

Mechanical Engineering
ME5493 Fundamentals of Robotics
Syllabus
Part A- Course Outline

This is a pre-final version. The final version will be posted in the 2nd week of classes and will not have this note.

Course Description:

This course covers mobile robots and manipulators. Specifically, this course covers topics such as kinematics, dynamics, path planning, and control of robots. A LEGO based laboratory supplement the lectures. MATLAB and ROS (Robot Operating System) are extensively used for simulation and visualization.

Textbook(s) and/or required material:

- 1. No textbook required. Lecture notes will be provided by the instructor.
- 2. MATLAB from Mathworks. A free version is available for UTSA students. Go to my.utsa.edu -> ASAP -> Software Downloads
- 3. LEGO Mindstorms EV3 software, runs on Windows or Mac (freely available)
<https://www.lego.com/en-us/mindstorms/downloads/download-software>
- 4. LEGO Mindstorms EV3 toolkit (will be provided)

Other Books for Reference (no need to buy any of these books):

- 1. Robot Modeling and Control. By Mark Spong, Seth Hutchinson, M Vidyasagar. First Edition, Wiley, 2005. ISBN-10: 0471649902. ISBN-13: 978-0471649908
- 2. Introduction to Robotics: Mechanics and Control. John Craig. Third Edition, Pearson Prentice Hall, 2005. ISBN-10: 0201543613. ISBN-13: 978-0201543612
- 3. Principles of Robot Motion: Theory, Algorithms, and Implementations. By Howie Choset, Kevin M. Lynch, Seth Hutchinson, George A. Kantor, Wolfram Burgard, Lydia E. Kavraki, Sebastian Thrun. A Bradford Book. ISBN-13: 978-0262033275. ISBN-10: 0262033275.
- 4. Introduction to Autonomous Mobile Robots. By Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza. Second Edition. The MIT Press, ISBN-13: 978-0262015356, ISBN-10: 0262015358.

Major prerequisites by topic:

- 1. Linear Algebra, Calculus, Ordinary Differential Equations, Matrix Algebra
- 2. MATLAB (helpful to know but not required)
- ~~3. Using terminal in Linux (helpful but not required)~~

Topics covered:

- 1. Kinematics of mobile robots.
- 2. Forward and Inverse Kinematics of manipulators
- 3. Trajectory generation for manipulators.
- 4. Path planning for mobile robots and manipulators.
- 5. Numerical optimization.
- 5. Other topics if time permits: Dynamics and feedback control of manipulators, legged robots.
- 6. MATLAB: solving ordinary differential equations, optimization, least squares, creating animation.

Contribution of course to meet the professional component:

This course builds the foundation for preparing students to work professionally in the area of mechanical systems and robotics

Part B - General Course Information and Policies

Instructor: Pranav Bhounsule

- o E-mail: pranav.bhounsule@utsa.edu
- o Office: AET 2.338 Phone: (210) 458-6570

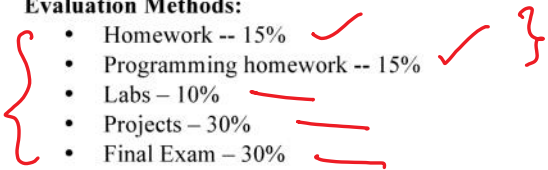
Class and Office Hours/Location:

- Class Hours: TR 10:00 am - 11:15 am
 - o Classroom: MH-3.03.06
- Office Hours: MT 11:30 - 1:00 PM
 - o Location: AET 2.338

Course Policies:

- On-line Blackboard System: Lecture notes/grades will be posted on UTSA Blackboard. Please make sure you have access to the course page and can receive message from the system.
- Homework:
 - o Homework will be due on Tuesday at the beginning of the class. You will submit a scanned copy of your HW through gradescope (<http://gradescope.com>) unless noted otherwise. No late submissions are allowed.
 - o **Please start the solution to each question on a new page.**
 - o You are encouraged to discuss homework solution with fellow classmates, however, everybody has to submit their own homework solutions to receive credit.
 - o Illegible handwriting will not be graded.
- Programming Homework
 - o All MATLAB code needs to be neatly commented.
 - o All MATLAB plots should have clear labels on the x-axis, y-axis with units and legends as needed.
 - o You are encouraged to discuss programming solution with fellow classmates, however, everybody has to submit their programs to the instructor/grader to receive credit.
- Labs:
 - o Labs can be done individually or in pairs.
 - o There are about 4 labs. The first lab is an introductory lab.
 - o Labs are done using LEGO Mindstorms kit. The instructor will provide the kit
- Projects
 - o There will be two projects: (1) Project 1: create an instructor assigned video game using MATLAB and (2) Project 2: create a robot to compete in an instructor assigned robotics challenge using LEGO Mindstorms.
 - o The project can be done individually or in pairs ideally with the same group members as the lab.
 - o The tentative dates for these projects are: Project 1, mid-March and Project 2, mid-April.
- Final Exam:
 - o There will be one exam in the last week of classes or during exam week (exact date is TBD).
 - o The exam will be take home and will have programming as well as pencil-paper type questions.

Evaluation Methods:

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- Homework -- 15%
 - Programming homework -- 15%
 - Labs – 10%
 - Projects – 30%
 - Final Exam – 30%

UTSA Policies and Resources:

“Please review UTSA’s Common Syllabus Information at the <http://utsa.edu/syllabus>. It includes information about: (1) Counseling Services, (2) Student Conduct and Scholastic Dishonesty, (3) Students with Disabilities, (4) Transitory/Minor Medical Issues, (5) Supplemental Instruction, (5) Tutoring Services, and (6) Roadrunner Creed.”

Scholastic Dishonesty: Scholastic dishonesty is a serious offense that includes, but is not limited to, cheating on a test, plagiarism, or collusion. Cases of suspected scholastic dishonesty will be prosecuted through the UTSA Office of Student Life (<http://www.utsa.edu/studentlife>), with the recommended penalty that the student receive a failing grade for the class.

Gun-free policy for private offices at UTSA

Pursuant to HOP 9.48, Carrying of Concealed Handguns on Campus, my private office AET 2.338 is a designated exclusion zone. As set out in Section 30.06, Penal Code (trespass by license holder with a concealed handgun), a person licensed to carry a Concealed Handgun under Subchapter H, Chapter 411 Government Code (handgun licensing law), may not enter this property/office with a concealed handgun.

De conformidad con HOP 9.48, Llevar Armas de Fuego Encubiertas en el Campus, mi oficina privada AET 2.338 es una zona designada de exclusión. Conforme a la sección 30.06 del código penal (trespasar portando armas de fuego) personas con licencia bajo del sub-capítulo H, capítulo 411, código de gobierno (ley de portar armas), no deben entrar a esta propiedad portando un arma de fuego.