



Alabama Department of Postsecondary Education

Representing the Alabama Community College System

STATEWIDE CAREER/TECHNICAL EDUCATION COURSE ARTICULATION REVIEW MINUTES

Articulation Agreement Identifier: ELT 118 (2005-1) Identifier is the postsecondary course prefix followed by Plan-of-Instruction version number (e.g.; INT 100 (2005-1)).

Applicable CIP code(s): 46.0302

Postsecondary course prefix, number, and title: ELT 118 – Commercial/Industrial Wiring

Secondary Course(s) of Study: 431504/430053 – Commercial Wiring + 431503/430052 – Industrial Wiring + 431505/430054 - Motor Control + 430301/430051 – Basic Wiring + 431510/430059 - AC + 431509/430058 - DC

Date of Review: October 8, 2009 DPE Annual Review: February 15, 2012

Effective date: **Fall Semester 2011.**

Course Content Analysis (all postsecondary course objectives must be sufficiently addressed in the secondary courses):

Notes:

- 1 Skills and knowledge contained in the postsecondary course objectives must be present in the corresponding secondary objectives for a “match” to occur.**
- 2. Postsecondary and Secondary objectives must reflect similar content and performance levels before the course articulation agreement will be recommended to the TEDAC Oversight Committee.**
- 3. More than one Secondary course may be used in order to articulate to a Postsecondary course.**

Postsecondary Course Objectives	Secondary Course(s) and Location(s)	TEDAC Comments
<p>Module A</p> <p>Competency:</p> <ul style="list-style-type: none"> • Perform tasks in a safe manner <p>Objectives:</p> <ul style="list-style-type: none"> • Perform assigned tasks in a safe manner. • Demonstrate the use of personal protection equipment. <p>Competency:</p> <ul style="list-style-type: none"> • Practice tool safety <p>Objectives:</p> <ul style="list-style-type: none"> • Use tools in a safe manner. • Explain hazards associated with specific types of equipment and tools <p>Competency:</p> <ul style="list-style-type: none"> • Plans layout and installation of electrical wiring, equipment and fixtures. <p>Objectives:</p> <ul style="list-style-type: none"> • Given knowledge gained from this course, and an electrical blueprint, interpret symbols and components from the blueprint. • Draw an electrical diagram according to specifications • Calculate voltage drops according to the diagram • Calculate conduit fill according to the diagram. <p>Learning Objectives</p> <ul style="list-style-type: none"> • Explain hazards associated with specific types of equipment and tools • Define electrical terms • Interpret electric symbols • Identify NEC requirements for industrial wiring • Identify insulation types 	<p>Commercial Wiring, Unit 1-2, Safety Content Standards</p> <ol style="list-style-type: none"> 1. Demonstrate use of safety procedures as recognized by governing agencies and approved industry standards when testing and replacing components or installing wiring. Examples: lockout, tagout 2. Identify electrical hazards and how to avoid and minimize them in the workplace. <p>Learning Objectives</p> <ol style="list-style-type: none"> 1. Explain the role that safety plays on the job-site. 2. Explain the appropriate safety precautions to take around common job-site hazards. 3. Demonstrate the use and care of appropriate personal protective equipment (PPE). 4. Properly don and remove personal protective equipment (safety goggles, hearing protection, hard hat, and personal fall protection). 5. Explain the importance of Hazard Communications (HazCom) and material safety data sheets (MSDSs). 6. Describe fire prevention and firefighting techniques. 7. Define safe work procedures to use around electrical hazards. 8. Demonstrate correct selection and use of electrical and hand tools. <p>Commercial Wiring, Unit 3-6, Distribution Equipment Content Standards</p> <ol style="list-style-type: none"> 3. Explain the purpose of switchgears in commercial wiring 	

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<ul style="list-style-type: none"> • Calculate voltage drops • Calculate conduit fill • Explain Delta and Wye electrical supply system • Explain principles of generation <p>Module B</p> <p>Competency:</p> <ul style="list-style-type: none"> • Install electrical wiring, equipment, apparatus, and fixtures <p>Objective:</p> <ul style="list-style-type: none"> • Wire a circuit according to a wiring diagram and test for continuity. • Connect an electric motor for high. • Connect an electric motor for low voltage. • Reverse rotation for an electric motor. <p>Competency:</p> <ul style="list-style-type: none"> • Inspect system and electrical parts to detect hazards, defects, and need for repair <p>Objective:</p> <ul style="list-style-type: none"> • Inspect an electric component and identify the fault. <p>Competency:</p> <ul style="list-style-type: none"> • Test electrical systems and continuity of circuits <p>Objective:</p> <ul style="list-style-type: none"> • Use a multimeter to test the power, resistance, volts, and amps of an electric circuit and compare the readings to specifications. • Use an ammeter to test a circuit and to determine if the readings are in accordance with specifications. • Use an ohmmeter to test the resistance of a circuit and determine if readings are in accordance with specifications. 	<p>applications.</p> <ol style="list-style-type: none"> 4. Describe construction, metering layouts, wiring requirements, and maintenance for switchgears. 5. Describe visual and mechanical inspections and electrical tests associated with low and medium voltage cables, bus ways, and instrumentation. 6. Describe the function of ground fault relay systems used in commercial wiring applications. <p>Learning Objectives</p> <ol style="list-style-type: none"> 1. Describe the purpose of switchgear. 2. Describe the four general classifications of circuit breakers and list the major circuit breaker ratings. 3. Describe switchgear construction, metering layouts, wiring requirements, and maintenance. 4. List NEC requirements pertaining to switchgear. 5. Describe the visual and mechanical inspections and electrical tests associated with low-voltage and medium-voltage cables, metal-enclosed busways, and metering and instrumentation. 6. Describe a ground fault relay system and explain how to test it. <p>Commercial Wiring, Unit 7-8, Distribution System Transformers</p> <p>Content Standards</p> <ol style="list-style-type: none"> 7. Describe the operation and function of Delta and Wye wired transformers. 8. Demonstrate connecting a multi-tap transformer to obtain required secondary voltage. <ul style="list-style-type: none"> • Connecting a control transformer for a given application • Calculating the power factor for a given circuit 	

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<ul style="list-style-type: none"> • Use a volt meter to measure the voltage of a Delta and Wye electrical supply system and determine if readings are in accordance with specifications. • Use a megohmmeter to test A circuit and determine if the readings are in accordance with specifications. • Use a clamp-on ammeter to test a circuit to determine if the readings are in accordance with specifications. <p>Competency:</p> <ul style="list-style-type: none"> • Install electrical conduit <p>Objective:</p> <ul style="list-style-type: none"> • Bend electrical conduit. • Install electrical conduit according to specifications. <p>Competency:</p> <ul style="list-style-type: none"> • Pull electrical cable <p>Objective:</p> <ul style="list-style-type: none"> • Pull the electrical cable. <p>Learning Objectives</p> <ul style="list-style-type: none"> • Explain the process of wiring an electric circuit • Explain the process of bending conduit • Explain the process of installing conduit • Explain the process of pulling electrical cable • Explain the use of a electrical test equipment 	<p>Learning Objectives</p> <ol style="list-style-type: none"> 1. Describe transformer operation. 2. Explain the principle of mutual induction. 3. Describe the operating characteristics of various types of transformers. 4. Connect a multi-tap transformer for the required secondary voltage. 5. Explain NEC requirements governing the installation of transformers. 6. Compute transformer sizes for various applications. 7. Explain types and purposes of grounding transformers. 8. Connect a control transformer for a given application. 9. Size the maximum load allowed on open delta systems. 10. Describe how current transformers are used in conjunction with watt-hour meters. 11. Apply capacitors and rectifiers to practical applications. 12. Calculate the power factor of any given electrical circuit. <p>Commercial Wiring, Unit 9-11, Hazardous Locations Content Standards</p> <ol style="list-style-type: none"> 9. Identify various types of hazardous locations encountered by commercial electricians. <p>Example: proximity work, limited-access work</p> <ol style="list-style-type: none"> 10. Select commercial wiring materials and methods for use in hazardous locations. 11. Demonstrate <p>Learning Objectives</p> <ol style="list-style-type: none"> 1. Define the various classifications of hazardous locations. 2. Describe the wiring methods permitted for branch circuits and feeders in specific hazardous locations. 	

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	<p>3. Select seals and drains for specific hazardous locations. 4. Select wiring methods for Class I, Class II, and Class III hazardous locations. 5. Follow NEC requirements for installing explosion proof fittings in specific hazardous locations.</p> <p>Commercial Wiring, Unit 12-14, Load Calculations for Feeders and Service Content Standards</p> <p>12. Select feeder over-current protection devices for continuous and noncontinuous duty loads in commercial wiring applications. 13. Calculate electrical loads for a variety of commercial applications. Examples: office building, marina, restaurant 14. Calculate motor loads on electrical feeder lines.</p> <p>Learning Objectives</p> <p>1. Size feeders and services in accordance with NEC requirements. 2. Calculate loads and ampacities for single-phase and three-phase feeders. 3. Understand and apply derating factors to size feeders. 4. Size feeder over-current protection devices (circuit breakers and fuses) for non-continuous duty and continuous duty loads. 5. Understand and apply tap rules. 6. Calculate loads for a retail store with a show window. 7. Calculate loads for an office building. 8. Calculate loads for both single-family and multi-family dwellings. 9. Calculate loads for a restaurant. 10. Calculate loads for hotels and motels. 11. Calculate loads for schools and other institutional projects.</p>	

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	<p>12. Perform feeder and service calculations for farms. 13. Calculate the power and supply feeders for marinas and boatyards. 14. Calculate electric motor loads on feeders.</p> <p>Commercial Wiring, Unit 15, Standby and Emergency Systems Content Standards</p> <p>15. Describe various types of standby and emergency generators. • Describing operating principles of automatic and manual transfer switches</p> <p>Learning Objectives</p> <p>1. Explain the basic differences between emergency systems, legally required standby systems, and optional standby systems. 2. Describe the operating principles of an engine-driven standby AC generator. 3. Describe the different types and characteristics of standby and emergency generators. 4. Recognize and describe the operating principles of both automatic and manual transfer switches. 5. Recognize the different types of storage batteries used in emergency and standby systems and explain how batteries charge and discharge. 6. For selected types of batteries, describe their characteristics, applications, maintenance, and testing. 7. Recognize double-conversion and single-conversion types of uninterruptible power supplies (UPSs) and describe how</p>	

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	<p>they operate. 8. Describe the NEC requirements that pertain to the installation of standby and emergency power systems.</p> <p>Commercial Wiring, Unit 16, Commercial Electrical Service Content Standards</p> <p>16. Demonstrate the installation of a commercial service entrance and load center or panel board.</p> <p>Learning Objectives</p> <ol style="list-style-type: none"> 1. Describe various types of electric services for commercial installations. 2. Read electrical blueprints and diagrams describing service installations. 3. Calculate and select service-entrance equipment. 4. Explain the role of the NEC in service installations. 5. Install main disconnect switches, panel boards, and over-current protection devices. 6. Identify the circuit loads, number of circuits required, and installation requirements for distribution panels. 7. Explain the types and purposes of service grounding. 8. Explain the purpose and required location(s) of ground fault circuit interrupters. 9. Describe single-phase service connections. 10. Describe both wye- and delta-connected three-phase services. <p>Industrial Wiring, Unit 3-4, Cable Tray Content Standards</p>	

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	<p>3. Demonstrate methods used to support and secure cable tray used in industrial wiring applications.</p> <p>4. Demonstrate the fabrication of complex cable tray configurations, including turns, offsets, and methods of hanging, according to specifications in industrial applications.</p> <p>Learning Objectives</p> <p>1. Describe the components that make up a cable tray assembly.</p> <p>2. Explain the methods used to hang and secure cable tray.</p> <p>3. Describe how cable enters and exits cable tray.</p> <p>4. Select the proper cable tray fitting for the situation.</p> <p>5. Explain the NEMA standards for cable tray installations.</p> <p>6. Explain the NEC requirements for cable tray installations.</p> <p>7. Select the required fittings to ensure equipment grounding continuity in cable tray systems.</p> <p>8. Interpret electrical working drawings showing cable tray fittings.</p> <p>9. Size cable tray for the number and type of conductors contained in the system.</p> <p>10. Select rollers and sheaves for pulling cable in specific cable tray situations.</p> <p>11. Designate the required locations of rollers and sheaves for a specific cable pull.</p> <p>Industrial Wiring, Unit 5-7, Contactors and Relays Content Standards</p> <p>5. Describe the operation of solid state and mechanical contactors in industrial wiring.</p> <p>6. Install contactors and relays according to National Electrical Code (NEC) specifications.</p> <p>7. Install a simple control circuit.</p>	

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	<p>Learning Objectives</p> <ol style="list-style-type: none"> 1. Describe the operating principles of contactors and relays. 2. Select contactors and relays for use in specific electrical systems. 3. Explain how mechanical contactors operate. 4. Explain how solid-state contactors operate. 5. Install contactors and relays according to the NEC requirements. 6. Select and install contactors and relays for lighting control. 7. Read wiring diagrams involving contactors and relays. 8. Describe how overload relays operate. 9. Connect a simple control circuit. 10. Test control circuits. <p>Industrial Wiring, Unit 8-10, Industrial Load Calculations Content Standards</p> <ol style="list-style-type: none"> 8. Calculate load for single- and three-phase branch circuits. 9. Determine capacity for single- and three-phase loads. 10. Select conductors and over-current protection devices appropriate to the load of specified equipment. <p>Examples: welding machines, motors, heating and cooling equipment</p> <p>Learning Objectives</p> <ol style="list-style-type: none"> 1. Calculate loads for single-phase and three-phase branch circuits. 2. Size branch circuit over-current protection devices (circuit breakers and fuses) for non-continuous duty and continuous duty circuits. 	

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	<p>3. Apply derating factors to size branch circuits. 4. Calculate ampacity for single-phase and three-phase loads. 5. Use load calculations to determine branch circuit conductor sizes. 6. Use <i>NEC Table 220.55</i> to calculate residential cooking equipment loads. 7. Select branch circuit conductors and over-current protection devices for electric heat, air conditioning equipment, motors, and welders.</p> <p>Industrial Wiring, Unit 11-12, Raceway, Box, and Fitting Fill Requirements Content Standards</p> <p>11. Calculate conduit size by conduit and box fill requirements according to the NEC codebook. 12. Determine electrical box and cabinet fill requirements. • Identifying bending radius requirements</p> <p>Learning Objectives</p> <p>1. Size raceways according to conductor fill and NEC installation requirements. 2. Size outlet boxes according to NEC installation requirements. 3. Size and select pull and junction boxes according to NEC installation requirements. 4. Calculate conduit fill using a percentage of the trade size conduit inside diameter (ID). 5. Calculate the required bending radius in boxes and cabinets.</p> <p>Industrial Wiring, Unit 13-15, Lamps, Ballasts, and Components Content Standards</p>	

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	<p>13. Identify occupancy sensors, photoelectric sensors, and timers used to control circuits. 14. Describe the function of ballasts in lighting systems. 15. Install various lighting components.</p> <p>Learning Objectives</p> <p>1. Recognize incandescent, fluorescent, and high-intensity discharge (HID) lamps and describe how each type of lamp operates. 2. Recognize ballasts and describe their purpose for use in fluorescent and HID lighting fixtures. 3. Explain the relationship of Kelvin temperature to the color of light produced by a lamp. 4. Recognize basic occupancy sensors, photoelectric sensors, and timers used to control lighting circuits and describe how each device operates. 5. Use troubleshooting checklists to troubleshoot fluorescent and HID lamps and lighting fixtures.</p> <p>Industrial Wiring, Unit 16-17, Rigid Conduit Bending Content Standards</p> <p>16. Calculate common conduit bends used in industrial applications. 17. Use pneumatic and electrical benders to produce conduit bends according to specifications.</p> <p>Learning Objectives</p> <p>1. Describe the process of conduit bending using power tools. 2. Identify all parts of popular electric and hydraulic benders. 3. Avoid excessive waste when working with conduit systems. 4. Bend offsets, kicks, saddles, segmented, and parallel</p>	

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	bends. 5. Explain the requirements of the NEC for bending conduit. 6. Compute the radius, degrees in bend, developed length, and gain for conduit up to six inches. 7. Explain how to correct damaged conduit and modify existing bends.	