MONROE COUNTY COMMUNITY COLLEGE

Course Outcome Summary

Required Program Core Course

ELEC 129 AC DC Motors and Controls

Course Information

Division	**Applied Science and Engineering Technology**
Contact Hours	**90**
Total Credits	**4.0**

Prerequisites **ELEC 125**

Course Description

This course is designed to provide students with a knowledge of AC/DC motor operating characteristics and control circuits including variable frequency drives, switchgear starting and control circuits and power control with various Thyristor (SCR's and Triac's) devices. It will provide hands-on experience with wiring control circuits, checking the operational characteristics of AC/DC motors and the use/installation of circuit protection devices. Development and application of ladder logic theory, diagrams and circuits will be covered along with basic programmable logic controller (PLC) operation. Basic operation and circuit characteristics of three-phase alternators and transformers will be covered as well as operating principles of DC generators.

This course is a required core course for students pursuing a degree **in**

Electrical Engineering Technology

Program Outcomes Addressed by this Course:

Upon successful completion of this course, students should be able to meet the program outcomes listed below:

A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
C. Develop and Demonstrate Problem Solving Skills.
D. Develop a willingness to learn independently.
E. Develop and demonstrate effective wiring and laboratory skills.
F. Demonstrate Equipment/Instrumentation Competence
G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams
H. Demonstrate effective Oral Presentation Skills
I. Value Safety Training, Safe Work Practices and acknowledge Safety Standards
J. Develop and demonstrate the synergistic relationship and integration of various technical and academic fields into the study of Electronics (i.e. Mechatronics)
K. Design, Construct, and Troubleshoot AC and DC Motor Control Circuits and demonstrate an understanding of process control.
L. Demonstrate a thorough understanding of DC and AC theory and operating concepts.

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Course Outcomes

1. In order to evidence success in this course, the students will be able to:
   Identify the advantages of 3-phase ac versus single-phase ac, versus dc and the significance of motor efficiency and motor power factor

   Applies to Program Outcome

   A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
   C. Develop and Demonstrate Problem Solving Skills.
   F. Demonstrate Equipment/Instrumentation Competence
   G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

2. Recognize a standard reversing 3-phase motor-starter, 3-phase induction motor-control circuits presented in ladder-logic format and recognize the necessity for multi-station control of an induction motor, and the jog versus run distinction.

   Applies to Program Outcome

   A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
   B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
   C. Develop and Demonstrate Problem Solving Skills.
   F. Demonstrate Equipment/Instrumentation Competence
   G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

3. Recognize the need for time delay to prevent simultaneous starting of two or more induction motors from the same 3-phase power feeder, and the essential difference between the synchronous motor's I/V phase relation and that of all other ac motors and recognize the need for time delay to prevent simultaneous starting of two or more induction motors from the same 3-phase power feeder, and the essential difference between the synchronous motor's I/V phase relation and that of all other ac motors

   Applies to Program Outcome

   A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
   B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
   C. Develop and Demonstrate Problem Solving Skills.
   D. Develop a willingness to learn independently.
   E. Develop and demonstrate effective wiring and laboratory skills.
   F. Demonstrate Equipment/Instrumentation Competence
   G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

4. Observe the essential disadvantage of ac induction motor speed control by voltage variation and the essential advantage of ac induction motor speed control by electronic (SCR) frequency variation and demonstrate wiring a 3-phase alternator and display its 3-phase ac output on an oscilloscope, wire a 3-phase transformer driving a 3-phase resistive load, and measure the line voltage and current, and the total system power using electronic wattmeters, Electronic/Rotary Phase Conversion

   Applies to Program Outcome

   A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
   B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
   C. Develop and Demonstrate Problem Solving Skills.
   D. Develop a willingness to learn independently.
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5. Demonstrate how to start a 3-phase induction motor with a manual disconnect switch, and show the relation between shaft rotational direction and phase winding connections to the 3-phase supply and attach a dynamometer to the shaft of an ac induction motor and take data to show the motor's torque relationships to current, speed, efficiency, and power factor and practice correct wiring access to the following standard-labeled terminals of a 3-pole reversing motor starter: L1, L2, L3, T1, T2, T3, 2, 3, 4, 5, OL, X1, X2, Design and draw, in ladder-logic format, wire and test a single-station reversing 3-phase motor control circuit with and without manual switch interlocks

   Applies to Program Outcome

   A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
   B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
   C. Develop and Demonstrate Problem Solving Skills.
   D. Develop a willingness to learn independently.
   E. Develop and demonstrate effective wiring and laboratory skills.
   F. Demonstrate Equipment/Instrumentation Competence
   G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

6. Draw in ladder-logic format, wire and test a two-station, reversing 3-phase motor control circuit with directional indicator lights and with Jog/Run capabilities and design, draw in ladder-logic format, wire and test a two-motor, single-station time-delay induction motor control circuit and wire and run a synchronous motor with a dynamometer load to demonstrate the motor's leading current/voltage relationship, which makes the motor unique, and wire and test a 3-phase feeder driving both an induction motor and a synchronous motor to demonstrate power factor correction

   Applies to Program Outcome

   A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
   B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
   C. Develop and Demonstrate Problem Solving Skills.
   D. Develop a willingness to learn independently.
   E. Develop and demonstrate effective wiring and laboratory skills.
   F. Demonstrate Equipment/Instrumentation Competence
   G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

7. Demonstrate the possibility of ac induction motor speed control by a) voltage variation b) frequency variation and recognize a standard reversing motor-starter and the natural difficulties accompanying the starting process for a dc motor

   Applies to Program Outcome

   Applies to Program Outcome

   A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
   B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
   C. Develop and Demonstrate Problem Solving Skills.
   D. Develop a willingness to learn independently.
   E. Develop and demonstrate effective wiring and laboratory skills.
   F. Demonstrate Equipment/Instrumentation Competence
   G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

8. Recognize motor-control circuits presented in ladder-logic format and the necessity for multi-station control of a motor and recognize the need to temporarily insert current-limiting resistor(s) in the armature path during motor acceleration and the elegant electric/magnetic braking schemes for a dc motor, contrasted with the crude mechanical braking idea and recognize the efficiency advantage of an SCR-based motor-drive circuit versus a variable-resistance armature control circuit and measure the winding resistances of a dc motor (armature, shunt field winding, and a series field winding)

   Applies to Program Outcome

   A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
   B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
   C. Develop and Demonstrate Problem Solving Skills.
   D. Develop a willingness to learn independently.
   E. Develop and demonstrate effective wiring and laboratory skills.
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9. Practice using an analog ammeter to demonstrate the inrush starting current problem of a dc motor that is started by the across- the-line method; and demonstrate the elimination of the inrush problem when a dc motor is started under reduced- voltage "soft-start" conditions and demonstrate the relationship between direction of shaft rotation and polarization of armature voltage for a dc motor

Applies to Program Outcome

A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
C. Develop and Demonstrate Problem Solving Skills.
D. Develop a willingness to learn independently.
E. Develop and demonstrate effective wiring and laboratory skills.
F. Demonstrate Equipment/Instrumentation Competence
G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

10. Practice design, draw in ladder-logic format, wire and test a single-station, reversing motor control circuit, with directional indicator lights and design, draw in ladder-logic format, wire and test a two-station, non-reversing motor control circuit with indicator lights

Applies to Program Outcome

A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
C. Develop and Demonstrate Problem Solving Skills.
D. Develop a willingness to learn independently.
E. Develop and demonstrate effective wiring and laboratory skills.
F. Demonstrate Equipment/Instrumentation Competence
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11. Practice design, draw in ladder-logic format, wire and test a two-station, reversing, Jog/Run motor control circuit, with directional indicator lights and design, draw in ladder-logic format, wire and test a two-motor, single-station time-delay motor control circuit
Applies to Program Outcome

    A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
    B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
    C. Develop and Demonstrate Problem Solving Skills.
    D. Develop a willingness to learn independently.
    E. Develop and demonstrate effective wiring and laboratory skills.
    F. Demonstrate Equipment/Instrumentation Competence
    G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

12. Practice design, draw in ladder-logic format, wire and test a two-motor, two-station time-delay motor control circuit and wire and test a current-limiting starting circuit, with field-failure protection and overload protection and wire the circuit and display and explain the waveforms of an SCR power-control circuit for an incandescent lamp
Applies to Program Outcome

    A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
    B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
    C. Develop and Demonstrate Problem Solving Skills.
    D. Develop a willingness to learn independently.
    E. Develop and demonstrate effective wiring and laboratory skills.
    F. Demonstrate Equipment/Instrumentation Competence
    G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

13. Demonstrate the process of flashing the field of a dc generator
Applies to Program Outcome

A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
C. Develop and Demonstrate Problem Solving Skills.
D. Develop a willingness to learn independently.
E. Develop and demonstrate effective wiring and laboratory skills.
F. Demonstrate Equipment/Instrumentation Competence
G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

14. Demonstrate building and testing various AC and DC motor speed control circuits including SCR and TRIAC control circuits as well as Variable Frequency Drives
Applies to Program Outcome

A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
C. Develop and Demonstrate Problem Solving Skills.
D. Develop a willingness to learn independently.
E. Develop and demonstrate effective wiring and laboratory skills.
F. Demonstrate Equipment/Instrumentation Competence
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15. Demonstrate wiring and testing a rotating field single phase AC alternator, and a three phase AC alternator
Applies to Program Outcome

A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
C. Develop and Demonstrate Problem Solving Skills.
D. Develop a willingness to learn independently.
E. Develop and demonstrate effective wiring and laboratory skills.
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16. Demonstrate wire and test a three phase circuit containing a delta to delta transformer and repeat for a delta to wye transformer

Applies to Program Outcome

A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
C. Develop and Demonstrate Problem Solving Skills.
D. Develop a willingness to learn independently.
E. Develop and demonstrate effective wiring and laboratory skills.
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17. Demonstrate the operation of Stepper and Servo Motors.

Applies to Program Outcome

A. Acquire and apply technical expertise in the areas of Circuit analysis, Analog electronics, Digital electronics, Microprocessors, and Communication systems.
B. Utilize Virtual Instrumentation, Data Acquisition, Schematic Capture and Test and Applications software packages to refine skills and to analyze and design various electronic circuits.
C. Develop and Demonstrate Problem Solving Skills.
D. Develop a willingness to learn independently.
E. Develop and demonstrate effective wiring and laboratory skills.
F. Demonstrate Equipment/Instrumentation Competence
G. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

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