Syllabus, MFG 199--Robotics
Spring 2014

Course and Instructor Information

Instructor: Mike Mattson
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Office Hours: Appointments are recommended—503-594-3318

Course Title: MFG 199, Introduction to Robotics
Credits: 2, 44 Hours Lecture/Lab
Meeting Time: T/TH 1-2:50, B
Textbook (required):
Title: CERT MH eLearn Web Courses Materials
Author: FANUC Automation
Publisher: FANUC Automation

Other Materials: Safety glasses, notebook, scientific calculator.

Course Description:
This course is an introduction to robotics and industrial motion control. Students will be exposed to the operation, programming and applications of a typical FANUC, six-axis industrial robot. Hands-on activities will include manual teach programming, testing with simulation software and programming of advance movements.

Student Learning Outcomes:
At the successful conclusion of this course the student will be able to:

1. demonstrate the safe, manual operation of a FANUC industrial robot;
2. manipulate the robot with the teach pendant and record simple motions such as machine loading and stacking,
3. perform software simulations to verify correct motion and timing of programs,
4. interface robotics hardware with a CNC machine tool to facilitate automated machining,
5. access the machine vision capabilities of the robot to select objects based upon shape, orientation and color.

Course Prerequisites:
None. Recommended: MTH 50 and MFG 209

Major Topic Outline:

1. Introduction to robotics
2. Manual operation and safety
3. Robot programming

4. Industrial applications
5. Electromechanical systems
6. Fluid power systems
7. End-of-arm tooling and sensors
8. Interfacing robots with other industrial systems
9. Machine vision
10. Preventative maintenance of robotic systems

Tentative Schedule and Assignments:

Topic	Activity	Notes
Introduction Basic Robot Operations	Robot Safety ELC Operations ELC All Labs from Workbook	
Programming and Motion Instructions	Overview All Labs from Workbook	
Handling Tool Operations with Shapes	Handling Tool ELC All Labs from Workbook	
Handling Pro (Simulation)	Handling Pro ELC Robot Cell Setup	

Grading Scale

Percentage	Grade	Performance
90% - 100%	A	Exceptional
80% - 89%	B	Competent
70% - 79%	C	Functional, but with minor mistakes
60% - 69%	D	Able to begin, but with serious mistakes
59% and below	F	No attempt or unable to begin

Weighting

Activity	Weighting
Labs, Quizzes and Homework	50%
E-learning Exams	40%
Professional Conduct and Attendance	10%

Attendance

College policy requires that you attend class regularly. If you do miss class, you are still responsible for the assigned work.

Computer/Electronics Policy

The computers should be left off during class unless needed for a classroom activity. It is not appropriate to surf the web, read/compose email, or participate in chat room or instant messaging during class. Do not install any unauthorized software on the computers. Please turn off your cell phones during lecture and labs.

Student Course Information

Confirmation of registration and grading will no longer be mailed to your home. To access your grades or financial account, to register for classes or to print a transcript use the MyClackamas account. You must have an email account to use MyClackamas. Learn more at: **my.clackamas.edu**

Note that your student I.D. number is stated in your admissions letter.

General Policies

A student who is enrolled in the college assumes a responsibility to conduct himself or herself in a manner compatible with the college's function as an educational institution. Although Clackamas Community College is dedicated to an open free society, there are some actions incompatible with an institution of higher education.

Other college policies regarding enrollment status, drop/add, credits, etc. are also found in the student handbook.

For more info refer to your Student Handbook, you could also view the handbook electronically at:
http://www.clackamas.cc.or.us/forms/handbk.pdf

Harassment

The policy of Clackamas Community College is that it will **not** tolerate harassment of any student. If such an incident should occur, it should be reported to the instructor in charge of the class so that immediate and appropriate action can be taken. Students should read the student handbook to be aware of their rights.

Course Outline, MFG 199
Clackamas Community College

Course Title: Robotics

Course Number: MFG 199
Credits: 1-6V
Contact Hours 132 Variable
Date: October, 2013

Institution: Clackamas Community College

Outline Developed by: Manufacturing Technology Department, Mike Mattson

Type of Program: Career Technical Education Preparatory

Course Description:
Manufacturing technology class. Content and credits vary. This course is an introduction to robotics and industrial motion control. Students will be exposed to the operation, programming and applications of a typical FANUC, six-axis industrial robot. Hands-on activities will included manual teach programming, testing with simulation software and programming of advance movements in the KAREL language.

Student Learning Outcomes:
At the successful conclusion of this course the student should be able to:

- demonstrate the safe, manual operation of a FANUC industrial robot;
- manipulate the robot with the teach pendant and record simple motions such as machine loading and stacking,
- write intermediate motion programs in the KARAL language,
- perform software simulations to verify correct motion and timing of programs,
- interface robotics hardware with a CNC machine tool to facilitate automated machining,
- access the machine vision capabilities of the robot to select object based upon shape, orientation and color.

Length of Course:
132V. lecture/lab hours

Grading Method:
Letter grades A-F, Pass/No Pass.

Course Prerequisites:
None. Recommended: MTH 50 and MFG 209

Required Textbooks:
Title: CERT MH eLearn Web Courses Materials
Author: FANUC Automation
Publisher: FANUC Automation

Major Topic Outline:

- Introduction to robotics
- Manual operation and safety
- Robot programming
- Industrial applications
- Electromechanical systems
- Fluid power systems
- End-of-arm tooling and sensors
- Interfacing robots with other industrial systems
- Machine vision
- Preventative maintenance of robotic systems

Lab 9
Create a Program

Student Name:

Assignment: The student will:

- **Create your first HandlingTool program**
- **Check the program Header information**
- **Teach, test, and execute from the Operator Panel**

Condition: A FANUC robot and controller loaded with LR HandlingTool application software. The students will complete task individually.

Step:

1 Power up the controller

2 Create a new teach pendant program, (refer to Procedure 9-1 Creating a Motion Program). Create a program and name it BOX and complete the program Header information as desired.

3 Fill in the default values from the Program Detail:

4 Program name: _____

5 Sub-type: _____

6 Group mask _____

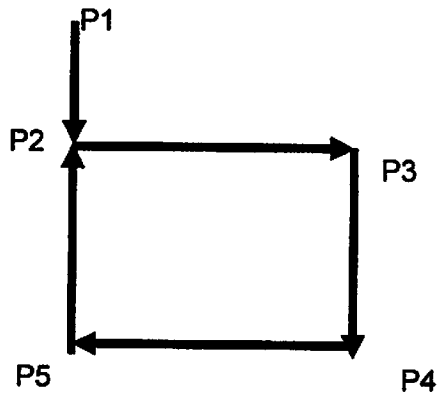
7 Write protect _____

8 Ignore Pause _____

9 Teach a simple HandlingTool path that begins from Start position and can return back to the Start position without colliding with any object.

BOX:

1: J P[1] 100% FINE
2: J P[2] 100% FINE
3: J P[3] 100% FINE
4: J P[4] 100% FINE
5: J P[5] 100% FINE
6: J P[2] 100% FINE
7: J P[1] 100% FINE
END



Lab 11

Motion Instruction

Student Name:

Assignment: The student will:

- **Create a pre-defined position.**
- **Modify motion instruction components**
- **Observe affect that changes on motion instruction have on program**
- **Execute a program from the Standard Operators Panel**
- **Use a position register in a motion instruction**

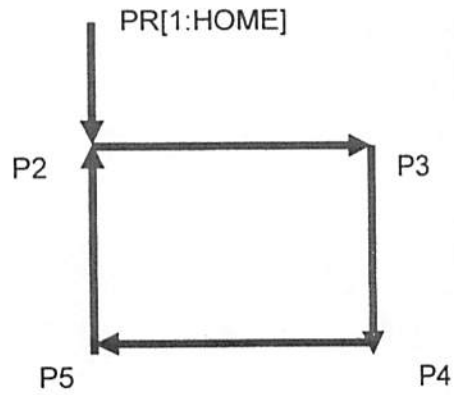
Condition: A FANUC robot and controller loaded with LR HandlingTool software.

Step:

1. Modify the BOX program.
2. Move to P[1] of the program. Record this position as a Position Register and label it HOME by following Procedure 10-2 Displaying and Setting Position Registers.
3. Change P[1] to the HOME Position Register that was defined, Modify a position in the program.
4. Change motion types, speed values, and termination type on some of the points and observe changes to the robot's path. Use TOUCHUP to adjust the robot's position and orientation.

BOX:

1: J PR[1:HOME] 100% FINE
2: J P[2] 100% FINE
3: L P[3] 2000mm/s CNT100
4: L P[4] 1000mm/s FINE
5: L P[5] 1500mm/s CNT50
6: L P[2] 2000mm/s CNT75
7: J PR[1] 100% FINE
END



5. Display and modify the Default Motion Instructions.
6. Perform all testing and test run your program from the teach pendant, then execute it from the cycle start on the operator panel.

Completed: ☐

Instructor: _____

9.7 Chapter Review

1) A Motion Group can define different groups of _____ that can be driven by FANUC servo motors used for independent pieces of equipment.

2) Within the program header, what does Group Mask represent when it displays the following? `[1,*,*,*,*]`

_____

3) What key combination is used to record a program point?

_____ _____

4) What key combination is pressed to touch up a point?

_____ _____

5) What status indicator will turn green when the robot step mode is off?

_____

6) To use the cycle start button from the SOP, which of the following setup modes should the **Remote/Local** be set at within the **System/Config** screen? (Circle the correct answer):

OP panel key Local Remote External I/O

10.4 Chapter Review

1) What combination of keys are used to record a position?_____ _____

2) Fine termination type causes the robot to _____ at the destination position before moving to the next position.

3) Identify the motion instruction elements:

J P[1] 100% FINE OFFSET, PR [2]

_____ _____ _____ _____ _____

4) What symbol is used to indicate that the robot is at the taught position? _____

5) What key(s) are pressed to change the default motion?

_____ _____

6) Where is Position Register (PR [ ]) data valid? (circle the correct answer).

LOCAL or GLOBAL

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Lesson Plan

Week Three

Topic: Creating Motion Programs, Chapter Nine

Learning Objectives

At the successful conclusion of this lesson the student should be able to:

- Create a simple motion program on the FANUC LR Mate
- Understand program naming methods
- View and edit program details
- Record a teach point
- Test the program operation

Review (10 Min)

- User and tool planes

Lecture Presentation/Demonstration Topics (45 Min)

- Teach pendant display
- How to create a program
- Program naming conventions
- View program details (subs and macros)
- Axis groups
- Program comments
- Demonstrate how to record a teach point
- TP touchup
- Testing a program prom the teach pendant
    - Safety
    - Single step
    - Continuous
    - Forward vs. Backwards

Lab: Create a Motion Program (75 Min)

- Prepare for Lab 9 by reviewing pages 161-167
- In small groups, follow the instruction in lab nine to create a teach point (TP) program.
- Demonstrate correct operation of the program through the single-step and continuous modes
- Demonstrate automatic program execution

Assessment (15 Min)

- Complete chapter nine review (pg. 170)

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Lesson Plan

Week Four

Topic: Motion Instructions, Chapter Ten

Learning Objectives

At the successful conclusion of this lesson the student should be able to:\

- Identify motion types and elements of motion instructions
- Examine the position register to analyze point data
- Understand and adjust robot speed
- Select termination types for specific applications
- Add, edit and delete motion instructions
- Use pre-defined positions

Review (10 Min)

- TP program creation and Testing

Lecture Presentation/Demonstration Topics (60 Min)

- Motion type overview
- Joint motion
- Linear motion
- Programming circular motion
- Fine vs continuous termination
- Application and accuracy
- Motion options—offsets
- Application of tool and user frames
-

Lab: Create a Motion Program (75 Min)

- Prepare for Labs 10-13 by reviewing pages 178-193
- In small groups, follow the instruction in labs 10, 11, 12 & 13 to create position registers for Home, Safe and Maintenance positions and to create the “shapes: program.
- Demonstrate correct operation of the program through the single-step and continuous modes
- Demonstrate automatic program execution

Assessment

- Students will correct program the “Shapes” program

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DOL Attribution
This workforce solution was funded by a grant awarded by the US Department of Labor’s Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the US Department of Labor. The Department of Labor makes no guarantees, warranties or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability or ownership.