OCC Career ADVANTAGE
ORANGE COAST COLLEGE

Recommendations for OCC
Program Structure and Curriculum/Competencies and Outcomes:

Automation Fundamentals Certificate

This 12 unit certificate consists of three common areas of study; DC Circuits, AC Circuits and programmable Logic Controllers. Additional competencies may vary depending upon the particular disciplines offered at the various colleges as described below.

- DC Electrical/Electronic theory, components, circuits and troubleshooting; typically a 3 unit course with hands on laboratory experiences.
- Detailed competencies and learning outcomes on following pages.
- AC Electrical/Electronic theory, components, circuits and troubleshooting; typically a 3 unit course with hands on laboratory experiences.
- Detailed competencies and learning outcomes on following pages.
- Programmable Logic Controllers, I/O interfacing, Programming and troubleshooting; typically a 3 unit course with hands on laboratory experiences.
- Detailed competencies and learning outcomes on following pages.
- One or more other related automation courses will be added based on the participating colleges' particular discipline or preference.
- Blueprint and Schematic Reading. 1-3 unit course
- OSHA 10 or OSHA 30 Safety training. 1-3 unit courses
- Introduction to Drafting and CAD. 3-4 unit course

In addition, OCC should working on creating an on-line, VR or AR one (1) unit course in the "Exploration of Careers in Automation" to make students aware of the Automation career possibilities in the many different disciplines and help guide students into a CTE program of their choice. It could also be used to help displaced workers choose a new career path. To be used in conjunction with our current assessment tools.

1. **DC Electrical/Electronic Content:**
   - Basic electrical concepts of Current, Voltage and Resistance using Kirchoff's and Ohm's
   - Laws
   - Appling Power Formulas
   - Technical Math Skills Including:

     a. Scientific and Engineering Notation
     b. Metric units and prefixes
     c. Precision and Significant Digits

- Series DC Circuits – Analysis, Design and Troubleshooting
- Parallel DC Circuits – Analysis, Design and Troubleshooting
- Voltage Divider Circuits and Variable resistance devices and sensors
- Conductors and Insulation
- Wire types and their applications
- Resistance, Voltage and Current carrying capabilities
- Connectors and Switches – types and applications
- Insulators – types, characteristics and applications.
- DC Power Sources – Batteries, Solar cells, AC/DC power supplies.

2. Electromagnetism

- Basic Principles
- Relay Circuits
- DC Motors
- Electromagnetic Induction (DC Generators)
- Inductance and applications with sensors

3. Capacitance

- Basic Operation – Charge and Discharge
- Basic Capacitor Characteristics – Capacitance, Breakdown Voltage, Dielectrics
- Series and Parallel Capacitor Circuits

4. Resistor-Capacitor (RC) time constants (NOTE: Interspersed through this course will be examples of how the topic of the day relates to various applications in various automation industries.)

5. AC Electrical/Electronic Content:

- **Principles of AC**
  - Frequency and Period
  - Amplitude and RMS units
  - Signal Generator operation and uses
  - Oscilloscope operation and uses

6. Inductance and Inductors, Transformers, Inductance-Resistance (L/R) time constants

7. Reactance – Inductive and Capacitive Principles, Applications and Calculations

8. Impedance

9. Circuit analysis and troubleshooting

- Shorts, Opens, Voltage Drops
- Interpreting Schematic Diagrams for Troubleshooting

- Test Equipment uses
- Common Component and Circuit Problems
- Series AC Circuits – RC and RL

10. AC Power Line and the Edison System

- Generator Stations
- Transformers
- Distribution Lines
- Local Transformer
- Power Panel
- Home Distribution System
- Safety

11. LRC Circuits and Resonance – series and parallel

12. Varying DC – Duty cycle and average DC value – Signal Generators and Oscilloscopes

13. Filters – Low Pass, High Pass, Band Pass and Bandstop1

14. Frequency Domain and Spectrum analysis principles and applications

15. Analog Voltages and Currents

16. Analog Circuit Applications

17. Amplifiers – Principles and applications

- NOTE: Interspersed through this course will be examples of how the topic of the day relates to various applications in various automation industries.

Programmable Logic Controllers Content:

1**. Introduction to Electromechanical Relay and Relay Ladder Diagrams**

2. Combinatorial Control Using Relays – AND, OR. INVERT, NAND, NOR

3. Latching Control Using Relays

4. Introduction to the Programmable Logic Controller (PLC)

5. Basic Functions and Advantages

- Computer simulation of relays and interconnecting wires
- Reprogramming vs rewiring relay circuits

6. Programming

- PLC Vendor supplied software
- Standard Ladder Diagram programming
- Downloading and uploading ladder diagram programs
- Software simulation for testing and troubleshooting PLC programs

7. Interfacing PLC inputs with sensors and switch controls

8. Interfacing PLC outputs with actuators, display indicators

9. Running the PLC Program – Start, Monitor, Stop and running the simulator.

10. Applications using Combinatorial control and Latching Control

11. Timing and Counting

- PLC Timer Function Registers and Operation
- PLC Counter Function Registers and Operation

12. PLC Math Functions

13. PLC Comparison Instructions

14. Digital Sensors – Examples and interface applications of On/Off type input sensors

15. Analog Sensors – Example types and interfacing to PLC inputs

16. Output Interfacing

- Direct Digital Control – Low current devices
- Control of High Current Devices

  i. DC using Transistors of Relays

  ii. AC using TRIAC's or Relays

  iii. Inductive loads such as motors

17. Sequential Control Methodology and Example Applications

- Time Driven Sequence
- Event Driven Sequence

18. Designing, constructing, programming and troubleshooting PLC control systems

- NOTE: Interspersed through this course will be examples of how the topic of the day

relates to various applications in various automation industries.

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STUDENT LEARNING OUTCOMES

DC Electrical/Electronics

Upon successful completion of this course the student will:

1. Correctly identify the characteristics, applications and measurement methods of Direct Current Electricity.
2. Correctly calculate electrical quantities in DC circuits containing resistors, capacitors and Inductors using Ohm's and Watt's Laws, Kirchhoff's Laws and appropriate circuit analysis methods.
3. Correctly perform circuit measurements using multi-meter, perform circuit fabrication using electronic schematic diagrams, and perform simple problem-isolation techniques on laboratory circuits.
4. Correctly identify common component symbols and explain the functions of common electronic components.
5. Be able to describe the operation of typical DC circuits used in Automation systems as presented throughout the class.

AC Electrical/Electronics

Upon successful completion of this course the student will be able to:

1. Accurately measure and correctly apply the related theories and characteristics of Alternating Current circuits, and accurately calculate reactive circuit quantities, including impedance and resonance.
2. Analyze (predict or calculate the behavior or change in behavior of) a given AC electric circuit or device.
3. Test and measure specified parameters of a given AC electric circuit or device using standard laboratory test equipment and procedures.
4. Troubleshoot (identify a faulty component in) a given malfunctioning AC electric circuit or device.
5. Design (specify all components and interconnections of) and construct an AC electric circuit to perform a specified function.

STUDENT LEARNING OUTCOMES, Continued

6. Evaluate the feasibility of a proposed design for an electronic circuit or system intended to satisfy given standards of performance subject to given constraints.
7. Correctly perform circuit prototyping, construction, testing/operational validation, and troubleshooting processes, and accurately use basic electronic test equipment in those processes.

Programmable Logic Controllers

Upon successful completion of this course the student will be able to:

1. Design and construct a PLC Ladder Logic circuit to control a series of specified loads with sequence and timing specified.
2. Locate an error in the design of the ladder diagram, or a defect in the connecting circuit of a given non-functioning PLC controller with symptoms or measurements supplied.
3. Explain the serial communication configurations for the PLC.
4. Understand and explain the PLC addressing structure needed to control discrete components.
5. Identify and recognize discrete inputs and outputs and their respective interface constraints to the PLC.