Point Loma Nazarene University

EGR 442-01: Mobile Robotics	2.0 units	**Course Syllabus, Spring 2017**

Instructor: Christopher T. Gabler
E-mail: cgabler@pointloma.edu
Office: Rohr Science 209
Office hours: T 2:30 – 3:30, W 3:00 – 4:00, R 11:00 – 12:00,
                 and by appointment
Phone: 619-849-2356   Cell: 858-354-8762
Class Meeting Time: (RS 219) 1:30 – 2:35, Lab 2:45-4:35 p.m. RS-219

PLNU Mission
To Teach ~ To Shape ~ To Send

University Mission:
Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service becomes an expression of faith.   Being of Wesleyan heritage, we aspire to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Department Mission: The Physics and Engineering Department at PLNU provides strong programs of study in the fields of Physics and Engineering. Our students are well prepared for graduate studies and careers in scientific and engineering fields. We emphasize a collaborative learning environment which allows students to thrive academically, build personal confidence, and develop interpersonal skills. We provide a Christian environment for students to learn values and judgment, and pursue integration of modern scientific knowledge and Christian faith.

Materials – *Main text*: Robot Programming: A Practical Guide to Behavior-Based Robotics, ISBN 978-0-0714-2778-4, Jones, J., Roth, D., January 2, 2004, McGraw-Hill Professional

Supplemental text: Introduction to Autonomous Mobile Robots ISBN 978-0-262-01535-6, Siegwart, S., Nourbakhsh, I., Scaramuzza, D., MIT Press, 2011, 2nd edition.

Supplemental text: Practical Electronics for Inventors, by Scherz, P., and Monk, S., McGraw Hill, 2013, 3rd Edition, ISBN 978-0-07-177133-7
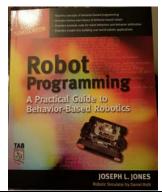
Prerequisites or Co-requisites - Prerequisite(s): EGR 432 Computer Interfacing.

Disclaimer: **The content of this syllabus and/or course outline may change during this semester.**
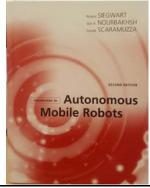
Canvas:
The online resource Canvas is integral for this course, and you are expected to login regularly.   You need a reliable internet connection to be able to use this resource.

Course Description
The objective of this course is to use a hands-on approach to introduce the basic concepts in robotics, focusing on mobile robots and the importance of sensors and the integration of those sensors. Also to be discussed are navigation mechanisms and the various robot learning and control paradigms. Three lectures and one laboratory each week.

Course Learning Outcomes - The objectives of the course are to:

1. Understand the concepts of behavior-based programming for autonomous robotics.
2. Understand the history and theory of behavior-based robots.
3. Learn the use and functions of robot behaviors, and behavior arbitration
4. Develop insight into building real-world robotic applications.
5. Design and analyze programs that integrate sensors and microcontrollers in robotic applications.

Attendance: Attendance is expected at each class session. In the event of an absence you are responsible for the material covered in class and the assignments given that day. Regular and punctual attendance at all classes is considered essential to optimum academic achievement. If the student is absent from more than 10 percent of class meetings, the faculty member can file a written report which may result in de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. See http://catalog.pointloma.edu/content.php?catoid=24&navoid=1581#Class_Attendance in the Undergraduate Academic Catalog.

Disclaimer: The content of this syllabus and/or course outline may change during this semester.

Credit Hour: In the interest of providing sufficient time to accomplish the stated course learning outcomes, this class meets the PLNU credit hour policy for a 2 unit class delivered over 8 weeks. Specific details about how the class meets the credit hour requirements can be provided upon request.

Class Enrollment: It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

Class Meetings – Studying analog electronics requires active learning and participation during class. In preparation for each class meeting there is a reading assignment. To maximize your learning and participation during our meetings it is very important that you have read this material before class.

Class Conduct – Attendance and punctuality are requirements for the course to help the student maximize his overall learning experience. Class exercises, questions and other elements of participation are factors in the students' overall grade assessment. The student is accountable for *all material* covered in class. In addition, students need to respect the classroom environment, and activity such as cell phone use, talking during the class lecture portions (when not engaged in questions and answers) and/or any other related behavior that interferes with the learning experience will be addressed to the student by the instructor.

Technology, devices and classroom participation: For my lecture classes, use of computers such as notebooks, iPad and similar devices shall be used just for class activities, PowerPoint, etc. Use of extra-curricular apps such as texting and social media needs to be controlled or closed such that it does not disrupt or distract the classroom environment, classmates or the instructor. Please be professional and courteous in this area of your use of technology in the classroom.

Course Objectives – An emphasis is placed on both conceptual understanding and the ability to solve problems dealing with the concepts studied

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design a system, component, or process to meet desired needs
(c) an ability to identify, formulate, and solve engineering problems

Disclaimer: The content of this syllabus and/or course outline may change during this semester.

Course Objectives (continued)
(d) a recognition of the need for, and an ability to engage in life-long learning
(e) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
(f) an ability to apply principles of engineering, basic science, and math to model, analyze, design and realize physical systems, components or processes

Homework – Homework is worth 10% of your final grade.
> *Submission:* Written homework solutions should be worked neatly in clear logical steps. (Solutions and explanations should be clear enough that one of your peers could easily follow what you did if they had not worked the problem before.)
> *Collaboration*: We expect and encourage collaboration between you and your peers while working on your homework, but your work should be your own original solutions. Allow adequate time to work and think about problems by yourself first before you work together with your peers or ask questions of me. When you sit down to write up a problem, you should not use notes copied from someone else. The guideline is that you should have no trouble explaining or repeating work that you turn in.

Late Work: I generally do not accept late work unless there is a documented emergency. If late work is submitted, the following applies:

Late Submission: Up to one late assignment per quad will be accepted late with a 10% reduction in grade for every day it is late. This begins with a 10% reduction for an assignment turned in later in the day after this homework has been collected at the beginning of class.

Lab – You will participate in a lab designed to give you hands-on experience with the concepts covered in the class meetings. Lab will also provide an opportunity for you to use computers, software and hardware to perform measurements, and analyze data using the scientific method. Labs will be completed in small groups, with each member of the team completing his or her own worksheet. Labs comprise 20% of your final grade. You must pass the lab portion of the class to pass the course.

Exams – Examinations will be given in class, which count toward 40% of your final grade, consisting of two midterms. The *class project/presentation* counts for 15% of your grade. Details about the class project/presentation will be added in the lecture class. Exams will be closed book.

Disclaimer: The content of this syllabus and/or course outline may change during this semester.

Exams (continued)
Partial credit will be given for correct reasoning at any step of the problem, but only if it is communicated clearly enough for me to understand. For problems that call for a solution or explanation, no credit will be given for an answer alone; the method or reasoning must also be shown.

Policy for missed exams: Unless you have express written permission from me long before the date of the exam to take the exam on another day, there will be no makeup exams for this course

Final Grades – The grade you earn in this course is roughly based on the following scale: 100%-88% A, 88%-85.5% A-, 85.5%-83% B+, 83%-78% B, 78%-75.5% B-, 75.5%-73% C+, 73%-68% C, 68%-65.5% C-, 65.5%-63% D+, 63%-58% D, 58%-55.5% D-. The points you receive during the course are weighted accordingly: in-class quizzes: 15%, homework: 10%, labs: 20%, exams (2): 40%, class presentation 15%.

Final Exam: Date and Time: The final exam date and time is set by the university at the beginning of the semester and may not be changed by the instructor. This schedule can be found on the university website and in the course calendar. No requests for early examinations will be approved. Only in the case that a student is required to take three exams during the same day of finals week, is an instructor authorized to consider changing the exam date and time for that particular student. The **Final Exam** date for this class is **Friday, May 5, 2017, 1:30 p.m - 4:00 pm.**

PLNU ACADEMIC HONESTY POLICY

Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

Disclaimer: The content of this syllabus and/or course outline may change during this semester.

PLNU ACADEMIC ACCOMMODATIONS POLICY

If you have a diagnosed disability, please contact PLNU's Disability Resource Center (DRC) within the first two weeks of class to demonstrate need and to register for accommodation by phone at 619-849-2486 or by e-mail at DRC@pointloma.edu. See Disability Resource Center for additional information.

For more details see the PLNU catalog:
http://catalog.pointloma.edu/content.php?catoid=24&navoid=1581#Academic_Accommodations

Students with learning disabilities who may need accommodations should discuss options with the instructor during the first two weeks of class.

PLNU COPYRIGHT PROTECTED MATERIALS POLICY

Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

FERPA POLICY

In compliance with federal law, neither PLNU student ID nor social security number should be used in publicly posted grades or returned sets of assignments without student written permission.

This class will meet the federal requirements by (Note: each faculty member should choose one strategy to use: distributing all grades and papers individually; requesting and filing written student permission; or assigning each student a unique class ID number not identifiable on the alphabetic roster.). Also in compliance with FERPA, you will be the only person given information about your progress in this class unless you have designated others to receive it in the "Information Release" section of the student portal. See Policy Statements in the (undergrad/ graduate as appropriate) academic catalog.

Questions are always welcome and encouraged. The best way to learn is to ask questions and challenge what you are being taught. Feel free to talk to me after class or via email if you have any questions. I hope you enjoy my course!

Disclaimer: The content of this syllabus and/or course outline may change during this semester.

EGR 442 Mobile Robotics Class Schedule
Professor Christopher Gabler
Rohr Science 209, 619-849-2356, cgabler@pointloma.edu
Office Hours: T 2:30 – 3:30, W 3:00-4:00, R 11:00-12:00 and by appointment
(Disclaimer: Content of this syllabus is subject to change according to the instructor

DATE	TOPICS	Ch. Reading	LAB
W 03/01	**Week 1 -Quad II** – Introduction to Autonomous	Intro. xix-xxvi	No Lab
F 03/03	Autonomous Mobile Robots	Ch 1: 1-20	
M 03/06	**Week 2 -Spring Break: no class**		
W 03/08	**Spring Break: no class**		
F 03/10	**Spring Break: no class**		
M 03/13	**Week 3 –** Control Systems – Open, closed loop, stability	Ch 2: 25-33	Lab #1 – Beginning Control Methods
W 03/15	Control Systems, saturation, parameters, hysteresis	Ch 2: 33-45	
F 03/17	Robotic behaviors, triggers and servos	Ch 3: 49-63	
M 03/20	**Week 4 -** Robotic behaviors, Finite State Analysis, implementation	Ch 3: 63-71	Lab #2 Control Methods II
W 03/22	Principle of Arbitration, path selection	Ch 4: 75-89	
F 03/24	Principle of Arbitration, other arbitration schemes	Ch 4: 89-103	
M 03/27	**Week 5 –** Programming, homing techniques, review	Ch 5: 107-117	Lab #3 – Paths and Arbitration
W 03/29	**EXAM #1**		
F 03/31	Programming, anti-canyoning, wall-following, confinement	Ch 5:118-134	
M 04/03	**Week 6 -** Area coverage, differential response, homing	Ch 5: 135-147	Lab #4 – Navigation I
W 04/05	Decomposition and behaviors, SodaBot	Ch 6: 151-163	
F 04/07	Mechanical Platform, sensors and behaviors	Ch 6: 164-174	
M 04/10	**Week 7 –** Physical Interfaces, sensors, avoidance	Ch 7: 177-190	Lab #5 – Navigation II
W 04/12	Homing and sensors, navigation	Ch 7: 191 -202	
F 04/14	**No Class: Easter Holiday**		
M 04/17	**Week 8 - No Class: Easter Holiday**		

DATE	TOPICS	Ch. Reading	LAB
W 04/19	Implementation of Machines - RoCK	Ch 8: 203-214	Lab #6 – Robot Behavior
F 04/21	**EXAM #2**		
M 04/24	**Week 9 -** RoCK behaviors, control and code	Ch 8: 215-226	No Lab
W 04/26	Future Robots	Ch 9: 229-242	
F 04/28	Review		
M 05/01	**Finals Week 3**		
W 05/03			
F 05/05	**FINAL EXAM – Friday, May 5, 2017 1:30-4:00**		

(Disclaimer: Content of this syllabus is subject to change according to the instructor