JEFFERSON COLLEGE

COURSE SYLLABUS

ETI277

SERVICING ROBOTIC SYSTEMS

5 Credit Hours

Prepared by
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Revised Date: January, 2008
By
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Division of Technology
Dr. John Keck, Dean
Ms. Brenda Russell, Associate Dean
I. Catalog Description

Prerequisite: ETI236 Industrial Control
Corequisite: ETI256 Introduction to Microprocessors

Credit Hours: 5

Servicing Robotic Systems is a project-oriented course involving the interaction and interfacing of the elements of automation. The course includes automation safety, installation, system analysis, integration, and system documentation. This course meets the computer literacy requirement for the degree-seeking students(S).

II. Expected Learning Outcomes with Assessment Measures

Upon Completion of this course, the student will be able to:

A. Demonstrate knowledge of the basic vocabulary and fundamental differences of technology levels in robots and automation. *(Evaluate by written exams, quizzes and observation of lab performance)*

B. Demonstrate knowledge of and practice standard safety procedures that must be followed concerning automation equipment. *(Evaluate by written exams, quizzes and observation of lab performance)*

C. Demonstrate knowledge of and practice keeping accurate records of service performed. *(Evaluate by written service logs)*

D. Demonstrate knowledge of and practice using the manufactures documentation to troubleshoot, repair, maintain, interface and identify components for automation equipment. *(Evaluate by written exams, quizzes and observation of lab performance)*

E. Demonstrate knowledge of and practice an acceptable level of professionalism as an automation technician. *(Evaluate by written exams, quizzes and observation of lab performance)*

F. Demonstrate knowledge of the process of planning and installing automation as it effects all divisions of the company. *(Evaluate by written exams, quizzes and observation of lab performance)*

G. Demonstrate the ability to identify and use components and tools associated with automation technology. *(Evaluate by observation of lab performance)*

H. Demonstrate the ability to integrate the components necessary to construct a work-cell with full documentation. *(Evaluate by computer generated system document and observation of lab performance)*
III. **Course Outline**

A. Robot Fundamentals
B. Safety
C. Service Log and Other Records
D. Machine Documentation and Operation
E. Machine Documentation and Repair
F. Machine Vision
G. Guidelines for the Service Technician
H. Automation Installation
I. Components and Tools
J. Batteries
K. Course Project
Unit: 1  
Lesson: 1

Title: Robot Fundamentals

Objectives: Upon completion of this lesson, the student should be able to:

1. State the difference between hard automation devices and robots  
2. Define the robot related terms  
   a. Axes  
   b. Actuator  
   c. Manipulator  
   d. Controller  
   e. Power supply  
3. State the difference between servo controlled and non-servo controlled robots  
4. List three basic methods of actuating robots  
5. Identify the most common way of controlling high technology robots  
6. State why pneumatics is the preferred way of actuating low technology robots  
7. Identify the devices that made special purpose robots practical  
8. List the order of complexity of the three coordinate systems used for robots  
9. Define low, medium, and high technology robots and their differences  
10. Define the difference between pick-and-place, point to point, and continuous path robots

Reading Assignment: Robot Fundamentals Heathkit text

Unit: 2  
Lesson: 1

Title: Safety

Objectives: Upon completion of this lesson, the student should be able to:

1. List several general rules of safety with regard to the mechanical industry  
2. List several rules of safety with regard to the electrical industry  
3. Define electrical shock hazards and how to avoid them  
4. Define the causes and hazards of undesired arcing and appropriate action  
5. List three pieces of test equipment specifically designed for safety testing  
6. List the three classes hazardous environments addressed by the NEC  
7. Define the hazard of acoustical radiation and how to protect against it
8. List the safety considerations with regard to the operator, observer, and maintenance persons
9. List and explain the operation of several perimeter safety sensors which are available
10. Explain the responsibility dealing with hazardous wastes

Unit: 3
Lesson: 1

Title: Service Log and Other Records

Objectives: Upon completion of this lesson, the student should be able to:

1. List and describe the appropriate components of a service log
2. Explain the purpose of a service log
3. List the benefits of keeping good records of service performed
4. Describe a logical layout of a log form
5. Describe the proper method of filling out the log form
6. Describe acceptable method of filing log forms
7. Develop a log form as a group
8. Keep a log of all manual practices in the laboratory
9. Describe ISO 9000 documentation, certification, and compliance requirements

Unit: 4
Lesson: 1

Title: Machine Documentation and Operation

Objectives: Upon completion of this lesson, the student should be able to:

1. Find and identify specific diagrams of each of the following
   a. Block
   b. Circuit
   c. Electrical
   d. Assembly
2. Use documentation to locate specific machine parts and part numbers
3. Use documentation to identify connectors and contact locations
4. Define the difference between mechanical compensation and electrical compensation for straight line movement of a robot
5. Use documentation to locate machine specifications of a robot
6. Use documentation to identify major systems of a machine
7. Describe drive system operation for several machines
a. Transmission
b. Link-rods
c. Roller chain
d. Cylinder

8. Describe the unique and general operating techniques of several machines
9. Program robot with teach pendant
   a. ASEA
   b. HERO

Unit: 4
Lesson: 2

Title: Machine Documentation and Repair

Objectives: Upon completion of this lesson, the student should be able to:

1. Describe the use of machine documentation for the purpose of:
   a. Troubleshooting system faults
   b. Read troubleshooting charts
   c. Measure and set power supply voltages
   d. Adjust stops
   e. Adjust and maintain mechanical components
   f. Work to manufactures specifications
2. Describe how to locate and repair connector and cable fault
3. Describe three systematic methods of troubleshooting systems and circuits
4. Describe differences between servicing with and without service documentation
5. State the basic servicing sequence of an efficient technician
6. Describe the difference between preventive, and corrective maintenance

Unit: 5
Lesson: 1

Title: Machine Vision

Objectives: Upon completion of this lesson, the student should be able to:

1. Define the terms related to visions systems
2. State and describe the basic components of a vision system
3. Describe the process and techniques of image acquisition
4. Describe the process and techniques of image analysis
5. Describe the process of image recognition
6. Describe industrial applications of vision
Title: Guidelines for the Service Technician

Objectives: Upon completion of this lesson, the student should be able to:

1. State how the changing technology will effect the future of the service technician
2. Describe the structure of effective troubleshooting
3. Describe the potential for the need of specialized test equipment
4. Describe the proper attitude necessary for effective servicing
5. State the components necessary for a technician to display a reasonable level of professionalism
6. Describe the approach to servicing systems without documentation

Unit: 6
Lesson: 2

Title: Automation Installation

Objectives: Upon completion of this lesson, the student should be able to:

1. Describe the components necessary to define the task of installation as it concerns engineering, and/or manufacturing, and/or quality control with reference to the following
   a. The process or part of process to be done
   b. Integration into the rest of the process
   c. Machine specifications required
   d. Personnel required
   e. Failures in the process
2. Describe a plan for an installation as it concerns engineering, and/or manufacturing, and/or quality control with reference to the following
   a. Time schedule
   b. Tooling and interface requirements
   c. New personnel required
   d. Operation and the effects on the process
3. Describe the general aspects relating to personnel and labor relations
4. Describe installation as it relates to personnel needed, materials, and start-up
5. State the safety considerations related to installation, operation, and emergencies

Unit: 7
Lesson: 1
Title: Components and Tools

Objectives: Upon completion of this lesson, the student should be able to:

1. Describe and state the importance of several EMI filters
2. Describe and select as required, relays according to their electrical and mechanical specifications
3. Describe and select as required, connectors according to their electrical and mechanical specifications
4. Describe and select as required, fuses according to their electrical and mechanical specifications
5. Describe and select as required, mechanical fasteners according to their mechanical specifications
6. State some of the less known electrical characteristics of resistors and capacitors
7. State some of the specific applications of the different types of resistors and capacitors
8. State the potential for the need of special tool relative to a specific machine and examples of some and how they are used
9. Describe and demonstrate the selection and proper use of a connector crimping tool
10. Describe and demonstrate the proper use of a micrometer and vernier calipers

Unit: 7
Lesson: 2

Title: Batteries

Objectives: Upon completion of this lesson, the student should be able to:

1. State the advantages and disadvantages of each type of battery: lead acid, Ni-Cad, and Gel-Cell
2. Describe the proper care and maintenance procedures for secondary cells
3. Define the terms capacity, charge rate, and discharge rate
4. List and describe the different charge rates
5. State the specific characteristics of Ni-Cad and Gel-Cell batteries relative to life expectancy, charge levels, and discharge levels
6. Describe the proper method of charging a battery
Objectives: Upon completion of this lesson, the student should be able to:

1. Describe the coordination of the operation of several pieces of automatic equipment for some end product
2. Describe and provide an interface between robots and other equipment for some end product
3. Describe and demonstrate the procedure for start-up and shut-down of an automated work cell
4. Describe and provide the information that would resemble an owner's manual (computer generated) of the project work cell: (project report).
IV. **Methods of Instruction**: Lecture, Demonstration, Laboratory Experiences, Discussion, Assigned Reading, Field Trip

V. **Required Textbook**

None

VI. **Required Materials**

Safety Glasses

VII. **Supplemental References**

A. ASEA Service and Maintenance Manuals
B. Fanuc Service and Maintenance Manuals
C. Nachi Service and Maintenance Manuals
D. Heathkit Robotics Course Manuals

VIII. **Methods of Evaluation**

A. Distribution of the Final Grade:

   30% - Theory (tests, quizzes, homework)
   50% - Laboratory (observing work habits, safety habits, follow verbal instructions, participation, attendance, homework and perform the exercises assigned)
   10% - Service Log
   10% - Project Report

B. Assignment of Final Grade Letter:

   A - 90 to 100%
   B - 80 to 89%
   C - 70 to 79%
   D - 65 to 69%
   F - Below 65%

IX. **ADA Statement**

Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (Library; phone 636-797-3000, ext. 169).
X. **Academic Honesty Statement**

As a student in the Electronics Department, you are advised of the Statement of Academic Honesty published in the Jefferson College Student Handbook. Plagiarism, Cheating, and Computer misuse violate the College’s standards of academic honesty, and the expectations for conduct in the Electronics Department. Conduct related to assignments, examinations, or computer usage during the completion of assignments or examinations in violation of the standards of academic honesty may result in a failing (F) grade given for the assignment or examination, and potentially, the course.