Lectures: MW 8:30–10:00am, 1200 EECS

Instructor: Prof. Dawn Tilbury, 3124 GG Brown, 936-2129, `tilbury@umich.edu`

Office Hours: MW 10:00–11:30am or by appointment

Texts (on reserve at the Duderstadt Center Library) and **Software** (free)

- (required) Spong, Hutchinson, and Vidyasagar, *Robot Modeling and Control*, Wiley, 2005.
- (required) Peter Corke, *Robotics Toolbox for Matlab*, an open-source freely available toolbox, download from `http://www.petercorke.com`
- (supplemental) Sciavicco and Siciliano, *Modelling and Control of Robot Manipulators*, Springer, 2000.
- (supplemental) Murray, Li, and Sastry, *A Mathematical Introduction to Robotic Manipulation*, CRC, 1994.
- (supplemental) Craig, *Introduction to Robotics: Mechanics and Control* Addison-Wesley, 1989.

Course Goals: This course provides an in-depth coverage of the central topics in robotics, namely geometry, kinematics, differential kinematics, dynamics, and control of robot manipulators. The mathematical tools required to describe spatial motion of a rigid body will be presented in full. In addition, we will cover motion planning, including obstacle avoidance methods and nonholonomic systems.

Target Audience and Prerequisites: This class is directed toward mechanical and electrical engineering and to some degree computer science graduate students. A basic understanding of linear algebra and differential equations is required. Programming experience will be helpful; MATLAB will be used extensively.

Course Format: This course will have a traditional lecture-based format with regular homework assignments, two exams, and a written project.

Grading: Final grades will be assigned based on the following:

Homework	25%
Midterm Exam	20%
Project	30%
Final Exam	25%

Homework: Homework will be assigned bi-weekly and will be due on Wednesdays.

Each student must turn in his/her own homework. Students may work together on the homework assignments, but individually prepared written material and Matlab code, without copying, is required. Consulting old copies of homework solutions, either from this course or a similar robotics course at another university, is not allowed.

Exams: There will be a midterm and a final exam. The midterm will be on **Wednesday, February 20, from 5–7pm.** The final exam schedule is **Thursday, April 17, from 10:30–12:30.** The exam will either be given during that two-hour time slot, or will be a take-home exam that is due at that time.

Class Schedule and Topics

Lec#	Date	Chapter	Topic	Assignment
L1	M Jan 7	1	Introduction	
L2	W Jan 9	2.1–2.3	Translations and rotations	
L3	M Jan 14	2.4–2.5	Composition and parameterization of rotations	
L4	W Jan 16	2.6–2.7	Rigid motions and homogeneous transformations	HW 1
	M Jan 21	no class	Martin Luther King day (office hours will be held)	
L5	W Jan 23	3.1	Kinematic chains, Denavit-Hartenberg parameters	Proposal
L6	M Jan 28	3.2	Spherical wrists, workspaces	
L7	W Jan 30	3.3	Inverse kinematics	HW 2
L8	M Feb 4	4.1–4.4	Differential kinematics and angular velocity	
L9	W Feb 6	4.6–4.8	Jacobians	
L10	M Feb 11	4.9	Singularities	
L11	W Feb 13	4.12	Manipulability	HW 3
L12	M Feb 18	5.1–5.2	Configuration space, potential fields	
	W Feb 20	no class	Exam 1, 5:00–7:00pm, will cover chapters 1–4	Exam 1
	M Feb 25	no class	Winter break, no office hours	
	W Feb 27	no class	Winter break, no office hours	
L13	M Mar 3	5.3	Roadmaps for planning	
L14	W Mar 6	7.1	Dynamics: Euler-Lagrange formulation	Midterm report
L15	M Mar 10	7.2–7.3	Dynamic equations of motion	
L16	W Mar 12	7.4–7.5	Properties of robot dynamics	HW 4
L17	M Mar 17	7.6	Dynamics: Newton-Euler formulation	
L18	W Mar 19	6.2–6.3	Single-joint control	
L19	M Mar 24	8.2	Control by feedback linearization	
L20	W Mar 26	8.3	Adaptive/robust control	HW 5
L21	M Mar 31	10.5	Nonholonomic mobile robots	
L22	W Apr 2	10.6–10.7	Planning for nonholonomic robots	
	M Apr 7		Project presentations	
	W Apr 9		Project presentations	HW 6
	M Apr 14		Project presentations	Final report
	Th Apr 17		Final Exam, 10:30–12:30, cumulative	Final exam