Division: Technical
Subject Code: ELME Course: 215
Course Title: Robotics and Motion Control

Thaddeus Stevens College of Technology

Master Course Form

Catalog Description: This course provides the student with a background in the programming and application of industrial robots and general purpose synchronized multi-axis motion control. Whereas in Rotating Electrical Machines the student learned how various types of motors and drives operate to create motion in a single axis, this course expands upon those concepts by combining multiple axes of motion to perform useful functions such as creating a flexible manufacturing system utilizing robots. In Introduction to PLC's, the student learned how to apply programming to create sequences of events. This course broadens that knowledge by using different programming languages to initiate and control motion sequences. The student will learn how to implement electronically many of the simple machines introduced in Industrial Mechanical Systems 1 & 2 such as gear drives, belt drives, line shafts and cams.

Digital Description:

- Credit Hours: 4
- Lecture Hours: 3
- Lab Hours: 3

Prerequisites: **Minimum Grade Required - D**

- ELME 109 – Programmable Logic Controllers 1
- ELME 116 – Mechanical Systems 2
- ELME 117 – Electrical Systems 2

Corequisites:

- PHYS 213 – General Physics I

Course Objectives:
Upon completion of this course, the student will be able to:

1. Describe Safety Components and Classifications
2. Demonstrate knowledge of Sensors Tooling and Peripheral Systems
3. Perform Robot Operational Programming
4. Explain file management
5. Toubleshooting and repair robotics systems

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Learning Outcomes:

Upon successful completion of the course, the student should be able to:

1. Describe safety rules and devices for working with or around industrial robots.
2. Describe advantages, functions, components, operation and applications of industrial robots and end effectors.
3. Describe how robots are applied to material handling, plastic injection molding, CNC machine loading, and parts inspection.
4. Describe how robots are applied to packaging of food and consumer products by collating, picking, placing, orienting, cartooning, casing and palletizing.
5. Describe the function, operation, storage and retrieval of robot programs and position points.
6. Describe the use, function and operation of on-line programming, off-line programming, teach pendants, operator stations, and digital inputs and outputs for industrial robots.
7. Use a teach pendant to teach robot position points, test points and edit points.
8. Use a teach pendant to enter, test, edit, run, stop, store, delete, and retrieve robot programs and to power up, shut down, jog, home and operate the arm and gripper of an industrial robot.
9. Use a teach pendant to test digital inputs and outputs.
10. Use a PC and robot programming software to design, enter, edit, upload, download, delete and run robot programs and to power up, power down, jog and home a robot.
11. Use flow charts to design programs with conditional, branching, subroutine, multitasking and interrupt functions.
12. Use variable names, variables, global variables, point variables and point arrays in a robot program.
13. Use the Cartesian coordinate system to command robot position and program with World Coordinates and Tool Coordinates.
14. Demonstrate how to connect, configure, program and operate a robot in conjunction with both servo-driven and non-servo-driven conveyors.
15. Design robot programs to handle material, use operator stations, unload an automatic machine, interface with conveyors, sort parts, measure parts, provide an operator interface on a computer screen, perform palletizing, perform point-to-point assembly, perform linear motion assembly, and exchange data with a barcode reader or gauge.
16. Describe how to interface a robot to other machines such as a CNC or packaging machine using solid state I/O, relays or RS-232 serial communications.
17. Use robot simulation software to design a workcell.
18. Describe the functions, components and operations of general purpose, synchronized, multi-axis motion control.
19. Describe the use of real and virtual master axes.
20. Demonstrate the operation of electronic camming, gearing, lineshafting and clutching.
21. Describe the need for deterministic networking for the implementation of synchronized multi-axis motion control. Describe the applicable standards and commonly used networks for motion control.
22. Describe the PLC Open motion function blocks.

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23. Describe the purpose of International Standards and the advantages and disadvantages of applying standards-based control.
24. Use PLC Open motion function blocks to implement a synchronized multi-axis motion application.
25. Describe how multi-axis motion control is applied to construct a robot arm.
26. Describe the issues of interfacing a high speed synchronized motion application with a PLC.
27. Troubleshoot a multi-axis motion system.

Planned Sequence of Learning Activities:

- Automated materials Handling Systems
- Flexible Manufacturing Systems
- General Purpose Motion Control System
- Multi-Axis Motion Control System

List of Texts, References, Selected Library Resources or other Learning Materials:

Basic Robotics, 1st Edition | 9781133950196

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