Eastern Mediterranean University
Faculty of Engineering
Department of Electrical and Electronic Engineering

EENG428 Introduction to Robotics

Year and Semester	**4, Spring**
Credit Hour	**(4,1) 4**
Pre/Corequisite(s)	**Math 106 (Linear Algebra)**
Academic Term	**Spring 2018-19**

Catalog Description:
Basic components of robot systems; coordinate frames, homogeneous transformations, kinematics for manipulator, inverse kinematics; manipulator dynamics, Jacobians: velocities and static forces , trajectory planning, Actuators, Sensors, Vision, Fuzzy logic control of manipulator and robotic programming.

Prerequisite by Topic:
Matrix addition, subtraction and multiplication. Inverse of matrix.

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Textbook:
Saeed B. Niku, *Introduction to Robotics 2e,* Wiley, 2011.

References:
Lung-S-Wen Tsai, *Robot Analysis*, John Wiley & Sons, Inc., 1999
K.S. Fu, R.C. Gonzalez, and C.S.G. Lee, *Robotics: Control, Sensing, Vision and Intelligence*, McGrawHill, 1987
H.Asada and J. Slotive, *Robot Analysis and Control*, John Wiley & Sons New York, 1986
J.J. Craig, *Introduction to Robotics Mechanics and Control,* Second Edition, Addison-Wesley, 1989

Course Objectives :
At the end of this course, students should be able to:

- *Describe* and *analyze* rigid motion.

- *Write down* manipulator kinematics and operate with the resulting equations
- *Solve* simple inverse kinematics problems.
- *Select* sensors for performing robotic tasks
- *Solve* motion planning problems.

Design Component:

Engineering Science Credit:	3
Engineering Design Credit	1

COURSE OUTLINE

WK #	HRS	D E S C R I P T I O N
1-2	6	Fundamentals. What is a Robot? Classification of Robots. What is Robotics? History of Robotics. Advantages and Disadvantages of Robots. Robot Components. Robot Degrees of Freedom. Robot Joints. Robot Coordinates. Robot Reference Frames. Programming Modes. Robot Characteristics. Robot Workspace. Robot Languages. Robot Applications. Other Robots and Applications. Social Issues.
2-5	12	Robot Kinematics: Position Analysis. Robots as Mechanisms. Matrix Representation. Homogeneous Transformation Matrices. Representation of Transformations. Inverse of Transformation Matrices. Forward and Inverse Kinematics of Robots. Denavit-Hartenberg Representation of Forward Kinematic Equations of Robots. The Inverse Kinematic Solution of Robots. Inverse Kinematic Programming of Robots. Degeneracy and Dexterity. The Fundamental Problem with the Denavit-Hartenberg Representation.
5-7	8	Differential Motions and Velocities. Differential Relationships. Jacobian. Differential Motions of a Frame. Interpretation of the Differential Change. Differential Changes Between Frames. Differential Motions of a Robot and Its Hand Frame. Calculation of the Jacobian. How to Relate the Jacobian and the Differential Operator. Inverse Jacobian. Design Project.
		Midterm Examination
9-10	6	Dynamic Analysis and Forces. Lagrangian Mechanics: A Short Overview. Effective Moments of Inertia. Dynamic Equations for Multiple-Degree-of-Freedom Robots. Static Force Analysis of Robots. Transformation of Forces and Moments Between Coordinate Frames. Design Project.

11-12	8	Trajectory Planning Path vs. Trajectory. Joint Space vs. Cartesian-Space. Basics of Trajectory Planning. Joint space trajectory planning, Cartesian space trajectories.
13-14	8	Presentations Actuators, Sensors, Image Processing and Analysis with Vision Systems, Fuzzy Logic Systems
16-17		FINAL EXAMS

Computer Usage:
Students are encouraged to use internet to search for various topics, including contents of similar courses offered elsewhere. MATLAB is used for manipulator kinematics, dynamics and orientations. Students can reach teaching material, solved problems, data sheets etc. on the allocated Web sites.

Teaching Techniques:
Power point presentation and white board are used in the classroom.

Laboratory/Studio Works:
Laboratory sessions are organized in parallel to theoretical study given in classrooms. Students perform at least 10 different experiments and submit reports for evaluation

GRADING POLICY

Mid-term Examination	30%
Homeworks and Quizzes	15%
Lab	15%
Final Examination	40%
Participation to Mini Sumo Robot Competition	15-40%

ACADEMIC HONESTY
Copying from others or providing answers or information (written or oral) to others is cheating. Copying from another student's paper or from another text without written acknowledgement is
plagiarism. According to University's by-laws cheating and plagiarism are serious offences resulting in a failure from exam or project and disciplinary action (which includes an official warning or/and suspension from the university for up to one semester).

NG Policy:
Attendance to the classes is compulsory. All students who receive a failing final grade and attend the classes less than 60% will receive the grade **NG**.

Make-Up Examination Policy:
Students missing an examination should provide a valid excuse within three days following the examination they missed. No separate make-up exams are administered for midterm and final exams. Students who fail to attend less than 60% of classes will not be given Make-up examination.