

MET-1640: ROBOTICS AND PROGRAMMABLE LOGIC CONTROLLERS IN PROCESS AUTOMATION

Cuyahoga Community College

Viewing: MET-1640 : Robotics and Programmable Logic Controllers in Process Automation

Board of Trustees:

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Academic Term:

Fall 2021

Subject Code

MET - Mech Eng/Manuf Ind Eng Tech

Course Number:

1640

Title:

Robotics and Programmable Logic Controllers in Process Automation

Catalog Description:

Introduction to automation concepts in the industry, AC/DC drives, PLC configuration, programming, and troubleshooting. Covers Industrial robots programming, operations, and set up. Includes handling tool applications, testing, and refining the program to interface with other production equipment. Prepares students for Rockwell PLC certification and Fanuc Robotic Tool Handling C-certification.

Credit Hour(s):

5

Lecture Hour(s):

2

Lab Hour(s):

9

Requisites

Prerequisite and Corequisite

MATH-0910 Basic Arithmetic and Pre-Algebra, or sufficient score on placement exam; or departmental approval; and MET-1120 Computer Applications and Programming or concurrent enrollment.

Outcomes

Course Outcome(s):

Apply the basic concept of PLC's process control and Robotic tooling in manufacturing automation.

Objective(s):

- a. Demonstrate how to program PLC and its application in controlling processes.
- b. Set up robotic interface for given manufacturing operations.
- c. Interconnect manufacturing equipment and robots using PLCs.

Course Outcome(s):

Distinguish appropriate automation and connections required for industry 4.0 process control.

Objective(s):

- a. Explain the role of PLCs in process control.
- b. Explain machine connectivity through PLCs.
- c. Explain robotic tooling and operation in manufacturing.

Course Outcome(s):

Apply appropriate process control using PLCs and robotics in an industrial setting.

Objective(s):

- a. Describe PLCs operation and processes.
- b. Program and tool robotics for manufacturing operation.
- c. Explain integration and connectivity between different types of equipment.

Course Outcome(s):

Set up robot for programming and operations.

Objective(s):

- a. Identify the robot components.
- b. Identify and learn the robot's major and minor axes, joints, and links.
- c. Describe servo motors and serial pulse coders.
- d. Describe what software and operating system that drive robots' operations.
- e. Identify with controller types.
- f. Discuss the different deadman switch positions and how the robot reacts.
- g. Identify and describe the robot's teach pendant.
- h. Learn functions of teach pendant key.
 - i. Differentiate between standard teach pendant and iPendant.
 - j. Differentiate between quick and full menus.
- k. Describe the function menu and status indicators
 - l. Discuss different deadman switch positions and how robots react.
- m. Power up, jog, and perform initial setup of the robot.
- n. Identify the robot frames.
- o. Describe the cartesian coordinate system.
- p. Identify the WORLD Frame, TOOL Frame, USER Frame, and JOG Frame.
- q. Access the position screen and how the location and orientation is measured.
- r. Jog in different jog coordinates.

Course Outcome(s):

Create, record, interpret, and troubleshoot programs for robot.

Objective(s):

- a. Create a motion program.
- b. Practice the program naming methods.
- c. Explain program details.
- d. Record a position.
- e. Interpret motion instructions.
- f. Test the program.
- g. Explain and practice how to add and delete motion instructions.
- h. Explain the use of redefined positions.
 - i. Create and edit program.
 - j. Program Instruction branching
- k. Apply position register instructions and positional register statement.

- l. Apply the OFFSET, PR [i, j] motion option instruction.
 - m. Apply miscellaneous instructions in a program.
 - n. Program robot's IO's.
 - o. Create and assign a macro program.
 - p. Create a program adjust schedule.
 - q. Perform program adjustments.
 - r. Perform program and file handling and preservation activities.
 - s. Recognize errors and faults and perform robot recovery.
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Methods of Evaluation:

- a. Quizzes
- b. Text assignments
- c. Tests
- d. Laboratory assignments
- e. Participation
- f. Instructor observation/evaluation of student lab exercise performance

Course Content Outline:

- a. Identifying drive system components and concepts
 - i. Identifying line protection and filtering methods
 - ii. Recognizing DC motor functions controlled by DC drives
 - iii. DC drive hardware and functions
 - iv. Recognize AC motor functions controlled by AC drives
- b. Identifying breaking methods for AC and DC drive systems
 - i. Comparing AC and DC drive systems for basic applications
- c. Preventing electrostatic damage to drive components
 - i. Identifying electrical measuring tools and functions
 - ii. Identifying basic startup procedures for AC and DC drives
- d. Using HIM to configure, control, and monitor a drive
 - i. Performing preventive maintenance and basic troubleshooting for drives
- e. Robot safety
 - i. Keeping people safe
 - ii. Using safety-enhancing devices
 - iii. Setting up a safe work cell
 - iv. Safety during automatic operation
- f. Robot System
 - i. Components
 - ii. Major and minor axes
 - iii. Joints
 - iv. Links
 - v. Servo motors
 - vi. Brakes
 - vii. Serial pulse coder
 - viii. Software and operating systems
 - ix. Controllers
 - x. Deadman switch positions
 - xi. Standard operation panel
 - xii. Starting up the controller
 - xiii. Powering down the controller
- g. Teach pendant
 - i. Functions
 - ii. Standard teach pendant vs. iPendant
 - iii. Quick menu
 - iv. Full menu
 - v. Function menu

- vi. Status indicators
- vii. Deadman switch positions
- h. iPendant
 - i. iPendant overview, switches, keys
 - ii. Energy stop button
 - iii. Menu navigation
- i. Power up, jogging and initial setup
 - i. Powering up robot
 - ii. Jogging the robot in joint and world
 - iii. Viewing positional data
 - iv. Robot axes limits
 - v. Robot mastering
- j. Jogging
 - i. Jog speed
 - ii. Coordinate system
 - iii. Jogging in joint
 - iv. Right-hand rule
- k. Error and faults recovery
 - i. Common faults and errors
 - ii. Robot singularity
 - iii. Recovering robot from DCS faults
 - iv. Chain failure detection error
- l. Frames
 - i. Cartesian coordinate system
 - ii. World frame
 - iii. Tool frame
 - iv. User frame
 - v. Jog frame
 - vi. Position screen
 - vii. Measuring location and orientation
 - viii. Jog coordinates
- m. File manipulation/ initial setup
 - i. Types of backup
 - ii. Setting the default device
 - iii. File backup
 - iv. Axis limits setup
 - v. Axis limits software setting
 - vi. Alarms
 - vii. Frames
- n. Creating a program
 - i. Motion instruction
 - ii. Edit command
 - iii. Input and outputs
 - iv. Breaching
 - v. Macros
 - vi. PR offset and misc. instruction
- o. Motion programs
 - i. How to create a motion program
 - ii. Program naming methods
 - iii. Program details
 - iv. Recording a position
- p. Motion Instructions
 - i. Testing the program
 - ii. Motion types
 - iii. Elements that describe a motion instruction
 - iv. Position register
 - v. Robot speed
 - vi. Termination types

- vii. Motion option
- viii. Adding motion instructions
 - ix. Deleting motion instructions
 - x. Use of redefined positions
- q. Copying and editing programs
 - i. Inserting a blank line into a program
 - ii. Deleting lines from program
 - iii. Finding program instructions within a program
 - iv. Replacing items
 - v. Renumbering positional ID's
 - vi. Copying a program
 - vii. Copying and pasting program lines
 - viii. Comments, replace, remark, renumber and undo commands
- r. Branching
 - i. Unconditional branching instructions
 - ii. Use of data registers
 - iii. Conditional branching
 - iv. If and select instructions
 - v. Wait instructions
- s. Instructions-position register and miscellaneous
 - i. Position register instructions
 - ii. Positional register statement
 - iii. OFFSET, PR [i,j] motion option instructions
 - iv. Miscellaneous instructions
- t. Inputs and outputs
 - i. I/O signals
 - ii. Types of hardware
 - iii. Configuration
 - iv. Monitoring of control I/O
 - v. Group I/O
- u. Macros
 - i. Creating a macro program
 - ii. Assigning a macro
 - iii. Program adjust schedule
- v. Program adjustment
 - i. Adjusting programs running in auto
 - ii. Deleting program from select menu
- w. Program and file manipulation
 - i. File backup
 - ii. Image backup
 - iii. Restore
 - iv. Setting the default storage device
 - v. Loading program from device after generating a directory
- x. Post-test
- y. Mastering

Resources

MATAGHAND0318CE. *Handling-Tool Operations and Programming Fanuc America corporation*. E. 2018.

Dwinwiddle, Keith. *Basic Robotics*. Boston, MA: Cengage Learning, 2016.

Dinwiddie, Keith. *Industrial Robotics*. Boston, MA: Cengage, 2018.

FANUC America Corporation. *Handling Tool Operations & Programming*. FANUC America Corporation, 2014.

Resources Other

AC and DC Drives Allen-Bradley. Rockwell Automation publication TCT-ADD-TLB- DEC 2012

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