Syllabus: Robotic Welding, MECH 2700

Part 1: Course Information

Description

This course is a basic robotic welding programming class. Students will be introduced to robotic welding systems as well as learn how to perform basic procedures on a system. The student will learn how to create welding routines, program their own weld paths, and be able to store and retrieve programs and parameters. Students will learn to program a welding robot through a teach pendant and through simulation software, edit programs, set weld schedules, as well as learn basic operator controls and indicators on the teach pendant and operator panel. This course also provides fundamental safety precautions while programming and operating the robotic equipment.

This course is designed to meet over a period of 14 weeks, 1 meetings per week, and 3 hours per meeting in a combined lecture-lab meeting.

Prerequisites

None

Required Materials

List of materials students should purchase

Recommended Reference Materials

Tools to be used

Part 2: Course Learning Outcomes (CLOs)

The course learning outcomes are to have students:

1. Use appropriate safety precautions while programming and operating the robot system.
2. Use and explain the operator controls and indicators on the teach pendant and standard operating panel (SOP).
3. Explain the fundamentals of teach pendant and arc tool programming languages and menu structures.
4. Correctly position the robot using teach pendant and various motion types.
5. Implement welding program structure and operation including straight line, circles, and weaving fundamentals.
6. Use proper editing procedures, program commands/functions, and basic error recovery techniques.
7. Conduct proper torch and wrist alignment checks and set up a Tool Center Point.
8. Set up/incorporate User, Tool, and Jog frames into a weld program.
9. Create Position Registers, manipulate Inputs/Outputs (I/O)
10. Make temporary adjustments to weld points to compensate for batch runs.
11. Program weld commands and parameters, monitor feedback signals, and change weld procedures in the middle of a weld.
12. Use logic instructions to simplify programming of parts with multiple, similar weld joints.

Part 3: Course Topics and Roadmap

Roadmap

The following roadmap is recommended for instructors

Week	Student Learning Outcomes	Content to be covered	Student Assignments and Supplementary Material
1	1,2,3	Safety Lock-out/Tag-Out Software Introduction - Getting started with WeldPro™	PPT 1 Intro & Safety PPT 2 Basic Robot Operations Safety Procedures on and around the robot
2	1,2,3	Motion Types Termination Types Position Data Travel Speeds Cell Browser – navigation, view manipulation, adding objects to cell browser, selecting objects	PPT 3 Teach Pendant Operations PPT 4 Power up, Jog, Initial set-up WeldPro SW: WorkCell Creation Wizard + Robot Motion Robot: Power up, Jogging, & initial set-up Labs 1 thru 6
3	1,2,3,4,5	Robot coordinated motion (COORD) WORLD, TOOL, USER, and JOG Frames Working with fixtures, parts	PPT 6 Frames PPT 7 Motion Programs WeldPro SW: adding objects to work cells, creating program Robot: creating a Teach Pendant

		Creating a Robot program Quiz 1	program Labs 7 thru 9
4	1,2,3,4,5	Create and test a program using speed rules Testing a program and getting around obstactacles Saving time in motion	PPT 8 Motion Instructions PPT 9 Copy/Edit Programs WeldPro SW: Motion Instructions Robot: Motion Instructions, Copy/Edit programs Labs 10 thru 14
5	1 - 6	Motion changes, speed changes Position duplication Branching of programs	PPT 10 Branching instructions WeldPro SW: programming a path, joint, linear, circular motions Robot: program editing from TP Labs 17 thru 19
6	1 – 6	Programming patterns with PRs Using Position Registers Quiz 2	PPT 11 Position Registers WeldPro SW: programming tasks Robot: Teach Pendant programming tasks Lab 20
7	1 - 7	Turn weld on Program full and half circle Entering and Changing Weld Procedures Torch and Wrist Alignment Tool Center Points Mid Term Exam	WeldPro SW: Creating a Tool Center. Point, Tool and Wrist Alignments Robot: Circle and Half Circle programming Tool Center Points Weld procedures Lab 21 Inputs and Outputs
8	1 - 8	Program a circle to weld and test run Assigning Macros Adjust program to compensate for batch runs	PPT 13 Macros PPT 14 Program Adjust WeldPro SW: individual programming tasks Robot: Lab 12, individual programming Lab 22
9	1 - 9	Adjust weld points for batch runs Programming Weave Patterns Correct weld deformities in patterns using Program Adjust Quiz 3	 WeldPro SW & Robot: weave patterns Robot: Lab 13, individual programming tasks
10	1 - 10	Weld commands and parameters (wait and timer instructions)	WeldPro SW: Commands and modifying parameters

		Feedback signals	Robot: Lab 14, individual programming tasks
11	1 – 12	Program manipulation Logic instructions Zero Program File management	WeldPro SW: Logic instructions, program adjust Robot: individual programming tasks
12	1 – 12	6-point tool center point Editing programs; on-the-fly changes to weld procedures Quiz 4	WeldPro SW: Program adjust; Program & File manipulation Robot: individual programming tasks
13	1 - 12	Program editing using "replace" command Individual programming tasks	WeldPro SW: Robot: individual programming tasks Robot: individual programming tasks
14	1 -12	Individual programming tasks	Individual programming tasks
15	1 -12	Individual programming tasks	Individual programming tasks
16	1 – 12	Final Exam	

Part 4: Grading and Assessment

Graded Assignments

Course grades are determined through programming assignments in class and participation. Instructor to create quizzes and exams as needed.

Proposed Grading Schedule

- Participation 10%
- Quizzes or Exams 30%
- Lab Assignments 60%

Part 5: Notes to Program Administrators

Resources

- Welding / Material Handling Robots
- Computer lab with FANUC WeldPro software

Instructor Qualification

- Bachelor's or higher degree in a qualifying field or
- Bachelor's or higher degree in any discipline and certifying credentials:
  - 30 undergraduate hours or 18 graduate hours of coursework in a qualifying field, or

- Bachelor's or higher degree with relevant supplemental experiential experience:
  - Two years professional employment or
  - Research or publications, or
- A.A.S. in a qualifying discipline and four years of relevant professional employment

Qualifying fields:
Mechanical or Electrical Engineering (including their subdisciplines and related interdisciplinary engineering fields)
Engineering Technology
Mechatronics/Industrial Automation or equivalent field

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