ATR-112, Intro to Automation

Orientation and Introduction

Introduction

Concept Content:

In this section you will give an introduction of yourself to your class. This is an opportunity to state your relevant experiences and credentials to teach this subject along with your personal background. This can help connecting with students. You can make a video introduction and upload it to this page as well.

Also, this is where you will give a brief overview of the course and what it's contents will be. There is a section later on in this module where you will give more detail about the course.

Course Syllabus

Concept Goals:

Insert the student learning outcomes for the course here.

Concept Content:

This is where you will upload the syllabus. You can do this either by uploading the syllabus text here or you can upload a copy of the syllabus under the resources tab for this section. If you do upload it to the resources, please be sure to give instructions to your students to look for the syllabus there.

Course Resources

Concept Goals:

You can leave this section blank provided you uploaded the student learning outcomes to the previous section.

Concept Content:

This is where you would outline student support resources such as tutoring services, listing your office ours, contact info for support for your college's learning management system, etc. If there are documents you wish to upload, be sure to upload them to the resources tab and give instructions for the students to find the documents there.

Reference Material:

Industrial Automation Glossary Fifth Edition - 132 Pages

Rockwell Automation. (1997, May). Industrial Automation Glossary. Millwaukee, WI; Rockwell Automation.

This glossary from Rockwell Automation is an extensive list of terms and concepts you will come across in the course of your mechatronics studies. This will be a good document to reference during this class as well.

Course Materials:

This course was created utilizing modules provided by AMATROL. Here are the Amatrol stations utilized in the course:

Mechatronics Stations:

87-MS1 Pick and Place Feeding Station

87-MS2 Gauging Station

87-MS3 Indexing Station

87-MS4 Sorting and Queuing Station

87-MS5 Servo Robotic Assembly Station

87-MS6 Torquing Station

87-MS7 Parts Storage Station

870-MPC-AB5300 Mechatronics Learning System for Allen-Bradley

CompactLogix - one per station

24510 CAT 5E Crossover Cable

82-800 Allen-Bradley RSLogix 5000 Programming Software - one per station

LAP Packets: All packets are the 1st edition from 2012

Learning Activity Packet 1 - Automations Operations

Learning Activity Packet 2 - Basics Components Adjustments

Learning Activity Packet 3 - Pick and Place Feeding Station

Learning Activity Packet 4 - Gauging Station

Learning Activity Packet 5 - Indexing Station

Learning Activity Packet 6 - Sorting and Queuing Station

Learning Activity Packet 7 - Serve Robotic Assembly Station

Learning Activity Packet 8 - Torquing Station

Learning Activity Packet 9 - Parts Storage Station

Learning Activity Packet 10 - Multiple Station Control

Course Overview

Concept Goals:

Course Learning Outcomes:

1. Apply and demonstrate relevant knowledge of OSHA standards and company-specific safety protocols.
2. Describe and operate control transformers, motor starters, and relays. Analyze and troubleshoot motor control circuits.
3. Thoroughly understand and operate in a safe manner automated machines and perform necessary adjustments.
4. Use and demonstrate programming software to develop, monitor, and troubleshoot PLC programs.
    1. Demonstrate an understanding of PLC operation and programming principles.
    2. Interface PLCs with various I/O devices.
5. Test and troubleshoot PLC components. A. Identify potential failure points and perform system-level troubleshooting.

Concept Content:

Instructor Note: This course has been set up to align with two certifications offered by FESTO: Introduction to Mechatronics and Level 1 Fundamentals Robotics. See the certification sections under instructor resources for more information.

This course introduces the basic principles of automated systems and describes the tasks that technicians perform on the job. Topics include the history, development, and current applications of robots and automated systems including their configuration, operation, components, and controls. Upon completion, students should be able to understand the basic concepts of automation and robotic systems.

Module	**Module Learning Objectives**
Week 1 - 5000 Programming	• Describe the difference between Input and Output Module (SLO 4) • Utilize RSLinix to upload and program using CompactLogix demos (SLO 5) • Describe the attributes that must be configured when creating a new project (SLO 4) • Configure an ethernet module using RSLinix (SLO 4) • Understand how open and closed loop control systems work (SLO 2)
Week 2 - Automation Operations	• Identify the types of logic input devices (SLO 4) • Describe how pick and place automation works (SLO 2) • Correctly identify the components of a control system (SLO 2)
Week 3 - Basic Control Adjustments	• Describe safety procedures regarding robotics (SLO 1) • Perform lockout/tagout successfully (SLO 1) • Describe safety rules regarding industrial practices (SLO 1)
Week 4 - Pick and Place Feeding	• Define and describe three types of material feeding systems. (SLO 3) • Make adjustments to parts such as vacuum grippers, shock absorbers, etc. (SLO 3) • Describe how a shock absorber works. (SLO 2) •
Week 5 - Pick and Place Feeding Week 2	• Define and describe three types of material feeding systems. (SLO 3) • Make adjustments to parts such as vacuum grippers, shock absorbers, etc. (SLO 3) • Describe how a shock absorber works. (SLO 2)
Week 6 - Gauging	• Demonstrate an understanding of how to use Go/No-Go Gages (SLO 3) • Make adjustments to analog sensors (SLO 4) • Design programs for PLCs (SLO 4)
Week 7 - Gauging Week 2	• Demonstrate an understanding of how to use Go/No-Go Gages (SLO 3) • Make adjustments to analog sensors (SLO 4) • Design programs for PLCs (SLO 4)
Week 8 - Indexing	• Describe different types of index tables (SLO 3) • Calibrate various sensors for correct use (SLO 2) • Define two point turning in basic calibration (SLO 2)
Week 9 - Indexing Week 2	• Design PLC programs that run specific types of indexers (SLO 4)

Week 10 - Sorting and Queuing	• Describe the basic facets of queuing theory (SLO 2) • Adjust conveyor belts and sensors (SLO 2) • Design PLC programs to drive work on sorting and queuing modules (SLO 4)
Week 11 - Servo Robotic Assembly	• List and describe different types of robots (SLO 2) • Describe the difference between servo robotic assembly and pick and place assembly systems (SLO 4) • Make adjustments to servo robotic systems (SLO 5)
Week 12 - Servo Robotic Assembly	• Program PLCs to operate servo robotics to perform specific functions (SLO 4, SLO 5)
Week 13 - Servo Robotic Assembly Week 2	• Program PLCs to operate servo robotics to perform specific functions (SLO 4, SLO 5) •
Week 14 - Torquing	• Operate an automated torquing station (SLO 2) • Adjust DC motor speed (SLO 3) • Design a PLC program that sequences a non-servo electric slide (SLO 4, SLO 5)
Week 15 - Parts Storage	• Describe how automated storage and retrieval system work (SLO 2) • Design PLC programs to work with parts pick up and parts storage modules (SLO 4)
Week 16 - Final Assessment	• Demonstrate Understanding of Course Material
Bonus Week - Multiple Station Control	• Describe what handshaking is in terms of I/O modules (SLO 2) • Define Flexible Manufacturing Systems (SLO 2) • Design PLC programs I/O handshaking for a multiple station reset (SLO 4)

Instructor Note: This course somes with a bonus week of content in case the one is needed.

Course Schedule: **(Instructor Note: this course schedule is just a suggestion based on North Carolina System standards. You can adjust the schedule as suits your needs.)**

Week 1:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 2:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 3:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 4:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 5:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 6:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 7:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 8:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 9:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 10:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 11:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 12:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 13:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 14:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 15:

Monday Class 1 - Lecture Material - 1 Hour: Wednesday Class 2 - Lab Material - 1.5 Hours

Week 16:

Monday Class 1 - Final Exam

Notes/Helpful Tips

Next Steps...

Your Census assignments are REQUIRED in order to remain in the class and they MUST be completed prior to the Census Date **[insert census date here]**. **If you do not have a census date requirement, you can delete this section.**

Effective note taking is also important for not only this course, but for your career as well. Note taking is a great way to retain information. The process of taking notes can keep you alert and focused on the information being presented. It also keeps your mind engaged with what you are hearing, increasing the likelihood you will retain that information. Note taking can also allow you to better organize your thoughts on the information being discussed.

Here is a video that provides some tips for effective note taking.

Week 1 - 5000 programming

1.1 Week Overview

Concept Goals:

By the end of this module, you should:

- Describe the difference between Input and Output Module (SLO 4)
- Utilize RSLinix to upload and program using CompactLogix demos (SLO 5)
- Describe the attributes that must be configured when creating a new project (SLO 4)
- Configure an ethernet module using RSLinix (SLO 4)
- Understand how open and closed loop control systems work (SLO 2)

Concept Content:

Welcome to ATR 112 - Intro to Automation. This course will cover the basics of automation and allow you to get hands on experience with programing various modules. This week we will talk about the RSLogix programing environment. See module 1.2 for more details.

This Week At A Glance:

Lecture:

RSLogix Introduction Lecture - 58 Pages

Videos:

PLC Programming Tutorial - Allen Bradley Training in RSLogix 5000 Ladder Logic Basics for Beginners - 22 Minutes

Supplemental Materials:

Reading:

Chapter 4 Extracted Pages

Videos:

Input, Output Modules of PLC - 5.5 Minutes

What are I/O Modules - 1.5 Minutes

How are Remote I/O and Distributed I/O Different - 5.5 Minutes

What is DeviceNet? - 10 Minutes

What is RSLINX - 15.5 Minutes

Assignments:

System Overview Assignment

CompactLogix Based Demos Assignment

Internet Explorer Assignment

RSLogix/Studio 5000 Overview Assignment

RSLinix Overview Assignment

Configuring Ethernet Modules Assignment

Download/Uploading Assignment

1.2 Week Content Resources

Concept Content:

This week we will discuss RSlogix. This module will introduce you to the concepts related to the programming you will be using in this course. We will also cover RLSLINX and I/O modules.

This Week's Material:

Lecture:

RSLogix Introduction Lecture - 58 Pages

Videos:

PLC Programming Tutorial - Allen Bradley Training in RSLogix 5000 Ladder Logic Basics for Beginners - 22 Minutes

Supplimental Material:

Reading:

Chapter 4 Extracted Pages - these pages will go over I/O modules in a bit more depth on top of what the lecture covers.

Reading:

Feedback Control Textbook Chapter - 23 Pages

Jouaneh, M. (2013). Fundamentals of Mechatronics. Cengage Learning. Pages 293 - 315

Open Loop System - Webpage

Teja, R. (2024, April 5). Open loop system. ElectronicsHub USA. https://www.electronicshub.org/open-loop-system/

Closed Loop System - Webpage

Teja, R. (2024a, March 22). Closed loop system: How it works & examples. ElectronicsHub USA. https://www.electronicshub.org/closed-loop-system/

Videos:

Input, Output Modules of PLC - 5.5 Minutes

What are I/O Modules - 1.5 Minutes

How are Remote I/O and Distributed I/O Different - 5.5 Minutes

What is DeviceNet? - 10 Minutes - this video gives a more in-depth explanation of the DeviceNet material covered in the lecture.

What is RSLINX - 15.5 Minutes - this video gives a visual representation of the material covered in the lecture regarding RSLINX.

1.3 Week Assessment/Assignment

Concept Content:

Assignments: These assignments are located in the lecture packet for this week. We will work on them in class.

System Overview Assignment- Page 18

CompactLogix Based Demos Assignment - Page 19

Internet Explorer Assignment - Page 20

RSLogix/Studio 5000 Overview Assignment - Page 34

RSLinix Overview Assignment - Page 44

Configuring Ethernet Modules Assignment - Page 50

Download/Uploading Assignment - Page 58

1.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

1.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

1.6 Week Wrap-Up

Concept Goals:

Module Learning Objectives:

- Describe the difference between Input and Output Module (SLO 4)
- Utilize RSLinix to upload and program using CompactLogix demos (SLO 5)
- Describe the attributes that must be configured when creating a new project (SLO 4)
- Configure an ethernet module using RSLinix (SLO 4)
- Understand how open and closed loop control systems work (SLO 2)

Concept Content:

This week we talked about the RSLogix programing environment. Next week we will start our

learning modules for the course.

This Week In Review:

Lecture:

RSLogix Introduction Lecture - 58 Pages

Videos:

PLC Programming Tutorial - Allen Bradley Training in RSLogix 5000 Ladder Logic Basics for Beginners - 22 Minutes

Supplemental Materials:

Reading:

Chapter 4 Extracted Pages

Videos:

Input, Output Modules of PLC - 5.5 Minutes

What are I/O Modules - 1.5 Minutes

How are Remote I/O and Distributed I/O Different - 5.5 Minutes

What is DeviceNet? - 10 Minutes

What is RSLINX - 15.5 Minutes

Assignments:

System Overview Assignment

CompactLogix Based Demos Assignment

Internet Explorer Assignment

RSLogix/Studio 5000 Overview Assignment

RSLinix Overview Assignment

Configuring Ethernet Modules Assignment

Download/Uploading Assignment

Week 2 – Automations Ops

2.1 Week Overview

Concept Goals:

By the end of this week, you will:

- Identify the types of logic input devices (SLO 4)
- Describe how pick and place automation works (SLO 2)
- Correctly identify the components of a control system (SLO 2)

Concept Content:

This week we will discuss automation operations. See module 2.2 for more detail.

This Week's Material:

Reading:

Learning Activity Packet 1: Automation Operations - Pages 4-58

Introduction to Mechatronics - 6 Pages

Videos:

Pick and Place Automation Example - 1 Minute

PLC Discrete Inputs - 17 Minutes

What is a Limit Switch - 2 Minutes

What is a Photoelectric Sensor - 3 Minutes

How a Reed Switch Works - 1.5 Minutes

Webpage:

PLC Basic Sensors and Input Devices - A Beginners Guide

Assignments:

Skill 1 - Identifying Control System Component Types

Review Questions - 10 Questions

2.2 Week Content Resources

Concept Content:

This week we will begin our module on automation operations. Our two segments this week will cover an introduction to mechatronics and going over some basic control system concepts, particularly with an emphasis on discrete logic input and output devices.

This Week's Material:

Reading:

Learning Activity Packet 1: Automation Operations - Pages 4-58

Introduction to Mechatronics - 6 Pages - An expansion upon defining mechatronics as discussed early in the LAP.

Videos:

Pick and Place Automation Example - 1 Minute

PLC Discrete Inputs - 17 Minutes - an expansion on the devices discussed in the reading from this week.

What is a Limit Switch - 2 Minutes - These last three videos all cover types of sensors discussed in the LAP manual and show examples of them in motion.

What is a Photoelectric Sensor - 3 Minutes

How a Reed Switch Works - 1.5 Minutes

Webpage:

PLC Basic Sensors and Input Devices - A Beginners Guide

Phillips, R. (n.d.). *Rick Phillips*. PLC Basics. https://basicplc.com/plc-basic-sensors-and-input-devices/

2.3 Week Assessment/Assignment

Concept Content:

Assignments:

Skill 1 - Identifying Control System Component Types - Pages 41-57 from the automation operations book. We will go over this in class.

Review Questions - 10 Questions from the self reviews in the LAP book.

2.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

2.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

2.6 Week Wrap-Up

Concept Goals:

Module Learning Objectives:

- Identifythe types of logic input devices (SLO 4)
- Describe how pick and place automation works (SLO 2)

- Correctly identify the components of a control system (SLO 2)

Concept Content:

This week we looked into automation operations. Next week, we will complete the learning activity packet and complete our study of this subject.

This Week's Material:

Reading:

Learning Activity Packet 1: Automation Operations - Pages 4-58

Introduction to Mechatronics - 6 Pages

Videos:

Pick and Place Automation Example - 1 Minute

PLC Discrete Inputs - 17 Minutes

What is a Limit Switch - 2 Minutes

What is a Photoelectric Sensor - 3 Minutes

How a Reed Switch Works - 1.5 Minutes

Webpage:

PLC Basic Sensors and Input Devices - A Beginners Guide

Assignments:

Skill 1 - Identifying Control System Component Types

Review Questions - 10 Questions

Week 3 – Basic Control Adj

3.1 Week Overview

Concept Goals:

By the end of this week, you should:

- Describe safety procedures regarding robotics (SLO 1)
- Perform lockout/tagout successfully (SLO 1)
- Describe safety rules regarding industrial practices (SLO 1)

Concept Content:

This week we will finish our section on automation operations. See module 3.2 for more details.

This Week's Material:

Reading:

Learning Activity Packet 1: Automation Operations - Pages 59-95

Preventing the Injury of Workers by Robots - CDC Webpage

Lectures:

Safety Module Lecture - 13 Pages

Industrial Safety and OSHA -26 Pages

Videos:

Safe Sequence Monitoring - 2 Minutes

Assignments:

Skill 2 - Perform a Lockout/Tagout On An Electrical System

Skill 3 - Perform a Lockout/Tagout On A Pneumatic System

Skill 4 - Power Up An Automatic Machine

Module Review - 10 Questions

3.2 Week Content Resources

Concept Content:

This week we will finish our section on automation operations. We will look over safety and the common steps of operating a machine and how machine operations function.

This Week's Material:

Reading:

Learning Activity Packet 1: Automation Operations - Pages 59-95

Preventing the Injury of Workers by Robots - CDC Webpage

Lectures:

Safety Module Lecture - 13 Pages - these two lectures expand upon the safety content covered in the learning activity packet.

Industrial Safety and OSHA -26 Pages

Industrial Maintenance and Mechatronics Chapter 2 Lecture, Goodheart-Wilcox

Videos:

Safe Sequence Monitoring - 2 Minutes

Optional Virtural Lab

Lockout/Tagout Procedures 141 - Tooling U Resource
This virtural lab gives practice with LO/TO on a machine both to get it ready for maintenance and turning it back on after maintenance.

3.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 2 - Perform a Lockout/Tagout On An Electrical System - Pages 64-67 in learning packet

Skill 3 - Perform a Lockout/Tagout On A Pneumatic System - Pages 70-72 in learning packet

Skill 4 - Power Up An Automatic Machine - Pages 83-94 in learning packet

Module Review - 10 Questions - Taken from the learning packet self reviews

We will complete the skills from the learning packet in the classroom.

3.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

3.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

3.6 Week Wrap-Up

Concept Goals:

Module Learning Objectives:

- Describe safety procedures regarding robotics (SLO 1)
- Perform lockout/tagout successfully (SLO 1)
- Describe safety rules regarding industrial practices (SLO 1)

Concept Content:

This week we finished our section on automation operations. Next week we will start on basic component adjustments.

This Week's Material:

Reading:

Learning Activity Packet 1: Automation Operations - Pages 59-95

Preventing the Injury of Workers by Robots - CDC Webpage

Lectures:

Safety Module Lecture - 13 Pages

Industrial Safety and OSHA -26 Pages

Videos:

Safe Sequence Monitoring - 2 Minutes

Assignments:

Skill 2 - Perform a Lockout/Tagout On An Electrical System

Skill 3 - Perform a Lockout/Tagout On A Pneumatic System

Skill 4 - Power Up An Automatic Machine

Module Review - 10 Questions

Week 4 - Pic N Place

4.1 Week Overview

Concept Goals:

By the end of this week, you should:

- List the steps of setting a jog function (SLO 3)

- Adjust a limit switch (SLO 2, SLO 3)

Concept Content:

This week we will look into basic component adjustment. See module 4.2 for more details.

This Week's Material:

Reading:

Learning Activity Packet 2 - Basic Component Adjustments

Videos:

How To Set The Jog Function of VFD - 3 Minutes

Box Stacking Pneumatic Pick & Place - 1 Minute

How to Adjust Limit Switches on an Actuator - 2.5 Minutes

Webpages:

What is a Pneumatic Actuator and How Does It Work

Assignments:

Skills 1-8 from the basic component adjustments pack.

Module 4 Review - 10 Questions

4.2 Week Content Resources

Concept Content:

This week we will look into basic component adjustments. We will look into manual operation of parts, discuss pneumatic and electrical pick and place machines, and electrical sensors.

This Week's Material:

Reading:

Learning Activity Packet 2 - Basic Component Adjustments (entire packet)

Videos:

How To Set The Jog Function of VFD - 3 Minutes - A visual example of setting a jog function for those who learn better via visuals.

Box Stacking Pneumatic Pick & Place - 1 Minute - An example of how a pick & place system can work.

How to Adjust Limit Switches on an Actuator - 2.5 Minutes - A visual example of adjusting a limit switch. The methods shown might not work on every actuator.

Webpages:

What is a Pneumatic Actuator and How Does It Work*What is a pneumatic actuator and how do they work?*. Process Industry Forum. (n.d.). https://www.processindustryforum.com/article/what-is-a-pneumatic-actuator

4.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 1 - Jog an Actuator - Pages 7-21

Skill 2 - Manually Override an Electro-Pneumatic Valve - Pages 25-28

Skill 3 - Adjust Penumatic Actuator Stroke Position - Pages 33-51

Skill 4 - Adjust Pneumatic Actuator Speed - Pages 54-58

Skill 5 - Manually Override a Magnetic Motor Starter - Pages 62-63

Skill 6 - Measure I/O Signals at a Digital I/O Interface Module - Pages 70-75

Skill 7 - Adjust A Limit Switch - Pages 85-91

Skill 8 - Adjust A Proximity Sensor - Pages 97-107

Module 4 Review - 10 Questions - collected from the self-review questions in the workbook

We will go over the skills in the lab.

4.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

4.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

4.6 Week Summary

Concept Goals:

By the end of this week, you should:

- List the steps of setting a jog function (SLO 3)
- Adjust a limit switch (SLO 2, SLO 3)

Concept Content:

This week we covered material related to basic component adjustments. Next week we will start our module on pick and place feeding.

This Week In Review:

Reading:

Learning Activity Packet 2 - Basic Component Adjustments

Videos:

How To Set The Jog Function of VFD - 3 Minutes

Box Stacking Pneumatic Pick & Place - 1 Minute

How to Adjust Limit Switches on an Actuator - 2.5 Minutes

Webpages:

What is a Pneumatic Actuator and How Does It Work

Assignments:

Skills 1-8 from the basic component adjustments pack.

Module 4 Review - 10 Questions

Week 5 - Pic N Place Week 2

5.1 Week Overview

Concept Goals:

By the end of this module, you should:

- Define and describe three types of material feeding systems. (SLO 3)
- Make adjustments to parts such as vacuum grippers, shock absorbers, etc. (SLO 3)
- Describe how a shock absorber works. (SLO 2)

Concept Content:

This week we begin our two week series on pick and place feeding. See module 5.2 for more detail.

This Week At A Glance:

Reading:

Learning Activity Packet 3 - Pick and Place Feeding - Pages 4 - 55

How do Shock Absorbers Work - Webpage

Lee, J. (2022, October 14). *Rest day reels: These climbing films will get you stoked*. GearJunkie. https://gearjunkie.com/outdoor/what-to-watch-climbing-movies

Videos:

AS/RS Automated Storage Systems - 7.5 Minutes

A Quick Guide To Servos - 4 Minutes

90 Seconds of Vacuum Grippers - 1.5 Minutes

Assignments:

Skill 1 - Operate a Pick and Place Feeding System

Skill 2 - Adjust a Vacuum Gripper

Skill 3 - Adjust a Vacuum Switch

Skill 4 - Adjust a Shock Absorber

Module Review - 10 Questions

5.2 Week Content Resources

Concept Content:

This week we will cover the first half of pick and place feeding. We will cover topics such as material feeding systems, pick and place manipulators, vacuum grippers, and shock absorbers. We will also cover four skill activities related to the material. More detail on those in module 5.3.

This Week's Material:

Reading:

Learning Activity Packet 3 - Pick and Place Feeding - Pages 4 - 55

How do Shock Absorbers Work - Webpage

Lee, J. (2022, October 14). *Rest day reels: These climbing films will get you stoked*. GearJunkie.

https://gearjunkie.com/outdoor/what-to-watch-climbing-movies

Videos:

AS/RS Automated Storage Systems - 7.5 Minutes

A Quick Guide To Servos - 4 Minutes

90 Seconds of Vacuum Grippers - 1.5 Minutes

5.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 1 - Operate a Pick and Place Feeding System - Pages 12-24

Skill 2 - Adjust a Vacuum Gripper - Pages 30-36

Skill 3 - Adjust a Vacuum Switch - Pages 40-46

Skill 4 - Adjust a Shock Absorber - Pages 52-54

Module Review - 10 Questions

We will go over the skills 1-4 in class. The module review questions are based on the material covered in the learning activity packet.

5.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

5.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be

appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

5.6 Week Review

Concept Goals:

By the end of this module, you should:

- Define and describe three types of material feeding systems. (SLO 3)
- Make adjustments to parts such as vacuum grippers, shock absorbers, etc. (SLO 3)
- Describe how a shock absorber works. (SLO 2)

Concept Content:

This week we began our two week series on pick and place feeding. Next week we will conclude this section.

This Week In Review:

Reading:

Learning Activity Packet 3 - Pick and Place Feeding - Pages 4 - 55

How do Shock Absorbers Work - Webpage

Lee, J. (2022, October 14). *Rest day reels: These climbing films will get you stoked*. GearJunkie. https://gearjunkie.com/outdoor/what-to-watch-climbing-movies

Videos:

AS/RS Automated Storage Systems - 7.5 Minutes

A Quick Guide To Servos - 4 Minutes

90 Seconds of Vacuum Grippers - 1.5 Minutes

Assignments:

Skill 1 - Operate a Pick and Place Feeding System

Skill 2 - Adjust a Vacuum Gripper

Skill 3 - Adjust a Vacuum Switch

Skill 4 - Adjust a Shock Absorber

Module Review - 10 Questions

Week 6 - Gauging

6.1 Week Overview

Concept Goals:

By the end of this module, you should:

- Design PLC programs for various functions (SLO 4, SLO 5)
- Understand how a PLC works (SLO 4, SLO 5)
- Describe how a 2-axis pick words (SLO 2)

Concept Content:

This week we will finish our series on pick and place feeding. See module 6.2 for more detail.

This Week's Material:

Reading:

Learning Activity Packet Three - Pick and Place Feeding - Pages 56-110

Lectures:

Intro to Programmable Logic Controllers - 21 Slides

Videos:

How to Use Two Axis Pick and Place in Factory IO Using Ladder Logic - 5 Minutes

PLC Basics for Beginners Part 1 - 3.5 Minutes

Assignments:

Skill 5 - Design a PLC Program That Sequences A Powered Parts Feeder

Skill 6 - Design A PLC Program That Sequencies A 2-Axis Pick And Place Pneumatic Manipulator

Skill 7 - Design a PLC Program That Sequences A Pick and Place Feeding Station

Skill 8 - Design A PLC Program That Provides Manual/Auto/Reset Functions For A Pick And Place Feeding Station

Module Review - 10 Questions

6.2 Week Content Resources

Concept Content:

This week is our second week on pick and place feeding. We will cover PLCs as well as several of our skills this week revolve around programing them.

This Week's Material:

Reading:

Learning Activity Packet Three - Pick and Place Feeding - Pages 56-110

Lectures:

Intro to Programmable Logic Controllers - 21 Slides - As our skills for this week revolve around designing PLC programs, we will cover the basics of PLCs here.

Videos:

How to Use Two Axis Pick and Place in Factory IO Using Ladder Logic - 5 Minutes - This video provides a visual example of two axis picks while also introducing ladder logic.

PLC Basics for Beginners Part 1 - 3.5 Minutes - This is a good introduction/summary of PLC Basics.

6.3 Week Assessment/Assignment

Concept Content:

Assignments:

Skill 5 - Design a PLC Program That Sequences A Powered Parts Feeder - Pages 62 - 67

Skill 6 - Design A PLC Program That Sequencies A 2-Axis Pick And Place Pneumatic Manipulator - Pages 82 - 88

Skill 7 - Design a PLC Program That Sequences A Pick and Place Feeding Station - Pages 92 - 99

Skill 8 - Design A PLC Program That Provides Manual/Auto/Reset Functions For A Pick And Place Feeding Station - Pages 102 - 109

Module Review - 10 Questions

We will cover skills 5-8 in class.

6.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

6.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

6.6 Week Wrap-Up

Concept Goals:

Module Learning Objectives:

- Design PLC programs for various functions (SLO 4, SLO 5)
- Understand how a PLC works (SLO 4, SLO 5)
- Describe how a 2-axis pick words (SLO 2)

Concept Content:

This week we finished our series on pick and place feeding. Next week we will discuss gauging.

This Week In Review:

Reading:

Learning Activity Packet Three - Pick and Place Feeding - Pages 56-110

Lectures:

Intro to Programmable Logic Controllers - 21 Slides

Videos:

How to Use Two Axis Pick and Place in Factory IO Using Ladder Logic - 5 Minutes

PLC Basics for Beginners Part 1 - 3.5 Minutes

Assignments:

Skill 5 - Design a PLC Program That Sequences A Powered Parts Feeder

Skill 6 - Design A PLC Program That Sequencies A 2-Axis Pick And Place Pneumatic Manipulator

Skill 7 - Design a PLC Program That Sequences A Pick and Place Feeding Station

Skill 8 - Design A PLC Program That Provides Manual/Auto/Reset Functions For A Pick And Place Feeding Station

Module Review - 10 Questions

Week 7 - Gauging Week 2

7.1 Week Overview

Concept Goals:

By the end of this week, you should:

- Demonstrate an understanding of how to use Go/No-Go Gages (SLO 3)
- Make adjustments to analog sensors (SLO 4)
- Design programs for PLCs (SLO 4)

Concept Content:

This Week At a Glance:

Reading:

Learning Activity Packet 4 - Gauging - the whole packet

Calibrating an Analog Sensor - 4 Pages - This expands upon how to calibrate an analog sensor, a topic covered in the learning activity packet.

Videos:

Go/No-Go Gages - 2 Minutes - A visual example of how to use go/no-go gauges.

Assignments:

Skills 1-9

Module Review - 10 Questions

7.2 Week Content Resources

Concept Content:

This week we will discuss gauging.

This Week's Material:

Reading:

Learning Activity Packet 4 - Gauging - the whole packet

Calibrating an Analog Sensor - 4 Pages - This expands upon how to calibrate an analog sensor, a topic covered in the learning activity packet.

Videos:

Go/No-Go Gages - 2 Minutes - A visual example of how to use go/no-go gauges.

7.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 1 - Adjust an Analog Sensor With a Discrete Output - Pages 16-25

Skill 2 - Operate an Automated Gauging Station - Pages 29-42

Skill 3 - Adjust Non-Servo Linear Traverse Axis Travel - Pages 48-52

Skill 4 - Adjust a Synchronous Belt Device - Pages 58-61

Skill 5 - Adjust a Clutch On a Ball Screw Drive - Pages 64-66

Skill 6 - Design a PLC Project That Sequences a Non-Serve Electric Traverse Axis - Pages 74-78

Skill 7 - Design a PLC Project That Sequences a Part Reject Module - Pages 88-92

Skill 8 - Design a PLC Project That Sequences a Go No-Go Gauging Station - Pages 98-106

Skill 9 - Design a PLC Project That Provides Manual/Auto/Reset Function for a Go No-Go Gauging Station - Pages 110-117

Module Review - 10 Questions

7.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your

reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

7.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

7.6 Week Review

Concept Goals:

Module Learning Objectives:

- Demonstrate an understanding of how to use Go/No-Go Gages (SLO 3)
- Make adjustments to analog sensors (SLO 4)
- Design programs for PLCs (SLO 4)

Concept Content:

This week we completed our module on gauging. Next week we will start our work on indexing.

This Week in Review:

Reading:

Learning Activity Packet 4 - Gauging - the whole packet

Calibrating an Analog Sensor - 4 Pages - This expands upon how to calibrate an analog sensor, a topic covered in the learning activity packet.

Videos:

Go/No-Go Gages - 2 Minutes - A visual example of how to use go/no-go gauges.

Assignments:

Skills 1-9

Module Review - 10 Questions

Week 8 - Indexing

8.1 Week Overview

Concept Goals:

By the end of this week you should:

- Describe different types of index tables (SLO 3)
- Calibrate various sensors for correct use (SLO 2)
- Define two point turning in basic calibration (SLO 2)

Concept Content:

This week we will cover indexing. See module 8.2 for more detail.

This Week At A Glance:

Reading:

Learning Activity Packet 5 - Indexing - Pages 4-78

What Are Indexing Tables? - Webpage

Videos:

Digital Fiber Optic Sensor/Amplifing Wiring and Setting - 5 Minutes

Basic Calibration: Two Point Turning - 1.5 Minutes

Assignments:

Skills 1-5

Module Review - 10 Questions

8.2 Week Content Resources

Concept Content:

This week we will begin our section on indexing. We will start by learning types of indexing tables. Then we will move into types of sensors and how to adjust them. Module 8.3 goes into more detail regarding the skills and activities for this week.

This Week's Material:

Reading:

Learning Activity Packet 5 - Indexing - Pages 4-78

What Are Indexing Tables? - Webpage - This expands upon what indexing tables are and the different types of them.

MotionIndexDrives. (2024, February 29). *What are indexing tables?*. Motion Index Drives. https://motionindexdrives.com/blog/what-are-indexing-tables/

Videos: Expanding upon the types of sensors and calibration you may use in industry.

Digital Fiber Optic Sensor/Amplifing Wiring and Setting - 5 Minutes

Basic Calibration: Two Point Turning - 1.5 Minutes

8.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 1 - Operating an Indexing Material Processing Station - Pages 15-34
Skill 2 - Adjust a fiber optic sensor - Pages 40-44
Skill 3 - Adjust a capacitive sensor - Pages 49-53
Skill 4 - Program a stepper motor controller - Pages 60-65
Skill 5 - Adjust a homing sensor - Pages 70-77

Module Review - 10 Questions

We will work on the skills in class using the equipment in the lab.

8.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

8.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

8.6 Week Wrap-Up

Concept Goals:

Module Learning Objectives:

- Describe different types of index tables (SLO 3)
- Calibrate various sensors for correct use (SLO 2)
- Define two point turning in basic calibration (SLO 2)

Concept Content:

This week we covered indexing. We will finish our unit on indexing next week.

This Week In Review:

Reading:

Learning Activity Packet 5 - Indexing - Pages 4-78

What Are Indexing Tables? - Webpage - This expands upon what indexing tables are and the different types of them.

MotionIndexDrives. (2024, February 29). *What are indexing tables?*. Motion Index Drives. https://motionindexdrives.com/blog/what-are-indexing-tables/

Videos: Expanding upon the types of sensors and calibration you may use in industry.

Digital Fiber Optic Sensor/Amplifing Wiring and Setting - 5 Minutes

Basic Calibration: Two Point Turning - 1.5 Minutes

Assignments:

Skills 1-5

Module Review - 10 Questions

Week 9 - Indexing Week 2

9.1 Week Overview

Concept Goals:

By the end of this week, you should:

- Design PLC programs that run specific types of indexers (SLO 4)

Concept Content:

This week we will finish our section on indexing. See module 9.2 for more detail.

This Week At A Glance:

Reading:

Learning Activity Packet Five - Indexing - Pages 79-143

What is IO Module in PLC: A Comprehensive Overview - Webpage

Basic Process Control Lecture 1 - 25 Slides

Basic Process Control Lecture 2 - 33 Slides

Videos:

Arduino Stepper Indexer Example - 3 Minutes

Assignments:

Skills 6 - 10

Module Review - 10 Questions

9.2 Week Content Resources

Concept Content:

This week we will complete our section on indexing. We will read about three different types of modules and learn how to program the PLCs to run them. We will also cover how to run a station module.

This Week's Material:

Reading:

Learning Activity Packet Five - Indexing - Pages 79-143

What is IO Module in PLC: A Comprehensive Overview - Webpage

What is IO Module In PLC:
https://www.sonnepowercontrol.com/company-news/what-is-io-module-in-plc-a-comprehensive-overview.html

Basic Process Control Lecture 1 - 25 Slides - the following presentations expand upon the basics of utilizing PLCs.

Basic Process Control Lecture 2 - 33 Slides

Videos:

Arduino Stepper Indexer Example - 3 Minutes - A visual example of one of the indexer types we will

be working with this week.

9.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 6 - Design a PLC Program That Sequences a Part Transfer Module - Pages 84-88

Skill 7 - Design a PLC Program That Sequences a Stepper Motor Index Table - Pages 95-100

Skill 8 - Design a PLC Program That Sequences a Parts Orientation Module - Pages 113-119

Skill 9 - Design a PLC Program That Sequences an Indexing Station - Pages 123-131

Skill 10 - Design a PLC Program That Provides Manual/Auto/Reset Functions For an Indexing Processing Station - Pages 135-149

Module Review - 10 Questions

9.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

9.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

9.6 Week Wrap-Up

Concept Goals:

By the end of this week, you should:

- Design PLC programs that run specific types of indexers (SLO 4)

Concept Content:

This week we finished our section on indexing. Next week we will go into sorting and queuing.

This Week At A Glance:

Reading:

Learning Activity Packet Five - Indexing - Pages 79-143

What is IO Module in PLC: A Comprehensive Overview - Webpage

Videos:

Arduino Stepper Indexer Example - 3 Minutes

Assignments:

Skills 6 - 10

Module Review - 10 Questions

Weeks 10 - Sorting and Queuing

10.1 Week Overview

Concept Goals:

By the end of this module, you should:

- Describe the basic facets of queuing theory (SLO 2)
- Adjust conveyor belts and sensors (SLO 2)

- Design PLC programs to drive work on sorting and queuing modules (SLO 4)

Concept Content:

This week we will go over details regarding sorting and queuing. See module 10.2 for more details.

Due to the density of this week's material, we will work on this material this week and next week.

This Week At A Glance:

Reading:

Learning Activity Packet 6 - Sorting and Queuing - Whole Packet

Simple Queuing Model - 9 Pages

Video:

The Ultimate Guide to PLC Prgramming for Sorting Operations - 22 Minutes

Inspection and Adjustment: Conveyor Belt - 1 Minute

Photoelectric Sensor Wiring and Setup - 7.5 Minutes

Assignments:

Skills 1-7

10.2 Week Content Resources

Concept Content:

This week we will discuss sorting and queuing. This will include going over queuing theory and how to make adjustments to various conveyor systems and sensors.

This Week's Content:

Reading:

Learning Activity Packet 6 - Sorting and Queuing - Whole Packet

Simple Queuing Model - 9 Pages- Talks about queuing theory and expands upon material presented in the learning activity packet.

Video:

The Ultimate Guide to PLC Prgramming for Sorting Operations - 22 Minutes - This gives a full lecture on the programming we will be doing to program our sorting module this week. It complements the text of the learning packet.

Inspection and Adjustment: Conveyor Belt - 1 Minute - A visual example of adjusting a flat belt conveyor belt, which is one of your skill activities for the week.

Photoelectric Sensor Wiring and Setup - 7.5 Minutes - A visual example of setting up photoelectric sensors, which is another one of the skill activities for the week.

10.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 1 - Operate a Sorting and Queuing Station - Pages 9 - 25

Skill 2 - Adjust a Flat Belt Conveyor - Pages 32 - 35

Skill 3 - Adjust a Photoelectric Sensor - Pages 42 - 46

Skill 4 - Design a PLC Program That Sequences a Sorting Module - Pages 58 - 63

Skill 5 - Design a PLC Program That Sequences a Parts Queuing Module - Pages 72 - 79

Skill 6 - Design a PLC Program That Sequences a Sorting and Queuing Station - Pages 83 - 90

Skill 7 - Design a PLC Program That Provides Manual/Auto/Reset Functions For a Sorting and Queuing Station - Pages 94 - 101

10.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

10.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

10.6 Week Wrap-Up

Concept Goals:

By the end of this module, you should:

- Describe the basic facets of queuing theory (SLO 2)
- Adjust conveyor belts and sensors (SLO 2)
- Design PLC programs to drive work on sorting and queuing modules (SLO 4)

Concept Content:

This week we discussed sorting and queuing. Next week we will continue discussing sorting and queuing.

This Week In Review:

Reading:

Learning Activity Packet 6 - Sorting and Queuing - Whole Packet

Simple Queuing Model - 9 Pages

Video:

The Ultimate Guide to PLC Prgramming for Sorting Operations - 22 Minutes

Inspection and Adjustment: Conveyor Belt - 1 Minute

Photoelectric Sensor Wiring and Setup - 7.5 Minutes

Assignments:

Skills 1-7

Week 11 - Sorting and Queuing Week 2

11.1 Week Overview

Concept Goals:

By the end of this module, you should:

- Describe the basic facets of queuing theory (SLO 2)
- Adjust conveyor belts and sensors (SLO 2)
- Design PLC programs to drive work on sorting and queuing modules (SLO 4)

Concept Content:

This week we will go over details regarding sorting and queuing modules. See module 10.2 for more details.

This Week At A Glance:

Reading:

Learning Activity Packet 6 - Sorting and Queuing - Whole Packet

Simple Queuing Model - 9 Pages

Video:

The Ultimate Guide to PLC Prgramming for Sorting Operations - 22 Minutes

Inspection and Adjustment: Conveyor Belt - 1 Minute

Photoelectric Sensor Wiring and Setup - 7.5 Minutes

Assignments:

Skills 1-7

Module Review - 10 Questions

11.2 Week Content Resources

Concept Content:

This week we are continuing our discussion on sorting and queuing. This will include going over queuing theory and how to make adjustments to various conveyor systems and sensors.

This Week's Content:

Reading:

Learning Activity Packet 6 - Sorting and Queuing - Whole Packet

Simple Queuing Model - 9 Pages- Talks about queuing theory and expands upon material presented in the learning activity packet.

Video:

The Ultimate Guide to PLC Prgramming for Sorting Operations - 22 Minutes - This gives a full lecture on the programming we will be doing to program our sorting module this week. It complements the text of the learning packet.

Inspection and Adjustment: Conveyor Belt - 1 Minute - A visual example of adjusting a flat belt conveyor belt, which is one of your skill activities for the week.

Photoelectric Sensor Wiring and Setup - 7.5 Minutes - A visual example of setting up photoelectric sensors, which is another one of the skill activities for the week.

11.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 1 - Operate a Sorting and Queuing Station - Pages 9 - 25

Skill 2 - Adjust a Flat Belt Conveyor - Pages 32 - 35

Skill 3 - Adjust a Photoelectric Sensor - Pages 42 - 46

Skill 4 - Design a PLC Program That Sequences a Sorting Module - Pages 58 - 63

Skill 5 - Design a PLC Program That Sequences a Parts Queuing Module - Pages 72 - 79

Skill 6 - Design a PLC Program That Sequences a Sorting and Queuing Station - Pages 83 - 90

Skill 7 - Design a PLC Program That Provides Manual/Auto/Reset Functions For a Sorting and Queuing Station - Pages 94 - 101

Module Review - 10 Questions

11.4 Module Reflection

11.5 Module Discussion Board

11.6 Module Wrap-Up

Concept Goals:

By the end of this module, you should:

- Describe the basic facets of queuing theory (SLO 2)
- Adjust conveyor belts and sensors (SLO 2)
- Design PLC programs to drive work on sorting and queuing modules (SLO 4)

Concept Content:

This week we discussed sorting and queuing. Next week we will start on servo robotics.

This Week In Review:

Reading:

Learning Activity Packet 6 - Sorting and Queuing - Whole Packet

Simple Queuing Model - 9 Pages

Video:

The Ultimate Guide to PLC Prgramming for Sorting Operations - 22 Minutes

Inspection and Adjustment: Conveyor Belt - 1 Minute

Photoelectric Sensor Wiring and Setup - 7.5 Minutes

Assignments:

Skills 1-7

Module Review - 10 Questions

Week 12 - Servo Robotic Assembly

12.1 Week Overview

Concept Goals:

By the end of this week, you should:

- List and describe different types of robots (SLO 2)
- Describe the difference between servo robotic assembly and pick and place assembly systems (SLO 4)
- Make adjustments to servo robotic systems (SLO 5)

Concept Content:

This week we will begin our section on servo robotics. See module 11.2 for more detail.

This Week At a Glance:

Reading:

Learning Activity Packet 7 - Servo Robotic Assembly - Pages 4-52

Types of Robots: Classification, Applications, and Examples

Servos Explained

Videos:

Modern Robotics: Control System Overview

Turbo Style Automatic Screw Feeder

Assignments:

Skills 1-4

Module Review - 10 Questions

12.2 Week Content Resources

Concept Content:

This week we will begin our module on servo robotic assembly. We will go over what servos are as well as discuss the types of robots used in industry. We will also discuss types or servo robotic assembly systems and machine parts that are related to those. We will also have four skill assignments this week that will go along with this subject. See module 11.3 for more detail.

This Week's Content:

Reading:

Learning Activity Packet 7 - Servo Robotic Assembly - Pages 4-52

Types of Robots: Classification, Applications, and Examples - Webpage - As we are beginning to work with robots this week, here is an article that goes over various types of robots and their applications.

Luciaclemares. (2023, May 25). *Types of robots: Classification, applications and examples*. Telefónica. https://www.telefonica.com/en/communication-room/blog/types-of-robots-classification-applications-and-examples/

Servos Explained - Webpage - This gives more explanation of how servos work.

Servos explained. Servos Explained - SparkFun Electronics. (n.d.). https://www.sparkfun.com/servos

Videos:

Modern Robotics: Control System Overview - 3.5 Minutes - This video gives a good overview of robotic control systems beyond what we are working with this week.

Turbo Style Automatic Screw Feeder - 10 Seconds - A visual example of one of the types of machines the text discusses this week.

12.3 Week Assessment/Assignment

Concept Content:

This week's assignments:

Skill 1 - Operate a Servo Robotic Assembly Station - Pages 12-36

Skill 2 - Adjust a Parts Feeder With Escapement - Pages 40-43

Skill 3 - Adjust an Automatic Screw Feeder - Pages 47-50

Skill 4 - Adjust a Pneumatic Part Shuttle - Pages 51-52

Module Review - 10 Questions

12.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task

for your specific subject, please feel free to delete this section from your class.

12.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

12.6 Week Wrap-Up

Concept Goals:

Module Learning Objectives:

- List and describe different types of robots (SLO 2)
- Describe the difference between servo robotic assembly and pick and place assembly systems (SLO 4)
- Make adjustments to servo robotic systems (SLO 5)

Concept Content:

This week we began our section on servo robotics. Next week we will complete our study on servos.

This Week In Review:

Reading:

Learning Activity Packet 7 - Servo Robotic Assembly - Pages 4-52

Types of Robots: Classification, Applications, and Examples

Servos Explained

Videos:

Modern Robotics: Control System Overview

Turbo Style Automatic Screw Feeder

Assignments:

Skills 1-4

Module Review - 10 Questions

Week 13 - Servo Robotic Assembly Week 2

13.1 Week Overview

Concept Goals:

By the end of this week, you should:

- Program PLCs to operate servo robotics to perform specific functions (SLO 4, SLO 5)

Concept Content:

This week we will finish our unit on servo robotics. See module 12.2 for more detail.

This week at a glance:

Reading:

Learning Activity Packet 7 - Servo Robotic Assembly - Pages 53-123

Videos:

Screw Feeder Animation - 30 Seconds - A visual example of one of the types of feeders we will work with this week.

Quick Guide to Servos - 4 Minutes - A good refresher on servos.

PLC Programming Tutorial for Beginners - 11 Minutes

Assignments:

Skills 5-9

Module Review - 10 Questions

13.2 Week Content Resources

Concept Content:

This week we will compete our section on Servo Robotic Assembly.

This week's content:

Reading:

Learning Activity Packet 7 - Servo Robotic Assembly - Pages 53-123

Videos:

Screw Feeder Animation - 30 Seconds - A visual example of one of the types of feeders we will work with this week.

Quick Guide to Servos - 4 Minutes - A good refresher on servos.

PLC Programming Tutorial for Beginners - 11 Minutes - Since our skill activities this week involve programming PLCs again, here is a video that gives a refresher on PLC programming basics.

13.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 5 - Design a PLC Program That Sequences a Part Insertion Module - Pages 63-68

Skill 6 - Design a PLC Program that Sequences a Screw Feed Module - Pages 78-82

Skill 7 - Design a PLC Program That Sequences a Screw Thread Engagement Module - Pages 92-97

Skill 8 - Design a PLC Program That Sequences a Servo Robotic Assembly Station - Pages 101-109

Skill 9 - Design a PLC Program That Provides Manual/Auto/Reset Functions For a Servo Robotic Assembly Station - Pages 113-122

Module Review - 10 Questions

We will work on the skills activities in class.

13.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

13.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

13.6 Week Wrap-Up

Concept Goals:

By the end of this week, you should:

- Program PLCs to operate servo robotics to perform specific functions (SLO 4, SLO 5)

Concept Content:

This week we finished our unit on servo robotics. Next week we will work on torquing.

This week in review:

Reading:

Learning Activity Packet 7 - Servo Robotic Assembly - Pages 53-123

Videos:

Screw Feeder Animation - 30 Seconds - A visual example of one of the types of feeders we will work with this week.

Quick Guide to Servos - 4 Minutes - A good refresher on servos.

PLC Programming Tutorial for Beginners - 11 Minutes

Assignments:

Skills 5-9

Module Review - 10 Questions

Week 14 - Torquing

14.1 Week Overview

Concept Goals:

By the end of this week, you will:

- Operate an automated torquing station (SLO 2)
- Adjust DC motor speed (SLO 3)
- Design a PLC program that sequences a non-servo electric slide (SLO 4, SLO 5)

Concept Content:

This week we will go over torquing. See module 13.2 for more detail.

This Week At A Glance:

Reading:

Learning Activity Packet 8 - Torquing - Whole Packet

How to Control the Speed and Direction of a DC Motor - Webpage

Videos:

Comparison of Linear Motion Systems - 3 Minutes

Assignments:

Skills 1-9

Module Review - 10 Questions

14.2 Week Content Resources

Concept Content:

This week we will cover torquing. This will include a look into DC motor speeds.

This Week's Content:

Reading:

Learning Activity Packet 8 - Torquing - Whole Packet

How to Control the Speed and Direction of a DC Motor - Webpage - This article expands upon controlling DC motor speed, which is a topic the learning packet goes over this week.

Mafukidze, H. (2021, December 11). *How to control the speed and direction of a DC motor*. Circuit Basics. https://www.circuitbasics.com/introduction-to-dc-motors-2/

Videos:

Comparison of Linear Motion Systems - 3 Minutes - this adds more information regarding motion systems on top of the material we have covered in the learning packets thus far.

14.3 Week Assessment/Assignment

Concept Content:

This Week's Assignments:

Skill 1 - Operate an Automated Torquing Station - Pages 13-23

Skill 2 - Adjust DC Motor Speed - Pages 27-31

Skill 3 - Adjust a Non-Servo Electric Slide - Pages 35-39

Skill 4 - Adjust Motor Torque Using a Clutch - Pages 43-48

Skill 5 - Adjust Motor Starter Overloads - Pages 53-57

Skill 6 -Design a PLC Program That Sequences a Non-Servo Electric Slide - Pages 67-71

Skill 7 - Design a PLC Program That Sequences a Screw Torque Module - Pages 82-87

Skill 8 - Design a PLC Program That Sequences an Automated Torquing Station - Pages 91-97

Skill 9 - Design a PLC Program That Provides Manual/Auto/Reset Functions For an Automated Torquing Station - Pages 100-107

Module Review - 10 Questions

14.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

14.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

14.6 Week Wrap-Up

Concept Goals:

Module Learning Objectives:

- Operate an automated torquing station (SLO 2)
- Adjust DC motor speed (SLO 3)
- Design a PLC program that sequences a non-servo electric slide (SLO 4, SLO 5)

Concept Content:

This week we went over torquing. Next week we will discuss parts storage.

This Week In Review:

Reading:

Learning Activity Packet 8 - Torquing - Whole Packet

How to Control the Speed and Direction of a DC Motor - Webpage

Videos:

Comparison of Linear Motion Systems - 3 Minutes

Assignments:

Skills 1-9

Module Review - 10 Questions

Week 15 - Parts Storage

15.1 Week Overview

Concept Goals:

By the end of this week, you will:

- Describe how automated storage and retrieval system work (SLO 2)
- Design PLC programs to work with parts pick up and parts storage modules (SLO 4)

Concept Content:

This week we will go over parts storage. See module 14.2 for more details.

This Week At A Glance:

Reading:

Learning Activity Packet 9 - Parts Storage

Automated Storage and Retrevial System, Types and Uses

Pneumatic Gripper: How They Work - Webpage

Assignments:

Skills 1-8

Module Review - 10 Questions

15.2 Week Content Resources

Concept Content:

This week we will cover parts storage. This will include the various types of storage systems and working with the mechanical components involved in those storage systems.

This Week's Content:

Reading:

Learning Activity Packet 9 - Parts Storage - Whole Packet

Automated Storage and Retrevial System, Types and Uses - Webpage - This article gives a more in depth discussion on ASRS systems

Marketing, C. (2023, August 15). *Automated Storage & Retrieval System (AS/RS) types & uses*. https://www.conveyco.com/blog/automated-storage-and-retrieval-types/

Pneumatic Gripper: How They Work - Webpage - This article gives a more in depth discussion on how pneumatic grippers can be used.

Kolstad, C. (2024, May 8). *Pneumatic gripper - how they work*. Tameson.com. https://tameson.com/pages/pneumatic-gripper

15.3 Week Assessment/Assignment

Concept Content:

This week's assignments:

Skill 1 - Operate a Programmable Parts Storage Station - Pages 13-30

Skill 2 - Adjust a Pneumatic Gripper - Pages 36-39

Skill 3 - Adjust an End Cushion - Pages 44-47

Skill 4 - Adjust a Phototransistor Optical Interrupter Switch - Pages 52-56

Skill 5 - Design a PLC Program That Sequences a Park Pickup Module - Pages 70-76

Skill 6 - Design a PLC Program That Sequences a Programmable Pneumatic Traverse Module - Pages 90-96

Skill 7 - Design a PLC Program That Sequences a Parts Storage Station - Pages 100-107

Skill 8 - Design a PLC Program That Provides Manual/Auto/Reset Functions for a Programmable Parts Storage Station - Pages 110-116

Module Review - 12 Questions

15.4 Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

15.5 Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

15.6 Week Wrap-Up

Concept Goals:

By the end of this week, you will:

- Describe how automated storage and retrieval system work (SLO 2)
- Design PLC programs to work with parts pick up and parts storage modules (SLO 4)

Concept Content:

This week we discussed parts storage. Next week we will close out the semester with our multiple station control module.

This Week In Review:

Reading:

Learning Activity Packet 9 - Parts Storage

Automated Storage and Retrevial System, Types and Uses

Pneumatic Gripper: How They Work - Webpage

Assignments:

Skills 1-8

Module Review - 10 Questions

Week - 16 Final Assessment

16.1 Week Overview

Concept Content:

This week we will take our final assesment. To access it, click on the assignments tab and look under test.

Final Exam - 49 Questions **(Instructor Note: This is a bank of questions you can use for the final assessment. You can choose which questions to use and add questions of your own. To remove questions, simply click on the live button and it will not appear for students).**

16.2 Week Wrap-Up

Concept Content:

Thank you for your work in class this semester. Best of luck moving forward in this program.

Extra Week - Multiple Station Control

Bonus Week Overview

Concept Goals:

By the end of this week, you should:

- Describe what handshaking is in terms of I/O modules (SLO 2)
- Define Flexible Manufacturing Systems (SLO 2)
- Design PLC programs I/O handshaking for a multiple station reset (SLO 4)

Concept Content:

Instructor Note: This is an extra week's worth of content in case you make it through the original content quickly.

This week we will go over multiple station control. See module 15.2 for more detail.

This week at a glance:

Reading:

Learning Activity Packet 10 - Multiple Station Control

What is Handshaking - Webpage

Videos:

FMS - Fastems Flexible Manufacturing System - 3 Minutes

Assignments:

Skills 1 - 7
Module Review - 12 Questions

Bonus Week Content Resources

Concept Content:

This week we will finish our semester with our module on multiple station control. We will learn about concepts such as I/O handshaking and flexible manufacturing systems.

This week's content:

Reading:

Learning Activity Packet 10 - Multiple Station Control - Whole Packet

What is Handshaking - Webpage - This expands upon I/O Handshaking that is discussed in the packet.

What is handshaking?. Tutorialspoint. (n.d.). https://www.tutorialspoint.com/what-is-handshaking

Videos:

FMS - Fastems Flexible Manufacturing System - 3 Minutes - This is an example of a flexible manufacturing system and how one can work.

Bonus Week Assignment/Assessment

Concept Content:

This Week's Assignments:

Skill 1 - Design a PLC Program to Use Discrete I/O Handshaking - Pages 11-19

Skill 2 - Design a PLC Program to Use Discrete I/O Handshaking for Multiple Station Startup - Pages 24-27

Skill 3 - Design a PLC Program to Use Discrete I/O Handshaking for a Multiple Station Halt - Pages 30-34

Skill 4 - Design a PLC Program to Use Discrete I/O Handshaking for a Multiple Station Cycle Stop - Pages 40-45

Skill 5 - Design a PLC Program to Use Discrete I/O Handshaking for a Multiple Station Reset - Pages 47-51

Skill 6 - Design a PLC Program to Use Discrete I/O Handshaking for Multiple Station FMS - Pages 56-61

Skill 7 - Modify a PLC Program to Use Discrete I/O Handshaking for Multiple Station Quantity Production - Pages 64-69

Module Review - 12 Questions

Bonus Week Reflection

Concept Content:

This is a completely optional section. The purpose of this section is to ask your students to reflect on the material they have learned in this course. Or, if there is a specific area of the content you wanted to make sure students understood, you could guide them to discuss that in their response to your reflection question(s). You could also use this section to discuss case studies related to the content this section went over. However, if you feel that this would not be an appropriate assignment/task for your specific subject, please feel free to delete this section from your class.

Bonus Week Discussion Board

Concept Content:

This is a completely optional section. The purpose of this section is to invite your students to discuss the week's content and what they learned from it with each other. If you feel this would not be appropriate for your class or at least this week's content, feel free to delete it. If you are interested in doing a discussion board, a good idea would be to come up with a question related to the week's content for the students to answer. From there, require them to answer the quesion and respond to a least one other student's answer to foster discussion.

Bonus Week Review

Concept Goals:

By the end of this week, you should:

- Describe what handshaking is in terms of I/O modules (SLO 2)
- Define Flexible Manufacturing Systems (SLO 2)
- Design PLC programs I/O handshaking for a multiple station reset (SLO 4)

Concept Content:

This week we finished our module on multiple station control. With that, we have finished up our semester in ATR-112. Thank you all for your participation in this course. Best of luck moving forward on your studies.

This week in review:

Reading:

Learning Activity Packet 10 - Multiple Station Control

What is Handshaking - Webpage

Videos:

FMS - Fastems Flexible Manufacturing System - 3 Minutes

Assignments:
Skills 1 - 7
Module Review - 12 Questions

Faculty Resources (For Instructor Only, Do Not Publish Live)

Odigia Guide

Concept Content:

Click on the resources tab to find the guide sheet for instructors.

FESTO Introduction to Mechatronics Information

Concept Content:

This document attached in this section outlines the Introduction to Mechatronics Certification that FESTO gives out. It outlines what must be in a course in order to qualify for the certification. The requirements have been mapped to the individual modules in this course that correspond to that requirement.

It also shows required equipment for the course.

Your institutions instructors will also have to be certified in order for the students to get credit towards their certification. Here is the link to FESTO's about us page in order to contact them.

For North Caronlina schools, this certification is awarded through NC3. Here is the instructor link for NC3 for interested instructors.

Intruduction to Mechatronics Certification Information