A. JAMES CLARK
SCHOOL OF ENGINEERING

**Course: ENPM 662 – Introduction to Robot Modeling**
**Instructor: William S. Levine**
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**Course Objectives:**
This course introduces basic principles for modeling a robot. Most of the course is focused on modeling manipulators based on serial mechanisms. The course begins with a description of the homogenous transformation and rigid motions. It then introduces concepts related to kinematics, inverse kinematics, and Jacobians. This course then introduces Eulerian and Lagrangian Dynamics. Finally, the course concludes by introducing basic principles for modeling manipulators based on parallel mechanisms. The concepts introduced in this course are subsequently utilized in control and planning courses.

**Grading Procedures:**
Homework 25%
Mid-term Exam 30%
Project 40%
Attendance and Class Participation 5%

**List of Student Learning Outcomes:**
1. Given a robot, the student will be able to create a reasonable mathematical model of the robot.
2. The student will be able to use the mathematical model to analyze the robots behavior and determine its capabilities.
2. The student will be able to simulate a robot using MATLAB/Simulink/SimMechanics.
3. The student will have the understanding of robot modeling that is needed for the design of robot controllers.

**Required Technology:**
Students will need a personal computer that has MATLAB/Simulink/SimMechanics. The software is available at no cost at http://www.it.umd.edu/techsavings/software.html

**Prerequisites:**
An undergraduate degree in Engineering, Mathematics, Computer Science, or Physics. A prior course in Mechanics would be helpful.

**Methods of Communication with Students Outside the Classroom:**
Email, electronic conversation via ELMS, telephone, in person.

**Written Absence Policy:**
Students are not required to attend class with the exception that the mid-term exam will be given in class and attendance is required. Note that classroom participation does contribute to the grade.

**Required/Recommended Textbooks:**
- *Robot Modeling and Control*, Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, ISBN-10 0-471-64990-2, John Wiley & Sons, 2006.

**Course Outline:**
Week Topics
1. Introduction
Simple examples
2. Rigid Motions and Homogeneous Transformations
3. Forward (configuration) Kinematics
4. Inverse Kinematics
5. Velocity Kinematics
6. Jacobian, Singularities, and Manipulability
7. Review
8. Exam
9. Path planning
10. Trajectory Planning
11. Actuator Dynamics and other Omissions from Standard Models
12. Euler-Lagrange Method
13. Newton-Euler Formulation
14. Review

**Code of Academic Integrity:**
The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity of the Student Honor Council, please visit http://shc.umd.edu/SHC/HonorPledgeInformation.aspx.