

University Of California, Berkeley
Department of Mechanical Engineering

ME 102B: Mechatronics Design (4 units)

Undergraduate Required Course

Syllabus

CATALOG DESCRIPTION

Introduction to design and realization of mechatronics systems. Micro computer architectures. Basic computer IO devices. Embedded Microprocessor Systems and Control, IO programming such as analogue to digital converters, PWM, serial and parallel outputs. Electrical components such as power supplies, operational amplifiers, transformers and filters. Shielding and grounding. Design of electric, hydraulic and pneumatic actuators. Design of sensors. Design of power transmission systems. Kinematics and Dynamics of robotics devices. Basic feedback design to create robustness and performance.

COURSE PREREQUISITES

E 25, E 26 (junior transfers students are exempt from this requirement), E 27, as well as EE 16A or EE 40.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Lecture Notes will be provided

COURSE OBJECTIVES

Introduce students to design and design techniques of mechatronics systems; provide guidelines to and experience with design of variety of sensors and actuators; design experience in programming microcomputers and various IO devices; exposure to and design experience in synthesis of mechanical power transfer components; understanding the role of dynamics and kinematics of robotic devices in design of mechatronics systems; exposure to and design experience in synthesis of feedback systems; provide experience in working in a team to design a prototype mechatronics device.

DESIRED COURSE OUTCOMES

By the end of this course, students should: Know how to set up micro computers and interface them with various devices; know how to understand the microcomputers architectures, IO devices and be able to program them effectively; understand the design of actuators and sensors; know how to do shielding and grounding for various mechatronics projects, know how to create feedback systems, know the role of dynamics and kinematics of robotic devices in design and control of mechatronics systems; know how to design mechanical components such as transmissions, bearings, shafts, and fasteners.

TOPICS COVERED

1. Design Process

recognition of the problem, translation of the problems into a meaningful set of engineering specifications, realization of the risks, goals, and capabilities.

2. Actuators

design and dynamic properties of hydraulic actuators, pneumatic actuators, electric actuators and I.C. engines.

3. Sensors

accuracy, dynamic range, stability, resistive, inductive, capacitive, optical, solid state, piezoelectric and ultrasonic

4. Basic Electronic Devices

power supplies, diodes, signal processing, shielding and grounding, transformers, filters, multiplexing, choppers, relays

5. Operational Amplifiers

ideal amplifiers, characteristics, integrators and differentiators, filters, analogue computers.

6. Embedded Microprocessor Systems and Control

CPU operation, system bus, memories, interrupt processing, input and output devices, IO programming (serial, parallel, A/D and D/A), PLC Control

7. Real Time Software Design and Implementation Methodology

Software design models, specifications and documentation, computer language and software

8. Power Transfer Components

shafts, transmission systems, brakes, clutches, fasteners, belts, chains, traction drives, indexing systems, cams, pulleys, ball screw systems, bearings, springs.

9. Mechanism Design

kinematics and dynamics of robotic type devices, articulation, speed, accuracy, bandwidth, inertia, vibration, static and dynamic loading, materials, integration of design requirements

10. Basics controller design

Robustness vs performance, feedback design in frequency domain, error analysis.

CLASS/LABORATORY SCHEDULE

3 hours of lecture per week and 3 hours of lab per week.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

This course exposes students to key design elements of the profession through a series of laboratory assignment, and a substantial term project.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems

- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

- 5 laboratory assignments (25%)
- One term project (60%)
- 1 Technical Report (10%)
- 2 In-Class Presentation (5%)

PERSON(S) WHO PREPARED THIS DESCRIPTION:

Homayoon Kazerooni (kazerooni@berkeley.edu)

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): MECHATRONICS DESIGN

TIE CODE: LECS

GRADING: Letter

SEMESTER OFFERED: Fall, Spring

COURSES THAT WILL RESTRICT CREDIT: None

INSTRUCTORS: Professor Homayoon Kazerooni, Staff

DURATION OF COURSE: 15 weeks

EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 12 Hrs

IS COURSE REPEATABLE FOR CREDIT? No

CROSSLIST: None