

**ENPM 809T – Autonomous Robotics: Spring 2022 Syllabus**

Master of Engineering Program in Robotics

<b>Lecture Details</b>	Section 0101 & DE01	Section 0201
	Mondays from 4:00 pm to 6:40 pm JMP 2217	Thursdays from 4:00 pm to 6:40 pm JMP 2217

Course Zoom: <https://umd.zoom.us/j/95931531367>

<b>Instructor</b>	Steven E. Mitchell, Ph.D.
	Office: EGR 2128 Office Hours: 330-400pm Mon/Thurs in lecture hall and via Zoom lecture link <b>Preferred Means of Contact:</b> <a href="mailto:mitchels@umd.edu">mitchels@umd.edu</a>

<b>Grader</b>	Abhishek Nalawade ( <a href="mailto:abhi1793@umd.edu">abhi1793@umd.edu</a> )
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<b>Course Description</b>	<p>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.</p>
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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.

<b>Required Technology</b>	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).
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<b>Textbook(s)</b>	There exists no single textbook that comprehensively covers the material included in this course. The following resources are <b>optional</b> and will augment the lecture materials:
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- [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.

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 809T – Autonomous Robotics: Spring 2022 Class Schedule**

Master of Engineering Program in Robotics

Week	Dates	Topic / Event	Reading / Other
1	1/24 1/27	Course Introduction Introduction to Python <b>Homework #0.1 due: <a href="#">Speed dating</a></b>	Python Fundamentals <a href="#">sanitycheck.py</a> Siegwart Chp. 1 DeCaria Chp. 1-5, 7, 10
2	1/31 2/3	Introduction to Course Project Python & the Raspberry Pi <b>Homework #1 due: <a href="#">data in Python &amp; Bill of Materials confirmation</a></b>	<a href="#">Ground-up setup/config of Raspberry Pi</a> Siegwart Chp. 4 DeCaria Chp. 1-5, 7, 10
3	2/7 2/10	Perception <b>Homework #2 due: <a href="#">confirm RPi up and running, cv2.videoWriter()</a></b>	OpenCV Fundamentals via VNC QR codes Siegwart Chp. 4 Toth Chapter 1 IntroRemoteSensing.pdf
4	2/14 2/17	Perception <b>Homework #3 due: <a href="#">object tracking with RPi</a></b>	Lidar & Velodyne demo GPIO Sonar & coding interface with distance sensor Siegwart Chp. 4 IntroLidar.pdf VLP-16
5	2/21 2/24	Locomotion & Kinematics <b>Homework #4 due: <a href="#">arrow tracking &amp; orientation with RPi</a></b>	Assemble vehicle Mount RPi camera Siegwart Chp. 2-3
6	2/28 3/3	Locomotion & Kinematics	Assemble vehicle Overview of DC motors & H-bridge Teleoperated control of vehicle Siegwart Chp. 2-3
7	3/7 3/10	Locomotion & Kinematics <b>Homework #5 due: <a href="#">complete assembly of ground vehicle, teleoperation</a></b>	Open vs. closed-loop control Servo motors & Gripper Siegwart Chp. 2-3
8	3/14 3/17	Localization <b>Repeatedly drive robot in user-defined straight line</b>	Motor encoders Siegwart Chp. 5
9	3/21 3/24	<i>SPRING BREAK</i>	
10	3/28 3/31	Localization <b>Homework #6 due: <a href="#">servo gripper functionality, localization basic theory</a></b>	<a href="#">SMTP &amp; IoT sending videos/data back to control station</a> Map trajectory using Matplotlib Siegwart Chp. 5
11	4/4 4/7	Localization / Sensor Fusion <b>Homework #7 due: <a href="#">motor encoder tracking, forward reverse left right</a></b>	IMU sensor fusion BNO055 datasheet Siegwart Chp. 5
12	4/11 4/14	Planning & Navigation <b>Homework #8 due: <a href="#">IMU functionality</a></b>	<a href="#">Auto-rotation using block tracking algorithm</a> <a href="#">Autonomous object retrieval</a> Siegwart Chp. 6
13	4/18 4/21	Grand Challenge Practice <b>Homework #9 due: <a href="#">sequence of moves, plot trajectory in Matplotlib</a></b>	
14	4/25 4/28	Grand Challenge Practice	
15	5/2 5/5	Grand Challenge	
16	5/9	Open Session <b>- Final Project Videos Due 11:59pm Friday 5/13 -</b>	