

## Syllabus

**Course Title:** CSCE 574 Robotics

**Instructor:** Ioannis Rekleitis,  
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Computer Science and Engineering  
Room 2235  
550 Assembly Street, Columbia, SC  
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**Class meeting:**

HZNPG 210 TTh 10:05 a.m. – 11:20 p.m.

Final Exam standard time.

**Course Description:** From the surface of Mars and the far reaches of our Solar System to the bottom of the ocean, robots are helping us expand our scientific understanding of the universe. In our everyday life, devices that gather information and interact with the environment are ever-present, taking over many of the undesirable or dangerous tasks that humans had to perform previously. Fundamental to all these robotic devices is their ability to sense the environment, reason about it, and then plan and safely execute the best action. This course is designed as an advance graduate course with a focus on design and operation of robot systems; dynamics, control, and motion trajectories of mobile robots; vision, LIDAR, SONAR and tactile sensing systems; state estimation; planning and learning.

At the beginning we will discuss how robots move and interact with their environment. Among other topics we will examine the underlying hardware enabling mobility, kinematics and inverse kinematics, and also the differences between manipulators and mobile robotic systems. Perception of the environment is another fundamental skill for intelligent systems. Sensors, sensor data interpretation, and sensor fusion would be presented next, including recent advances in the field of sensor networks. Reasoning about the environment and the actions a robot takes is the third area we would cover in this course. This would include path planning for mobile robots and configuration spaces for manipulators. The task of mapping, with the underpinning concepts of position estimation and localization, will be explored. We will go over the notion of multi-agent systems, and finally look at applications of robotics in the real world.

The course material would cover the fundamentals of intelligent robotic systems with special focus on the computational aspects. The students would also have the chance to apply some of the theoretical concepts seen in class on a mobile robot (TurtleBots, Tello UAV). The instructor would draw from his experiences in robotic research to enrich the material with aspects of active research problems, such as: multi-robot coverage for humanitarian demining; environmental coral reef monitoring using an underwater robot; robotic planetary exploration; etc. Even though the focus of this course is on mobile robotics, the methodologies discussed can be applied to a variety of computer systems equipped with sensors and actuators.

**Course learning outcomes:**

- Develop the ability to work with different robot platforms
- Develop the ability to understand basic robotic algorithms: Planning, Sensing, Acting

**Prerequisites:**

CSCE 211, 212, 240.

**Required text(s):**

The required textbook: is:

- [Computational Principles of Mobile Robotics](#), Gregory Dudek and Michael Jenkin, 2nd Edition, Cambridge University Press

Other texts include:

- A Gentle Introduction to ROS, Jason M. O'Kane, Independently published, 2013

**Schedule, deliverables, and evaluation:**

<b>Component</b>	<b><u>Undergraduate</u></b>	<b><u>Graduate</u></b>
Assignments (5) <ul style="list-style-type: none"><li>• First two individual</li><li>• Last three 50% team, 50% individual</li></ul>	10%	10%
Midterm Exam	20%	20%
Final Exam (standard time)	30%	30%
<b>Total</b>	<b>100%</b>	<b>100%</b>

## **Schedule:**

- Week 01: Syllabus presentation, Round Table, Introduction, History of Robotics. ROS
- Week 02: Actuators. Locomotion. Sensor (Tactile, Range Finders, GPS, IMU, Position Encoders).
- Week 03: Reactive Path Planning. Potential Fields. State Estimation,
- Week 04: Bayesian Filtering Particle Filters
- Week 05: Kalman Filters
- Week 06: Exploration, HRI
- Week 07: Mapping: Metric Maps, Topological Maps, hybrid.
- Week 08: Visibility Graphs, Bug Algorithm, Generalized Voronoi Graphs, Atlas.
- Week 09: Coordinate Systems, Control
- Week 10: Semantic hierarchy of spatial representations. Configuration Space, PRMs
- Week 11: Architectures.
- Week 12: Coverage, Multi-Robot Coverage
- Week 13: Learning in Robotics
- Week 14: Sensors (Vision).
- Week 15: Review of Material

## **Grading Scheme:**

- >90% : A
- >87% : B+
- >80% : B
- >77% : C+
- >70% : C
- >60% : D
- <60% : F

## **How to do poorly**

Here are some habits that have correlated with poor performance in this course in the past:

- Not starting/making progress on the programming assignments until the last minute
- Skipping class
- Ignoring the communications from the instructor
- Not properly reading the instructions
- Ignoring the homework
- Not asking questions and interacting with the instructor

**Graduate/Honor Grading Policy:**

Graduate and Honors student we will have an additional part on each assignment, which will count for ten percent of the marks. Failure to complete these parts will cost one letter grade.

**Academic Integrity:**

You are expected to practice the highest possible standards of academic integrity. Any deviation from this expectation will result in a minimum academic penalty of your failing the assignment, and will result in additional disciplinary measures. This includes improper citation of sources, using another student's work, and any other form of academic misrepresentation.

**Attendance Policy:**

When you miss class, you miss important information. If you are absent, you are responsible for learning material covered in class. If you are absent when an assignment is due, you must have submitted the assignment prior to the due date to receive credit. If you miss more than 20% of the classes, whether excused or unexcused, your grade will be dropped one letter grade.

**Accommodating Disability:**

Reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, contact the Office of Student Disability Services: 777-6142, TDD 777-6744, email [sasds@mailbox.sc.edu](mailto:sasds@mailbox.sc.edu), or stop by LeConte College Room 112A. All accommodations must be approved through the Office of Student Disability Services.

**Diversity:**

In order to learn, we must be open to the views of people different than ourselves. In this time we share together over the semester, please honor the uniqueness of your fellow classmates and appreciate the opportunity we have to learn from one another. Please respect each others' opinions and refrain from personal attacks or demeaning comments of any kind. Finally, remember to keep confidential all issues of a personal or professional nature that are discussed in class.