BIRZEIT UNIVERSITY

College of Engineering

Department of Mechanical Engineering

ENMC 532: Robotics

Fall 2017/2018

Credit Hours: 3

Prerequisites: ENME 332: Machine Dynamics
ENME 438: Control Theory

Instructor: Eng. Sima Rishmawi srishmawi@birzeit.edu

Office Hours: **MW 12:00 – 1:00 pm, R 12:00 - 1:00 pm,** or by appointment, **Office #: 314**

Lecture Room and Times: Section 1, SMW 1:00 – 1:50, Aqqad336

Textbook: Introduction to Robotics: Mechanics and Control, 3rd Edition
John Craig, Pearson, Prentice Hall.

References: [1] Peter Corke, "Robotics, Vision and Control, Fundamental Algorithms in MATLAB", Springer, 1st Edition, 2011.

[2] Foundations of Robotics. T. Yoshikawa. 1990.

ABET SOs:

(c) An ability to design a system, component, or process to meet desired needs.
(e) An ability to identify, formulate, and solve engineering problems.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Description:

Robot classification. Robotic systems; actuators, transmission elements, and sensors. Description of object location. Kinematics of manipulator position; joints, links, coordinate frames, matrices, homogeneous transformation, direct and inverse kinematics. Kinematics of manipulator motion; velocity, acceleration, differential motion, Jacobian. Trajectory generation. Static; compliance, inserting a peg into a hole. Dynamics; Lagrange formulations, Newton-Euler recursive formulations. Control; linear and nonlinear methods, position and force control. Programming languages.

Objectives:

This course aims at introducing the basic concepts of robotic manipulator systems, including position analysis (Transformations in 3D), and forward and inverse kinematics. The students should become able to model robotic manipulators, and solve inverse kinematic problems (Jacobian Transformation). Also, students will be able to perform dynamic analysis and forces, in addition to trajectory planning.

Intended Outcomes:

1. Recognize the different types of spatial rotations about fixed and moving axes, and obtain the rotation/translation matrix in a systematic way.
2. Solve manipulator's forward and inverse kinematics.
3. Solve velocity and static and dynamic force relations based on the Jacobian matrix.
4. Design the trajectory of the end effector of the manipulator to accomplish general conditions.

Grading:

Homework and Quizzes …… 5%
First Exam ……..... 20%
Second Exam ……..... 20%
Project ……..... 15%
Final Exam …….... 40%

Homework Assignments:

Over the course of the semester, you will be given some assignments that may need you to use a computer. These assignments will have a certain announced due date. You can work in groups, but it is your responsibility to fully understand the problems on your own, and submit your own work. Late submissions are not acceptable.

Throughout the semester, quizzes will be held in class. There will be NO make-up for these quizzes; if you miss a quiz, you get a zero.

Academic Integrity: (النزاهة الاكاديمية)

Academic honesty is very important to achieve high-quality education. While I encourage you to work together and form study groups, it is important that you take responsibility for the information you write on tests and quizzes. Cheating on exams or quizzes and/or copying from solution manuals will NOT be tolerated. When uncovered, the student will be immediately reported to the Dean of Students.

Attendance:

Students are required to attend ALL classes unless extraordinary circumstances occur. In this case, the student must provide a written excuse in the previous or following class. Any student who skips 7 classes (WITH or WITHOUT an excuse) including the first day will be dropped out of the course immediately, knowing that you will be informed after you skip 6 classes. This includes late registration students. If you skip an exam without informing the instructor beforehand or on the next day, you will be given a zero even if you provide a medical report afterwards.

There will be no make-up exams under any circumstance. If you miss an exam, you are required to present an excuse. If the excuse is acceptable, the grade of the missed exam will be estimated using the university equation. However if the excuse is not acceptable, you will be given a zero.

Topics:

1. Introduction
2. Spatial Description and Orientation
3. Manipulator Forward Kinematics
4. Manipulator Inverse Kinematics
5. Jacobian, Velocities, and Static Forces
6. Manipulator Dynamics
7. Trajectory Generation
8. Manipulator Control **