

ENME808V - A Mathematical Introduction to Robotics
Department of Mechanical Engineering

Instructor:

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Credits: 3

Time: MW 10:00AM - 11:15AM

Location: EGL 1202

This course can be used to meet the Math requirement for the Ph.D. Program in Mechanical Engineering.

Introduction:

This course is designed to provide graduate students with an understanding of some of the concepts in robotics from a mathematical viewpoint. The first part of the course will cover basic concepts of Manifold, Jacobian, Group theory, Lie groups, Lie Algebra, and Lie Brackets. This knowledge will then be applied to:

- Rigid body motion in 3-D
- Velocity and acceleration analysis
- Robot kinematic singularities
- Motion planning
- Grasping
- Trajectory optimization
- Application areas – space robotics, mobile robotics, medical robotics, etc.

Textbook and Software:

Text - A Mathematical Introduction to Robotic Manipulation, by R. M. Murray, Z. Li, and S. S. Sastry, Published by CRC Press, ISBN: 0-8493-7981-4

Software - Students are required to use Mathematica software. This software will be used by them in the course to solve some of the problems. This software is also available at a highly discounted price through the university – probably \$10.

Suggested Reading:

S1) *Topics in Algebra*, I. N. Herstein, Published by John Wiley and Sons, ISBN: 0-471-01090-1

S2) *Matrix Groups*, Morton L. Curtis, Published by Springer, ISBN: 0-387-96074-0

S3) *Introduction to Theoretical Kinematics*, J. M. McCarthy, Published by The MIT Press, ISBN: 0-262-13252-4

S4) *Geometrical Methods in Robotics*, J. M. Selig, Published by Springer, ISBN: 0-387-94728-0 – *This is a good reference for those who want to get a differential geometric flavor of the material.*

Research Paper presentation

There will be several research papers that will be covered in this course to cover some of the above mentioned areas. Additional application area papers will also be presented in the course.