

2012 – 2013

**Florida Department of Education
Curriculum Framework**

Program Title: Electrical Power Technology
Career Cluster: Energy

	AS	AAS
CIP Number	1615030318	0615030318
Program Type	College Credit	College Credit
Standard Length	68 Credit Hours	68 Credit Hours
CTSO	SkillsUSA	SkillsUSA
SOC Codes (all applicable)	49-2095	49-2095
Targeted Occupation List	http://www.labormarketinfo.com/wec/TargetOccupationList.htm	
Perkins Technical Skill Attainment Inventory	http://www.fl DOE.org/workforce/perkins/perkins_resources.asp	
Statewide Articulation	http://www.fl DOE.org/workforce/dwdframe/artic_frame.asp	

Purpose

This program offers a sequence of courses that provides coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in the Energy career cluster; provides technical skill proficiency, and includes competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of the Energy career cluster.

The content includes but is not limited to DC/AC circuits, power generation, instrumentation and electrical network analysis, design, theory, solid state devices, and analog circuits. Integrated into this content will be communications skills, safe and efficient workplace practices, and technical recording and reporting. This program focuses on broad, transferable skills and stresses understanding and demonstration of the following elements of the Electrical Power industry; planning, management, finance, technical and product skills, underlying principles of technology, labor issues, community issues and health, safety, and environmental issues.

Program Structure

This program is a planned sequence of instruction consisting of sixty-eight credit hours.

Laboratory Activities

Laboratory activities are an integral part of this program. These activities include instruction in the use of safety procedures, tools, equipment, materials, and processes related to these occupations. Equipment and supplies should be provided to enhance hands-on experiences for students.

Special Notes

Career and Technical Student Organization (CTSO)

SkillsUSA is the appropriate career and technical student organization for providing leadership training and reinforcing specific career and technical skills. Career and Technical Student Organizations provide activities for students as an integral part of the instruction offered. The activities of such organizations are defined as part of the curriculum in accordance with Rule 6A-6.065, F.A.C.

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities as identified on the secondary student's IEP or 504 plan or postsecondary student's accommodations plan to meet individual needs and ensure equal access. Postsecondary students with disabilities must self-identify, present documentation, request accommodations if needed, and develop a plan with their postsecondary service provider. Accommodations received in postsecondary education may differ from those received in secondary education. Accommodations change the way the student is instructed. Students with disabilities may need accommodations in such areas as instructional methods and materials, assignments and assessments, time demands and schedules, learning environment, assistive technology and special communication systems. Documentation of the accommodations requested and provided should be maintained in a confidential file.

Articulation

To be transferable statewide between institutions, this program must have been reviewed, and a "transfer value" assigned the curriculum content by the appropriate Statewide Course Numbering System discipline committee. This does not preclude institutions from developing specific articulation agreements with each other.

For details on articulation agreements which correlate to programs and industry certifications refer to http://www.fldoe.org/workforce/dwdframe/artic_frame.asp.

Program Length

The AS degree requires the inclusion of a minimum of 15 credits of general education coursework according to SACS, and it must be transferable according to Rule 6A-14.030 (2), F.A.C. The AAS degree requires the inclusion of a minimum of 15 credits of general education coursework according to SACS. The standard length of this program is sixty-eight credit hours according to Rule 6A-14.030, F.A.C.

Certificate Programs

A College Credit Certificate consists of a program of instruction of less than sixty (60) credits of college-level courses, which is part of an AS or AAS degree program and prepares students for

entry into employment (Rule 6A-14.030, F.A.C.). This AS/AAS degree program includes the following College Credit Certificates:

Alternative Energy Engineering Technology (0615050304) – 18 Credit Hours

Standards for the above certificate programs are contained in separate curriculum frameworks.

Standards

After successfully completing this program, the student will be able to perform the following:

- 01.0 Demonstrate proficiency in laboratory practices.
- 02.0 Demonstrate proficiency in DC circuits.
- 03.0 Demonstrate proficiency in AC circuits.
- 04.0 Demonstrate proficiency in solid state devices.
- 05.0 Demonstrate proficiency in technical recording and reporting.
- 06.0 Demonstrate proficiency in DC network analysis.
- 07.0 Demonstrate proficiency in AC network and coupled circuit analysis.
- 08.0 Demonstrate proficiency in principles of rotating machinery.
- 09.0 Demonstrate proficiency in principles of power generation systems.
- 10.0 Demonstrate proficiency in principles of power transformers.
- 11.0 Demonstrate proficiency in principles of power transmission systems.
- 12.0 Demonstrate proficiency in principles of power distribution systems.
- 13.0 Demonstrate proficiency in principles of switchgear, motor control centers, and ac breaker panels.
- 14.0 Demonstrate proficiency in interpretation of electric codes.
- 15.0 Demonstrate proficiency in employability skills.
- 16.0 Demonstrate an understanding of the energy industry.
- 17.0 Demonstrate proficiency in generators, exciters, and voltage regulators.

Generation Option

- 18.0 Demonstrate proficiency in transformers.
- 19.0 Demonstrate proficiency in switchgear, motor control centers, breaker panels, and AC and DC plant power distribution.
- 20.0 Demonstrate proficiency in protective devices.
- 21.0 Demonstrate proficiency in power cable, control cable, instrumentation cable and raceways.
- 22.0
- 23.0 Demonstrate proficiency in motors.
- 24.0 Demonstrate proficiency in the plant cycle (both I & C and Electric).
- 25.0 Demonstrate proficiency in electric motors.

Instrumentation and Control Option

- 26.0 Demonstrate proficiency in the plant cycle (both I and Electric).
- 27.0 Demonstrate proficiency in primary elements and transmitters.
- 28.0 Demonstrate proficiency in final elements.
- 29.0 Demonstrate proficiency in process control.
- 30.0 Demonstrate proficiency in microprocessor systems.
- 31.0 Demonstrate proficiency in combustion control.

- 32.0 Demonstrate proficiency in electric motor control.
- 33.0 Demonstrate proficiency in digital circuits.

Distribution Option

- 34.0 Demonstrate proficiency in the application of power transformers.
- 35.0 Demonstrate proficiency in the use of electrical equipment.
- 36.0 Demonstrate proficiency in the principles of system protection.
- 37.0 Demonstrate proficiency in 3 phase power system analysis.
- 38.0 Demonstrate proficiency in basic surveying skills.
- 39.0 Demonstrate proficiency in distribution circuit design.

2012 – 2013

**Florida Department of Education
Student Performance Standards**

Program Title: Electrical Power Technology
CIP Numbers: A.S. 1615030300, A.A.S. 0615030300
Program Length: 60 Credit Hours
SOC Code(s): 49-2095

The AS degree requires the inclusion of a minimum of 15 credits of general education coursework according to SACS, and it must be transferable according to Rule 6A-14.030 (2), F.A.C. The AAS degree requires the inclusion of a minimum of 15 credits of general education coursework according to SACS. At the completion of this program, the student will be able to:

01.0 Demonstrate proficiency in laboratory practices—The student will be able to:

- 01.01 Apply proper OSHA safety standards.
- 01.02 Make electrical connections to include power conductor connections.
- 01.03 Identify and use hand tools properly.
- 01.04 Identify and use power tools properly.
- 01.05 Demonstrate acceptable soldering and desoldering techniques.

02.0 Demonstrate proficiency in DC circuits—The student will be able to:

- 02.01 Solve algebraic problems to include exponentials (prerequisite to DC content).
- 02.02 Solve problems in electronic units utilizing metric prefixes.
- 02.03 Relate electricity to the nature of the matter.
- 02.04 Identify sources of electricity.
- 02.05 Define voltage, current, resistance, power and energy.
- 02.06 Apply Ohm's Law and Power formula.
- 02.07 Read and interpret color codes and symbols to identify electrical components and values.
- 02.08 Measure properties of a circuit using VOM and DVM meters and oscilloscopes.
- 02.09 Compute conductance and measure resistance of conductors and insulators.
- 02.10 Apply Ohm's Law to series circuits.
- 02.11 Construct and verify the operation of series circuits.
- 02.12 Analyze and troubleshoot parallel circuits.
- 02.13 Apply Ohm's Law to parallel circuits.
- 02.14 Construct and verify the operation of a parallel circuit.
- 02.15 Analyze and troubleshoot parallel circuits.
- 02.16 Apply Ohm's Law to series-parallel/parallel-series circuits.
- 02.17 Construct and verify the operation of series-parallel/parallel-series and bridge circuits.
- 02.18 Troubleshoot series-parallel/parallel-series and bridge circuits.
- 02.19 Identify and define voltage divider circuits (loaded and unloaded).
- 02.20 Construct and verify the operation of voltage divider circuits (loaded and unloaded).
- 02.21 Analyze and troubleshoot voltage divider circuits (loaded and unloaded).
- 02.22 Apply maximum power transfer theory.
- 02.23 Construct and verify operation of circuits that demonstrate maximum power transfer theory.

- 02.24 Describe magnetic properties of circuits and devices.
- 02.25 Determine the physical and electrical characteristics of capacitors and inductors.
- 02.26 Define RC and RL time constants and classify the output differentiators and integrators.
- 02.27 Set up and operate power supplies for DC circuits.

03.0 Demonstrate proficiency in AC circuits—The student will be able to:

- 03.01 Solve basic trigonometric problems applicable to electrical technology (prerequisite to AC).
- 03.02 Identify properties of an AC signal.
- 03.03 Identify AC sources.
- 03.04 Analyze and measure AC signals utilizing VOM, DVM, oscilloscope, frequency counter and function generator.
- 03.05 Define the characteristics of AC capacitive circuits.
- 03.07 Construct and verify the operation of AC capacitive circuits.
- 03.08 Analyze and troubleshoot AC capacitive circuits.
- 03.09 Define and apply the characteristics of AC inductive circuits.
- 03.10 Construct and verify the operation of AC inductive circuits.
- 03.11 Analyze and troubleshoot AC inductive circuits.
- 03.12 Define and apply the principles of transformers to AC.
- 03.13 Construct and verify the operation of AC circuits utilizing transformers.
- 03.14 Analyze and troubleshoot AC circuits utilizing transformers.
- 03.15 Construct and verify the operation of differentiators and integrators to determine RC and RL time constants.
- 03.16 Analyze and troubleshoot differentiator and integrator circuits.
- 03.17 Define the characteristics of RLC circuits (series, parallel, and complex).
- 03.18 Construct and verify the operation of RLC circuits (series, parallel, and complex).
- 03.19 Define the characteristics of series and parallel resonant circuits.
- 03.20 Construct and verify the operation of series and parallel resonant circuits.
- 03.21 Analyze and troubleshoot RC, RL, and RLC circuits.
- 03.22 Define the characteristics of polyphase circuits.
- 03.23 Define the basic motor theory and operation.
- 03.24 Define the basic generator theory and operation.
- 03.25 Set up and operate power supplies for AC circuits.
- 03.26 Analyze and measure power in AC circuits (real, reactive and apparent power).

04.0 Demonstrate proficiency in solid state devices—The student will be able to:

- 04.01 Identify and define properties of semiconductor materials.
- 04.02 Identify and define operating characteristics and applications of junction diodes.
- 04.03 Identify and define operating characteristics and applications of special diodes (xener, MOV for example metal oxide).
- 04.04 Construct diodes circuits.
- 04.05 Analyze and troubleshoot diode circuits.
- 04.06 Identify and define operating characteristics and application of bipolar transistors.
- 04.07 Identify and define operating characteristics and applications of Field Effect Transistors (FET's).
- 04.08 Identify and define operating characteristics and application of single stage amplifiers.
- 04.09 Construct single-state amplifiers.

- 04.10 Analyze and troubleshoot single-state amplifiers.
 - 04.11 Construct thyristor circuitry.
 - 04.12 Analyze and troubleshoot thyristor circuitry.
 - 04.13 Set up and operate a VOM for solid-state devices.
 - 04.14 Set up and operate a DVM for solid-state devices.
 - 04.15 Set up and operate power supplies for solid-state devices.
 - 04.16 Set up and operate oscilloscopes for solid-state devices.
 - 04.17 Set up and operate function generators for solid-state devices.
- 05.0 Demonstrate proficiency in technical recording and reporting--The student will be able to:
- 05.01 Draw engineering electrical sketches, interpret electrical schematics, writing diagrams, charts, graphs and geographical sketches.
 - 05.02 Record data and design curves and graphs.
 - 05.03 Write reports and make oral presentations.
 - 05.04 Maintain test logs.
 - 05.05 Make equipment failure reports.
 - 05.06 Specify and requisition simple electrical components.
 - 05.07 Compose technical letters and memoranda.
 - 05.08 Write formal reports of laboratory experiences.
- 06.0 Demonstrate proficiency in DC network analysis--The student will be able to:
- 06.01 Analyze multisource circuits using Millman's Theorem.
 - 06.02 Analyze multisource circuits using Superimposition Theorem.
 - 06.03 Analyze multisource circuits using Mesh Currents.
 - 06.04 Analyze multisource circuits using Branch Currents or similar method.
 - 06.05 Analyze multisource circuits using Nodal Analysis.
 - 06.06 Analyze multisource circuits using Thevenin's Theorem.
 - 06.07 Analyze DC circuits using computer programs.
- 07.0 Demonstrate proficiency in AC network and coupled circuit analysis--The student will be able to:
- 07.01 Analyze magnetic circuits.
 - 07.02 Apply Faraday's Law of induced voltages.
 - 07.03 Solve for mutual inductance in a coupled circuit.
 - 07.04 Analyze AC circuits using network theorems.
 - 07.05 Solve problems in transient analysis in RC and RL circuits.
 - 07.06 Demonstrate and analyze the effects of loading on transformers.
 - 07.07 Analyze RLC circuits using complex numbers.
 - 07.08 Analyze RC/RCL filters.
 - 07.09 Analyze AC circuits using computer programs.
- 08.0 Demonstrate proficiency in principles of rotating machinery--The student will be able to:
- 08.01 Identify and define the characteristics of DC, series, shunt, compound motors, and generators.
 - 08.02 Identify and define the characteristics of AC, single phase, and polyphase motors.
 - 08.03 Set up and operate DC and AC motors.

- 09.0 Demonstrate proficiency in principles of power generation systems--The student will be able to:
 - 09.01 Identify the elements of a power generation system.
 - 09.02 Solve problems involving alternators.
- 10.0 Demonstrate proficiency in principles of power transformers—The student will be able to:
 - 10.01 Identify the characteristics of power transformers.
 - 10.02 Solve problems involving the application of power transformers.
- 11.0 Demonstrate proficiency in principles of power transmission systems--The student will be able to:
 - 11.01 Identify power transmission lines.
 - 11.02 Solve problems involving transmission lines.
- 12.0 Demonstrate proficiency in principles of power distribution systems--The student will be able to:
 - 12.01 Identify power distribution systems.
 - 12.02 Solve problems involving distribution systems.
- 13.0 Demonstrate proficiency in principles of switchgear, motor control centers, and ac breaker panels--The student will be able to:
 - 13.01 Identify the properties of switchgears.
 - 13.02 Describe the operation of switchgear, motor control centers, and AC breaker panels.
- 14.0 Demonstrate proficiency in interpretation of electric codes—The student will be able to:
 - 14.01 Understand the need for IEEE (Institute of Electrical, Electronics and Engineers), NEMA (National Electrical Manufacturers Association) and ANSI (American National Standards Institute) codes.
 - 14.02 Demonstrate proficiency in interpretation/explanation of the IEEE (Institute of Electrical, Electronics and Engineers), NEMA (National Electrical Manufacturers Association) and ANSI (American National Standards Institute) codes.
- 15.0 Demonstrate proficiency in employability skills--The student will be able to:
 - 15.01 Conduct a job search.
 - 15.02 Secure information about a job.
 - 15.03 Identify documents that may be required when applying for a job.
 - 15.04 Complete a job application form correctly.
 - 15.05 Demonstrate competence in job interview techniques.
- 16.0 Demonstrate an understanding of the energy industry--The student will be able to:
 - 16.01 Describe the importance of the power industry to the American economy.

- 16.02 Define the differences between energy production, energy transmission, and energy distribution.
 - 16.03 Describe the importance of a reliable power grid to the American economy.
 - 16.04 Describe the role of the power grid in energy distribution.
 - 16.05 Identify and discuss the regulatory characteristics associated with the energy industry.
 - 16.06 Identify the necessary personal characteristics of a successful energy professional.
- 17.0 Demonstrate proficiency in generators, exciters, and voltage regulators--The student will be able to:
- 17.01 Demonstrate proficiency in the principles of generators.
 - 17.02 Identify the magnetic field associated with a generator.
 - 17.03 Identify positive and negative rotation.
 - 17.04 Identify the purpose and function of a generator or field ground circuit.
 - 17.05 Identify the different methods of excitation.
 - 17.06 Identify the most common parameters of a generator.
 - 17.07 Identify each component of the generator, how they interrelate and their individual function.

Generation Option

- 18.0 Demonstrate proficiency in transformers--The student will be able to:
- 18.01 Demonstrate proficiency in the principles of transformers including the autotransformer.
 - 18.02 Identify the magnetic fields associated with a transformer.
 - 18.03 Identify the characteristics of a power transformer.
 - 18.04 Identify and make proper single phase transformer connections.
 - 18.05 Identify and make proper three phase (delta, WYE) transformer connections.
 - 18.06 Make proper tap changes.
 - 18.07 Analyze the ideal circuit model of a transformer.
 - 18.08 Identify and analyze transformer nomenclature, polarity, name plate data and ratings.
 - 18.09 Identify and analyze transformer losses and efficiency.
 - 18.10 Perform basic maintenance procedures and testing including oil testing and ratio test phasing.
 - 18.11 Locate and correct fault currents.
- 19.0 Demonstrate proficiency in switchgear, motor control centers, breaker panels, and AC and DC plant power distribution—The student will be able to:
- 19.01 Demonstrate proficiency in the various classifications and components of switchgear, motor control centers, and distribution breaker panels.
 - 19.02 Demonstrate knowledge in the standards that govern the application of switchgear, motor control centers, and breaker panel (NEMA standards, IEEE National Electric Code).
 - 19.03 Demonstrate knowledge in fault current calculations equipment rational (continuous, interrupt, and with standard capabilities).

- 19.04 Demonstrate knowledge of insulation test materials and the application of various test equipment (Megger, hi-pot, Doble).
 - 19.05 Demonstrate knowledge in cable entry and termination. This includes power cable, control cable, shield terminations, current transformer, and potential transformer locations and wiring ratings.
 - 19.06 Demonstrate knowledge in plant one line electrical diagram configurations and various distribution systems to include auxiliary power systems, reserve power systems, DC power systems, automatic power systems and automatic transfer systems.
 - a. Demonstrate the application of plant one line electrical diagram configurations and various distribution systems to include auxiliary power systems, reserve power systems, DC power systems, automatic power systems and automatic transfer systems.
 - b. Identify the characteristics of fused panels and breaker panels.
 - c. Demonstrate knowledge and use (application) of ground bus, neutral bus, and grounded neutral bus.
 - d. Demonstrate proficiency in plant DC power distribution systems to include batteries (inverters and troubleshooting techniques).
- 20.0 Demonstrate proficiency in protective devices--The student will be able to:
- 20.01 Demonstrate knowledge of what a protective devise is for motors, generators, transformers and switchgear and why they are necessary.
 - 20.02 Demonstrate proficiency in understanding the IEEE standard device numbering system.
 - 20.03 Demonstrate knowledge in various categories of protective devices and their coordination (overcurrent, differential, etc.).
 - 20.04 Perform an acceptance test on a breaker, fuse, and overcurrent relay.
 - 20.05 Demonstrate proficiency in selecting the correct protective device and its rating for a motor, cable and lighting load.
 - 20.06 Know of potential transformer, current transformers and their application in metering and protection circuits.
- 21.0 Demonstrate proficiency in power cable, control cable, instrumentation cable and raceways--The student will be able to:
- 21.01 Demonstrate proficiency in how power cables, control cables and instrumentation cables are constructed.
 - 21.02 Demonstrate proficiency in the standard voltage ratings of power cables, control cables and instrumentation cables.
 - 21.03 Demonstrate proficiency in the standard current ratings of power cables and control cables.
 - 21.04 Demonstrate proficiency in power cable effects of heat (internal and external) on the ampere rating of a cable, magnetic effects of conductors, knowledge of when the ground shields are necessary and how to terminate them, methods of installing power cables in conduits, trays, and duct banks (pulling cables, single and multiple groups) and selecting terminating materials and how they are used.
 - 21.05 Demonstrate proficiency in control cable identification codes of different conductors within a control cable.

- 21.06 Demonstrate knowledge in selecting terminating materials and equipment, termination of a control circuit and perform the actual termination, and proper installation methods (pulling cable, single and multiple groups).
 - 21.07 Demonstrate proficiency in instrumentation cable, the different metals used to make conductors for instrumentation cables, the effects of large power circuits in close proximity to instrumentation cables, how and why shields are included in instrumentation cables, proper methods of installing instrumentation cables, knowledge on when to extend ground shield, terminate a ground shield, and the methods used, how to terminate a thermocouple cable and make actual installation, knowledge of the standard conductor identification methods, and 802 differences between thermocouple extension cable.
- 22.0 Demonstrate proficiency in grounding--The student will be able to:
- 22.01 Explain why grounding is necessary.
 - 22.02 Demonstrate knowledge in how ground circuits are necessary for the interruptions of protective devices.
 - 22.03 Demonstrate knowledge in how ground systems protect individuals from shocks.
 - 22.04 Demonstrate proficiency in layout, installing, and sizing ground conductors.
 - 22.05 Demonstrate proficiency in the magnetic effects of phase conductors and ground conductors.
 - 22.06 Demonstrate proficiency in the identification of grounding conductors.
 - 22.07 Demonstrate the principles of point source grounding and maintaining it.
 - 22.08 Demonstrate proficiency in ground systems effectiveness.
- 23.0 Demonstrate proficiency in motors--The student will be able to:
- 23.01 Identify the characteristics needed to properly select a motor for replacement or a new application.
 - 23.02 Demonstrate knowledge of the NEMA Standards MG1 and MG2.
 - 23.03 Identify and test a DC motor for receiving criteria.
 - 23.04 Identify and test an AC motor for receiving criteria.
 - 23.05 Demonstrate proficiency in establishing a motor direction of rotation and changing it.
 - 23.06 Applicable to AC single phase, AC three phase, DC motors.
 - 23.07 Demonstrate proficiency in the various methods of starting AC and DC motors.
 - 23.08 Demonstrate proficiency in motor control circuits by developing the logic and wiring a control circuit.
 - 23.09 Demonstrate proficiency in control and application of 3 phase synchronize motors.
- 24.0 Demonstrate proficiency in the plant cycle (both I & C and Electric)--The student will be able to:
- 24.01 Identify and define the basic elements of the basic steam cycle.
 - 24.02 Describe major plant components, such as: boilers, turbine, generators, pollution control equipment, heat exchangers, pumps, etc.
 - 24.03 Demonstrate proficiency in reading and using steam tables, basic heat rate calculations (feed water heater performance).
- 25.0 Demonstrate proficiency in electric motors--The student will be able to:

- 25.01 Read, interpret and troubleshoot from elementary diagrams.
- 25.02 Demonstrate competency in the elements of the elementary diagrams (relays, timers, limit switches, selector switches).

Instrumentation And Control Option

26.0 Demonstrate proficiency in the plant cycle (both I and Electric)--The student will be able to:

- 26.01 Identify and define the basic elements of the basic steam cycle.
- 26.02 To describe major plant components, such as: boilers, turbine, generators, pollution control equipment, heat exchangers, pumps, etc.
- 26.03 Demonstrate proficiency in reading and using steam tables, basic heat rate calculations (feed water heater performance).

27.0 Demonstrate proficiency in primary elements and transmitters--The student will be able to:

- 27.01 Define physical properties relating to pressure, level, temperature, ph, conductivity, vibration, and flow.
- 27.02 Identify the types and appropriate application of primary elements used in measuring those physical properties.
- 27.03 Operate basic test equipment (deadweight test, vacuum pump, potentiometer, thermal bath).
- 27.04 Setup, calculate and measure the output of primary elements and transmitters under varying conditions.
- 27.05 Identify and define the operating characteristics of electric and pneumatic transmitters.
- 27.06 Specify appropriate primary elements and transmitters for basic process measurements (e.g., case ratings, ranges accuracy, basic data sheets, ISA standards).
- 27.07 Calibrate, configure and troubleshoot analog and digital transmitters.
- 27.08 Design, setup and test pneumatic and electronics instrument loops.

28.0 Demonstrate proficiency in final elements--The student will be able to:

- 28.01 Define operating characteristics and appropriate applications for control valves (valve sizing calculations, flashing, cavitation, types (plug, globe, ball, butterfly) action (linear, quick opening, equal percentage).
- 28.02 Define operating characteristics for dampers (relationship between driver and flow; cams, types (e.g. guillotine, louver).
- 28.03 Define the operating characteristics of valve/damper operator: pneumatic, hydraulic, electric and interface devices: SOV's, positioners, I/P's.
- 28.04 Calibrate and troubleshoot final elements and interface devices.
- 28.05 Design, setup and test instrument loop with final element.

29.0 Demonstrate proficiency in process control--The student will be able to:

- 29.01 Identify and define the elements of automatic control integral, derivative, proportional, direct acting, feed forward, ration, cascade, three element feedwater control, etc.)
 - 29.02 Analyze and test tuning constant relationships (example: Define the output of a process with a set or ramp change using a proportional plus derivative action controller).
 - 29.03 Read and interpret basic functional diagrams.
- 30.0 Demonstrate proficiency in microprocessor systems--The student will be able to:
- 30.01 Identify CPU (Architecture) building blocks and their uses.
 - 30.02 Analyze BUS concepts.
 - 30.03 Analyze various memory schemes.
 - 30.04 Set up and operate oscilloscopes for microprocessor systems.
 - 30.05 Set up and operate logic/data analyzers for troubleshooting microprocessor systems.
 - 30.06 Identify types of input and output devices and peripherals.
 - 30.07 Interface input and output ports to peripherals.
 - 30.08 Analyze and troubleshoot input and output ports.
 - 30.09 Specify, program and troubleshoot programmable logic controllers.
 - 30.10 Analyze and troubleshoot a communications link.
 - 30.11 Configure and troubleshoot distributed digital controllers.
 - 30.12 Analyze and troubleshoot Distributed Control Systems (DCS's).
- 31.0 Demonstrate proficiency in combustion control--The student will be able to:
- 31.01 Demonstrate competence in the following: steam flow – air flow relationship
steam flow – fuel flow relationship fuel flow – air flow relationship excess oxygen
steam flow – air flow – fuel flow relationship.
 - 31.02 Demonstrate competencies in the simple cycle and combine cycle combustion turbines.
 - 31.03 Demonstrate competence in drum level control and in heat recovery steam generator control.
 - 31.04 32.03 Demonstrate competency in using the elements of elementary ladder logic diagrams in PLCs.
 - 31.05 Define critical protection systems such as implosion protection systems such as implosion protection, burner management systems.
 - 31.06 Read, interpret, and troubleshoot from functional diagrams.
- 32.0 Demonstrate proficiency in electric motor control–The student will be able to:
- 32.01 Read, interpret and troubleshoot from elementary diagrams.
 - 32.02 Demonstrate competency in the elements of the elementary diagrams (relays, timers, limit switches, selector switches).
- 33.0 Demonstrate proficiency in digital circuits–The student will be able to:
- 33.01 Define and apply numbering systems to codes and arithmetic operations.
 - 33.02 Analyze, minimize logic circuits using Boolean operations.
 - 33.03 Setup and operate power supplies for digital circuits and solve power distribution and noise problems.

- 33.04 Set up and operate oscilloscopes for digital circuits.
- 33.05 Identify types of logic gates and their truth tables.
- 33.06 Troubleshoot logic circuits.
- 33.07 Analyze types of flip-flops and their truth tables.
- 33.08 Identify, define and measure characteristics of Integrated Circuit (IC) logic families.
- 33.09 Identify types of registers and counters.
- 33.10 Analyze clock and timing circuits.
- 33.11 Relate the uses of digital-to-analog and analog-to-digital circuits.
- 33.12 Identify types of digital displays.
- 33.13 Construct digital display circuits.
- 33.14 Troubleshoot digital display circuits.

Distribution Option

34.0 Demonstrate proficiency in the application of power transformers--The student will be able to:

- 34.01 Demonstrate proficiency in the principles of transformers including the autotransformer.
- 34.02 Identify the magnetic fields associated with a transformer.
- 34.03 Identify the characteristics of a power transformer.
- 34.04 Identify and make proper single phase transformer connections.
- 34.05 Identify and make proper three phase (delta, WYE) transformer connections.
- 34.06 Make proper load tap changes.
- 34.07 Analyze the ideal circuit model of a transformer.
- 34.08 Identify and analyze transformer nomenclature, polarity, name plate data and ratings.
- 34.09 Identify and analyze transformer losses and efficiency.
- 34.10 Perform basic maintenance procedures and testing including oil testing and ratio test phasing.
- 34.11 Locate and correct fault currents.

35.0 Demonstrate proficiency in the use of electrical equipment--The student will be able to:

- 35.01 Identify and troubleshoot circuit breakers and reclosers in transmission and distribution systems.
- 35.02 Identify and analyze the use of conductors (overhead and underground) in transmission and distribution systems.
- 35.03 Identify the characteristics and uses of poles, wood, concrete and aluminum.
- 35.04 Identify the types of wood treatments for poles.
- 35.05 Identify and analyze the use of capacitors, insulators, regulators and arresters.
- 35.06 Design and analyze guying and anchor systems.
- 35.07 Make high voltage connection.
- 35.08 Identify load management devices.
- 35.09 Identify and analyze the use of switches and switchgear.
- 35.10 Identify and analyze the use of conduit and panel guards.
- 35.11 Set up and operate instrument transformers PT and CT.
- 35.12 Identify and analyze, metering systems.
- 35.13 Identify and analyze lighting systems.

36.0 Demonstrate proficiency in the principles of system protection--The student will be able to:

- 36.01 Identify and analyze the use of feeder breaker recloser and fuses.
- 36.02 Identify and define the characteristics of a substation.
- 36.03 Design, identify and analyze motor projection devices.
- 36.04 Analyze the loading, voltage drops, balance and circuit balance of a 3 phase system.

37.0 Demonstrate proficiency in 3 phase power system analysis—The student will be able to:

- 37.01 Covert between physical units (amperes, volts, OHMS, watts, and VARS and per unit parameters).
- 37.02 Analyze radial distribution systems (complete line and phase, voltages, currents and power flows).
- 37.03 Analyze 3 phase systems on a single phase basis (assume balanced systems).
- 37.04 Analyze the loading, voltage drops, balance and circuit balance of a 3 phase system.

38.0 Demonstrate proficiency in basic surveying skills—The student will be able to:

- 38.01 Define and apply the general principles of surveying.
- 38.02 Be proficient in the use of and application of survey equipment.
- 38.03 Identify easements and analyze legal descriptions.

39.0 Demonstrate proficiency in distribution circuit design --The student will be able to:

- 39.01 Design basic overhead and underground single and 3 phase line extensions.
- 39.02 Demonstrate an understanding of fuse and breaker coordination.
- 39.03 Demonstrate an understanding of the “per unit” system of calculations.
- 39.04 Demonstrate an understanding of grounded and ungrounded systems.