July 2010

Florida Department of Education
Curriculum Framework

Program Title: **Electronics Engineering Technology**
Career Cluster: **Manufacturing**

	AS	AAS
CIP Number	1615030301	0615030301
Program Type	College Credit	College Credit
Standard Length	68 Credit Hours	68 Credit Hours
CTSO	SkillsUSA	SkillsUSA
SOC Codes (all applicable)	17-3023	17-3023
Targeted Occupation List	http://www.labormarketinfo.com/wec/TargetOccupationList.htm	
Perkins Technical Skill Attainment Inventory	http://www.fldoe.org/workforce/perkins/perkins_resources.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 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 content includes but is not limited to DC circuits, AC circuits, solid-state devices, analog circuits, digital circuits and microprocessor systems. Integrated into this content will be communications skills, leadership skills, human relations skills, employability skills, safe and efficient work practices, use of circuit diagrams and schematics, soldering, laboratory practices and technical recording and reporting.

This program focuses on broad, transferable skills and stresses understanding and demonstration of the following elements of the Electronics Engineering 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 existing articulation agreements, 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:

Basic Electronics Technician (0615030310) – 14 Credits
Electronics Technician (0615030309) – 31 Credits
Laser and Photonics Technician (0615030311) – 12 Credits
Robotics and Simulation Technician (0615030314) – 12 Credits
Solar Energy Technician (0615030317) - 12 (Primary) or 14 (Secondary) Credits

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 direct current (DC) circuits.
03.0 Demonstrate proficiency in direct current (DC) network analysis.
04.0 Demonstrate proficiency in alternating current (AC) circuits.
05.0 Demonstrate proficiency in alternating current (AC) network and coupled circuit analysis.
06.0 Demonstrate proficiency in solid-state devices.
07.0 Demonstrate proficiency in design and analysis of discrete solid-state circuits.
08.0 Demonstrate proficiency in analog circuits.
09.0 Demonstrate proficiency in design and analysis of systems using linear integrated circuits.
10.0 Demonstrate proficiency in digital circuits.
11.0 Demonstrate proficiency in microprocessor systems.
12.0 Demonstrate proficiency in technical recording and reporting.
13.0 Demonstrate proficiency in programming, design and analysis of microprocessor based systems.
14.0 Demonstrate employability skills.
15.0 Understand, install, configure and troubleshoot issues relating to computer hardware and software.(Optional)

Optional standards for programs specializing in Laser and Photonics

16.0 Demonstrate proficiency in photonics, optics, and lasers.
17.0 Demonstrate proficiency in electro-optical devices

Optional standards for programs specializing in Telecommunications

18.0 Demonstrate proficiency in telecommunications.

Optional standards for programs specializing in Robotics and Simulation

19.0 Demonstrate proficiency in robotics and automation
20.0 Demonstrate proficiency in modeling and simulation

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Florida Department of Education
Student Performance Standards

Program Title: **Electronics Engineering Technology**
CIP Numbers: **A.S. 1605030301** **A.A.S. 0615030301**
Program Length: **68 Credit Hours**
SOC Code(s): **17-3023**

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 Occupational Safety Health Administration (OSHA) safety standards.
01.02 Make proper electrical wire connections.
01.03 Identify and use electrical/electronic hand tools properly (wire stripper, wire nose, clippers, etc.).
01.04 Identify and use power tools associated with electrical/electronic industry properly (solder and desolder station, etc.).
01.05 Explain the theoretical concepts of soldering.
01.06 Identify proper solder connections.
01.07 Demonstrate acceptable soldering techniques.
01.08 Demonstrate acceptable desoldering techniques.
01.09 Demonstrate solder rework and repair techniques.
01.10 Demonstrate electrostatic discharge (ESD) safety procedures.
01.11 Describe the construction of printed circuit boards (PCBs).
01.12 Demonstrate proficiency in the use of an operating system.
01.13 Demonstrate proficiency in the use of a high level computer language.
01.14 Demonstrate proficiency in the use of microcomputer application programs (i.e., word processing, data base, spreadsheet, PowerPoint).
01.15 Demonstrate the use of microcomputer circuit simulation programs.
01.16 Demonstrate the use of microcomputer and instrumentation and module analytical software.
01.17 Load operating system and application software.
01.18 Read and interpret data sheet specifications for electronic components.
01.19 Demonstrate proficiency in the use of multimeters.
01.20 Demonstrate proficiency in the use of oscilloscopes.
01.21 Demonstrate proficiency in the use of function generators.
01.22 Demonstrate proficiency in the use of power supplies.
01.23 Identify basic limitations of multimeters, oscilloscopes, function generators, and power supplies.

02.0 Demonstrate proficiency in direct current (DC) circuits - The student will be able to:

02.01 Solve algebraic problems applied to DC circuits.
02.02 Solve problems in electronic units utilizing metric prefixes.
02.03 Relate electricity to the nature of matter.

02.04 Identify sources of electricity.
02.05 Define voltage, current, resistance, power and energy.
02.06 Apply Ohm's law and power formulas to electrical/electronic circuits.
02.07 Read and interpret color codes and symbols to identify electrical components and values.
02.08 Measure properties of a circuit using Digital Multimeter (DMM) and oscilloscopes.
02.09 Calculate conductance and compute and measure the resistance of the conductors and insulators.
02.10 Apply Ohm's law and Kirchoff s voltage and current laws to series circuits.
02.11 Construct and verify operation of series circuits.
02.12 Analyze and troubleshoot series circuits.
02.13 Apply Ohm's law and Kirchoff s voltage and current laws to parallel circuits.
02.14 Construct and verify the operation of parallel circuits.
02.15 Analyze and troubleshoot parallel circuits.
02.16 Apply Ohm's law and Kirchoff's voltage and current laws to series-parallel and parallel-series circuits.
02.17 Construct and verify the operation of series-parallel and parallel-series and bridge circuits.
02.18 Analyze and troubleshoot series-parallel and 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 the operation of DC circuits that demonstrate the maximum power transfer theory.
02.24 Describe magnetic properties of circuits and devices.
02.25 Define resistor-capacitor (R-C) and resistor inductor (R-L) time constants and classify the output of differentiators and integrators.
02.26 Setup and operate power supplies for DC circuits.

03.0 Demonstrate proficiency in direct current (DC) network analysis - The student will be able to:

03.01 Analyze multi source circuits using superposition theorem.
03.02 Analyze circuits using Thevenin's theorem.
03.03 Analyze circuits using Norton's theorem.
03.04 Use mesh currents, branch currents, nodal, and/or source transformation analysis to analyze circuits.
03.05 Analyze circuits using maximum power transfer theorem.
03.06 Analyze DC circuits using computer programs.

04.0 Demonstrate proficiency in alternating current (AC) circuits - The student will be able to:

04.01 Solve basic trigonometric problems as applicable to electronics (prerequisite to AC).
04.02 Identify properties of an AC signal.
04.03 Identify AC sources.
04.04 Analyze and measure AC signals utilizing VOM, DVM, oscilloscope, frequency counter and function generator.
04.05 Define the characteristics of AC capacitive circuits.

04.06 Construct and verify the operation of AC capacitive circuits.
04.07 Analyze and troubleshoot AC capacitive circuits.
04.08 Define the characteristics of AC inductive circuits.
04.09 Construct and verify the operation of AC inductive circuits.
04.10 Analyze and troubleshoot AC inductive circuits.
04.11 Define and apply the principles of transformers to AC circuits.
04.12 Construct and verify the operation of AC circuits utilizing transformers.
04.13 Analyze and troubleshoot AC circuits utilizing transformers.
04.14 Construct and verify the operation of passive differentiators and integrators to determine R-C and R-L time constraints.
04.15 Compute the impedance of passive RC, RL, and RLC circuits.
04.16 Analyze and troubleshoot passive differentiator and integrator circuits.
04.17 Define the characteristics of resistive, inductive, and capacitive (RLC) circuits (series, parallel and complex).
04.18 Construct and verify the operation of RLC circuits (series, parallel and complex).
04.19 Define the characteristics of series and parallel resonant circuits.
04.20 Construct and verify the operation of series and parallel resonant circuits.
04.21 Analyze and troubleshoot R-C, R-L and RLC circuits.
04.22 Define the characteristics of frequency selective filter circuits.
04.23 Construct and verify the operation of frequency selective filter circuits.
04.24 Analyze and troubleshoot frequency selective filter circuits.
04.25 Define the characteristics of polyphase circuits.
04.26 Define basic motor theory and operation.
04.27 Define basic generator theory and operation.
04.28 Setup and operate power supplies for AC circuits.
04.29 Analyze and measure power in AC circuits.
04.30 Define power factor and power factor correction in AC circuits.
04.31 Set up and operate capacitor and inductor analyzers for AC circuits.

05.0 Demonstrate proficiency in alternating current (AC) network and coupled circuit analysis - The student will be able to:

05.01 Analyze magnetic circuits.
05.02 Apply Faraday's law of induced voltages.
05.03 Solve for mutual inductance in a coupled circuit.
05.04 Use mesh currents, branch currents, nodal, and/or source transformation analysis to analyze circuits.
05.05 Identify the effects of transient spikes in RC, RL, and RLC circuits.
05.06 Identify the effects of loading on transformers.
05.07 Analyze multi source circuits using superposition theorem.
05.08 Analyze circuits using Thevenin's theorem.
05.09 Analyze circuits using Norton's theorem.
05.10 Analyze circuits using maximum power transfer theorem.
05.11 Analyze AC circuits using computer programs.
05.12 Identify three-phase power concepts.

06.0 Demonstrate proficiency in solid-state devices - The student will be able to:

06.01 Identify and define properties of semiconductor materials.
06.02 Identify and define operating characteristics and applications of junction diodes.
06.03 Identify and define operating characteristics and applications of special diodes.

06.04 Construct diode circuits.
06.05 Analyze and troubleshoot diode circuits.
06.06 Identify and define operating characteristics and applications of bipolar junction transistors.
06.07 Identify and define operating characteristics and applications of field effect transistors.
06.08 Identify and define operating characteristics and applications of single-stage amplifiers.
06.09 Construct single-stage amplifiers.
06.10 Analyze and troubleshoot single-stage amplifiers.
06.11 Construct thyristor circuitry.
06.12 Analyze and troubleshoot thyristor circuitry.
06.13 Demonstrate proficiency in the use of curve tracers and/or transistor testers.

07.0 Demonstrate proficiency in design and analysis of discrete solid-state circuits - The student will be able to:

07.01 Analyze the construction of various types of pn junction diodes.
07.02 Construct, analyze, and troubleshoot diode circuits.
07.03 Construct, analyze, and troubleshoot regulator circuits using zener diodes.
07.04 Construct, analyze, and troubleshoot bipolar junction transistor biased circuits.
07.05 Construct, analyze, and troubleshoot field effect transistor biased circuits.
07.06 Construct, analyze small signal amplifier circuits using bipolar junction or field effect transistors.
07.07 Construct, analyze, and troubleshoot multistage amplifiers.
07.08 Construct, analyze, and troubleshoot power amplifiers.
07.09 Analyze low and high frequency amplifier responses.
07.10 Discuss troubleshooting techniques applied to discrete solid state circuits.
07.11 Discuss performance and applications for discrete solid state circuits.
07.12 Analyze discrete solid-state circuits using computer programs.

08.0 Demonstrate proficiency in analog circuits - The student will be able to:

08.01 Identify and define operational characteristics and applications of multistage amplifiers.
08.02 Construct, analyze and troubleshoot multistage amplifiers.
08.03 Identify and define operating characteristics and applications of linear integrated circuits.
08.04 Identify and define operating characteristics and applications of unregulated power supplies and filters.
08.05 Construct unregulated power supplies and filters.
08.06 Troubleshoot basic power supplies and filters.
08.07 Identify and define operating characteristics and applications of differential and operational amplifiers.
08.08 Construct differential and operational amplifier circuits.
08.09 Analyze and troubleshoot differential and operational amplifier circuits.
08.10 Identify and define operating characteristics of audio power amplifiers.
08.11 Construct audio power amplifiers.
08.12 Identify and analyze different amplifier classes and their applications.
08.13 Analyze and troubleshoot audio power amplifiers.

08.14 Identify and define operating characteristics and applications of power supply regulator circuits.
08.15 Construct power supply regulator circuits.
08.16 Analyze and troubleshoot power supply regulator circuits.
08.17 Identify and define operating characteristics and applications of active filters.
08.18 Construct active filter circuits.
08.19 Analyze and troubleshoot active filter circuits.
08.20 Identify and define operating characteristics and applications of sinusoidal and nonsinusoidal oscillator circuits.
08.21 Construct oscillator circuits.
08.22 Analyze and troubleshoot oscillator circuits.
08.23 Identify and define operating characteristics and applications of cathode ray tubes.
08.24 Identify and define operating characteristics and applications of optoelectronic devices.

09.0 Demonstrate proficiency in design and analysis of systems using linear integrated circuits - The student will be able to:

09.01 Construct, analyze, and troubleshoot an operational amplifier circuit.
09.02 Solve problems in heat sinking and power limitations for AF power amplifiers.
09.03 Select the integrated circuit (IC) appropriate to the defined parameters of a circuit.
09.04 Analyze and troubleshoot operational amplifier circuits with negative or positive feedback.
09.05 Analyze the operational amplifier frequency response and compensation circuits.
09.06 Construct, analyze, and troubleshoot basic linear and non-linear amplifier circuits.
09.07 Construct, analyze, and troubleshoot active filters using operational amplifiers.
09.08 Construct, analyze, and troubleshoot oscillator circuits using operational amplifiers.
09.09 Construct and analyze phased lock loop circuits.
09.10 Construct and analyze integrated circuit voltage regulators.
09.11 Understand and describe fundamental modulation/demodulation concepts.

10.0 Demonstrate proficiency in digital circuits - The student will be able to:

10.01 Define and apply numbering systems to codes and arithmetic operations.
10.02 Analyze and minimize logic circuits using Boolean and Karnaugh Map (K-Map) operations.
10.03 Demonstrate proficiency in the use of logic probes for digital circuits.
10.04 Demonstrate proficiency in the use of power supplies for digital circuits.
10.05 Demonstrate proficiency in the use of pulsers for digital circuits.
10.06 Demonstrate proficiency in the use of oscilloscopes for digital circuits.
10.07 Demonstrate proficiency in the use of logic analyzers for digital circuits.
10.08 Demonstrate proficiency in the use of pulse generators for digital circuits.
10.09 Examine power distribution and possible noise problems.
10.10 Identify types of logic gates and their truth tables.
10.11 Construct combinational logic circuits using integrated circuits.
10.12 Troubleshoot logic circuits.

10.13 Analyze types of flip-flops and their truth tables.
10.14 Construct flip-flops using integrated circuits.
10.15 Troubleshoot flip-flops.
10.16 Identify types of logic circuits using integrated circuits.
10.17 Identify types of registers and counters.
10.18 Construct registers and counters using flip-flops and logic gates.
10.19 Troubleshoot registers and counters.
10.20 Analyze clock and timing circuits.
10.21 Construct clock and timing circuits.
10.22 Troubleshoot clock and timing circuits.
10.23 Identify types of adder/subtractor logic circuits.
10.24 Construct adder/subtractor logic circuits.
10.25 Troubleshoot adder/subtractor logic circuits.
10.26 Identify types of encoding and decoding devices.
10.27 Construct encoders and decoders.
10.28 Troubleshoot encoders and decoders.
10.29 Identify types of multiplexer and demultiplexer circuits using integrated circuits.
10.30 Construct multiplexer and demultiplexer circuits using integrated circuits.
10.31 Troubleshoot multiplexer and demultiplexer circuits.
10.32 Identify types of memory circuits.
10.33 Relate the uses of digital-to-analog and analog-to-digital conversions.
10.34 Construct digital-to-analog and analog-to-digital circuits.
10.35 Troubleshoot digital-to-analog and analog-to-digital circuits.
10.36 Identify types of digital displays.
10.37 Construct digital display circuits.
10.38 Troubleshoot digital display circuits.
10.39 Identify and apply PLD concepts to logic circuits.

11.0 Demonstrate proficiency in microprocessor systems – The student will be able to:

11.01 Recognize terminology used in technical literature and in industry.
11.02 Demonstrate knowledge of the central processing unit's (CPU) operation and processes.
11.03 Demonstrate the use of software to examine the operation of the CPU.
11.04 Analyze BUS concepts.
11.05 Identify and analyze addressing concepts.
11.06 Write, assemble, execute, and debug software instructions and programs.
11.07 Identify the various types of RAM and ROM memories and their interfacing to the microprocessor.
11.08 Interface input and output devices with the microprocessor.
11.09 Setup and operate oscilloscope to test and evaluate a microprocessor system.
11.10 Setup and operate logic analyzer to test and troubleshoot a microprocessor system.

12.0 Demonstrate proficiency in technical recording and reporting - The student will be able to:

12.01 Demonstrate proficiency in the use of microcomputer application programs (i.e. word processor, database, spreadsheet).
12.02 Demonstrate the use of microcomputer circuit capture and simulation programs.
12.03 Demonstrate the use of microcomputer analytical software.

12.04 Record data including the use of curves and graphs.
12.05 Write reports and make oral presentations.
12.06 Maintain test logs.
12.07 Make equipment failure reports.

13.0 Demonstrate proficiency in programming, design and analysis of microprocessor based systems - The student will be able to:

13.01 Analyze the connections for interrupt driven input/output.
13.02 Write a machine-level program and verify correct operation of simple input/output devices.
13.03 Implement the addition of RAM in a microprocessor system.
13.04 Erase and program an EPROM.
13.05 Write a machine-level program to initialize a peripheral interface adaptor.
13.06 Analyze and draw a timing diagram showing all pertinent bus signals in a microprocessor system.
13.07 Use a diagram to analyze the instruction cycle of a microprocessor.
13.08 Program and interface input devices.
13.09 Program and interface output devices.
13.10 Program and interface a serial data link using a microprocessor.
13.11 Write programs using data movement, logical and shifting instructions.
13.12 Write programs using control loops and integer arithmetic operations on arrays of numbers.
13.13 Set up equipment using the Automated Test Equipment (ATE) such as USB.

14.0 Demonstrate employability skills - The student will be able to:

14.01 Conduct a job search.
14.02 Secure information about a job.
14.03 Identify documents that may be required when applying for a job.
14.04 Complete a job application form correctly.
14.05 Write a professional resume and cover letter.
14.06 Demonstrate competence in job interview techniques.
14.07 Demonstrate knowledge of how to make appropriate decisions.
14.08 Demonstrate appropriate work/behavioral habits.
14.09 Demonstrate acceptable employee personal hygiene and health.
14.10 Demonstrate knowledge of the "Florida Right-To-Know Law" as recorded in Florida Statutes Chapter 442.

15.0 Understand, install, configure and troubleshoot issues relating to computer hardware and software – The student will be able to:

15.01 Describe the functions and major components (BIOS, task management, etc.) of a computer operating system.
15.02 Use an operating system for activities such as data and file management.
15.03 Identify various coding schemes (ASCII, etc.).
15.04 Identify the major hardware platforms.
15.05 Set up and use multiple hardware platforms built on various processor architectures.
15.06 Use system software to perform routine maintenance tasks such as backup, hard drive defragmentation, etc.

15.07 Use both stand-alone operating systems and network operating systems.
15.08 Describe and demonstrate the primary features and functions of the major. categories of applications software (word processing, database, spreadsheet, presentation, email, browsers, etc.) (CGS 1000).
15.09 Describe the functions of major components of a computer system (CGS 1000).
15.10 Discuss various computer applications in society (CGS 1000).
15.11 Describe the categories of computers (CGS 1000).
15.12 Recognize the value of computer literacy within an individual's personal and career environments (CGS 1000).
15.13 Set up and configure systems and peripherals.
15.14 Set up and upgrade BIOS.
15.15 Install and configure storage and I/O device interfaces.
15.16 Describe the architecture of a typical microcomputer system.
15.17 Perform component maintenance tasks on microcomputer systems.
15.18 Perform preventive maintenance tasks on microcomputer systems.
15.19 Describe issues that affect system design and construction (redundancy, fault tolerance, etc.).

Optional standards for programs specializing in Laser and Photonics

16.0 Demonstrate proficiency in photonics, optics and lasers – The student will be able to:

16.01 Describe the nature and properties of light.
16.02 Demonstrate the proper handling of optical components and positioning equipment.
16.03 Describe the different light sources used in the photonics industry.
16.04 Demonstrate understanding of laser safety.
16.05 Setup and operate basic optical systems.
16.06 Demonstrate understanding of geometrical and physical optics.
16.07 Demonstrate understanding of the principles of lasers.
16.08 List and describe the operational characteristics of lasers.
16.09 Categorize and explain the operation of lasers.
16.10 Explain the construction, operation, and applications of optical detectors.
16.11 Explain the principles of human vision and related laser safety issues.
16.12 List and explain the characteristics of photonic devises used for imaging, display and storage.
16.13 Explain the principles of fiber optic communications.

17.0 Demonstrate proficiency in electro-optical devices – The student will be able to:

17.01 Demonstrate proficiency in fundamentals of Light.
17.02 Demonstrate proficiency in Reflection, Refraction, and mirrors.
17.03 Demonstrate proficiency in measurement of maximum power and pulse energy.
17.04 Define radiation sources, their types, properties, and applications.
17.05 Demonstrate proficiency in measurement of detector rise time.
17.06 Demonstrate proficiency in Prisms, optical filters, Resonator, and beam splitters.
17.07 Demonstrate proficiency in Characteristics of a helium-neon laser.
17.08 Demonstrate proficiency in the use of Photo detectors, and LEDs.
17.09 Demonstrate proficiency in bandwidth in optical power measurements.
17.10 Demonstrate proficiency in different applications of solid-state lasers.

17.11 Demonstrate proficiency in explaining and describing different types of gases used as active media or lasers.
17.12 Demonstrate proficiency in calculating the power, irradiance and area of a laser beam.
17.13 Demonstrate proficiency in energy-transfer processes that increase the lower lasing level in gas lasers and solid-state lasers.
17.14 Explain the processes that account for all the light energy striking a surface.
17.15 Demonstrate proficiency in safety precautions when operating a laser.
17.16 Demonstrate proficiency in four elements of a laser.

Optional standards for programs specializing in Telecommunications

18.0 Demonstrate proficiency in telecommunications – The student will be able to:

18.01 Demonstrate understanding of the basics of communication systems.
18.02 Demonstrate understanding of AM modulation.
18.03 Understand the AM spectrum.
18.04 Demonstrate understanding of SSB modulation.
18.05 Demonstrate understanding of the SSB spectrum.
18.06 Demonstrate understanding of the AM demodulation process.
18.07 Demonstrate understanding of FM modulation.
18.08 Demonstrate understanding of FM demodulation.
18.09 Demonstrate understanding of tuned LC filters.
18.10 Demonstrate understanding of the mixing up/down process and resulting spectrum.
18.11 Demonstrate understanding of the performance IF and ZIF systems.
18.12 Demonstrate understanding of impedance matching requirements.
18.13 Demonstrate understanding of the basic of receiver noise and the effect on system performance.
18.14 Demonstrate understanding of Antennas, Transmission Lines, and Radio Wave Propagation.
18.15 Demonstrate understanding of Microwave Techniques.
18.16 Demonstrate understanding of Satellite Communications.
18.17 Demonstrate understanding of Data Communications.
18.18 Demonstrate understanding of Fiber-Optic Communications.
18.19 Demonstrate understanding of High Definition Television Systems.
18.20 Demonstrate understanding of the Telephone System and Its Applications.

Optional standards for programs specializing in Robotics and Simulation

19.0 Demonstrate proficiency in robotics and automation – The student will be able to:

19.01 Describe the major parts of a robotic system.
19.02 Explain and use sensors used in robotics applications.
19.03 Describe the operation of DC motors, gearing, and electronic control.
19.04 Describe proportional and derivative feedback control systems.
19.05 Construct robot platforms.
19.06 Explain serial communications and data collection.
19.07 Write control programs for robots.
19.08 Download programs to robots and test them.
19.09 Describe shaft encoding and infrared sensing.
19.10 Explain ultrasonic distance sensing.

19.11 Describe the architecture and provide a system overview for the hardware and software found in a typical automated work cell.
19.12 Analyze and interpret typical PLC ladder logic programs.

20.0 Demonstrate proficiency in modeling and simulation – The student will be able to:

20.01 Define Interactive Simulation/Intelligent Systems/Automated Equipment, Robotics, Artificial Intelligence.
20.02 Demonstrate an understanding of Modeling and Simulation Paradigms and Concepts/Types, Randomness, Time, Application, Domain.
20.03 Demonstrate an understanding of Modeling Methods/Definition, Non-Executable Models, Executable Models, Other Model Types.
20.04 Explain architecture and Conceptual Modeling/What does a Modeling and Simulation System do? Explain Interoperability Techniques, Live, Virtual and Constructive, Phases of Modeling.
20.05 Define Hardware - Outputs/Glasses (Filter glasses, Shutter glasses)/Sound and Audio (Human Auditory System, 3D Sound, Head- based unit)/Haptic Feedback/ Visual Displays/Vestibular and Other Senses.
20.06 Define Modeling, Mathematics and Physics/Geometry Modeling/Kinematics Modeling/Physical Modeling/Model Management.
20.07 Define 3D and Graphics/Computer Graphic/dynamic Objects/Perspective Views/3D Clipping/Stereoscopic Vision/Rendering Image, Algorithms/Mapping (Texture, Bumps) Shadows, Reflection, Refraction.
20.08 Demonstrate an understanding of Applications/Creating an Application (From other Media, from an existing VR System)/Industrial (Manufacturing, Robotics)/Training Simulators/ Education/Arts/Entertainment and Games/Medical/Military.