Industry Certification/Credential/PSAV to AS Industrial Management
Credit Articulation Identification Form

AS Degree Name: Industrial Management Technology **CIP Number:** 1652020501

Industry Certification/Credential/PSAV: **Electrical- IEC (Independent Electrical Contractors)**

College Credit: According to State of Florida's Curriculum Frameworks (http://www.fldoe.org/academics/career-adult-edu/career-tech-edu/curriculum-frameworks/2017-18-frameworks/manufacturing.stml), the purpose of the AS Degree in Industrial Management Technology is to:

> *...offer 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 manufacturing 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 manufacturing career cluster.*

The State Curriculum Framework goes on in the *Special Notes* section to state:

> *Students may provide valid evidence of technical or industrial competencies as specified in the curriculum frameworks of an accredited postsecondary adult or postsecondary vocational institution. Students may also provide valid evidence of acquired skills through portfolios, documented work history, and registered apprenticeship programs that meet program outcomes as determined by the college.*
>
> *Industrial elective credits may also be awarded based on the type of program, length of program, certifications or licenses awarded under articulation agreements between PSAV program schools and/or industrial/technical license articulation agreements.*
>
> *Industrial elective credits may also be satisfied by the completion of special courses and certificate programs offered by the college specified in the elective section of the college's degree plan.*

The purpose of this form is to document the validation of acceptable forms of evidence of the students' *technical or industrial competencies* and/or *acquired skills* that meet program outcomes.

The number of college credits awarded by the articulation agreement is determined by HCC faculty's assessment of the certification/credential/PSAV. A minimum of 30 clock hours of training or work experience will be required for every college credit awarded to a maximum of 30 credit hours. The 30 to 1 clock hour conversion is based on the guidelines for state reporting and FLDOE unit definition of a clock hour.

Validation Mechanism: To be eligible for articulation, the student must show evidence of their current ~~Carpentry~~ VOC.BCV-IEC Certification certification/credential and it must have been issued within three (3) years prior to their enrollment in the program.

Rationale/Justification: IEC-Electrical certification represents industry acknowledgement of technical skill attainment of competencies in the AS in Industrial Management Technology program. HCC faculty reviewed the following:

_X_ State Curriculum Frameworks

_*_ Course Syllabi

_*_ Course Exams

_X_ Course Scope and Sequence

_*_ Textbooks/Course Materials

_*_ Other * **Proprietary** to the Program (Offered through Associated Builders & Contractors (ABC) and the National Center for Construction Education and Research (NCCER)

The IEC Electrical certification/credential will serve as equivalent substitutions for the HCC courses identified below.

Post-Secondary Adult Vocational/Apprenticeship/Corporate Training Program			Post-Secondary Institution: Hillsborough Community College		
Program/Courses	Clock Hours	PSAV Course Numbers	Course Code	Course Name	Awarded Credits
Apprenticeship I			ETI2941	Industrial Management Practicum	30
Apprenticeship Co-op I					
Apprenticeship II					
Apprenticeship Co-op II					
Apprenticeship III					
Apprenticeship Co-op III					
Apprenticeship IV					
Apprenticeship Co-op IV					

Apprenticeship V					
Apprenticeship Co-op V					
Apprenticeship VI					
Apprenticeship Co-op VI					
Apprenticeship VII					
Apprenticeship Co-op VII					
Apprenticeship VIII					
Apprenticeship Co-op VIII					
Total Clock Hours	1500			**Total credits**	30

Total Credits Awarded for the courses listed above is **30**.

Signatures

Signature Dean, PSAV and Workforce Training — Date

Signature Department Chair, Engineering Technology — Date 4/16/19

Signature Department Chair, Industrial Management — Date 3/28/19

Signature Dean — Date 4/16/19

Signature Director, Associate in Science Programs — Date 4/22/19

Signature Vice President, Academic Affairs — Date 5/23/2019

2013 – 2014

Florida Department of Education
Curriculum Framework

Program Title: Electrician
Program Type: Career Preparatory
Career Cluster: Architecture and Construction

	PSAV
Program Number	I460314
CIP Number	0646030204
Grade Level	30,31
Standard Length	1500 Hours
Teacher Certification	ELECTRICAL @7 7G
CTSO	SkillsUSA
SOC Codes (all applicable)	47-3013 – Helpers - Electricians 47-2111 - Electricians
Facility Code	245 - http://www.fldoe.org/edfacil/sref.asp (State Requirements for Educational Facilities)
Targeted Occupation List	http://www.labormarketinfo.com/wec/TargetOccupationList.htm
Perkins Technical Skill Attainment Inventory	http://www.fldoe.org/workforce/perkins/perkins_resources.asp
Industry Certifications	http://www.fldoe.org/workforce/fcpea/default.asp
Statewide Articulation	http://www.fldoe.org/workforce/dwdframe/artic_frame.asp
Basic Skills Level	Mathematics: 9 Language: 9 Reading: 9

Purpose

The purpose of this program is to prepare students for employment or advanced training in a variety of construction electrical industries

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 Architecture and Construction 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 Architecture and Construction career cluster.

Program Structure

This program is a planned sequence of instruction consisting of four occupational completion points. The recommended sequence allows students to complete specified portions of a program for employment or to remain for advanced training. A student who completes the applicable competencies at any occupational completion point may either continue with the training program or terminate as an occupational completer.

When offered at the postsecondary adult career and technical level, this program is comprised of courses which have been assigned course numbers in the SCNS (Statewide Course Numbering System) in accordance with Section 1007.24 (1), F.S. Career and Technical credit shall be awarded to the student on a transcript in accordance with Section 1001.44(3)(b), F.S.

The following table illustrates the program structure:

OCP	Course Number	Course Title	Course Length	SOC Code
A	BCV0603	Electrician Helper	300 Hours	47-3013
B	BCV0640	Residential Electrician	450 Hours	47-2111
C	BCV0652	Commercial Electrician	450 Hours	47-2111
D	BCV0667	Industrial Electrician	300 Hours	47-2111

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, Inc. 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.

Cooperative Training – OJT

On-the-job training is appropriate but not required for this program. Whenever offered, the rules, guidelines, and requirements specified in the OJT framework apply.

Essential Skills

Essential skills identified by the Division of Career and Adult Education have been integrated into the standards and benchmarks of this program. These skills represent the general knowledge and skills considered by industry to be essential for success in careers across all

career clusters. Students preparing for a career served by this program at any level should be able to demonstrate these skills in the context of this program. A complete list of Essential Skills and links to instructional resources in support of these Essential Skills are published on the CTE Essential Skills page of the FL-DOE website (http://www.fldoe.org/workforce/dwdframe/essential_skills.asp).

Basic Skills

In PSAV programs offered for 450 hours or more, in accordance with Rule 6A-10.040, F.A.C., the minimum basic skills grade levels required for postsecondary adult career and technical students to complete this program are: Mathematics 9, Language 9, and Reading 9. These grade level numbers correspond to a grade equivalent score obtained on a state designated basic skills examination.

Adult students with disabilities, as defined in Section 1004.02(7), Florida Statutes, may be exempted from meeting the Basic Skills requirements (Rule 6A-10.040). Students served in exceptional student education (except gifted) as defined in s. 1003.01(3)(a), F.S., may also be exempted from meeting the Basic Skills requirement. Each school district and Florida College must adopt a policy addressing procedures for exempting eligible students with disabilities from the Basic Skills requirement as permitted in Section 1004.91(3), F.S.

Students who possess a college degree at the Associate of Applied Science level or higher; who have completed or are exempt from the college entry-level examination; or who have passed a state, national, or industry licensure exam are exempt from meeting the Basic Skills requirement (Rule 6A-10.040, F.A.C.) Exemptions from state, national or industry licensure are limited to the certifications listed at http://www.fldoe.org/workforce/dwdframe/rtf/basicskills-License-exempt.rtf.

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 counselor and/or instructors. 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.

In addition to accommodations, some secondary students with disabilities (students with an Individual Educational Plan (IEP) served in Exceptional Student Education or ESE) will need modifications to meet their needs. Modifications change the outcomes or what the student is expected to learn, e.g., modifying the curriculum of a secondary career and technical education course. Note postsecondary curriculum cannot be modified.

Some secondary students with disabilities (ESE) may need additional time (i.e., longer than the regular school year), to master the student performance standards associated with a regular Occupational Completion Point (OCP) or a Modified Occupational Completion Point (MOCP). If

needed, a student may enroll in the same career and technical course more than once. Documentation should be included in the IEP that clearly indicates that it is anticipated that the student may need an additional year to complete an OCP/MOCP. The student should work on different competencies and new applications of competencies each year toward completion of the OCP/MOCP. After achieving the competencies identified for the year, the student earns credit for the course. It is important to ensure that credits earned by students are reported accurately. The district's information system must be designed to accept multiple credits for the same course number (for eligible students with disabilities).

Articulation

This program (I460314) has a statewide articulation agreement approved by the Florida State Board of Education:

Building Construction Technology AS (1615100101) – 3 credits

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

Standards

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

01.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance.
02.0 Identify, use and maintain the tools and accessories used in the electrical industry.
03.0 Demonstrate an understanding of basic Direct-Current (DC) electrical-circuit skills.
04.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas.
05.0 Demonstrate mathematics knowledge and skills.
06.0 Demonstrate an understanding of basic electricity.
07.0 Read and interpret basic electric codes.
08.0 Apply mathematics knowledge and skills to electricity.
09.0 Demonstrate further understanding of electricity.
10.0 Solve problems using critical thinking skills, creativity and innovation.
11.0 Demonstrate language arts knowledge and skills.
12.0 Demonstrate science knowledge and skills.
13.0 Demonstrate proficiency in electrical math problems and skills.
14.0 Use information technology tools.
15.0 Describe the importance of professional ethics and legal responsibilities.
16.0 Demonstrate personal money-management concepts, procedures, and strategies.
17.0 Demonstrate Alternating-Current (AC) circuit skills.
18.0 Explain the importance of employability and entrepreneurship skills.
19.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment.
20.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives.
21.0 Install residential wiring.
22.0 Install residential wiring systems.
23.0 Demonstrate proficiency in commercial wiring.

24.0 Demonstrate specialized electrical skills.
25.0 Demonstrate competency in industrial wiring.
26.0 Demonstrate competency in transformers.
27.0 Demonstrate competency in AC and DC motors.
28.0 Demonstrate competency in electrical and electronic control circuits and equipment.

2013 – 2014

Florida Department of Education
Student Performance Standards

Program Title: Electrician
PSAV Number: I460314

Course Number: BCV0603
Occupational Completion Point: A
Electrician Helper – 300 Hours – SOC Code 47-3013

01.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance--The student will be able to:

- 01.01 Clean the work area and maintain it in a safe condition.
- 01.02 Describe personal and jobsite safety rules and regulations that maintain safe and healthy work environments. SHE1.0
- 01.03 Identify and operate workplace-safety electrical devices.
- 01.04 Identify health-related problems that may result from exposure to work-related chemicals and hazardous materials, and know the proper precautions required for handling such materials.
- 01.05 Explain emergency procedures to follow in response to workplace accidents.
- 01.06 Create a disaster and/or emergency response plan. SHE2.0
- 01.07 Demonstrate knowledge of CPR (cardiopulmonary resuscitation) and first aid.
- 01.08 Describe "Right-to-Know" Law as recorded in (29 CFR.1910.1200)

02.0 Identify, use and maintain the tools and accessories used in the electrical industry--The student will be able to:

- 02.01 Identify and select tools, equipment, materials, and wires to complete a job.
- 02.02 Drill holes in metal, wood, and concrete for electrical wiring.
- 02.03 Lay out electrical devices, complying with regulations.
- 02.04 Install the following, complying with the appropriate local, state, or national electric codes:
  - a. Conductors and cable
  - b. Standard outlets and switch boxes
  - c. Explain cord connections on major appliances
  - d. Cords switches, receptacles, and dimmers, including a single-pole switched lighting circuit, a three-way switched lighting circuit, and a four-way combination circuit.

03.0 Demonstrate an understanding of basic Direct-Current (DC) electrical-circuit skills--The student will be able to:

- 03.01 Define the terms "voltage," "current," "resistance," "power," and "energy."
- 03.02 Measure voltage, amperage, and resistance, using a Volt-Ohm Meter (VOM) and a Digital Volt-Ohm Meter (DVM).
- 03.03 Analyze, and explain a series, series-parallel, and parallel circuit.
- 03.04 Draw each type of circuit and calculate the circuit values.
- 03.05 Explain and apply Ohm's Law.

03.06 Compute conductance and resistance of conductors and insulators.

04.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas--The student will be able to:

04.01 Select and employ appropriate communication concepts and strategies to enhance oral and written communication in the workplace. CM1.0
04.02 Locate, organize and reference written information from various sources. CM3.0
04.03 Design, develop and deliver formal and informal presentations using appropriate media to engage and inform diverse audiences. CM5.0
04.04 Interpret verbal and nonverbal cues/behaviors that enhance communication. CM6.0
04.05 Apply active listening skills to obtain and clarify information. CM7.0
04.06 Develop and interpret tables and charts to support written and oral communications. CM8.0
04.07 Exhibit public relations skills that aid in achieving customer satisfaction. CM10.0

05.0 Demonstrate mathematics knowledge and skills--The student will be able to:

05.01 Demonstrate knowledge of arithmetic operations. AF3.2
05.02 Analyze and apply data and measurements to solve problems and interpret documents. AF3.4
05.03 Construct charts/tables/graphs using functions and data. AF3.5

06.0 Demonstrate an understanding of basic electricity--The student will be able to:

06.01 Explain the principles of electromagnetism.
06.02 Explain the magnetic properties of circuits and devices.
06.03 Relate electricity to the nature of matter.
06.04 Describe various ways that electricity is produced.

07.0 Read and interpret basic electric codes--The student will be able to:

07.01 Describe the importance of following the local, state and national electric codes.
07.02 Read and interpret basic electric codes, wiring plans and specifications.
07.03 Identify licensure requirements for electrical occupations.
07.04 Demonstrate knowledge of National Fire Protection Agency (NFPA) 70E and how it relates to job safety.

08.0 Apply mathematics knowledge and skills to electricity--The student will be able to:

08.01 Demonstrate Solve basic algebraic formulas related to electricity.
08.02 Solve basic trigonometric functions related to electrical theory.
08.03 Explain basic AC theory and solve related mathematical problems using appropriate test equipment.
08.04 Solve math-related problems from measurements on training aids. (Optional)

09.0 Demonstrate further understanding of electricity--The student will be able to:

09.01 Explain molecular action as a result of temperature extremes, chemical reaction and moisture content.

09.02 Explain how voltage is produced by chemical, mechanical, thermal, photoelectric and piezo electric means.
09.03 Identify electrical symbols in construction documents.

10.0 Solve problems using critical thinking skills, creativity and innovation--The student will be able to:

10.01 Employ critical thinking skills independently and in teams to solve problems and make decisions. PS1.0
10.02 Employ critical thinking and interpersonal skills to resolve conflicts. PS2.0
10.03 Identify and document workplace performance goals and monitor progress toward those goals. PS3.0
10.04 Conduct technical research to gather information necessary for decision-making.PS4.0

11.0 Demonstrate language arts knowledge and skills--The students will be able to: AF2.0

11.01 Locate, comprehend and evaluate key elements of oral and written information. AF2.4
11.02 Draft, revise, and edit written documents using correct grammar, punctuation and vocabulary. AF2.5
11.03 Present information formally and informally for specific purposes and audiences. AF2.9

12.0 Demonstrate science knowledge and skills--The students will be able to: AF4.0

12.01 Discuss the role of creativity in constructing scientific questions, methods and explanations. AF4.1
12.02 Formulate scientifically investigable questions, construct investigations, collect and evaluate data, and develop scientific recommendations based on findings.AF4.3

Course Number: BCV0640
Occupational Completion Point: B
Residential Electrician – 450 Hours -- SOC Code 47-2111

13.0 Demonstrate proficiency in electrical math problems and skills--The student will be able to:

13.01 Calculate wiring costs.
13.02 Draw an industrial electrical-wiring plan.
13.03 Describe the use of high-voltage test equipment.
13.04 Describe how to test insulation.
13.05 Describe how to balance a load.
13.06 Use electrical related math skills.

14.0 Use information technology tools--The students will be able to:

14.01 Use Personal Information Management (PIM) applications to increase workplace efficiency. IT1.0
14.02 Employ technological tools to expedite workflow including word processing, databases, reports, spreadsheets, multimedia presentations, electronic calendar, contacts, email, and internet applications. IT2.0

14.03 Employ computer operations applications to access, create, manage, integrate, and store information. IT3.0
14.04 Employ collaborative/groupware applications to facilitate group work. IT4.0

15.0 Describe the importance of professional ethics and legal responsibilities--The student will be able to:

15.01 Evaluate and justify decisions based on ethical reasoning. ELR1.0
15.02 Evaluate alternative responses to workplace situations based on personal, professional, ethical, legal responsibilities, and employer policies. ELR1.1
15.03 Identify and explain personal and long-term consequences of unethical or illegal behaviors in the workplace. ELR1.2
15.04 Interpret and explain written organizational policies and procedures. ELR2.0

16.0 Demonstrate personal money-management concepts, procedures, and strategies--The students will be able to:

16.01 Identify and describe the services and legal responsibilities of financial institutions. FL2.0
16.02 Describe the effect of money management on personal and career goals. FL3.0
16.03 Develop a personal budget and financial goals. FL3.1
16.04 Complete financial instruments for making deposits and withdrawals. FL3.2
16.05 Maintain financial records. FL3.3
16.06 Read and reconcile financial statements. FL3.4
16.07 Research, compare and contrast investment opportunities.

17.0 Demonstrate Alternating-Current (AC) circuit skills--The student will be able to:

17.01 Identify the physical and electrical characteristics of capacitors and inductors.
17.02 Demonstrate proficiency in measuring, testing and connecting a transformer.
17.03 Apply the principles of transformers to AC circuits.
17.04 Identify the properties of an AC signal.
17.05 Identify AC sources.
17.06 Analyze and apply the principles of transformers to AC circuits.
17.07 Analyze polyphase circuits.
17.08 Install a simple polyphase circuit.

18.0 Explain the importance of employability and entrepreneurship skills--The student will be able to:

18.01 Identify and demonstrate positive work behaviors needed to be employable.ECD1.0
18.02 Develop personal career plan that includes goals, objectives, and strategies.ECD2.0
18.03 Examine licensing, certification, and industry credentialing requirements. ECD3.0
18.04 Maintain a career portfolio to document knowledge, skills, and experience.ECD5.0
18.05 Evaluate and compare employment opportunities that match career goals.ECD6.0
18.06 Identify and exhibit traits for retaining employment. ECD7.0
18.07 Identify opportunities and research requirements for career advancement.ECD8.0
18.08 Research the benefits of ongoing professional development. ECD9.0
18.09 Examine and describe entrepreneurship opportunities as a career planning option. ECD10.0

19.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment--The students will be able to:

19.01 Describe the nature and types of business organizations. SY1.0
19.02 Explain the effect of key organizational systems on performance and quality.
19.03 List and describe quality control systems and/or practices common to the workplace. SY2.0
19.04 Explain the impact of the global economy on business organizations.

20.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives--The students will be able to:

20.01 Employ leadership skills to accomplish organizational goals and objectives. LT1.0
20.02 Establish and maintain effective working relationships with others in order to accomplish objectives and tasks. LT3.0
20.03 Conduct and participate in meetings to accomplish work tasks. LT4.0
20.04 Employ mentoring skills to inspire and teach others. LT5.0

21.0 Install residential wiring--The student will be able to:

21.01 Identify residential-wiring requirements and specifications in accordance with a wiring plan.
21.02 Draw a residential wiring plan, using electrical-wiring symbols.
21.03 Identify and install a recessed lighting fixture, a fluorescent lighting fixture, and a surface lighting fixture according to the specifications, complying with the appropriate local, state, or national electric codes.
21.04 Identify, install, and wire a duplex- receptacle-outlet circuit, a split-circuit duplex-receptacle-outlet circuit, and a special-purpose receptacle-outlet circuit according to the specifications, complying with the appropriate local, state, or national electric codes.

22.0 Install residential wiring systems--The student will be able to:

22.01 Install and wire a low-voltage signal system.
22.02 Install conduit systems.
22.03 Provide power for heating, ventilation, and air-conditioning equipment.
22.04 Install the following, complying with the appropriate local, state, or national electric codes:
a. Service-entrance main panel
b. Service-entrance meter base
c. Alarm system/smoke detectors
22.05 Demonstrate knowledge of the requirements for the installation of a swimming-pool electrical system.
22.06 Connect single-phase and three-phase transformers.
22.07 Troubleshoot residential electric circuits.

Course Number: BCV0652
Occupational Completion Point: C
Commercial Electrician – 450 Hours -- SOC Code 47-2111

23.0 Demonstrate proficiency in commercial wiring--The student will be able to:

23.01 Read and interpret a commercial wiring plan and specifications.
23.02 Draw a commercial electrical-wiring plan.
23.03 Select tools, equipment, materials, and wires to complete a job.
23.04 Install the following according to the plan and specifications, complying with appropriate electric codes:
  a. Wire mold
  b. Conduit, duct, and raceway systems
  c. Conductors in a conduit
23.05 Describe the difference between a residential and a commercial lighting circuit.
23.06 Construct control circuits from schematics.
23.07 Describe high-voltage (over 600V) wiring requirements.
23.08 Demonstrate knowledge of installing wiring in hazardous areas.
23.09 Explain a commercial three-phase receptacle circuit, and an emergency-lighting system.
23.10 Explain commercial-service-entrance requirements.

24.0 Demonstrate specialized electrical skills--The student will be able to:

24.01 Explain solid-state control devices.
24.02 Explain data cable installation according to the plan and specifications.

Course Number: BCV0667
Occupational Completion Point: D
Industrial Electrician – 300 Hours – SOC Code 47-2111

25.0 Demonstrate competency in industrial wiring--The student will be able to:

25.01 Draw an industrial one-line power diagram.
25.02 Test insulation resistance using a megohmmeter.
25.03 Install a motor branch circuit.
25.04 Using the National Electrical Code (NEC), make the following required calculations:
  a. Conductor size
  b. Overcurrent protection
  c. Overload protection
  d. Short circuit protection
25.05 Install a 277 V lighting branch circuit.
25.06 Describe a bus duct power distribution system.
25.07 Describe fiber-optic installation requirements.
25.08 Demonstrate the use of industrial test equipment.
25.09 Install the following:
  a. Disconnect switch - fused and unfused
  b. Raceways
  c. Emergency stop switch
  d. Circuit breaker
  e. Panelboard

26.0 Demonstrate competency in transformers--The student will be able to:

26.01 Explain the basic principles of mutual induction and transformer action.

26.02 Explain the operation and use of a current transformer.
26.03 Explain the operation and use of a potential transformer.
26.04 Explain the operation and use of a buck-boost transformer and when it is used.
26.05 Explain and connect 3 phase transformers in both delta and wye configuration.
26.06 Calculate the over current protection requirements for the primary and secondary.
26.07 Explain what transformer impedance is and its importance.

27.0 Demonstrate competency in AC and DC motors--The student will be able to:

27.01 Install and connect the following types of DC motors:
a. Series
b. Shunt
c. Compound
27.02 Install and connect the following types of single phase AC motors:
a. Capacitor-start
b. Capacitor-start and run
c. Split-phase inductor
d. Universal
e. Repulsion-start, induction-run
27.03 Install and connect the following types of three phase AC motors:
a. Squirrel-cage induction
b. Wound-rotor
c. Synchronous
27.04 Demonstrate the ability to select and connect a three-phase induction motor for either high or low voltage requirements.

28.0 Demonstrate competency in electrical and electronic control circuits and equipment--The student will be able to:

28.01 Draw an elementary motor control ladder diagram.
28.02 Interpret symbols, read and troubleshoot from schematics and ladder diagrams.
28.03 Describe the operation of the following overload relays:
a. Thermal
b. Magnetic
c. Thermal-magnetic
28.04 Install a manual single phase and three phase control station.
28.05 Install a three-phase magnetic starter.
28.06 Install the following control devices:
a. Start/stop station
b. Forward/reverse/stop station
c. Hands/off/auto station
d. Start/jog/stop station
e. Limit switches
f. Pressure, temperature, level, and float switches
g. Pilot, run, and stop indicator lights
h. Control relay, and timing relays
i. Multi-motor push-button station
28.07 Install, operate, and troubleshoot the following relay control circuits:
a. Start/stop
b. Forward/reverse

c. Hands-off-auto
d. Start/jog
e. Automatic timed sequence, "ON" and "OFF" delays
f. Manually timed sequence, "ON" and "OFF" delays
g. Plugging
h. DC injection braking

28.08 Install, operate and troubleshoot the following electronic control equipment and circuits:
a. Variable Frequency Drive (VFD)
b. DC drive

28.09 Explain the alternatives to relay logic control.