1. Course Number and Name: 415 CPE – Robotics

2. Credits and Contact Hours: 3 Credit

a. Lecture – 2 day per week at 50 minutes for 16 weeks
b. Laboratory – 1 day per week at 100 minutes for 16 weeks

3. Course Coordinator or Instructor:

Dr. Mohammed Shiblee

4. Text Book:

- Introduction to Robotics, Analysis, System, Application by S. B. Niku, Prentic Hall, 2001.
- Introduction to Robotics, Mechanics and Control, by John J Craig, Prentic Hall, 2005.

5. Specific Course Information:

a. **Catalog Description:** This subject examines fundamental principles used for the design of robots and also various control mechanisms used to plan the movement and control of robots.

b. **Prerequisites:** 321 CPE Automatic control system

c. **Status:** Required

6. Specific Goals for the Course:

a. Course Outcomes:

1. State the concept of sensors and actuators and Identify sensors and actuators required for specific applications.
2. Write the current job market, recent development and key components of robotics technologies.
3. Explain programming principles in MATLAB and Labview for robot control.
4. Develop an ability to design hardware and software to build a robot that can perform a task.
5. Explain the impact of robotics in a global and economical context.
6. Demonstrate act responsibly and ethically in conducting their work.
7. Demonstrate skills of documentation and communication to ideas of robotics.

b. Student outcomes in Criterion 3 addressed by course:

Course LOs #	Map course LOs with the program LOs. (Place course LO #s in the left column and Student LO #s across the top.)											
	Student Learning Outcomes Use LOs Codes											
	a1	**a2**	**b1**	**b2**	**b3**	**b4**	**c1**	**c2**	**c3**	**c4**	**d1**	**d2**
1	√											
2		√										
3				√								
4					√							
5							√					
6									√			
7											√	

7. List of Topics: 415CPE – Robotics

List of Topics for Theory:

- **Introduction to Robotics:** Overview of issues and challenges in Autonomous Robotics, Robot Definition, What is in a Robot, Types of Robots and brief introduction, Issues from robot perspective, Typical Mobile robot Implementation
- **Sensing Techniques:** Understand various definitions related to sensing, different sensor types, Understand challenges of sensing and perception in robotics, Attributes of a sensor, Sensor Fusion, Types of Multiple Sensor Combinations, Classification of Sensors, Proprioceptive Sensors, Dead Reckoning/Encoders, Inertial Navigation System, Differential Global Positioning System, DGPS Challenges, Gyroscopes, Proximity Sensors, Infrared, Bump and feeler sensors, Sonar (Ultrasonic), Sonar Challenges, Modeling common sonar sensors.
- **Manipulator kinematics:** Introduction, Link description, link-connection description, convention for affixing frames to links, manipulator kinematics, actuator space, joint space, and Cartesian space, examples: kinematics of two industrial robots, frames with standard names.
- **Inverse Kinematics:** Introduction, Solvability, the notion of manipulator subspace when n <6, algebraic solution by reduction to polynomial, examples of inverse manipulator kinematics, the standard frames, solving a manipulator, repeatability and accuracy.
- **Topological Path Planning:** Define natural and artificial landmarks and gateways, understand the relational method, and understand the associative method. Trajectory Generation, Joint Space scheme, Cubic polynomials for a path.
- **Navigation and Metric path planning:** Introduction to Navigation, Understand the Meadow maps, Generalized Voroni graph and A* search techniques for metric path planning. Force control of manipulators, a framework for control in partially constrained tasks, and the hybrid position/force control problem.

List of Topics for Laboratory:

- Evaluate Joint Positions in R-RRT robotic mechanism using LABVIEW.
- Evaluate Joint Angles in Slider- Crank robotic mechanism using LABVIEW.
- Sub-VI to find joint positions and to find the area under the robotic mechanism
- Forward Kinematics of the TWO – LINK Robot using LABVIEW
- Inverse Kinematics of the TWO – LINK Robot using LABVIEW (Case-1:Elbow Up)
- Inverse Kinematics of the TWO – LINK Robot using LABVIEW (Case-1:Elbow Down)
- Modeling and forward kinematics of two-arm robot using Robotics Toolbox of Matlab
- Modeling and forward kinematics of PUMA560 robot using Robotics Toolbox of Matlab.
- Movement of Puma560 robot from one state to another state using Robotics Toolbox of Matlab.
- Movement of Puma560 robot under gravity using Robotics Toolbox of Matlab.
- Forward & Inverse Dynamics of the PUMA robot, Line Follower robot using PROTEUS SOFTWARE.