9/3/2024 DATE
☑ REQUIRED COURSE
☐ ELECTIVE COURSE

TEC DIVISION
☑ NEW COURSE
☐ REVISION

Lake Land College

Course Information Form

COURSE NUMBER:	APT-046		TITLE: *(30 Characters Max)*		Motor Control Systems I						
SEM CR HRS:	1	Lecture:	0.5	Lab:	1	ICCB Lab:	1	ECH:	1.5		
Course Level:	☐ Gen Ed/IAI ☐ Baccalaureate/Non-IAI ☑ Career/Technical ☐ Dev Ed/Not in Degree Audit			Clinical Practicum:	0	Work-based Learning:	0	WBL ECH:	0		
COURSE PCS #	12 - 15.0406		IAI Code	N/A				Contact Hours (Minutes/Week)			
Repeatable (Y/N):	N	Pass/Fail (Y/N):	N	Variable Credit (Y/N):	N	Min:		Max:		16 Wks	75	8 Wks	150
Prerequisites:	AET-040, AETC-040 or previous electrical experience										
Corequisites:	None										
Catalog Description: (40 Word Limit)	Students will understand of industrial electrical and electronic power systems. Topics covered include electrical safety, three phase circuits, motors wiring, ladder logic, transformers and electronic motor controllers. (Meets SACA Automation Specialist I C-202 Electric Motor Control Systems 1 credential.)										

List the Major Course Segments (Units)	Contact Lecture Hours	Contact Lab Hours	Clinical Practicum	Work-based Learning
Standard 202.1 Apply approved safety practices for electric motor control systems	0.75	1		
Standard 202.2 Interpret ladder logic schematics	2	3		
Standard 202.3 Make proper electrical ground connections	0.25	1		
Standard 202.4 Connect and operate a 3-phase motor	0.5	1		
Standard 202.5 Connect and operate a manual motor control circuit	0.5	1		
Standard 202.6 Select and install a control transformer	0.5	1		
Standard 202.7 Connect and operate a basic ladder logic control circuit	0.5	1		
Standard 202.8 Connect and operate a 2/3 wire magnetic motor starter circuit	0.5	1		
Standard 202.9 Connect and operate a reversing motor control circuit	0.5	1.5		
Standard 202.10 Connect and operate a hands-off-auto motor control circuit	0.5	1.5		
Standard 202.11 Connect and operate automatic input devices	0.5	1		
Standard 202.12 Connect and operate basic timer control circuits	1	2		
TOTAL	8	16	0	0

EVALUATION							
QUIZZES	☑	EXAMS	☑	ORAL PRES	☑	PAPERS	☑
LAB WORK	☑	PROJECTS	☐	COMP FINAL	☑	OTHER	☐

COURSE MATERIALS		
TITLE:	Electric Motors and Control Systems	
AUTHOR:	Petruzella	
PUBLISHER:	McGraw Hill	
VOLUME/EDITION/URL:	2nd	
COPYRIGHT DATE:	2010	

MAJOR COURSE SEGMENT	HOURS	LEARNING OUTCOMES
		The student will be able to:
Standard 202.1 Apply approved safety practices for electric motor control systems	1.75	Performance Indicators 1. Perform a lockout/tagout. 2. Identify and correct electrical hazards. Knowledge Indicators 1. Describe electrical and electric motor hazards. 2. Describe PPE/safe dress for operating or troubleshooting motor control systems. 3. Describe the purpose of the lockout/tagout system used in industry. 4. Describe how to determine if equipment is properly grounded. 5. Describe the basic rules of electrical safety.

Standard 202.2 Interpret ladder logic schematics	5	Performance Indicators 1. Identify the symbols for transformers, lamps, motors, solenoids, meters, fuses, coils, contacts, limit switches, float switches, pressure switches, magnetic motor starters, manual motor starters, pushbutton switches and selector switches. Knowledge Indicators 1. Interpret ladder diagram of a control circuit. 2. Draw a ladder diagram of a control circuit. 3. Describe the function of an electrical ladder diagram. 4. Describe six rules of drawing a ladder diagram. 5. Describe the function of electrical control systems. 6. Describe the operation of a separate control and power circuits. 7. Describe the operation of AND, OR, NOT, NOR, and NAND circuits.
Standard 202.3 Make proper electrical ground connections	1.25	Performance Indicators 1. Use a multimeter to measure the voltage at a point referenced to ground. 2. Install a grounding circuit for an electrical control system. 3. Inspect and verify an installed grounding circuit. 4. Identify and interpret NEC code for an electrical system. Knowledge Indicators 1. Define a ground. 2. Describe the parts of an electrical control system grounding circuit. 3. Explain the importance of the equipment ground connection. 4. Describe the operation of grounded and ungrounded systems. 5. Explain the function of a neutral line. 6. Describe the National Electrical Code (NEC). grounding requirements for electrical systems.
Standard 202.4 Connect and operate a 3-phase motor	1.5	Performance Indicators 1. Connect and operate a dual-voltage three-phase motor for low-voltage operation. 2. Connect and operate a dual-voltage three-phase motor for high-voltage operation. Knowledge Indicators 1. Interpret a motor nameplate. 2. Describe the functions of common standards associated with electrical control. 3. Describe the basic operation of three-phase power. 4. Describe the three-phase voltage systems: Wye and Delta. 5. Explain why time-delay fuses are used with motor starting circuits. 6. Describe the operation of overcurrent protection devices. 7. Define service factor and explain its importance. 8. Explain why dual-voltage motors should be run on the highest available voltage. 9. Select heaters for a NEMA overload.
Standard 202.5 Connect and operate a manual motor control circuit	1.5	Performance Indicators 1. Connect and operate a motor control circuit with a manual motor starter. 2. Test the operation of a manual motor starter using a multimeter. 3. Test the low-voltage protection of a manual starter. 4. Adjust and test the trip level of a bimetallic overload. 5. Connect and operate a drum switch to reverse a motor. Knowledge Indicators 1. Describe functions of motor control. 2. Describe the basic requirements for motor installation. 3. Describe types of motor starters. 4. Describe the operation and importance of low-voltage protection. 5. Describe the function and operation of magnetic and thermal overloads.

Standard 202.6 Select and install a control transformer	1.5	Performance Indicators 1. Calculate the turns ratio of a transformer. 2. Calculate the secondary voltage of a transformer. 3. Connect and operate a control transformer. 4. Test a control transformer. 5. Size a control transformer. Knowledge Indicators 1. Describe the operation of a control transformer and give its schematic symbol.
Standard 202.7 Connect and operate a basic ladder logic control circuit	1.5	Performance Indicators 1. Connect and operate a basic electrical control circuit with pushbutton switch. 2. Connect and operate a basic electrical control circuit with selector switch. 3. Connect and operate a control circuit given a ladder diagram. 4. Connect and operate a control relay in a memory logic circuit. 5. Connect and operate a forward/reverse jog control circuit. Knowledge Indicators 1. Describe the three steps of a control process. 2. Describe the functions of the components of a ladder diagram.
Standard 202.8 Connect and operate a 2/3 wire magnetic motor starter circuit	1.5	Performance Indicators 1. Connect and operate a two-wire motor control circuit. 2. Connect and operate a three-wire motor control circuit. 3. Design a multiple operator station three-wire control circuit. Knowledge Indicators 1. Describe the operation of a control relay and give an application. 2. Describe the operation/construction of 2 types of control relays. 3. Describe the operation of a magnetic motor starter.
Standard 202.9 Connect and operate a reversing motor control circuit	2	Performance Indicators 1. Connect and operate a reversing magnetic motor starter to reverse a motor. 2. Connect and operate a reversing motor circuit with mechanical and auxiliary contact interlocking. Knowledge Indicators 1. Describe two methods used to reverse a three-phase motor. 2. Describe the function of interlocking control. 3. Describe three interlocking methods used in reversing motor control. 4. Describe the function of manual and automatic modes. 5. Describe the operation of two types of motor jogging circuits. 6. Describe the operation of a hand-off-automatic motor control circuit. 7. State the NEMA and IEC standards for reversing the rotation of a three-phase motor.
Standard 202.10 Connect and operate a hands-off-auto motor control circuit	2	Performance Indicators 1. Connect and operate a hand-off-automatic motor control circuit. 2. Design a hands-off-automatic motor control circuit. 3. Design a pump control circuit that includes hand-off operation. Knowledge Indicators 1. Describe the function of a hand-off-automatic motor control circuit. 2. Describe the function of a hand-off automatic circuit.
Standard 202.11 Connect and operate automatic input devices	1.5	Performance Indicators 1. Connect and operate a limit switch, pressure switch and a float switch. 2. Connect and operate a pump control circuit. 3. Connect and operate a motor control sequence control circuit. 4. Design a sequence control circuit. Knowledge Indicators 1. Describe the function of a motor control sequence control circuit. 2. Describe the operation of a limit switch, pressure switch, and float switch.

Standard 202.12 Connect and operate basic timer control circuits	3	Performance Indicators 1. Connect and operate an On-Delay timer circuit. 2. Design a control circuit to perform an unloaded start of a motor. 3. Connect and operate an Off-Delay timer circuit. 4. Design a motor control circuit to perform time-driven sequencing. Knowledge Indicators 1. Describe the function and application of a time-delay relay. 2. Describe the function of 2 types of timer relays: on-delay and off-delay. 3. Describe the operation of an On-Delay timer relay and give its schematic symbol. 4. Describe the operation of an unloaded motor start circuit. 5. Describe the operation of an Off-Delay timer relay and give its schematic symbol. 6. Describe the operation of a time-delay relay in a time-driven sequencing.
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Outcomes*	At the successful completion of this course, students will be able to:
Course Outcome	Standard 202.1 Apply approved safety practices for electric motor control systems.
Course Outcome	Standard 202.2 Interpret ladder logic schematics.
Course Outcome	Connect and operate a motor control circuits.
Course Outcome	Calculate, select, connect and operate a control transformer.
Primary Laker Learning Competency	Creative Thinking & Problem Solving: Students think creatively to solve problems.
Secondary Laker Learning Competency	Communication: Students communicate through the exchange of information.

**Course and program outcomes will be used in the software for outcomes assessment and should include at least 1 primary and 1 secondary Laker Learning Competency. Limit to 3-5.*