UNLV ME 729 – Robotics II (Analysis and Synthesis)

COURSE OUTLINE - Syllabus

Instructor:	Prof. Paul Oh	Office: FAB Building	Tel: 702-895-0168
		Email: paul.oh@unlv.edu	
		Office Hours: Mondays 17:00-18:00 and by appointment	No Teaching Assistant
Required or Recommended Books:	None (course notes will be provided on the course website)		
Required Reading Assignments	None (course notes will be provided on the course website)		

- Library and information resources: Not applicable
- In- and out-of-class assignments and due dates: provided on course website
- Relative weight of assignments and course grade: Described below
- Date/time and location of final examination if known: Estimated Week 16 in location below
- Policies to be contained wholly within syllabus (see below)
- Student Syllabus Policies Handbook: https://www.unlv.edu/sites/default/files/page_files/27/SyllabiContent-MinimumCriteria-2019-2020.pdf
- University Policies e.g. Classroom conduct, Copyright, etc https://www.unlv.edu/about/policies/current-policies - and see below

Lecture/Lab Location: FAB Building (1325 E. Flamingo Rd, Suite B)
Time: Mondays 18:00-20:30

Objectives:

> Course Catalog description: "In-depth study of advanced automation concepts and robotic manipulators. Topics include 3-D kinematics, trajectory generation, compliance analysis, dynamic control of robotics along with concept of assembly operations and machine vision. Prerequisite: ME 421 or consent of instructor."

Preamble: The above course catalog description documents the only advanced robotics course offered at UNLV. As a 700-level course, it suggests target audiences are UNLV graduate level (Masters/PhD) students, primarily majoring in mechanical engineering. Prior to fall 2015, ME 729 was not offered for many years. Moreover, robotics is cross-disciplined and has advanced that ME 421 is simply not enough as a pre-requisite. ME 729 demands skills in mechanisms, electronics, and programming. As such ME 425/625 was completely revamped as a self-contained introductory course. Students (mainly senior undergraduates and beginning graduate students) get an overview of the field and are instilled with skills would have broad use in fields like mechatronics, systems integration, automation, and entertainment engineering.

The ME 729 catalog description essentially is about robot analysis and synthesis. Similar courses elsewhere leverage linear and control systems theory and Lagrangian dynamics. This demands competencies in matrix manipulation, partial differential equations, numerical analysis and set theory. Moreover, simulations and software toolboxes are used to help reinforce these topics.

Approach: By contrast, ME 729 uses a lecture/lab approach with hands-on experiments to deliver these topics. By having a "real-world" implementation, students can better appreciate issues like connectivity, communication latency, and systems integration. Simulations often overlook these issues. Software toolboxes are often "black boxes" where students do not fully appreciate their limitations. The Lego NXT and Robotis Dynamixel smart servos will be used to synthesize a robot manipulator based on lectures that motivate the underlying math and analyze the approaches.

Grade Breakdown

Item	Scheme
Attendance (Lectures and Labs)	5%
Projects (2 projects at 10% each)	20%
Homework: submit as PDF via email filename: firstLastName-homework-MMDDYY.pdf e.g. **paulOh-Homework-012819.pdf** Free PDF creator: Nitro PDF Creator https://www.gonitro.com/download	25%
Mid-term	25%
Final	25%

AO	85-100		C+	60-64
A-	80-84		CO	55-59
B+	75-79		C-	50-54
BO	70-74		D	45-49
B-	65-69		F	0-44

Core Technical Skills:

Provide a "hands-on" experience with robotic sensors, actuators, communications, control, computer vision, and trajectory generation	An understanding the 6 fundamental components of robotics
Relate mechanical, electrical and computer engineering concepts to design, control, and interface robots	An understanding of and application of hardware and software concepts to realize robots
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 robotics	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 experience, strong communication skills and awareness for the need of continuous professional development.	**2**	Students are exposed to hardware and software tools, simulation 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	**1**	Digital concepts through hardware and software are essential in the design of robotic	Brief videos of robots and robot-based platforms for society e.g. driverless cars are introduced and

and ethical importance of their future profession.		systems in automobiles, power plants and other vital areas of the economy.	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 robotics will be part of the future technology	Brief videos of robots and robot-based platforms for society e.g. driverless cars are introduced and discussed.

Relation to ABET Criteria 3 Learning 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**	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 theory and to verify their experimental results with expected theoretical results.	Lab exercises and homework
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*	**1**	Improvements in control come from innovations and advanced technology. Need	Videos and discussion

learning		for lifelong learning is recognized.	
***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 729 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 729 contributes toward the 1-½ year of engineering topics appropriate to developing the ability to work in the controls and dynamic systems area.

Policies (as per UNLV) to be listed in Syllabus:

Academic Misconduct—Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution.
An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: https://www.unlv.edu/studentconduct/student-conduct.

Copyright—The University requires all members of the University Community to familiarize themselves **with** and to follow copyright and fair use requirements. **You are individually and solely responsible for violations of copyright and fair use laws. The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws.** Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at: http://www.unlv.edu/provost/copyright.

Disability Resource Center (DRC)—The UNLV Disability Resource Center (SSC-A 143, http://drc.unlv.edu/, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

Religious Holidays Policy— Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor **within the first 14 calendar days of the course for fall and spring courses (excepting modular courses), or within the first 7 calendar days of the course for summer and modular courses,** of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit: http://catalog.unlv.edu/content.php?catoid=6&navoid=531.

Transparency in Learning and Teaching—The University encourages application of the transparency method of constructing assignments for student success. Please see these two links for further information: https://www.unlv.edu/provost/teachingandlearning
https://www.unlv.edu/provost/transparency

Incomplete Grades—The grade of I—Incomplete—can be granted when a student has satisfactorily completed three-fourths of course work for that semester/session but for reason(s) beyond the student's control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving "I" grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

Tutoring and Coaching—The Academic Success Center (ASC) provides tutoring, academic success coaching and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, visit http://www.unlv.edu/asc or call 702-895-3177. The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of the SSC (ASC Coaching Spot). Drop-in tutoring is located on the second floor of the Lied Library and College of Engineering TEB second floor.

UNLV Writing Center—One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 702-895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: http://writingcenter.unlv.edu/.

Rebelmail— By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu. **Emailing within WebCampus is acceptable.**

Final Examinations—The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: http://www.unlv.edu/registrar/calendars.

Any other class specific information—(e.g., absences, make-up exams, status reporting, extra credit policies, plagiarism/cheating consequences, policy on electronic devices, specialized department or college tutoring programs, bringing children to class, policy on recording classroom lectures, etc.)