**Point Loma Nazarene University**
**EGR 442 COMPUTER INTERFACING (2 units)**
**Spring Semester 2019**

**CREDIT AND CONTACT HOURS**: 2 credit hours. Class meets 3 times per week for 1 hour and Lab meets for 2 hours one time per week.

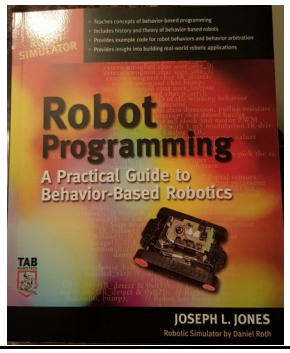
| | | |
|---|---|---|
| Lecture Class | MWF 1:30 – 2:25 pm | RLC 104 |
| Lab Class | Tuesday 12:30 – 2:25 pm | LA102 |
| Lab Class Assistant: | Joey Tuttobene | |

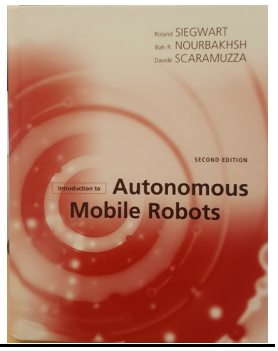
**INSTRUCTOR**: Professor Chris Gabler
CONTACT INFO: cgabler@pointloma.edu Cell phone: 858-354-8762
Office hours: By appointment –Trailer 2 - RS282 (avail. 2/04)

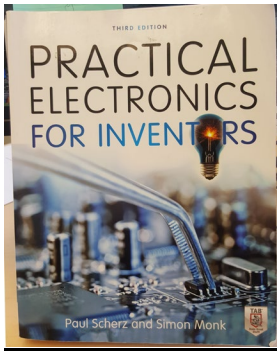
**TEXTBOOKS**:
**Materials –** *Main text*: Robot Programming: A Practical Guide to Behavior-Based Robotics, ISBN 978-0-0714-2778-4, Jones, J., Roth, D., January 2, 2004, McGraw-Hill Professional

*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








**Other materials:**
For an engineering class, you will need a "Scientific Calculator" that allows you to use powers of ten to represent numbers in scientific notation, (e.g. $6.02 \times 10^{23}$), with an "EXP" or "EE" function button. These calculators can be any brand, like Casio. Most of them you can get for a few dollars each.

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**CATALOG DATA**:
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. Two lectures and one laboratory each week. (Quad 2 course)
Prerequisite(s): EGR 432 Computer Interfacing. .

**COURSE LEARNING OUTCOMES/EXPECTED PERFORMANCE CRITERIA**:
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.

**PROGRAM OUTCOMES**: An emphasis is placed on both conceptual understanding and the ability to solve problems dealing with the concepts studied. Student will gain

1. An ability to apply knowledge of mathematics, science, and engineering.
2. An ability to design a system, component, or process to meet desired needs.
3. An ability to identify, formulate, and solve engineering problems.
4. A recognition of the need for, and an ability to engage in life-long learning.
5. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
6. An ability to apply principles of engineering, basic science, and math to model, analyze, design and realize physical systems, components or processes.

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**GRADING**:

| | | | |
|---|---|---|---|
| Class Activities/Assignments | 10% | Quizzes | 10% |
| Homework | 25% | Exams | 30% |
| Labs | 25% | | |

Final grades will be determined as follows:

| | |
|---|---|
| 100-93% | A |
| 90-92.9% | A- |
| 87-89.9% | B+ |
| 83-86.9% | B |
| 80-82.9% | B- |
| 77-79.9% | C+ |
| 73-76.9% | C |
| 70-72.9% | C- |
| 67-69.9% | D+ |
| 63-66.9% | D |
| 60-62.9% | D- |
| 0-59.9% | F |

**COURSE ORGANIZATION**:

**Lectures:** PowerPoint and interactive discussion will cover the topics below. In class assignments on the topics will be performed within designated groups and handed in before the end of class. All members present for the assignment will receive the same grade on that assignment. Students that not present will not receive any credit for that assignment.

**Homework:** will be assigned weekly at the end of the lecture period and due usually by the end of the week. Many of the homework assignments will have questions and problems with no single "right" answer. Those will be graded based on your originality, creativity and ability to independently research. Copied answers will be given zero credit.

**Quizzes:** Regular quizzes will be given during the class period to test your understanding and retention of the material covered since the last quiz. These tests may not be announced ahead of time and absence or late arrival to a class will not be accommodated except as discussed below. Your own personal handwritten notes may be used.

**Labs:** Hands-on lab assignments will be made weekly, culminating in an independent group project. Lab sessions are mandatory and will include weekly documentation. All hands-on work must be done in the lab room and during lab period or other times when the room is specifically made available. Unless otherwise stated the lab assignments are due no later than the beginning of the next lab session. If the lab requires a demonstration, you will be given one opportunity to do so. It will be signed off at this time and results marked. Labs will be graded primarily on creativity, teamwork and adherence to the engineering process/project goals and constraints, including schedules and requirements. Each lab group will receive the same base grade for each assignment but this base grade may be adjusted up or down based on an individual's observed level of contribution.

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**No late assignments will be accepted** but the lowest grade for each type of assignment (homework, in-class assignments and quizzes) will be dropped. Independent thinking and communication skills are a big part of the class objectives so **answers should be original and in your own words** and will be graded accordingly. **If you will miss a class, lab or exam for a school function**, you must arrange to make it up **ahead of time**. This includes accommodations for missing real-time group assignments due to your requirement at a school function. These will be addressed on a case by case basis and depending on the assignment may require you to do it on your own ahead of time as feasible. It is your responsibility to let the professor know of such an absence enough ahead of time to accommodate. Absences due to unexpected emergencies will require documentation from a reliable and verifiable source of the time and reason for such absence.

**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.

**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 strive 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.

**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 Attendance Policy in the in the Undergraduate Academic Catalog.

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**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.

**ACADEMIC ACCOMMODATIONS:**
While all students are expected to meet the minimum standards for completion of this course as established by the instructor, students with disabilities may require academic adjustments, modifications or auxiliary aids/services. At Point Loma Nazarene University (PLNU), these students are requested to register with the Disability Resource Center (DRC), located in the Bond Academic Center. (DRC@pointloma.edu or 619-849-2486). The DRC's policies and procedures for assisting such students in the development of an appropriate academic adjustment plan (AP) allows PLNU to comply with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. Section 504 (a) prohibits discrimination against students with special needs and guarantees all qualified students equal access to and benefits of PLNU programs and activities. After the student files the required documentation, the DRC, in conjunction with the student, will develop an AP to meet that student's specific learning needs. The DRC will thereafter email the student's AP to all faculty who teach courses in which the student is enrolled each semester. The AP must be implemented in all such courses.

If students do not wish to avail themselves of some or all of the elements of their AP in a particular course, it is the responsibility of those students to notify their professor in that course. PLNU highly recommends that DRC students speak with their professors during the first two weeks of each semester about the applicability of their AP in that particular course and/or if they do not desire to take advantage of some or all of the elements of their AP in that course.

**ACADEMIC HONESTY**:
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 the catalog for definitions of kinds of academic dishonesty and for further policy information.

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**FINAL EXAM**:
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 **Wednesday, May 1, 2017, 1:30 p.m - 4:00 pm.**

**COPYRIGHT PROTECTED MATERIALS:**
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.

**CREDIT HOURS:**
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 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 IN THE CLASSROOM**: 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.

**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!

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# EGR 442 Mobile Robotics Class Schedule

Professor Christopher Gabler

| DATE | TOPICS | Ch. Reading | LAB TOPIC |
|---|---|---|---|
| W 02/27 | **Week 1 -Quad II** – Introduction to Autonomous | Intro. xix-xxvi | No Lab, no T class |
| F 03/01 | Autonomous Mobile Robots | Ch 1: 1-20 | |
| **M 03/04** | **Week 2 -Spring Break: no class** |  | No Lab |
| **W 03/06** | **Spring Break: no class** | | |
| **F 03/08** | **Spring Break: no class** | | |
| M 03/11 | **Week 3 –** Control Systems – Open, closed loop, stability | Ch 2: 25-33 | Lab #1 – Beginning Control Methods |
| W 03/13 | Control Systems, saturation, parameters, hysteresis | Ch 2: 33-45 | |
| F 03/15 | Robotic behaviors, triggers and servos | Ch 3: 49-63 | |
| M 03/18 | **Week 4 -** Robotic behaviors, Finite State Analysis, implementation | Ch 3: 63-71 | Lab #2 Control Methods II |
| W 03/20 | Principle of Arbitration, path selection | Ch 4: 75-89 | |
| F 03/22 | Principle of Arbitration, other arbitration schemes | Ch 4: 89-103 | |
| M 03/25 | **Week 5 –** Programming, homing techniques, review | Ch 5: 107-117 | Lab #3 – Paths and Arbitration |
| W 03/27 | **EXAM #1** | | |
| F 03/29 | Programming, anti-canyoning, wall-following, confinement | Ch 5:118-134 | |
| M 04/01 | **Week 6 -** Area coverage, differential response, homing | Ch 5: 135-147 | Lab #4 – Navigation I |
| W 04/03 | Decomposition and behaviors, SodaBot | Ch 6: 151-163 | |
| F 04/05 | Mechanical Platform, sensors and behaviors | Ch 6: 164-174 | |
| M 04/08 | **Week 7 –** Physical Interfaces, sensors, avoidance | Ch 7: 177-190 | Lab #5 – Navigation II |
| W 04/10 | Homing and sensors, navigation | Ch 7: 191 -202 | |
| F 04/12 | Implementation of Machines - RoCK | Ch 8: 203-214 | |
| M 04/15 | **Week 8 –** EXAM #2 | | Lab #6 – Robot Behavior |
| W 04/17 | Control of Machines: Ex. RoCK behaviors, control and code | Ch 8: 215-226 | |

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|---|---|---|---|
| R 04/18 | **No Class: Easter Holiday** |  | |
| F 04/19 | **No Class: Easter Holiday** | | |
| **DATE** | **TOPICS** | **Ch. Reading** | **LAB TOPIC** |
| M 04/22 | **Week 8 - No Class: Easter Holiday** | | |

| | | | |
|---|---|---|---|
| W 04/24 | Future Robots | Ch 9: 229-242 | Lab #7 – Robot Behavior II |
| F 04/26 | Review | | |
| | **Finals Week 3** | | |
| W 05/01 | **FINAL EXAM – Friday, May 5, 2017 1:30-4:00** | | |

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