Virginia Western Community College
ETR 286
Principles and Applications of Robotics

Prerequisites

ETR 113- Studies DC and AC circuits, basic electrical components, instruments, network theorems, and techniques used to predict, analyze and measure electrical quantities.

Corequisites
None

Course Description
Provides an overview of terminology, principles, practices, and applications of robotics. Studies development, programming; hydraulic, pneumatic, electronic controls; sensors, and system troubleshooting.

Semester Credits: 3 Lecture Hours: 2 Lab Hours:2

Required Materials

Textbook:
Various resources provided by instructor

Software:
All software available in the VWCC Labs

Other Required Materials:
None

Course Outcomes

At the completion of this course, successful students will be able to

- Understand gear types and gear ratios
- Understand belt drives and belt types
- Understand the benefits of pneumatic and hydraulic actuation
- Understand the basics of a vacuum system for gripping
- Understand how sensors and sensing are used for closed-loop actuation
- Understand how linkages are used to enhance degrees of freedom.
- Understand how to calculate degrees of freedom

- Describe and draw all the robot joint types
- Understand the various reference frame definitions in a multi-joint robot
- Define Forward and Inverse Kinematics and when they are used
- Construct simple Denavit-Hartenburg diagrams for multiaxis robots
- Calculate rotation and translation transformations for a simple 2D robot
- Manipulate transformation matrices for a 3D robot.
- Understand the robot coordinate system and the differences between Cartesian and polar systems
- Understand how gcode works with a coordinate system
- Understand the different robot configurations
- Understand how to program a pick and place robot (SCARA)
- Understand the advantages and disadvantages of a collaborative robot
- Teach and Program a collaborative robot
- Program a collaborative robot which interfaces with other hardware (i.e. conveyor belts and safety equipment)

Topical Description

- History of Robotics by Universal Robots
- Gears and Belts
- Electrical actuation-Steppers and Servos
- Intro to Degrees of Freedom
- Robot joint types
- DC motors and encoder resolution
- Polar vs. Cartesian translation
- Intro to user frames and kinematics
- Mech/Actuation-Fluid Power
- Epson SCARA with vacuum gripper.
- Offline Programming using multi-axis robot
- SCARA Teaching and I/O
- Fanuc industrial robot operation
- Intro to D-H parameters
- Simple D-H transformations
- Universal Robot operations and motion
- Universal Pick and Place
- Universal Robot programming
- Universal Robot subprograms
- Universal Robot palletizing
- Universal Robot features and planes
- Universal Robot safety and force feedback

- Universal Robot Gcode

Notes to Instructors

Beginning Fall 2020, VWCC will require students to have a computer or reliable access to a computer, capable of participating in an online format. Online courses at Virginia Western require a significant amount of interaction with Canvas, the Learning Management System, and many require real-time class sessions using the Zoom web-conferencing tool. To be successful in online classes, students must have substantial access to a computer with hi-speed internet connectivity. The expected requirements are listed on the college webpage.

This class uses the Universal Robot Academy Training Material to prepare students for a certification in collaborative robot programming. Students will be able to receive a UR certification at the finale of the class.

ADA Statement (PDF)
Title IX Statement (PDF)