

Course Schedule: Spring 2022 (Subject to Change)

Updated 2022-01-23

Class Date		#	Due	In Class	Out of Class
January	1/25 (T)	1		<i>Intro, Syllabus, Hardware. What is a Robot? Introduction to Robotics Areas. Short Overview of software tools.</i>	Syllabus Quiz. Install Python: Anaconda/Miniconda. Test CAE Labs with VNC remote desktop. Goals/Dreams Reflections. Skills and Interests Inventory. Python tutorials. Install Ubuntu and ROS. ROS tutorials.
	1/27 (Th)	2	Goals and Dreams Reflection (online) Skills and Experience Inventory (online)	<i>Discussion of G&D. Ethics discussion. Teams designated. Kinematics Warm-up Problems. Robot Kits, RasPi, Log in, Troubleshoot. Python Hello World.</i>	ROS: Introduction; Publish/Subscribe model. Nodes, Topics. Work Turtlesim tutorials. Assigned: Social/Ethical Issues paper.
February	2/1 (T)	3	Worked ROS examples. Quiz: Syllabus	<i>ROS Overview.</i> Hands-on: Turtlesim with publish and subscribe.	Sensors. Quadrature Encoders, Ultrasonic range, Light/Dark, Camera (RGB, RGBD), Inertial sensor.
	2/3 (Th)	4	Sensors Info.	<i>Sensors Q&A. Discuss Sensor choices.</i> Hands-on: Sensors in ROS	Actuators. DC and Servo Motors, Transmissions.
	2/8 (T)	5	Actuator Info.	<i>Actuators Q&A. Discuss Actuator choices.</i> Hands-on: Play with DC motors and Servos. Assemble Robot, ROS Motor Commands node.	DC Motors: Reflected Inertia, Motor Dynamics, PID Control. Motor Speed PID Control program Team Program: Control Motor Speed based on Sensor Input.
	2/10 (Th)	6	ROS programs: Motor Speed Control PID, Sensor Controls Motor	<i>Motor Dynamics Concept Problems.</i> Hands-on: DC Motor Control, ROS Motor PID ctrl. Control Motor based on Sensor Input(s)	rosviz, roslaunch, remapping teleop_key with turtlesim publisher
	2/15 (T)	7	Quiz: Sensors and Actuators	Hands-on: roslaunch, rosparam, rosbag, remapping	ROS Practice. Master ROS commands, roslaunch, remapping, rosbag, <i>rat_graph</i> .
	2/17 (Th)	8	Custom ROS node: goal-seeking controller Ethics Paper Due	<i>Mobile robot mechanisms (wheels) Application in Different Scenarios</i> Hands-on: ROS make-it-work	New Topic: ROS on a Network
	2/22 (T)	9	ROS Networking: remote control of Turtlesim	Hands-on: Distributed ROS make-it-work	New Topic: Mobile Robot Mechanisms & Kinematics. Node: Kinematic Simulation. Assigned: Mobile Robot Case Study
	2/24 (Th)	10	Node: Kinematic Sim. Mob. Robot Case Study. Quiz: ROS Structure	<i>Famous Mobile Robots</i> Hands-on: Differential Drive	New Topic: Open-Loop Path Following. Control settings - Lines and Circles. Simulate!
	3/1 (T)	11	Python programs: Simulated Paths. O.L. Path Following	Hands-on: O.L. Path Following <i>Compare to real motion</i>	New Topic: Odometry / Dead-Reckoning. ROS Node: Dead Reck. path reconstruction with plot
	3/3 (Th)	12	Node: Dead Reckoning with Plot	Hands-On: O.L. Path Following and Dead-Reckoning <i>Path Forensics</i>	New Topic: World Frame Path Planning. Closed-Loop Path Following. Catch up on ROS/simulations/etc.
	3/8 (T)	13	Simulated Paths: C.L. Path Following Quiz: Mobile Robot Kinematics	Hands-On: C.L. Path Following	Study for Midterm!

March	3/10	(Th)	14		MIDTERM 1	New Topic: Waypoint Seeking ROS node: goal-seekingcontroller
				Spring Break - No Class		
	3/22	(T)	15	Node: Waypoint-seeking controller	Hands-On: C.L. Path Following, Waypoint-Seeking	New Topic: Reactive Control. Wall Following. Obstacle Avoidance. LIDAR ROS: SLAM tutorial
	3/24	(Th)	16	Node: wall-following controller and/or launch file: LIDAR SLAM	<i>Obstacle Avoidance.</i> Hands-On: LIDAR and SLAM day 1	
	3/29	(T)	17		Hands-On: LIDAR and SLAM day 2	New Topic: Multi-Link Kinematics. Homogeneous Transform (2D). ROS Node: 2-link 2D kinematics
3/31	(Th)	18	Node: 2D kinematics QUIZ - Path following, Waypoint seeking	<i>2d Kinematics, Inverse Kinematics, Workspace. Homogeneous Transform (2D). Simulations in Class.</i>	New Topics: 3D Arm Kinematics, Homogeneous Transform (3D). ROS Node: 3-joint 3D kinematics	
April	4/5	(T)	19	Node: 3D kinematics	<i>3D Homog T'Form. 3D Workspace. Simulations in class</i>	New Topic: 2D & 3D Inverse Kinematics (IK). Design for IK Decomposition. ROS Node: 3D inverse kinematics
	4/7	(Th)	20	Node: 3D Inv. Kin.	Hands-On: Calibrating the Arm. Endpoint Positioning. Inv. Kin. Eqns.	New Topic: Trajectory Planning ROS Node: const. vel. interpolation
	4/12	(T)	21	Trajectory Planning Problems. Node: Interpolation	Hands-On: Continuous Trajectory Following	New Topic: Wrist Pose Control
	4/14	(Th)	22	QUIZ - Arm Kinematics.	<i>Q&A for Midterm.</i> Hands-On: Make Arms draw pictures.	Study for Midterm 2 Assigned: Final Robot Project Proposal
	4/19	(T)	23		MIDTERM 2	
	4/21	(Th)	24	Due 4/20: Project Proposal.	<i>ROS RVIZ, URDF for Arms. Computer Vision - OpenCV Project: consult with others, plan, Start</i>	<i>Work on Project</i>
	4/26	(T)	25	TBD	<i>ROS Utilities: Arms, Path Planning, Navigation, Simulation, etc.</i>	Assigned: Case Study of famous bipedal robot. <i>Work on Project</i>
4/28	(Th)	26	Case Studies: Famous Biped Robots	<i>Discuss Bipedal Robots. Balance, stability, control.</i>	New Topic: Force and Velocity Jacobians. <i>Work on Project</i>	
May	5/3	(T)	27	Problems on Jacobians	<i>Discuss Force and Velocity Jacobians. Force Control. Haptics.</i>	<i>Work on Project</i>
	5/5	(Th)	28	Quiz - Advanced Topics ?	<i>Last Day of Classes: "Other topics", Questions, Review and Evaluations.</i>	AEFIS - Skill/Interest Post-Eval - Feedback <i>Finish Project</i>
	5/8	(Su)		FINAL EXAM = Project Demonstrations	10:05am-12:05pm. Location TBD. Final Project Demo and Report	Disassemble and Return Robots!

Other Potential Topics:

Unmanned Aerial Vehicles (Drones), Fleets/Flocks of Robots, Human-Interactive Robots, Haptics, Bionics/Rehab. Robots