVANCED TOPICS

Attendance Policy

N/A

List of Course Requirements (Grading Rubric)

GRADING

- MECENG 150 students need to complete 6 out of the 8 projects detailed above, worth 70% of overall grade
- Final Exam worth 30% of overall grade
- This course will room share with MECENG C201/NUCENG C226/MATSCI C286. Students enrolled in MECENG 150 may attempt graduate-level homework and exam problems for extra credit.