

# ENGR 4421: Robotics II (CRN33091)

## Spring, 2023

### Instructor

*Name:* Lin Zhang

*Office:* LSCA105 *I may also show up in LSC013 or LSC110.*

*Office Hours:* Wednesday 10:00 AM – 12:00 PM

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### Class & Lab

*Time:* Tuesday & Thursday, 10:50 AM–1:30 PM

*Location:* Lewis Science Center Annex (LSCA) 105

*Course Materials:* [https://linzhanguca.github.io/robotics\\_2-2023](https://linzhanguca.github.io/robotics_2-2023)

**All students are expected to comply with the University policy regarding face coverings. UCA's Coronavirus page for students can be found here: <https://uca.edu/coronavirus/>. Students having any symptom of COVID-19 should stay at home and report to your healthcare provider. Check CDC with the most updated information of COVID-19. <https://www.cdc.gov/coronavirus/2019-ncov>**

### Overview

#### Course Description

Robotics II is an engineering course that introduces a variety of advanced theories and technologies in robotics to our students. Students will be introduced to the more advanced navigation strategies using Robot Operating System (ROS). Students are expected to manage relatively complex mobile robots integrated with all kinds of sensors and actuators. The classes will mix lectures and labs to help students better understand such principles. Students will work in teams to bring up their robots.

#### Prerequisites

Minimum grade of C in ENGR 3421: Robotics I is pre-required.

#### Textbooks

The course will heavily rely on the official online [ROS2 Documentation](#).

## Supplies

This course will provide all the supplies for free, including computers, robot assembly parts, microcontrollers, sensors, crafting tools, measuring tools, programming software etc.. Students are welcome to ask the instructor to purchase supplies if needed.

Students can take the robots and laptop computers out of the classroom. Tools, computer peripherals (monitors, keyboards and mice) can be taken out if asked for permission.

## Classroom Policy

The instructor and the students are expected to appear in the classroom/lab in every class. If any student cannot show up on time, he/she needs to contact the instructor in advance. The instructor will notify the students with any changes of a class in advance. No food nor drinks are allowed in the classroom/lab.

## Grading

A's are 86-100%, B's are 71-85%, C's are 56-70%, D's are 50-55%, F's are 0-49%. The final grade will be determined by following criteria.

| Component     | Percentage | Note                     |
|---------------|------------|--------------------------|
| Attendance    | 1%         | Show up in every class   |
| Assignments   | 19%        | working code             |
| Project 1     | 25%        | Documents                |
| Project 2     | 25%        | Documents & Presentation |
| Final Project | 30%        | Documents & Presentation |
| Total         | 100%       |                          |

## Other Policies

The policies and procedures detailed in the UCA 2022-2023 Student handbook are also part of this syllabus. Please refer to the relevant policies as your guidance.

<https://uca.edu/student/files/2022/08/STUDENT-HANDBOOK-2022-2023.pdf>

If a student discloses an act of sexual harassment, discrimination, assault, or other sexual misconduct to a faculty member (as it relates to “student-on-student” or “employee-on-student”), the faculty member is encouraged to report the act to the Title IX coordinator, deputy coordinator, or employee with the authority to institute corrective measures on behalf of the University. An investigation of a formal complaint of Title IX Sexual Harassment will only be initiated when the Complainant (individual who suffers actual harm from the violation of the Title IX Sexual Harassment Policy) or the Title IX Coordinator signs a complaint. For further information, please visit: <https://uca.edu/titleix/>. \*Disclosure of sexual misconduct by a third party who is not a student and/or employee is also encouraged if the misconduct occurs when the third party is a participant in a university-sponsored program, event, or activity.

## Academic Integrity

The University of Central Arkansas affirms its commitment to academic integrity and expects all members of the university community to accept shared responsibility for maintaining academic integrity. Students in this course are subject to the provisions of the university's Academic Integrity Policy, approved by the Board of Trustees as Board Policy No. 709 on February 10, 2010, and

published in the Student Handbook. Penalties for academic misconduct in this course may include a failing grade on an assignment, a failing grade in the course, or any other course-related sanction the instructor determines to be appropriate. Continued enrollment in this course affirms a student's acceptance of this university policy.

### **Building Emergency Plan**

An Emergency Procedures Summary (EPS) for the building in which this class is held will be discussed during the first week of this course. EPS and Building Emergency Plan (BEP) documents for most buildings on campus are available at <https://uca.edu/go/bep-library>. Every student should be familiar with emergency procedures for any campus building in which he/she spends time for classes or other purposes.

### **Disabilities**

The University of Central Arkansas adheres to the requirements of the Americans with Disabilities Act. If you need an accommodation under this Act due to a disability, please contact the Office of Accessibility Resources and Services (OARS), 450-3613.

### **Course Evaluation**

The Student Course Experience Survey is a crucial element in helping faculty achieve excellence in the classroom and the institution in demonstrating that students are gaining knowledge. Students may complete surveys for courses they are taking starting on Monday, April 10th, through the Sunday, May 14th by logging in to myUCA and clicking on the Course Evaluations task.

### **Course Contents**

Please refer to the following for a tentative course plan. The actual contents will be subject to changes due to the progress of the course.

- **Students need to work on assignments individually.**
- **Students can work on projects in teams.**
- **All assignments and projects due at 1:30 PM.**

### **Module 1 - Build the Robot**

Students will use the knowledge and skills learned in Robotics 1 to build differential drive mobile robot prototypes. The students will be introduced to the Robot Operating System (ROS).

- **Assignment 1:** Create ROS package. **Due date:** Thursday, 02/02/2023.
- **Project 1:** Assemble the robot. **Due date:** Thursday, 02/09/2023.

## Module 2 - Model the Robot

Students will learn how to model a robot using URDF file. Student will learn how to import the descriptive model file into Gazebo to simulate their robot.

- **Assignment 2:** Robot description. **Due date:** Thursday, 02/16/2023.
- **Assignment 3:** Robot simulation. **Due date:** Thursday, 02/23/2023.

## Module 3 - Control the Robot

Students will be introduced to a specific micro-controller, Raspberry Pi Pico. Students will learn how to monitor and adjust robot speed using the encoders and the micro-controller.

- **Assignment 4:** Speed, mileage reading. **Due date:** Thursday, 03/02/2023.
- **Project 2:** Mapping. **Due date:** Thursday, 03/23/2023.

## Module 4 - Navigate the Robot

Students will integrate LiDAR and/or IMU in their robotic projects. Students will be introduced to *Nav2* and *slam\_toolbox* packages to build maps and navigate the robot in the map.

- **Final Project:** Navigation. **Due date:** Thursday, 05/04/2023.