MOBILE ROBOTS SPRING 2023

COURSE:	CENG 5437-02 26233 /4391-03 26272
	Wednesday 4PM-6:50PM Delta D158B

Expect Zoom meetings Occasionally

INSTRUCTOR:	Dr. Thomas L. Harman harman@uhcl.edu
OFFICE:	D104 Phone: 283-3774 (e-mail best)
OFFICE HOURS:	Mostly by Zoom OR e-mail
PREREQUISITES:	Basic engineering and Physics knowledge of moving bodies.
DESCRIPTION:	The course presents a study of techniques applied to the study of mobile robots. The purpose is to introduce the students to the use of robots and the techniques necessary to design and develop or specify hardware and software for applications.
COURSE WEBSITE:	https://sceweb.sce.uhcl.edu/harman/courses.htm

CENG 5437/4391 – Spring 2023: Mobile Robots

Most Data for the course will be held on my website.

BLACKBOARD	Assignments will be posted on **Blackboard** along with Announcements and information
COURSE FORMAT:	The course format will consist of lectures with homework and examinations. In addition to regular homework and examinations, a project report will be due at the end of the semester.
TEXT:	BOOK Recommended: *ROS Robotics By Example 2ND Edition,* Fairchild and Harman, ISBN 139781788479592, Paperback 484 pages It is posted on the Course Website.

Textbook for Course *RosRoboticsByExample*

GRADING:	The grade will be divided as follows-
	PLEASE ALLOW SOME FLEXIBILITY (I WILL INFORM YOU)

Exams and Quizzes	25%
Homework	50%
Project and presentation	25%

MOBILE ROBOTS Spring 2023

CENG 5437/4391 Mobile Robots Course Outline
(**Tentative** – Changes with interest of the Instructor and the students)

<u>Material to be covered</u>

First Class: Our Lecturer and Robotics Expert Miguel Angel Pagan will introduce the class. Dr. Luong Nguyen another robotic expert from UHCL will present some of the exciting things going on in Robotics.

1. **Introduction to the Course**
    To the videos – History, Cars, Applications. ROS robots

2. **Physics, Inertia, URDF models**

3. **Selecting Motors for Wheeled Robots**

4. **PID control of Wheeled Robots**

5. **Wheeled Robots and Differential Drive Steering**
    Basic Kinematics and Math
    Basic Physics of Wheeled Robots

6. **SENSORS**
    Classes of Sensors
    Characterization of Sensors
    Types of Errors – Statistical and Random

7. **Specific Sensors**
    Position- Absolute and Relative
    Range

8. **Connect Sensors to the Computer – A2D converters, etc.**

9. **Control Theory PID and Digital Control of Robots**

MIDTERM EXAMINATION

DUE: BRIEF ORAL AND WRITTEN SUMMARY OF PROJECT.

10.   Software for Navigation
The Robot Operation System will be used as an example
Gazebo and MATLAB for Simulation

11.   Systems View of Robots
12.   Sensing, data acquisition, control, and navigation

13. **Localization, Sensor Noise and Aliasing, Path Planning and Navigation**

14. **How Autonomous Cars Drive** –
Localization GNSS, Perception and Deep Learning, Prediction and Routing, Control, Cloud Data, Testing

Other Possible Topics   Flying Robots, Underwater Robots, Safety, Regulations, New Trends --- Depending on time.

DUE: Night of Final PROJECT DEMONSTRATIONS AND REPORTS.

HOMEWORK RULES and Honesty

HOMEWORK IS DUE ON DATE GIVEN IN THE ASSIGNMENT UNLESS CHANGED IN CLASS

ONLY VALID EXCUSES ARE ACCEPTED FOR LATE WORK

EACH DAY LATE   -10 POINTS

A WEEK LATE   30 POINTS MAXIMUM IS YOUR SCORE

Honesty

Academic Honesty

The Academic Honesty Policy at UHCL (found in the university of Houston-Clear Lake Catalog) states: Academic honesty is the cornerstone of the academic integrity of the university.

It is the foundation upon which the student builds personal integrity and establishes a standard of personal behavior.

> Because honesty and integrity are such important factors in the professional community, you should be aware that failure to perform within the bounds of these ethical standards is sufficient grounds to receive a grade of "F" in this course and be recommended for suspension from UHCL.

The Honesty Code of UHCL states "I will be honest in all my academic activities and will not tolerate dishonesty."

- Academic Honesty Code – A suggested statement: The Academic Honesty Code states "*I will be honest in all my academic activities and will not tolerate dishonesty*" and is detailed on pages 77-80 of the 2008-2009 Catalog. Online at: http://www.uhcl.edu/XDR/Render/catalog/06/#A0213

Learning Outcomes CENG 5437 Mobile Robots

Understand the various types and capabilities of mobile robots.

Understand how a robot's component parts are used in applications for mobility and navigation.

Understand and apply the mathematics used to coordinate a robot's movement.

Describe the mechanical parts of a mobile robot and their characteristics.

Understand how a robotic system is controlled and how the control parameters are measured or acquired using sensors.

Describe the sensors of a mobile robot and their characteristics for various applications. Consider sensor errors and correction techniques.

Understand the types of software used to guide a mobile robot

Be able to design a project to use a robot in an application.

Be able to design a computer system architecture to apply to a robotic system.

Write a project report according to the directions and give presentations in class.