# ENPM 701 – Autonomous Robotics: Spring 2025 Syllabus

Master of Engineering Program in Robotics

**Lecture Details**

Section 0101
Tuesdays 1:00 pm to 3:40 pm
JMP 2216

Course Zoom: https://umd.zoom.us/j/97128970581

**Instructor**

Steven E. Mitchell, Ph.D.
Office: EGR 2128
Office Hours: Tuesdays in lecture hall and via Zoom lecture link
***Preferred Means of Contact***: mitchels@umd.edu

**Teaching Assistant**

TBD
Office Hours: TBD

**Course Description**

This is a hand-on course exploring the principles of robotic autonomy. Students will explore the theoretical, algorithmic, and implementation aspects of autonomous robotic modeling and controls, perception, localization and SLAM, planning, and decision making. These techniques will be applied through completion of a semester-long hands-on project employing the course material, ground-based mobile robots, and Python. Each student is required to build and test their own robot this semester.

Students will perform hands-on exercises in most lectures to gain a deeper understanding of how a selected set of these technologies can be applied to real-world robotic environments.

**Required Technology**

Students will need a personal computer on which Python can be installed (installation details provided during first lecture) along with a Raspberry Pi and robotics kit (both available for purchase).

**Textbook(s)**

There exists no single textbook that comprehensively covers the material included in this course. The following resources are ***optional*** and will augment the lecture materials:

- Introduction to Autonomous Mobile Robots by Siegwart, 2011
- Probabilistic Robotics by Thrun, 2005
- Planning Algorithms by LaValle, 2006
- Intro to Mechatronics and Measurement Systems, by Alciatore, 2012
- Introduction to Sensors for Ranging and Imaging by Booker, 2009
- Python Programming and Visualization for Scientists by DeCaria, 2016
- Practical Python and OpenCV by Rosebrock, 2014
- Raspberry Pi for Computer Vision by Rosebrock, 2019

**Grading Policy**

Course grades will be based on the following ***approximate*** grade weights:

| | |
|---|---|
| Assignments & Exercises | 80% |
| Final Project | 20% |

Assignments and exercises will be performed both in and outside class hours. Attendance and participation will be self-evaluated and considered with final grade decisions made by the professor.

**NOTE:** NO LATE HOMEWORK WILL BE ACCEPTED.

It is your responsibility to confirm the proper grades are recorded on ELMS for all graded work. You have **two weeks from the date graded work is returned to dispute a grade**.

**Academic Integrity**

By enrolling in this course, each student assumes full responsibility as a participant in UMCP's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

**Syllabus Note**

This course syllabus is subject to change. The most recent version is available on the course website (ELMS). ***Please check regularly for updates***.

## ENPM 701 – Autonomous Robotics: Spring 2025 Class Schedule

Master of Engineering Program in Robotics

| Week | Dates | Topic / Event | Reading / Other |
|---|---|---|---|
| 1 | 1/28 | Course Introduction — Python Fundamentals<br>Introduction to Python — sanitycheck.py<br>Python & the Raspberry Pi — Ground-up setup/config of Raspberry Pi<br>**Homework #0.1** | Siegwart Chp. 1, 4<br>DeCaria Chp. 1-5, 7, 10 |
| 2 | 2/4 | Introduction to Course Project<br>Perception — OpenCV Fundamentals via VNC<br>QR codes<br>**Homework #1 due: data in Python & Bill of Materials confirmation** | Siegwart Chp. 4<br>Toth Chapter 1<br>IntroRemoteSensing.pdf |
| 3 | 2/11 | Perception — Lidar & Velodyne demo<br>GPIO<br>Sonar & coding interface with distance sensor<br>**Homework #2 due: confirm RPi up and running, cv2.videoWriter()** | Siegwart Chp. 4<br>IntroLidar.pdf<br>VLP-16 |
| 4 | 2/18 | Locomotion & Kinematics — Assemble vehicle<br>Mount RPi camera<br>**Homework #3 due: object tracking with RPi** | Siegwart Chp. 2-3 |
| 5 | 2/25 | Locomotion & Kinematics — Assemble vehicle<br>Overview of DC motors & H-bridge<br>Teleoperated control of vehicle | Siegwart Chp. 2-3 |
| 6 | 3/4 | Locomotion & Kinematics — Open vs. closed-loop control<br>Servo motors & Gripper<br>**Homework #4 due: arrow tracking & orientation with RPi** | Siegwart Chp. 2-3 |
| 7 | 3/11 | Localization — Motor encoders<br>Repeatedly drive robot in user-defined straight line<br>**Homework #5 due: complete assembly of ground vehicle, teleoperation** | Siegwart Chp. 5 |
| 8 | 3/18 | *SPRING BREAK* | |
| 9 | 3/25 | Localization — SMTP & IoT sending videos/data back to control station<br>Map trajectory using Matplotlib<br>**Homework #6 due: servo gripper functionality, localization basic theory** | Siegwart Chp. 5 |
| 10 | 4/1 | Localization / Sensor Fusion — IMU sensor fusion<br>**Homework #7 due: motor encoder tracking, forward reverse left right** | Siegwart Chp. 5<br>BNO055 datasheet |
| 11 | 4/8 | Planning & Navigation — Auto-rotation using block tracking algorithm<br>Autonomous object retrieval<br>**Homework #8 due: IMU functionality** | Siegwart Chp. 6 |
| 12 | 4/15 | Grand Challenge Practice<br>**Homework #9 due: sequence of moves, plot trajectory in Matplotlib** | |
| 13 | 4/22 | Grand Challenge Practice | |
| 14 | 4/29 | Grand Challenge Practice –must complete at least 1 practice run, for credit! | |
| 15 | 5/6 | Grand Challenge Practice | |
| 16 | 5/13 | Grand Challenge<br>- **Final Project Videos Due 11:59pm Friday 5/16** - | |