UNLV ME 425/625 – Robotics I (Mechanisms and Algorithms)

COURSE OUTLINE

Instructor: Prof. Paul Oh Office: HRC 245 Phone: 702-895-0168
Email: paul.oh@unlv.edu
Office Hours: By Appointment

Lecture/Lab UG Lab Mondays 18:00 – 21:00

Objectives:

This course serves Masters-level and/or senior undergraduate students. Mechanisms and electronics are the 2 essential elements of every robotics system. This course (Robotics 1) has the objective of equipping students with a library of the most common mechanisms and algorithms needed to construct working robotic systems. Class time labs are used to reinforce lectures. The theory and construction of levers, shafts, cranks, cams, springs, linkages, ratchets, drives and gears will be studied and built. Algorithms for several control theories will be studied and programmed. Weekly labs culminate in 2 or 3 projects: an automaton (open-loop control); the inverted pendulum or ball-and-beam balancer (closed-loop control); and basic robots (gantry, SCARA, Puma). *Lectures and labs are designed to develop technical skills in conducting experiments and analyzing data, to produce several distinct outcomes required by the accrediting body, (Criteria 3 a-k), to contribute to the MEM educational objectives, and to satisfy professional components specified by ASME.*

Grade Breakdown

Item	Scheme
Attendance (Lectures and Labs)	10%
Project 1 Open-Loop (Presentation, Report and Reproducibility)	25-35%
Project 2 Closed-Loop (Presentation, Report and Reproducibility)	25-35%
Project 3 Robotic	25-35%
Homework, Exercises, Quizzes	20%

A = 85 – 100%: B = 75 – 84%: C = 65 – 74%: D = 55 – 64%: F = Less than 55%

Core Technical Skills:

Provide a "hands-on" experience with sensors, actuators and computer programming and computer-aided design tools	An understanding mechanisms, motors, sensors and programming
Relate mechanical movement with basic kinds of simple machines	An understanding of simple machines like levers, cranks, cams, gears and linkages
Develop the ability to work together in groups and the organizational and leadership skills required to perform a technical analysis and engineering evaluation	An increased skill level in general experimental methods, systems integration, and effective report writing

ABET Relation to Program Objective

(0 = No content; 1 = some content; 2 = significant content)

Objective	Conten	Explanation	Evidence*
1. To deliver a comprehensive mechanical engineering curriculum which emphasizes both the foundations and breadth of the mechanical engineering profession	**2**	Advanced laboratory experience in mechatronics	Project reports and lab exercises
2. To provide an education that equips students with the tools necessary to become successful mechanical engineers based on their Co-op experience, strong communication skills and awareness for the need of continuous professional development.	**2**	Students are exposed to programming and CAD-tools, simulation software and report writing.	Class discussions, project reports, class handouts.
3. To provide an education that will allow mechanical engineering students to understand the social, economic, environmental, political and ethical importance of their future profession.	**1**	Mechanisms and algorithms are essential in the design of mechatronic systems in automobiles, power plants and other vital areas of the economy.	Brief videos of mechatronic-based platforms for moving people e.g. Segway, are introduced and discussed.
4. To provide mechanical engineering students with a thorough understanding of impact of mechanical engineers and the mechanical engineering profession in the development, implementation and creation of future technology	**2**	Development and innovation of mechatronics will be part of the future technology	Brief videos of mechatronic-based platforms for moving people e.g. Segway, are introduced and discussed.

Relation to ABET Criteria 3 Outcomes

(0 = No content; 1 = some content; 2 = significant content)

Criteria a - k	Content	Explanation	Evidence
a*. An ability to apply knowledge of mathematics, science and engineering*	**2**	Relevant physics, equations of motion, state space realizations and control techniques are derived	In-class lectures, lab exercises and homework
b*. An ability to design and conduct experiments as well as to analyzed and interpret data*	**2**	Students write software and interface mechanical and electrical hardware. They are also required to analyze and interpret the experimental data in the report.	Lab exercises and projects
c. *An ability to design a system, component or process to meet desired needs*	**2**	Controllers are both simulated and implemented experimentally.	Lab Exercises and projects
d. *An ability to function on multidisciplinary teams*	**2**	Two students work as a team to use their knowledge in electronics, and computers to achieve the objective of each experiment in this course.	Lab Exercises and projects
e. *An ability to identify, formulate and solve engineering problems*	**2**	The students are required to formulate and solve the control problem based on	Lab exercises and homework

		theory and to verify their experimental results with expected theoretical results.	
f. *An understanding of professional and ethical responsibility*	**1**	This is emphasized as part of the design engineer's overall responsibility.	Guest Lecturers
g. *An ability to communicate effectively*	**2**	Oral and written presentations of the experimental procedure and results are required.	Project reports
h. *The broad education necessary to understand the impact of engineering solutions in a global or societal context*	**1**	The impact of engineering design on the environment (pollution, greenhouse effect, etc.) and society are covered.	Videos and discussion
i. *A recognition of the need for and an ability to engage in lifelong learning*	**1**	Improvements in control come from innovations and advanced technology. Need for lifelong learning is recognized.	Videos and discussion
j. *A knowledge of contemporary issues*	**1**	Design of control systems is related to contemporary issues	Videos and discussion
k. *An ability to use the techniques, skills and modern engineering tools necessary for engineering practice*	**2**	Students use modern engineering instrumentation and software	Lab exercises and project reports

Contribution to Professional Component:

ME 425/625 Robotics 1 builds upon and provides hands-on laboratory reinforcement of fundamental mechanical engineering courses – specifically kinematics, dynamics, mechanisms and design. It therefore helps integrate analytical experimental and numerical engineering techniques to solve real engineering problems. ME 425/625 contributes toward the 1-½ year of engineering topics appropriate to developing the ability to work in the controls and dynamic systems area.