Electronics and Related Engineering Technology
Mississippi Curriculum Framework

Program CIP: 15.0303 – Electrical, Electronic, and Communications Engineering Technology
Program CIP: 15.0305 – Telecommunications Technology
Program CIP: 47.0101 – Biomedical Equipment Repair Technology
Program CIP: 47.0105 – Industrial Electronics Technology/Technician

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The Office of Curriculum and Instruction (OCI) was founded in 2013 under the Division of Workforce, Career, and Technical Education at the Mississippi Community College Board (MCCB). The office is funded through a partnership with The Mississippi Department of Education (MDE), who serves as Mississippi's fiscal agent for state and federal Career and Technical Education (CTE) Funds. The OCI is tasked with developing statewide CTE curriculum, programming, and professional development designed to meet the local and statewide economic demand.

For information, please contact curriculum@mccb.edu

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ADOPTION OF NATIONAL CERTIFICATIONS

The following national certifications have been adopted for the electronics and Related Engineering Technology curriculum: Associate C.E.T. © Competency Listing Basic Electronics Certification©, CTNS: Certified: Certified Telecommunications Network Specialist©, CTA: Certified Telecommunications Analyst©, and SMC Advanced Manufacturing Certification©.

Associate C.E.T©

The Associate C.E.T was founded in 1978 by electronics technicians, ETA© International is a not-for-profit 501(c) 6 association whose mission is to represent and support the technical professional. ETA aligns with ISO 17024 standards, vocational and education curriculums, and businesses' resource initiatives through certification programs, conferences, speaking engagements, books, and other publications.

The Associate C.E.T. (CETa) is designed for covering the basic electronics theory and applications used in all electronics disciplines. The competencies listed below are considered the foundation of component based general electronics knowledge and skills.

CTNS Certified Telecommunications Network Specialist, CTA Certified Telecommunications Analyst©

The Certified Telecommunications Network Specialist (CTNS) certification offered by the Telecommunications Certification Organization (TCO) is aimed at project team members, managers, analysts, planners and developers who understand telecom networking fundamentals, including services and infrastructure requirements. CTNS usually work for a telecommunications services provider, reseller or telecom equipment manufacturer.

Achieving the CTNS requires attending six courses and then passing the respective exams. Exam topics cover traditional telephony, wireless communications, carrier networks and a host of more general networking topics, such as the OSI reference model and protocols, Ethernet LANs, virtual networking, networking equipment, and addressing.

SMC Advanced Manufacturing Certification©

SMC Corporation of America has a long tradition of offering quality, real-world training to its customers, distributors and anyone else interested in Pneumatics applications. The value-added services we offer include: classroom learning, online learning and online locations, you can access the classroom anywhere you have internet connection. SMC offers student the bases for skills and experience to understand, upgrade and maintain equipment.

INDUSTRY JOB PROJECTION DATA

The Electronics and Related Engineering Technology require an education level of short-term on-the-job training or work experience in a related field. There is expected to be a 10.87% increase in occupational demand at the regional level and 10.77% increase at the state level. Median annual income for this occupation is $27,145.63 at the state level. A summary of occupational data from the State Workforce Investment Board Data Center is displayed below:

Table 1: Education Level

Program Occupations	Education Level
Electrical and electronic Engineering Technicians	Associate Degree

Table 2: Occupational Overview

	Region	State	United States
2014 Occupational Jobs	1234	1234	137920
2024Occupational Jobs	1186	1186	137179
Total Change	-48	-48	-741
Total % Change	-3.89%	-3.89%	-054%
2014 Median Hourly Earnings	$26.50	$26.10	$28.76
2024 Median Annual Earnings	$54,288.00	54,288.00	59,820.80
Annual Openings	-4	-4	-74

Table 3: Occupational Breakdown

Description	2014 Jobs	2024 Jobs	Annual Openings	2014 Hourly Earnings	2024 Annual Earnings 2,080 Work Hours
Electrical and electronic Engineering Technicians	1234	1186	-4	$26.10	%54,288.00
TOTAL	**1234**	**1186**	**-4**	**$26.10**	$54,288.00

Table 4: Occupational Change

Description	Regional Change	Regional % Change	State % Change	National % Change
Electrical and Electronic Engineering Technicians	-48	-3.89%	-3.89%	-0.54%

Table 1: Education Level

Program Occupations	Education Level
Electric Motor, Power Tool, and Related Repairers	Post-Secondary and Career and Technical Award
Installation, Maintenance, and Repair Workers, All Other	Moderate-Term On-The- Job Training

Table 2: Occupational Overview

	Region	State	United States
2014 Occupational Jobs	849	849	152743
2024 Occupational Jobs	868	868	153769

Total Change	19	19	1026
Total % Change	2.24%	2.24%	0.67%
2014 Median Hourly Earnings	$17.86	%18.27	$18.25
2024 Median Annual Earnings	$37,138.40	$38,004.47	$37,960.00
Annual Openings	1	1	1020

Table 3: Occupational Breakdown

Description	2014 Jobs	2024 Jobs	Annual Openings	2014 Hourly Earnings	2024 Annual Earnings 2,080 Work Hours
Electrical and electronic Engineering Technicians	171	171	0	$16.13	$33,550.40
Installation, Maintenance, and Repair Workers, All Other	678	697	1	$19.58	$40,726.40
TOTAL	849	**868**	**1**	**$17.86**	$37,138.40

Table 4: Occupational Change

Description	Regional Change	Regional % Change	State % Change	National % Change
Electric Motor, Power Tool, and Related Repairers	0	.000%	0.00%	0.37%
Installation, Maintenance, and Repair Workers, All Other	19	2.80%	2.80%	0.71%

Table 1: Education Level

Program Occupations	Education Level
Electrical and Electronics Repairs Commercial and Industrial equipment	Post-Secondary and Career and Technical Award
Semiconductor Processors	Associate Degree

Table 2: Occupational Overview

	Region	State	United States
2014 Occupational Jobs	578	578	87393
2024 Occupational Jobs	572	572	86854
Total Change	-6	-6	-539
Total % Change	-1.04%	-1.04%	-0.62%
2014 Median Hourly Earnings	$23.08	$23.08	$24.52
2024 Median Annual Earnings	$48,006.40	$48,006.40	$51,011.05
Annual Openings	0	0	-53

Table 3: Occupational Breakdown

Description	2014 Jobs	2024 Jobs	Annual Openings	2014 Hourly Earnings	2014 Annual Earnings 2,080 Work Hours
Electrical and Electronic Repair, Commercial and Industrial	578	572	0	$23.08	$48,006.40

Equipment					
TOTAL	515	522	0	$23.08	$48,006.40

Table 4: Occupational Change

Description	Regional Change	Regional % Change	State % Change	National % Change
Electrical and Electronic Repair, Commercial and Industrial Equipment	-6	-1.04%	-1.04%	-0.03

ARTICULATION

There is currently no secondary program that articulates in the Electronics and Related Engineering Technology to articulate to this program.

TECHNICAL SKILLS ASSESSMENT

Colleges should report the following for students who complete the program with a career certificate, technical certificate, or an Associate of Applied Science Degrees for technical skills attainment. To use the approved Alternate Assessment for the following programs of study, colleges should provide a Letter of Notification to the Director of Career Technical Education at the MS Community College Board. Please see the following link for further instructions: http://www.mccb.edu/wkfEdu/CTDefault.aspx.

CIP Code	Program of Study	
15.0303	Electrical, Electronic, and Communications Engineering Tech	
Level	**Standard Assessment**	**Alternate Assessment**
Career	MS-CPAS-2	
Level	**Standard Assessment**	**Alternate Assessment**
Technical/AAS	MS-CPAS-2	Associate C.E.T. Competency Listing Basic©

CIP Code	Program of Study	
15.03050	Telecommunications Tech	
Level	**Standard Assessment**	**Alternate Assessment**
Career	MS-CPAS-2	CTNS: Certified Telecommunications Network Specialist©
Level	**Standard Assessment**	**Alternate Assessment**
Technical/AAS	MS-CPAS-2	CTA: Certified Telecommunications Analyst©

CIP Code	Program of Study	
47.0101	Biomedical Equipment Repair Technology	
Level	**Standard Assessment**	**Alternate Assessment**
Career	MS-CPAS-2	
Level	**Standard Assessment**	**Alternate Assessment**
Technical/AAS	MS-CPAS-2	Associate C.E.T. Competency Listing Basic©

CIP Code	Program of Study	
45.0105	Industrial Electronics Technology/ Technician	
Level	**Standard Assessment**	**Alternate Assessment**
Career	MS-CPAS-2	
Level	**Standard Assessment**	**Alternate Assessment**
Technical/AAS	MS-CPAS-2	SMC Advanced Manufacturing Certification LEVEL I Basic©

Online and Blended Learning Opportunities

Course content includes lecture and laboratory semester credit hours. Faculty members are encouraged to present lecture related content to students in an online or blended learning environment. Training related to online and blended learning will be available to faculty members through the MS Community College Board.

Instructional Strategies

Instructional strategies for faculty members implementing the curriculum can be found through the Office of Curriculum and Instruction's professional development.

Assessment Strategies

The Office of Curriculum and Instruction's professional development offer assessment strategies to faculty members implementing the curriculum. Additionally, standards were included in course content when appropriate.

Research Abstract

In the spring of 2017, the Office of Curriculum and Instruction (OCI) met with the different industry members who made up the advisory committees for the Electronics and Related Engineering Technology. An industry questionnaire was used to gather feedback concerning the trends and needs, both current and future, of their field. Program faculty, administrators, and industry members were consulted regarding industry workforce needs and trends.

Industry advisory team members from the college involved with this program were asked to give input related to changes to be made to the curriculum framework. Specific comments related to soft skills needed in this program include having a positive attitude, being at work every day and on time, and having reading and writing skills to complete work orders and other forms. Occupation-specific skills stated include having knowledge of mechanical and electrical skills, theory and understanding of molding, working knowledge of PLC, communication skills, knowledge of terminology, eye- hand coordination, good attitude, reading comprehension, basic computer skills and understand AC and DC circuits.

The writing team identified core courses for the program of study which includes EET 1145 DC/AC combined or EET 1123 AC Circuits, and EET 1114 DC Circuits, EET 1214 Digital Electronics, and EET 1334 Solid State Devices and Circuits.

Curriculum Core Courses

Course Number	Course Name	Semester Hours
EET 1145 OR EET 1123 AND EET 1114*	DC/AC Circuits OR AC Circuits* AND DC Circuits*	5 or 7*
EET 1214	Digital Electronics	4
EET 1334	Solid State Devices and Circuits	4

Communications Systems Installation and Repair Technology CIP 47.0103 was retired as a program of study for Mississippi in 2007. As a result, all CET courses were removed from the current framework.

REVISION HISTORY:

2011, Revised, Research and Curriculum Unit, Mississippi State University
2017, Revised, Office of Curriculum and Instruction, Mississippi Community College Board

PROGRAM DESCRIPTION

Electronics and Related Engineering Technology

Electronics Technology

Electronics Technology is an instructional program that prepares individuals to support electrical engineers and other professionals in the design, development, and testing of electrical circuits, devices, and systems. The program includes instruction in model and prototype development and testing; systems analysis and integration, including design and development of corrective and preventive maintenance techniques; application of engineering data; and the preparation of reports and test results.

The purpose of the Electronics Technology curriculum is to provide instruction necessary for a student to become a competent electronic technician. A graduate of this curriculum will be eligible for entry-level employment into any of the options in electronics and will be capable of correlating the activities of scientific research, engineering, and production for a wide variety of occupational fields. A graduate of the Electronics Technology curriculum will possess the capability of working and communicating directly with engineers, scientists, and other technical personnel in his or her specialized area.

Biomedical Equipment Repair Technology

Biomedical Equipment Repair Technology is an instructional and field service program that provides the students with technical knowledge and skills necessary for gaining employment as a biomedical equipment technician. They are entry-level technicians who can install, set up, troubleshoot, integrate, program, test, operate, and repair biomedical equipment.

The AAS Degree in Electronics Technology (BMET) option will be awarded upon the successful completion of a minimum of 60 semester hours of the courses within the program. Upon completion, the student will have an opportunity to apply for the Biomedical Equipment Technician Certification Examination.
This curriculum corresponds with the international certification content areas from the Examination for Certification as Biomedical Equipment Technician of the Association for the Advancement of Medical Instrumentation.

This curriculum corresponds with the international certification content areas from the Examination for Certification as Biomedical Equipment Technician of the Association for the Advancement of Medical Instrumentation.

Telecommunications Technology

This 2-year program is designed to prepare students for a wide range of technical positions within the telecommunications industry. Specific preparation is in modes, techniques, mediums of voice, and data transmissions and reception. Emphasis is on the telephone instrument, key systems, PBX systems, analog and digital voice communications, data communications, fiber-optic communications, and satellite and microwave communications. Graduates will be qualified to help select, install, operate, maintain, troubleshoot, and repair telecommunications systems. An Associate of Applied Science Degree is awarded upon successful completion of a minimum of 60 semester credit hours of approved course work.

This curriculum was developed using the Electronics Technicians Association, International, standards from the National Coalition for Electronics Education and ETA's Associate C.E.T©. Examination Development Committee.

Industrial Electronics Technology

This 2-year program is designed to prepare students for a wide range of technical positions within the industrial manufacturing industry. The Industrial Electronics program is designed to prepare graduates for a career in the installation, maintenance, testing, and repair of industrial electrical and electronic equipment and systems. This program introduces the fundamentals of electricity, electronics, digital techniques, electrical power distribution, motor controls, fluid systems controls, programmable logic controllers, and instrumentation. Graduates will possess the skills necessary to enter the workforce as technicians in the fields of telephone service, industrial electronic and electrical servicing, plc and process control, industrial automation, and power distribution and as general electronic technicians. An Associate of Applied Science Degree is awarded upon successful completion of a minimum of 60 semester credit hours of approved course work.

SUGGESTED COURSE SEQUENCE

Accelerated Integrated Career Pathway

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
EET 1145 OR EET 1123 AND EET 1114*	DC/AC Circuits OR AC Circuits* AND DC Circuits *	5 or 7*						
EET 1214	Digital Electronics	4						
EET 1334	Solid State Devices and Circuits	4						
	Instructor approved technical electives*	2						
	Total	**15**						

***Colleges choosing to teach AC Circuits and DC Circuits separately as 2 courses for a total of 7 SCH will have less elective hours available in this program of study.**

Career Certificate Required Courses (Electronics Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
EET 1145 OR EET 1123 AND EET 1114*	DC/AC Circuits OR AC Circuits* AND DC Circuits*	5 or 7*						
EET 1214	Digital Electronics	4						
EET 1334	Solid State Devices and Circuits	4						
EET 1363	Microcontrollers	3						
	Instructor approved technical electives*	14 or 12						
	TOTAL	**30**						

***Colleges choosing to teach AC Circuits and DC Circuits separately as 2 courses for a total of 7 SCH will have less elective hours available in this program of study.**

Technical Certificate Required Courses (Electronic Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
EET 2334	Linear Integrated Circuits	4						Associate C.E.T. Competency Listing Basic©
EET 2414	Electronic Communications	4						
	Technical electives per instructor approval	7						
	TOTAL	**15**						

Career Certificate Required Courses (Biomedical Equipment Repair Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
EET 1145 OR EET 1123 AND EET 1114*	DC/AC Circuits OR AC Circuits* AND DC Circuits*	5 or 7*						
EET 1214	Digital Electronics	4						
EET 1311	Orientation for Biomedical Equipment Repair	1						
EET 1334	Solid State Devices and Circuits	4						
BIO 2513	Anatomy and Physiology I	3						
BIO 2511	Anatomy and Physiology I Lab	1						
	Instructor approved technical electives*	12 or 10						
	TOTAL	**30**						

***Colleges choosing to teach AC Circuits and DC Circuits separately as 2 courses for a total of 7 SCH will have less elective hours available in this program of study.**

Technical Certificate Required Courses (Biomedical Equipment Repair Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
BIO 2523	Anatomy and Physiology II	3						Associate C.E.T. Competency Listing Basic©
BIO 2521	Anatomy and Physiology Lab II	1						
EET 2334	Linear Integrated Circuits	4						
EET 2423	Fundamentals of Fiber Optics	3						
	Technical electives per instructor approval	4						
	TOTAL	**15**						

Career Certificate Required Courses (Telecommunications Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
EET1145 OR EET 1123 AND EET 1114*	DC/AC Circuits OR AC Circuits* AND DC Circuits*	5 or 7*						
EET 1214	Digital Electronics	4						
EET 1334	Solid State Devices and Circuits	4						
TCT 1114	Fundamentals of Telecommunications	4						
TCT 2244	Fundamentals of Telephony	4						
TCT 2354	Fundamentals of Wireless Technology	4						
	Instructor approved technical electives*	5						
	TOTAL	**30**						

***Colleges choosing to teach AC Circuits and DC Circuits separately as 2 courses for a total of 7 SCH will have less elective hours available in this program of study.**

Technical Certificate Required Courses (Telecommunications Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
EET 2423	Fundamentals of Fiber Optics	3						CTA: Certified Telecommunications Analyst©
TCT 2364	Wireless Telecommunications	4						
TCT 2414	Microwave and Satellite Systems	4						
	Technical electives per instructor approval	4						
	TOTAL	**15**						

Career Certificate Required Courses (Industrial Electronics Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
EET 1133	Electrical Power	3						
EET 1145	DC/AC Circuits	5						
EET 1214	Digital Electronics	4						
EET 1334	Solid State Devices and Circuits	4						
EET 1343	Motor Control Systems	3						
	Instructor approved technical electives	11						
	TOTAL	**30**						

Technical Certificate Required Courses (Industrial Electronics Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
EET 2354	Solid State Motor Control	4						SMC Advanced Manu-facturing Certification Level I BASIC©
EET 2363	Programmable Logic Controllers	3						
	Technical electives per instructor approval	8						
	TOTAL	**15**						

General Education Core Courses – Electronics and Related Engineering Technology

To receive the Associate of Applied Science Degree, a student must complete all of the required coursework found in the Career Certificate option, Technical Certificate option and a minimum of 15 semester hours of General Education Core. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester or provided primarily within the last semester. Each community college will specify the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college. The Southern Association of Colleges and Schools (SACS) Commission on Colleges Standard 2.7.3 from the Principles of Accreditation: Foundations for Quality Enhancement1 describes the general education core.

Section 2.7.3 In each undergraduate degree program, the institution requires the successful completion of a general education component at the collegiate level that (1) is substantial component of each undergraduate degree, (2) ensures breadth of knowledge, and (3) is based on a coherent rationale. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours or the equivalent. These credit hours are to be drawn from and include at least one course from the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

General Education Courses

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
	Humanities/Fine Arts	3						
	Social/Behavioral Sciences	3						
	Math/Science	3						
	Academic electives	6						
	TOTAL	**15**						

1 Southern Association of Colleges and Schools Commission on Colleges. (2012). *The principles of accreditation: Foundations for quality enhancement*. Retrieved from http://www.sacscoc.org/pdf/2012PrinciplesOfAcreditation.pdf

Listing

			SCH Breakdown				Contact Hour Breakdown		
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Externship	Total Contact Hours	Lecture	Lab	Externship
EET 1114	DC Circuits	4							
EET 1123	AC Circuits	3							
EET 1145	DC/AC Circuits	5							
EET 1133	Electrical Power	3							
EET 1143	Commercial & Industrial Wiring	3							
EET 1153	IT Foundations	3							
EET 1154	Equipment Maintenance Troubleshooting and Repair	4							
EET 1163	Motor maintenance and Troubleshooting	3							
EET 1174	Fluid Power	4							
EET 1192	Fundamentals of Electricity	2							
EET 1214	Digital Electronics	4							
EET 1233	Computer Servicing Lab	3							
EET 1243	Operating Platforms	3							
EET 1253	Systems Maintenance	3							
EET 1311	Orientation to Biomedical Equipment Repair	1							
EET 1334	Solid State Devices and Circuits	4							
EET 1343	Motor Control Systems	3							
EET 1353	Fundamentals of Robotics	3							
EET 1413	Math for Electronics	3							
EET 1443	Fundamentals of Instrumentation	3							
EET 1613	Computer Fundamentals Electronics/Electricity	3							
EET 1713	Draft for Electronic/ Electrical Technology	3							

EET 211 (3-6)	Supervised Work Experience in Biomedical Equipment Repair Technology	(3-6)							
EET 222 (3-6)	Supervised Work Experience in Biomedical Equipment Repair Technology II	(3-6)							
EET 2233	Computer Servicing Lab II	3							
EET 2334	Linear Integrated Circuits	4							
EET 2354	Solid State Motor Control	4							
EET 2363	Programmable Logic Controllers	3							
EET 2373	Programmable Logic Controllers Multi-Platform	3							
EET 2383	Advanced Programmable Logic Controllers	3							
EET 2414	Electronic Communications	4							
EET 2423	Fundamentals of Fiber Optics	3							
EET 2433	Physics for Electronics	3							
EET 2514	Interfacing Techniques	4							
EET 2823	Digital Television Systems	3							
EET 291(1-3)	Special Projects	(1-3)							
EET 291 (1-6)	Supervised Work Experience in Electronics technology	(1-6)							
EET 292 (1-6)	Supervised Work Experience in Electronic Technology	(1-6)							
TCT 1114	Fundamentals of Telecommunication	4							
TCT 2244	Fundamentals of Telephony	4							
TCT 2354	Fundamentals of Wireless Technology	4							
TCT 2364	Wireless Telecommunication	4							

TCT 2414	Microwave and Satellite Systems	4							
TCT 2424	Network Systems	4							
TCT 291 (1-4)	Special Project	(1-4)							
TCT 292 (1-6)	Supervised Work Experience	(1-6)							

ELECTRONICS AND RELATED ENGINEERING TECHNOLOGY COURSES

Course Number and Name: **EET 1114** **DC Circuits**

Description: Principles and theories associated with DC circuits. This course includes the study of electrical circuits, laws and formulae, and the use of test equipment to analyze DC circuits.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Demonstrate and apply an understanding of a basic electrical circuit.
    a. Write numbers in scientific and engineering notation.
    b. Perform mathematical manipulations with numbers expressed in engineering notation.
    c. Explain the basic structure of matter to include the atom and element.
    d. Explain the laws of electrical charge.
    e. Differentiate among the characteristics of conductors, semiconductors, and insulators.
    f. Demonstrate the ability to determine resistor types, value, tolerance, and power rating.
    g. Differentiate between DC circuit schematic symbols.
    h. Demonstrate proper techniques for measuring resistance.
    i. Discuss methods of generating electricity.
    j. Explain theories of current flow including electron and conventional method.
    k. Demonstrate an understanding of principles of and operation of batteries.
    l. Explain and demonstrate the measurement of resistance of conductors and insulators and the computation of conductance.

3. Demonstrate an understanding of voltage, current, resistance, and power and how they relate.
    a. Explain the physical properties of voltage, current, and resistance.
    b. State three equations used to express Ohm's law
    c. Analyze circuit parameters using Ohm's law.
    d. Explain how power is developed in a circuit.
    e. State three forms of power equations.
    f. Demonstrate techniques for determining power.
    g. Describe and demonstrate the proper technique for measuring voltage using a voltmeter.
    h. Describe and demonstrate the proper technique for measuring current using an ammeter.
    i. Describe and demonstrate the proper technique for measuring resistance using an ohmmeter.
    4. Analyze and evaluate the parameters of a series circuit.
    a. Identify series circuits.
    b. Compute total resistance of a series circuit.
    c. Using Ohm's law, compute the current in a series circuit.

d. Explain why current is the same at all points in a series circuit.
e. State and apply Kirchhoff's voltage law in analysis of series circuits.
f. Explain why a series circuit is known as a voltage divider.
g. Using Ohm's law, compute the voltage drops in a series circuit.
h. Compute the power developed by each resistor and the total power of a series circuit.

i. Explain the difference between series-aiding and series-opposing voltage sources.
j. Construct, analyze, and troubleshoot a series circuit.

5. Analyze and evaluate the parameters of a parallel circuit.
a. Identify parallel circuits.
b. Compute total resistance of a parallel circuit.
c. Utilize Ohm's law to solve circuit parameters of a parallel DC circuit.
d. Explain why voltage is the same across all branches of a parallel circuit.
e. State and apply Kirchhoff's current law in the analysis of parallel circuit.
f. Explain why a parallel circuit is a current divider.
g. Compute branch currents in a parallel resistive circuit using the current divider equation.
h. Construct, analyze, and troubleshoot a parallel circuit.

6. Analyze and evaluate the parameters of a series–parallel circuit.
a. Differentiate between series and parallel in a series–parallel resistive circuit.
b. Compute total resistance of a series–parallel circuit.
c. Analyze series–parallel circuits for the current through and the voltage across each component.
d. Construct, analyze, and troubleshoot a series–parallel circuit.
e. Analyze loaded and unloaded voltage dividers.
f. Explain the operation and application of a Wheatstone bridge.
g. Construct a resistive bridge circuit, and measure an unknown resistance.
h. Measure the error voltage of an unbalanced bridge.

7. Apply network theorems to the analysis of complex circuits.
a. Perform voltage source to current source conversions and current source to voltage source conversions.
b. In circuits containing multiple resistors and sources, use the superposition theorem to solve for unknown voltages and currents.
c. Through analysis, construction, and testing of an actual circuit, prove the validity of the superposition theorem.
d. Reduce series–parallel resistive circuits to their Thevenin's equivalent.
e. Measure the Thevenin's voltage and resistance of a DC circuit.
f. Reduce series–parallel resistive circuits to their Norton equivalent.
g. Measure the Norton current and Norton resistance of a series circuit.
h. Perform conversions between Thevenin's and Norton equivalent circuit.
i. Explain the conditions under which maximum power occurs.
j. Construct a circuit, and prove the maximum power transfer theorem.

8. Explain capacitance, and demonstrate its application in DC and transient circuits.
a. Explain capacitance and terms related to capacitance.
b. Explain the construction of a capacitor and its relationship to capacitance value.
c. Draw the symbols for capacitance, and identify the unit of measurement for capacitance.
d. Explain how the capacitor is charged and discharged.
e. Identify various types of capacitors.

f. Explain specifications of connections including values and voltage ratings.
g. Calculate the total capacitance of capacitors in series and in parallel.
h. Define and compute RC time constant.
i. Measure capacitance in series and in parallel.
j. Construct a circuit, and using an oscilloscope, display and measure the charge and discharge waveforms in a series RC circuit.
k. Explain and demonstrate techniques for troubleshooting capacitors.

9. Explain inductance, and demonstrate its application in DC and transient circuits.
a. Explain the laws of repulsion and attraction between two magnetic poles.
b. Explain how an electromagnet is developed.
c. Explain several applications of magnetism.
d. Define inductance and the terms relating to inductance.
e. Sketch the symbols for inductors, and identify the unit of measurements for inductance.
f. List the factors that determine the value of an inductor, and state whether the factors have a direct or inverse effect on the value.
g. Calculate total inductance in series and parallel.
h. Explain the Henry in terms of induced voltage and the rate of charge of current with respect to time.
i. Calculate the time constant for an RL circuit.
j. Fabricate and demonstrate the operation of an RL circuit.
k. Explain and demonstrate techniques for troubleshooting DC circuits.

ASSOCIATE C.E.T. (CETa) - COMPETENCY LISTING BASIC ELECTRONICS CERTIFICATION

1.0 Electrical Theory

1.1 Describe atomic structure, the components of the atom, their charges and importance to electronics technology

1.3 Explain basic uses for electricity

1.5 Explain the differences between current, voltage and resistance

1.6 List different types of resistive materials and how resistors are used in electronics

1.11 List Ohms law formulas for current, voltage, resistance and power.

1.12.1 Solve math problems utilizing each formula

1.13 Calculate power consumption and requirements

1.11 List voltage sources, AC and DC, batteries and natural generation

2.0 Electrical Components

2.1 Identify resistor values from color code or other marks and list composition and reasons for different usages

5.0 Cablins

5.1 List wire types and construction

5.2 List wire gauges used for various purposes

5.7 Explain the effects of proper and improper termination

5.8 Explain the purposes of grounding and common conventions used in electrical /electronics work

7.0 test Equipment and Measurements

7.1 Describe how volt-ohm-current meters operate

7.2 Explain meter construction and components

7.3 Identify meter protection, safety and usage

7.4 Explain care of equipment and test leads

7.9 List the uses and precautions for logic test probes

8.0 Safety Precautions

8.1 Describe the physiological reactions electrical shock causes; list various degrees of current the human body can tolerate

9.0 Mathematics and Formulas

9.1 Quote Ohms law power, voltage, current and resistance formulas and solve for circuit values

9.2 List other common basic electronic formulas

11.0 Electronics Circuit: Series and Parallel

11.1 Identify and describe the operation of common DC circuits

11.9 Explain Kirchhoff's law and its importance to electronics technicians

13.0 Interfacing of Electronics Products

13.5 Explain grounding, proper and improper methods, and the results of power source mismatch

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Course Number and Name: **EET 1123 AC Circuits**

Description: Principles and theories associated with AC circuits. This course includes the study of electrical circuits, laws and formulae, and the use of test equipment to analyze AC circuits. Principles and theories associated with DC circuits. This course includes the study of electrical circuits, laws and formulae, and the use of test equipment to analyze DC circuits.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Analyze a sine wave, and explain its characteristics and application to AC circuits.
    a. Explain and calculate the following AC values: Period, frequency, time, angle, instantaneous values of voltage and current, peak, peak-to-peak voltage and current, RMS voltage and current, average voltage and current, and power.
    b. Analyze AC resistive circuits and solve for voltage drops, branch currents, and power dissipations.
    c. Explain and use phasors/vectors to represent the relative phase and amplitude of AC voltages and currents.
    d. Explain and use voltage and power decibels.
    e. Use the oscilloscope to measure AC voltage and frequency.
    f. Use a frequency counter to measure frequency.
    g. Use multimeters to measure AC voltage and current.
    h. Define the square and sawtooth waves in terms of harmonic content.
    i. Determine the duty cycle of a square wave.
    j. Determine period and frequency for sine waves, square waves, sawtooth waves, and triangle waves.

2. Analyze inductive and capacitive reactance in series and parallel circuits.
    a. Calculate inductive reactance (XL) using Ohm's law or the inductive reactance formula when signal frequency and inductance are known.
    b. Solve for signal frequency when inductance and inductive reactance are known, or inductance when frequency and inductive reactance are known.
    c. Calculate capacitive reactance (XC) using Ohm's law or the capacitive reactance formula when signal frequency and capacitance are known.
    d. Solve for signal frequency when capacitance and capacitive reactance are known, or capacitance when frequency and capacitive reactance are known.)
    e. Calculate all voltages and currents in series and parallel capacitive and inductive circuits.

3. Analyze transformer voltage, current, impedance transformations, and applications.
    a. Explain how mutual inductance affects transformer action.
    b. Calculate primary and secondary transformer voltage and current as related to the transformer's turns ratio.

4. Explain RLC non-resonant and resonant circuits.
    a. Use basic trigonometric functions and the Pythagorean theorem for right triangles in the analysis of AC circuits.

b. Calculate impedance, current, voltages, and power for series RL, RC, and RCL circuits.
c. Represent series AC circuits with voltage, impedance, and power phasors in phasor diagrams.
d. Use an RL and RC circuit as a lead or lag circuit.
e. Express phase relationships in terms of time.
f. Explain and calculate AC circuit efficiency.
g. Construct RC, RL, and RCL series circuits and use a dual-trace oscilloscope for sinewave-voltage phase comparison.
h. Calculate branch currents and total current for parallel RL, RC, and RCL circuits.
i. Calculate the phase angle for each branch current and total current of a parallel AC circuit.
j. Calculate real power, reactive power, apparent power, and the power factor for parallel AC circuits.
k. Calculate the power efficiency of a parallel AC circuit.
l. Correct the power factor of a parallel AC circuit by changing the size of L or C.
m. Construct and analyze RC, RL, and RCL parallel AC circuits.
n. Name applications for series and parallel resonant circuits.
o. List all of the significant parameters and characteristics of series and parallel resonant circuits.
p. Explain the characteristic graphs for series and parallel resonant circuits.
q. Calculate the resonant frequency for series and parallel resonant circuits.
r. Calculate circuit Q and bandwidth when the resonant frequency and total circuit resistance are known.
s. Calculate bandpass when the resonant frequency and bandwidth are known.
t. Calculate the proper size capacitor to resonate with a given inductor at a specified resonant frequency.
u. Calculate the proper amount of total resistance needed to provide a specified bandwidth for a given series resonant circuit.
v. Accurately test series and parallel resonant circuits using a variable-frequency generator and an oscilloscope.
w. Explain similarities and differences between series and parallel resonance.

5. Explain and classify filters.
   a. Identify filters by type and configuration.
   b. Discuss and analyze filter types in terms of frequency response, phase response, insertion loss, and roll off shape.
   c. Discuss practical applications of each of the basic filter types.
   d. Predict and plot frequency response for common filter types using the insertion loss formula.
   e. Analyze RL, RC, and RCL high-pass filters.
   f. Analyze RL, RC, and RCL low-pass filters.
   g. Analyze series and parallel resonant band-pass filters.
   h. Analyze series and parallel resonant band stop filters.

ASSOCIATE C.E.T. (CETa) - COMPETENCY LISTING BASIC ELECTRONICS CERTIFICATION

1.0 Electrical Theory

1.7 Show different purposes for capacitors and list common types and construction.
1.8 Explain how inductance relates to magnetism and describe coil construction, cores and usages

1.9 Show a comparison between reactance and resistance and describe current/voltage relationships

1.10 Compare impedance with reactance and resistance and explain the causes and effects of impedance

2.0 Electrical Components

2.2 Identify capacitor types: list common usages; methods of varying capacitance and explain the terms charge and coulomb

2.3 Identify inductor types and reason for various core materials; how diameter and wire size affects the values

2.4 Identify common types of transformers and list uses for each; explain step up/down voltage methods; explain why laminations are used

7.0 Test Equipment and Measurements

7.11 Describe oscilloscope uses; explain the purposes of each front panel control

7.12 List the uses for pattern generators

11.0 Electronic Circuits: Series and Parallel

11.2 Identify and describe the operation of common AC Circuits

11.3 Explain how series circuits, R,L,C are used in electronics equipment

11.6 Classify circuits as inductive, capacitive and resistive

11.7 Explain resonance and show how to calculate resonant frequency

11.8 Describe polar and rectangular presentations of L, R, C circuits

11.9 Explain Kirchhoff's law and its importance to electronics technicians

Course Number and Name: **EET 1133 Electrical Power**

Description: This course covers electrical motors and their installation and offers instruction and practice in using the different types of motors, transformers, and alternators.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Discuss safety and environmental protection concerns associated with electrical power equipment.
    a. List safety precautions associated with motors and transformers.
    b. Explain the procedures for working with and disposing of hazardous materials.

2. Wire single-phase electrical components.
    a. Sketch and connect a single-phase transformer for high- and low-voltage applications.

    b. Identify, sketch, and wire different types of single-phase motors.
    c. Explain and demonstrate the applications of an AC generator.

3. Wire three-phase electrical components.
    a. Sketch and connect a three-phase AC transformer to include delta and wye, threewire, and four-wire systems.
    b. Identify, draw, and wire different types of three-phase motors to include low- and high-voltage requirements.

SMC ADVANCED MANUFACTURING CERTIFICATION LEVEL I BASIC©

Mechatronics Level I –Basic

Basic Electrical

Course Number and Name: **EET 1143 Commercial and Industrial Wiring**

Description: Instruction and practice in the installation of commercial and industrial electrical services including the types of conduit and other raceways, NEC code requirements, and three phase distribution networks.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Apply general safety rules and current NEC and local codes.
    a. Explain and demonstrate safety rules and regulations for working near or on load centers and safety switches.
    b. Explain and demonstrate the ability of safe lifting and work habits.
    c. Identify the code requirements for industrial and commercial locations.

2. Install and maintain raceways, conduit, and fittings.,
    a. Identify types of raceways, conduit, and fittings.
    b. Apply usage of raceways, conduit, and fittings as required by electrical codes.
    c. Demonstrate the use of mechanical and hydraulic conduit benders to make specified bends to different sizes and types of conduit.
    d. Identify other types of raceways and their associated bodies.

3. Explain different types of three-phase service entrances, metering devices, main panels, raceways or ducts, subpanels, feeder circuits, and branch circuits according to electrical codes.
    a. Explain the codes (NEC and local codes) for the installation of a three-phase service entrance.
    b. Explain safety precautions to be used when installing a three-phase service entrance.

    c. Construct a sketch to install a three-phase service entrance.
    d. Explain terms associated with a three-phase service entrance from codes and industry terminology.
    e. Identify components of a three-phase service entrance.

4. Prepare a job estimate including supplies and labor costs.
    a. Compute the local labor cost for a given job.
    b. Determine the amount of supplies for a given job.
    c. Compute the cost of supplies for a given job.
    d. Justify in writing the total cost for a given job.

Course Number and Name: **EET 1145 DC/AC Circuits**

Description: Principles and theories associated with DC and AC circuits. This course includes the study of electrical circuits, laws and formulae, and the use of test equipment to analyze DC and AC circuits.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
5	4	2	90
5	3	4	105
5	2	6	120

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.

   a. Apply relevant and appropriate safety techniques.
   b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Demonstrate and apply an understanding of a basic electrical circuit.

   a. Write numbers in scientific and engineering notation.
   b. Perform mathematical manipulations with numbers expressed in engineering notation.
   c. Explain the basic structure of matter to include the atom and element.
   d. Explain the laws of electrical charge.
   e. Differentiate among the characteristics of conductors, semiconductors, and insulators.
   f. Demonstrate the ability to determine resistor types, value, tolerance, and power rating.
   g. Differentiate between DC circuit schematic symbols.
   h. Demonstrate proper techniques for measuring resistance.
   i. Discuss methods of generating electricity.
   j. Explain theories of current flow including electron and conventional method.
   k. Demonstrate an understanding of principles of and operation of batteries.
   l. Explain and demonstrate the measurement of resistance of conductors and insulators and the computation of conductance.

3. Demonstrate an understanding of voltage, current, resistance, and power and how they relate.

   a. Explain the physical properties of voltage, current, and resistance.
   b. State three equations used to express Ohm's law
   c. Analyze circuit parameters using Ohm's law.
   d. Explain how power is developed in a circuit.
   e. State three forms of power equations.
   f. Demonstrate techniques for determining power.
   g. Describe and demonstrate the proper technique for measuring voltage using a voltmeter.
   h. Describe and demonstrate the proper technique for measuring current using an ammeter.
   i. Describe and demonstrate the proper technique for measuring resistance using an ohmmeter.

4. Analyze and evaluate the parameters of a series circuit.

   a. Identify series circuits.
   b. Compute total resistance of a series circuit.
   c. Using Ohm's law, compute the current in a series circuit.
   d. Explain why current is the same at all points in a series circuit.
   e. State and apply Kirchhoff's voltage law in analysis of series circuits.
   f. Explain why a series circuit is known as a voltage divider.
   g. Using Ohm's law, compute the voltage drops in a series circuit.
   h. Compute the power developed by each resistor and the total power of a series circuit.

   i. Explain the difference between series-aiding and series-opposing voltage sources.
   j. Construct, analyze, and troubleshoot a series circuit.

5. Analyze and evaluate the parameters of a parallel circuit.

   a. Identify parallel circuits.
   b. Compute total resistance of a parallel circuit.
   c. Utilize Ohm's law to solve circuit parameters of a parallel DC circuit.
   d. Explain why voltage is the same across all branches of a parallel circuit.
   e. State and apply Kirchhoff's current law in the analysis of parallel circuit.
   f. Explain why a parallel circuit is a current divider.
   g. Compute branch currents in a parallel resistive circuit using the current divider equation.
   h. Construct, analyze, and troubleshoot a parallel circuit.

6. Analyze and evaluate the parameters of a series–parallel circuit.

   a. Differentiate between series and parallel in a series–parallel resistive circuit.
   b. Compute total resistance of a series–parallel circuit.
   c. Analyze series–parallel circuits for the current through and the voltage across each component.
   d. Construct, analyze, and troubleshoot a series–parallel circuit.
   e. Analyze loaded and unloaded voltage dividers.
   f. Explain the operation and application of a Wheatstone bridge.
   g. Construct a resistive bridge circuit, and measure an unknown resistance.
   h. Measure the error voltage of an unbalanced bridge.

7. Apply network theorems to the analysis of complex circuits.

   a. Perform voltage source to current source conversions and current source to voltage source conversions.
   b. In circuits containing multiple resistors and sources, use the superposition theorem to solve for unknown voltages and currents.
   c. Through analysis, construction, and testing of an actual circuit, prove the validity of the superposition theorem.
   d. Reduce series–parallel resistive circuits to their Thevenin's equivalent.
   e. Measure the Thevenin's voltage and resistance of a DC circuit.
   f. Reduce series–parallel resistive circuits to their Norton equivalent.
   g. Measure the Norton current and Norton resistance of a series circuit.
   h. Perform conversions between Thevenin's and Norton equivalent circuit.

i. Explain the conditions under which maximum power occurs.
j. Construct a circuit, and prove the maximum power transfer theorem.

8. Explain capacitance, and demonstrate its application in DC and transient circuits.

a. Explain capacitance and terms related to capacitance.
b. Explain the construction of a capacitor and its relationship to capacitance value.
c. Draw the symbols for capacitance, and identify the unit of measurement for capacitance.
d. Explain how the capacitor is charged and discharged.
e. Identify various types of capacitors.
f. Explain specifications of connections including values and voltage ratings.
g. Calculate the total capacitance of capacitors in series and in parallel.
h. Define and compute RC time constant.
i. Measure capacitance in series and in parallel.
j. Construct a circuit, and using an oscilloscope, display and measure the charge and discharge waveforms in a series RC circuit.
k. Explain and demonstrate techniques for troubleshooting capacitors.

9. Explain inductance, and demonstrate its application in DC and transient circuits.

a. Explain the laws of repulsion and attraction between two magnetic poles.
b. Explain how an electromagnet is developed.
c. Explain several applications of magnetism.
d. Define inductance and the terms relating to inductance.
e. Sketch the symbols for inductors, and identify the unit of measurements for inductance.
f. List the factors that determine the value of an inductor, and state whether the factors have a direct or inverse effect on the value.
g. Calculate total inductance in series and parallel.
h. Explain the Henry in terms of induced voltage and the rate of charge of current with respect to time.
i. Calculate the time constant for an RL circuit.
j. Fabricate and demonstrate the operation of an RL circuit.
k. Explain and demonstrate techniques for troubleshooting DC circuits.

10. Analyze a sine wave, and explain its characteristics and application to AC circuits.
a. Explain and calculate the following AC values: Period, frequency, time, angle, instantaneous values of voltage and current, peak, peak-to-peak voltage and current, RMS voltage and current, average voltage and current, and power.
b. Analyze AC resistive circuits and solve for voltage drops, branch currents, and power dissipations.
c. Explain and use phasors/vectors to represent the relative phase and amplitude of AC voltages and currents.
d. Explain and use voltage and power decibels.
e. Use the oscilloscope to measure AC voltage and frequency.
f. Use a frequency counter to measure frequency.
g. Use multimeters to measure AC voltage and current.
h. Define the square and saw tooth waves in terms of harmonic content.
i. Determine the duty cycle of a square wave.
j. Determine period and frequency for sine waves, square waves, saw tooth waves, and triangle waves.

11. Analyze inductive and capacitive reactance in series and parallel circuits.
    a. Calculate inductive reactance (XL) using Ohm's law or the inductive reactance formula when signal frequency and inductance are known.
    b. Solve for signal frequency when inductance and inductive reactance are known, or inductance when frequency and inductive reactance are known.
    c. Calculate capacitive reactance (XC) using Ohm's law or the capacitive reactance formula when signal frequency and capacitance are known.
    d. Solve for signal frequency when capacitance and capacitive reactance are known, or capacitance when frequency and capacitive reactance are known.)
    e. Calculate all voltages and currents in series and parallel capacitive and inductive circuits.

12. Analyze transformer voltage, current, impedance transformations, and applications.
    a. Explain how mutual inductance affects transformer action.
    b. Calculate primary and secondary transformer voltage and current as related to the transformer's turns ratio.

13. Explain RLC non-resonant and resonant circuits.
    a. Use basic trigonometric functions and the Pythagorean theorem for right triangles in the analysis of AC circuits.
    b. Calculate impedance, current, voltages, and power for series RL, RC, and RCL circuits.
    c. Represent series AC circuits with voltage, impedance, and power phasors in phasor diagrams.
    d. Use an RL and RC circuit as a lead or lag circuit.
    e. Express phase relationships in terms of time.
    f. Explain and calculate AC circuit efficiency.
    g. Construct RC, RL, and RCL series circuits and use a dual-trace oscilloscope for sinewave-voltage phase comparison.
    h. Calculate branch currents and total current for parallel RL, RC, and RCL circuits.
    i. Calculate the phase angle for each branch current and total current of a parallel AC circuit.
    j. Calculate real power, reactive power, apparent power, and the power factor for parallel AC circuits.
    k. Calculate the power efficiency of a parallel AC circuit.
    l. Correct the power factor of a parallel AC circuit by changing the size of L or C.
    m. Construct and analyze RC, RL, and RCL parallel AC circuits.
    n. Name applications for series and parallel resonant circuits.
    o. List all of the significant parameters and characteristics of series and parallel resonant circuits.
    p. Explain the characteristic graphs for series and parallel resonant circuits.
    q. Calculate the resonant frequency for series and parallel resonant circuits.
    r. Calculate circuit Q and bandwidth when the resonant frequency and total circuit resistance are known.
    s. Calculate bandpass when the resonant frequency and bandwidth are known.
    t. Calculate the proper size capacitor to resonate with a given inductor at a specified resonant frequency.
    u. Calculate the proper amount of total resistance needed to provide a specified bandwidth for a given series resonant circuit.
    v. Accurately test series and parallel resonant circuits using a variable-frequency generator and an oscilloscope.
    w. Explain similarities and differences between series and parallel resonance.

14. Explain and classify filters.
    a. Identify filters by type and configuration.
    b. Discuss and analyze filter types in terms of frequency response, phase response, insertion loss, and roll off shape.
    c. Discuss practical applications of each of the basic filter types.
    d. Predict and plot frequency response for common filter types using the insertion loss formula.
    e. Analyze RL, RC, and RCL high-pass filters.
    f. Analyze RL, RC, and RCL low-pass filters.
    g. Analyze series and parallel resonant band-pass filters.
    h. Analyze series and parallel resonant band stop filters.

ASSOCIATE C.E.T. (CETa) - COMPETENCY LISTING BASIC ELECTRONICS CERTIFICATION

1.0 Electrical Theory

1.1 Describe atomic structure, the components of the atom, their charges and importance to electronics technology

1.3 Explain basic uses for electricity

1.5 Explain the differences between current, voltage and resistance

1.6 List different types of resistive materials and how resistors are used in electronics

1.7 Show different purposes for capacitors and list common types and construction.

1.8 Explain how inductance relates to magnetism and describe coil construction, cores and usages

1.9 Show a comparison between reactance and resistance and describe current/voltage relationships

1.10 Compare impedance with reactance and resistance and explain the causes and effects of impedance

1.11 List voltage sources, AC and DC, batteries and natural generation

1.12 List Ohms law formulas for current, voltage, resistance and power.

1.12.1 Solve math problems utilizing each formula

1.13 Calculate power consumption and requirements

2.0 Electrical Components

2.1 Identify resistor values from color code or other marks and list composition and reasons for different usages

2.2 Identify capacitor types: list common usages; methods of varying capacitance and explain the terms charge and coulomb

2.3 Identify inductor types and reason for various core materials; how diameter and wire size affects the values

2.4 Identify common types of transformers and list uses for each; explain step up/down voltage methods; explain why laminations are used.

5.0 Cablins

5.1 List wire types and construction

5.2 List wire gauges used for various purposes

5.7 Explain the effects of proper and improper termination

5.8 Explain the purposes of grounding and common conventions used in electrical /electronic work

7.0 Test Equipment and Measurements

7.1 Describe how volt-ohm-current meters operate

7.2 Explain meter construction and components

7.3 Identify meter protection, safety and usage

7.4 Explain care of equipment and test leads

7.9 List the uses and precautions for logic test probes

7.11 Describe oscilloscope uses; explain the purposes of each front panel control

7.12 List the uses for pattern generators

8.0 Safety Precautions

8.1 Describe the physiological reactions electrical shock causes; list various degrees of current the human body can tolerate

9.0 Mathematics and Formulas

9.1 Quote Ohms law power, voltage, current and resistance formulas and solve for circuit values

9.2 List other common basic electronic formulas

11.0 Electronic Circuits: Series and Parallel

11.1 Identify and describe the operation of common DC circuits

11.2 Identify and describe the operation of common AC Circuits

11.3 Explain how series circuits, R,L,C are used in electronics equipment

11.6 Classify circuits as inductive, capacitive and resistive

11.7 Explain resonance and show how to calculate resonant frequency

11.8 Describe polar and rectangular presentations of L, R, C circuits

11.9 Explain Kirchhoff's law and its importance to electronics technicians

13.0 Interfacing of Electronics Products

• Understand and follow all safety procedures common to industrial manufacturing and related fields to include:

- Appropriate Personal Protective Equipment (PPE)

- Verification of circuit de-energization

- Lockout/Tagout procedures and

- NFPA 70 and NFPA 70e

13.5 Explain grounding, proper and improper methods, and the results of power source mismatch

SMC ADVANCED MANUFACTURING CERTIFICATION LEVEL I BASIC©
Mechatronics Level I –Basic
Basic Electrical

- Understand and follow all safety procedures common to industrial manufacturing and related fiesd to include:
    - Appropriate Personal Protective Equipment (PPE)
    - Verification of circuit de-energization
    - Lockout/Tagout procedures and
    - NFPA 70 and NFPA 70e
    - OSHA CCFR 1910
- Calculate basic circuit values
    - Voltage
    - Current
    - Resistance
    - Reactance (Inductive & Capacitive)
    - Power (True, Reactive, and &Apparent)
- Evaluate basic types of electrical circuits
    - Series
    - Parallel
    - Series –Parallel
    - Complex Systems
- Identify and sketch common electronic and electrical symbols
- Demonstrate an understanding of setup and use of various types of electrical test equipment.
    - Analog Voltmeter, Ammeter, Ohmmeter
    - Digital Multimeter
    - Megohommeters
    - Oscilloscope
- Demonstrate an understanding of source of electrical power
    - AC Power Sources
    - DC Power Sources

Course Number and Name: **EET 1154 Equipment Maintenance, Troubleshooting, and Repair**

Description: Maintenance and troubleshooting techniques, use of technical manuals and test equipment, and inspection/evaluation/repair of equipment

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	1	6	105

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Discuss and apply proper safety procedures regarding maintenance, troubleshooting, and repair of equipment.

2. Perform preventive maintenance on equipment.
    a. Develop a preventive maintenance program for a given piece of equipment.
    b. Inspect and adjust belts, chains, and other moving parts.
    c. Lubricate a machine following manufacturer's recommendations.

3. Troubleshoot and repair equipment.
    a. Identify symptoms that indicate a machine is not operating properly (excessive noise, vibration, heat, speed, etc.).
    b. Determine the cause of the symptoms.
    c. Inspect machinery for broken or worn parts, and determine if replacement is needed.
    d. Prepare a report on time and costs involved in repairing equipment.
    e. Perform lockout–tagout procedures for broken equipment.
    f. Disassemble, inspect, repair, and reassemble equipment to specifications.
    g. Perform preventive maintenance on an electric motor (disassemble, clean and inspect, repair mechanical components, lubricate, and reassemble).
    h. Check and service a battery, including recharging.

4. Estimate expenses for a given project.
    a. Prepare a bill of materials list for a specific job.
    b. Calculate the labor factor for a specific job.

Course Number and Name: **EET 1163 Motor Maintenance and Troubleshooting**

Description: This course covers the principles and practice of electrical motor repair and includes topics on the disassembly/assembly and preventive maintenance of common electrical motors.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Apply general safety principles and safety requirements for working with electric motors.
    a. Apply principles of safety in the use and repair of electrical motors.
    b. Describe safety procedures to utilize during connecting, operating, and repairing of electrical motors.
    c. Practice lockout–tagout procedure.
2. Use instruments and tools in maintaining, troubleshooting, and operating electrical motors.
    a. Identify, describe, and demonstrate the use of instruments and tools used to maintain, troubleshoot, and repair motors, to include megohm meters, volt–amp meters, and multimeters.
    b. Describe the procedures for the maintenance, testing, and/or repair of instruments and tools.
3. Troubleshoot and perform basic maintenance on electrical motors.
    a. List and describe functions of the major parts and windings of single-phase motors.
    b. List and describe the functions of split-phase, capacitor-start, capacitor-start/capacitor-run, and permanent split capacitor electric motors.
    c. Describe and list the functions of a shaded pole and repulsion/induction electric motors.
    d. List and describe functions of major parts and windings of three-phase motors to include squirrel cage induction, synchronous, and wound rotor motors.
    e. List and describe functions of the major parts and windings of DC motors to include series, shunt, and compound wound motors.
    f. Develop a preventive maintenance program for electric motors.

Course Number and Name: **EET 1174 Fluid Power**

Description: This basic course provides instruction in hydraulics and pneumatics. The course covers actuators, accumulators, valves, pumps, motors, coolers, compression of air, control devices, and circuit diagrams. Emphasis is placed on the development of control circuits and troubleshooting techniques.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	3	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Define and describe basic laws governing fluids.
    a. Describe the concept of force, flow, and pressure.
    b. Analyze the relationship of force and pressure in a circuit.
    c. Explain what causes flow in a circuit.
    d. Calculate area, pressure, velocity, and rate of flow.
    e. Explain and apply the ideal gas laws, Boyle's law, and Charles' law in fluid systems.

2. Identify and draw symbols for hydraulics and pneumatics.
    a. Explain the logic for drawing symbols for hydraulic components.
    b. Draw individual hydraulic and pneumatic components.

3. Describe the operation and nomenclature of various pumps and compressors.
    a. Analyze the operation of vane, gear, and piston pumps in hydraulics.
    b. Analyze the operation of air compressors.

4. Explain fluids as pertaining to the transmission of energy.
    a. Describe various types of hydraulic fluids.
    b. Explain the purpose of the fluid reservoir, the filtration system, and the heat exchanger in hydraulics.
    c. Explain the purpose of the receiver in pneumatics.
    d. Explain the purpose of trio units in compressed air.

5. Describe the operation of flow, pressure, and directional control valves.
    a. Explain basic design features used in each type of control valve.
    b. Demonstrate how flow, pressure, and directional valves are used in hydraulics and pneumatics.

6. Explain the types of actuators used in pneumatics and hydraulics.
    a. List important cylinder design features.
    b. Explain basic design features of hydraulic motors and other rotary actuators.
    c. Identify common types of air motors.

7. Explain, construct, and troubleshoot various hydraulic and pneumatic circuits.
    a. Explain the purpose of a sequence circuit.
    b. Construct and troubleshoot a sequence circuit.

8. Demonstrate the use of electro-mechanical controls in hydraulic and pneumatic circuits.
    a. Explain the construction and use of solenoids in directional controls.

b. Construct a hydraulic or pneumatic circuit that is controlled electrically.

SMC ADVANCED MANUFACTURING CERTIFICATION LEVEL I BASIC©
Mechatronics Level I-Basic
Basic Pneumatics

- Perform basic calculations pertaining to fluids and the laws that govern them.
- Calculate Force, Pressure, & Area
- Identify and sketch basic symbols used to represent pneumatic components]
- Discuss design and characteristics of common pumps/compressors.
- Compare and contrast hydraulics and pneumatics.
- Discuss design and operation of common directional control valves
    - Mono-stable Directional Control Valves
    - Bi-stable Directional Control Valves
- Discuss and implement different types of actuators
    - Single Acting Cylinders
    - Double Acting Cylinders
    - Rotary Actuators
- Design and construct fluid power circuits incorporating electromechanical controls.
- Understand and construct fluid power circuits incorporating electromechanical controls.
- Discuss and understand principles of vacuum generation.

Course Number and Name: **EET 1192 Fundamentals of Electronics**

Description: Fundamental skills associated with all electronics courses. Safety, bread boarding, use of calculator, test equipment familiarization, soldering, electronic symbols, and terminology

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
2	1	2	45

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Explain, demonstrate, and practice general safety procedures in the shop, lab, and industrial environments.
    a. Apply proper safety techniques for all types of circuits and components.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.
    c. Demonstrate an understanding of and comply with relevant lock-out, tag-out procedures.

2. Demonstrate and utilize proper bread boarding techniques.
    a. Identify the various electronic components and schematic symbols.
    b. Identify the various resistor and capacity codes.
    c. Lay out a breadboard by the use of a schematic.
    d. Demonstrate forming components to fit into a breadboard.
    e. Demonstrate techniques for selecting and forming wires to make connections.

3. Demonstrate proficiency in the use of a calculator.
    a. Use SI symbols and prefixes to describe electrical values.
    b. Manipulate numbers in mathematical operations using scientific notation, engineering notation, and E notation to aid in mathematical circuit analysis.
    c. Perform basic algebraic operations using electronic equations to express the rules of symbol transformation.
    d. Perform basic trigonometry to include the Pythagorean theorem, sine function, cosine function, and tangent function.
    e. Perform practical math in solving ratio, percentage, proportions, powers, and roots of numbers on digital conversions.

4. Demonstrate the proper use and operation of test equipment.
    a. Demonstrate the use and care of test instruments including volt-ohm meters, current meters, oscilloscopes, and so forth.
    b. Explain the cause and effects of current and voltage circuit loading.
    c. Describe the differences between analog and digital multimeters.
    d. Discuss the advantages and disadvantages of analog and digital multimeters.
    e. Explain zeroing the ohmmeter prior to use and effects of battery drain on its accuracy.
    f. Demonstrate proper troubleshooting techniques by use of selected meters.

5. Demonstrate proper soldering and desoldering techniques.
    a. Apply acceptable soldering/desoldering techniques, including thru-hole and surface mount devices.
    b. Apply acceptable standards of proper solderless connections.

Course Number and Name: **EET 1214 Digital Electronics**

Description: Number systems, logic circuits, counters, registers, memory devices, combination logic circuits, Boolean algebra, and a basic computer system

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	3	2	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Perform mathematical operations in digital number systems.
    a. Convert between binary, octal, hex, and decimal values.
    b. Add and subtract binary, octal, and hex numbers.
    c. Subtract binary numbers using both ones and twos complements.
    d. Generate and interpret even and odd parity.
    e. Use the terms bit, byte, MSB, LSB, and nibble appropriately.
    f. Encode and decode ASCII codes from code charts.

2. Classify logic gates, and explain their functions.
    a. Describe and complete truth tables for logic gates.
    b. Sketch schematic diagrams for logic gates.
    c. Solve timing diagrams for logic gates.
    d. Apply procedures to protect devices against electrostatic discharge (ESD).
    e. Wire and test logic gates.
    f. Write Boolean expression for logic gates.

3. Analyze logic circuits.
    a. Construct, develop, and interpret combinational logic circuits.

4. Minimize logic circuits using Boolean algebra and Karnaugh mapping.
    a. Write and describe the Boolean algebra theorems.
    b. Apply DeMorgan's theorem to convert between OR and AND logic.
    c. Apply Boolean algebra to minimize given Boolean expressions.
    d. Convert between sum of products and product of sums.
    e. Use Karnaugh maps to simplify Boolean expressions.

5. Analyze principles and operations of digital display devices.
    a. Construct and demonstrate seven-segment LED digital displays.
    b. Describe the principle at operation for multiplying multidigit displays.
    c. Contrast LED and LCD digital display devices.

6. Explain the operation of basic memory circuits.
    a. Describe the characteristics of memory types including static RAM, dynamic RAM, PROM, and EPROM.
    b. Interpret manufacturers' data sheets for memory integrated circuits.

7. Demonstrate an understanding of other digital circuits:

    a. counters
    b. clock generators
    c. multi- vibrators

d. flip-flops.

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9.0 Mathematica and Formulas

9.4 Convert binary, decimal, octal, hex number

9.5 Explain Boolean algebra and its use in digital circuitry

14.0 Digital Concepts and Circuity

14.1 Describe ASCII code

14.2 Identify each basic digital gate

14.3 Construct truth tables for common gates

14.4 Explain how counters operate

14.5 Explain the purpose of flip flops and list common types

14.6 Explain the purpose of a digital bus and show how it is connected to various sections of a product

14.7 List types of display circuitry and describe how numbers and letter are activated digitally

14.8 Explain the purpose of computer clocks

14.9 Show how pulsers are used for digital signal tracing and how logic probes are used to verify states in digital equipment

14.10 Describe digital clock usage and circuitry

14.11 describe how microprocessors function and identify the basic components and pin-outs

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Mechatronics Level I –Basic
Basic Sensors

- Identify and sketch common logic symbols
- Demonstrate an understanding of logic as it pertains to digital and solid state components used in common industrial sensors
- Install and troubleshoot common digital and analog sensors, as well as switches and pushbuttons, associated with control of a complex automated system.
    - Reed Sensors
    - Photo Sensors
    - Proximity Sensors
    - Vacuum Sensors
    - Pushbutton Sensors
    - Selector Switches

(Note: The common analog and digital sensors above all incorporate PN junctions, diodes, BJTs FETs, and thyristors in some capacity. Therefore, understanding of the operation and inner workings of these sensors is a clear insication of understanding the principles of EET 1334.)

Course Number and Name: **EET 1233 Computer Servicing Lab I**

Description: This course covers fundamentals of computer servicing including configuration, test equipment usage, basic disassembly and assembly methods, preliminary tests and diagnostics, schematic interpretation, and building cables.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	0	6	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Complete maintenance documentation.
    a. Prepare an identification tag.
    b. Prepare an equipment sketch.
    c. Prepare a repair log.
    d. Prepare an invoice.

3. Explain antistatic control procedures and equipment for computer repair.
    a. Identify antistatic equipment.
    b. Identify antistatic procedures.

4. Set up soldering and desoldering stations using correct safety procedures.
    a. Select correct equipment.
    b. Apply correct soldering and desoldering techniques.

5. Identify and utilize hand tools needed for basic computer servicing.
    a. Identify hand tools used for basic computer servicing.
    b. Utilize hand tools for basic computer servicing.

6. Identify and use various test equipment.
    a. Identify and use multimeters.
    b. Identify and use an oscilloscope.
    c. Identify and use circuit testers to correct wiring problems.

7. Demonstrate repair procedures for disassembly and reassembly of various components.
    a. Demonstrate repair procedures for disassembly and reassembly of computers.
    b. Demonstrate repair procedures for disassembly and reassembly of printers.

8. Construct and test cables.
    a. Construct various control cables.
    b. Test various control cables.

9. Isolate a malfunction.
    a. Determine symptoms of hardware and software failures.

b. Perform diagnostic procedures.
c. Eliminate the malfunction.

10. Demonstrate effective behaviors that contribute to the achievement and maintenance of customer satisfaction.
    a. Explain what a professional attitude is.
    b. Utilize professional procedures in a customer interview.
    c. Conduct isolation procedures.

Course Number and Name: **EET 1311** **Orientation to Biomedical Equipment Repair**

Description: Orientation to the biomedical equipment repair field. Topics covered are the different career paths open to students, types of biomedical equipment, and the organization and operation of the hospital environment.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
1	1	0	15

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Explain the operation and responsibilities of the clinical engineering department.
    a. Explain functions and roles.
    b. Explain how this department's services are related to the patients.
    c. Explain end results desired.

2. Identify and describe biomedical devices and related safety issues.
    a. Describe different types of biomedical equipment.
    b. Discuss safety issues related to electrical equipment.
    c. Discuss safety issues related to pathological agents and the risk of infection.

3. Define and discuss the hospital organization of services and how they are delivered.
    a. Define the legal organization of hospitals.
    b. Discuss the major organization structure of hospitals.
    c. Discuss the major services provided by the hospital and the impact on medical equipment repair.
    d. Develop an organizational chart of a typical hospital.

4. Discuss and define the management by committee concept.
    a. Define the management by committee concept.
    b. Explain the advantages and disadvantages of the management by committee concept.
    c. Identify the major committees within a hospital setting.

Course Number and Name: **EET 1334 Solid State Devices and Circuits**

Description: Active devices that include PN junction diodes, bipolar transistors, bipolar transistor circuits, and unipolar devices with emphasis on low-frequency application and troubleshooting

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Explain the characteristics of semiconductor materials and theory of operation of PN junctions.
    a. Explain basic atomic structure.
    b. Define intrinsic, P-type, and N-type.
    c. Analyze an unbiased PN junction.
    d. Analyze a forward-biased PN junction.
    e. Analyze a reverse-biased PN junction.

2. Explain semiconductor diode theory and apply to diode circuits.
    a. Describe the characteristics of a diode.
    b. Analyze and demonstrate a half-wave rectifier circuit.
    c. Analyze and demonstrate a full-wave rectifier circuit.
    d. Analyze and demonstrate a bridge rectifier circuit.

3. Analyze the operation of semiconductor special purpose diodes.
    a. Analyze and demonstrate the operation of a Zener diode circuit.
    b. Analyze and demonstrate the operation of a light-emitting diode circuit.
    c. Explain the characteristics of Schottky diodes.
    d. Explain the characteristics of varactor diodes.

4. Analyze the operation of bipolar junction transistors.
    a. Define and identify transistor voltages and currents.
    b. Analyze and demonstrate the operation of a DC common emitter circuit.
    c. Demonstrate the use of collector curves.
    d. Demonstrate the use of load lines.
    e. Explain and demonstrate base, emitter, and voltage divider biasing.

5. Explain and analyze the construction of BJT amplifiers.
    a. Analyze and discuss the basic operation of a common emitter voltage amplifier.)
    b. Given a common emitter amplifier circuit, draw the AC equivalent circuit, and solve for V-in, V-out, and A.
    c. Explain how the swamped common emitter amplifier works, and discuss its advantages.
    d. Given a swamped common emitter amplifier circuit, draw the AC equivalent circuit, and solve for Z-in, V-in, V-out, and A.
    e. Construct a common emitter amplifier, and compare measured parameters to calculated values.
    f. Given a cascaded common emitter amplifier, calculate gain of stage one, gain of stage two, and output voltage.

g. Given a power amplifier circuit, solve for the maximum generator voltage that will produce an unclipped output signal, and solve the maximum efficiency of the amplifier.
h. Given an emitter-follower circuit, solve for Z-in, V-in, A, and V-out.
i. Describe the characteristics of a Class A power amplifier to include the factors that limit the power rating of a transistor.
j. Construct Class A and Class B amplifiers, and troubleshoot the circuits.

6. Analyze the operation of field effect transistors, and demonstrate their applications.
   a. Describe the basic construction of a JFET.
   b. Calculate the proportional pinch off voltage, and determine the operating area of a JFET.
   c. Given a JFET circuit, determine ID and Vds.
   d. Given a JFET amplifier circuit, draw the AC equivalent circuit, and solve for gmo, gm, Z-in, V-in, A, and V-out.
   e. Given a JFET source follower circuit, with a given gm, solve for V-in, A, and V-out.
   f. Illustrate the construction of and describe the operation of the depletion-mode and the enhancement-mode MOSFET.
   g. Analyze other FET applications, such as multiplying, switching, chopper, AGC, and sample and hold amplifier.
7. Analyze the operation of thyristors, and demonstrate their applications.
   a. Describe the four-layer diode, and discuss how it is turned on and off.
   b. Describe how the SCR operates in different applications.
   c. Construct a latching SCR with a varying input voltage, and determine when the output voltage is latched.
   d. Describe the main characteristics of the variations of the SCR, and discuss the difference in device symbols.
   e. Describe the characteristics of the diac and triac.
   f. Calculate the intrinsic standoff voltage for a unijunction transistor (UJT), and state how it works.
   g. Analyze thyristor applications, such as over voltage detector, sawtooth generator, SCR crowbar, and controlled SCR circuits phase angle controlled circuits.
   h. Construct thyristor circuits, and vary the latching parameters; measure the output to view switching and control of the device.

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2.0 Electronic Components

2.5 Identify transistors as to type and usage, such as unijunction, FETs and MOSFETS; explain beta and and provide common DC and bias voltage ranges; list common usages

2.6 Identify other semiconductors and explain their uses; Darlington pairs; unijunction transistors and Gunn diodes

2.7 Compare thyristors with other semiconductors; identifying diacs, triacs and SCRs and explain their operation

2.8 Explain zener diode ratings; describe their usage in regulator circuits

2.9 List common optical devices (LEDs, LCDs, etc.) describe how photovoltaic cells are activated. Draw symbols for phot resistors, photodiodes and photo transistors; list materials from which these devices are made

2.10 Describe MOS, CMES, FET applications

3.0 Soldering- Desoldering Tools

3.1 Describe solder safety as it pertains to burns and potential fires or damage to facilities or customer products

3.2 Explain the cause of solder fumes and the effects of lead poisoning

3.3 List causes and precautions to prevent or reduce solder splatter

3.4 Explain reasons for flux usage and describe types

3.5 List types of solder and reasons for choosing each

3.6 Explain heat shunts, why and how they are used

3.7 Identify cold solder joints and explain causes

3.8 Describe the differences between good and bad mechanical and electrical solder connections

3.9 Describe proper care of solder and de-solder equipment and aids

3.10 Explain de-soldering principles

3.11 Describe various types of de-soldering equipment and how it is used

3.12 Demonstrate the use of braid-wick solder removers

6.0 Power Supplies

6.1 Explain sock hazards when servicing power supplies in electronic equipment

6.2 Describe the differences between transformer powered supplies and line-connected supplies

6.3 Describe battery supplies and list common usages, also explain recharging principles

6.5 Explain the reason for power supply regulation and list common components used in regulated supplies

6.7 Explain how multiple output supplies are able to supply more than one voltage

8.0 Safety Precautions

8.6 Explain static causes and CMOS damage prevention straps, mats, and grounding

8.11 Explain eye and ear protection needed by technicians

12.0 Amplifiers

12.4 Describe biasing and gain characteristics

SMC ADVANCED MANUFACTURING CERTIFICATION LEVEL I BASIC©

Mechatronics Level I –Basic
Basic Sensors

- Identify and sketch common logic symbols
- Demonstrate an understanding of logic as it pertains to digital and solid state components used in common industrial sensors
- Install and troubleshoot common digital and analog sensors, as well as switches and pushbuttons, associated with control of a complex automated system.

- Reed Sensors
- Photo Sensors ‘
- Proximity Sensors
- Vacuum Sensors
- Pushbutton Sensors
- Selector Switches

(Note: The common analog and digital sensors above all incorporate PN junctions, diodes, BJTs FETs, and thyristors in some capacity. Therefore, understanding of the operation and inner workings of these sensors is a clear insication of understanding the principles of EET 1334.)

Course Number and Name: **EET 1343 Motor Control Systems**

Description: This course covers installation of different motor control circuits and devices. Emphasis is placed on developing the student's ability to diagram, wire, and troubleshoot the different circuits and mechanical control devices.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Install different control circuits and devices.
   a. Diagram and wire a two-wire and three-wire motor control circuit with indicating pilot lights.
   b. Diagram, wire, and troubleshoot an on-delay and off-delay timer circuit.
   c. Diagram and wire a multi-control manual station.
   d. Diagram and wire a hands-off automatic control station.
   e. Diagram and wire a jog-forward/jog-reverse control.

2. Troubleshoot different control circuits and devices.
   a. Troubleshoot a two-wire and three-wire motor control circuit with indicating pilot lights.
   b. Troubleshoot an on-delay and off-delay timer circuit.
   c. Troubleshoot a multi-control manual station.
   d. Troubleshoot a hands-off automatic control station.
   e. Troubleshoot a jog-forward/jog-reverse control.

SMC ADVANCED MANUFACTURING CERTIFICATION LEVEL I BASIC©
Mechatronics Level I –Basic
Basic Sensors

- Identify and sketch common logic symbols
- Demonstrate an understanding of logic as it pertains to digital and solid state components used in common industrial sensors
- Install and troubleshoot common digital and analog sensors, as well as switches and pushbuttons, associated with control of a complex automated system.
  - Reed Sensors
  - Photo Sensors ‘
  - Proximity Sensors
  - Vacuum Sensors
  - Pushbutton Sensors
  - Selector Switches

(Note: The common analog and digital sensors above all incorporate PN junctions, diodes, BJTs FETs, and thyristors in some capacity. Therefore, understanding of the operation and inner workings of these sensors is a clear insication of understanding the principles of EET 1334.)

Course Number and Name: **EET 1353 Fundamentals of Robotics**

Description: This course is designed to introduce the student to industrial robots. Topics to be covered include robotics history, industrial robot configurations, operation, and basic programming and how they relate to the electrical industry.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Describe the various major components of all robots.
    a. Explain the axes of movement.
    b. Label each major component.
    c. Identify four general types of work envelopes.
    d. Discuss three general forms of robot actuation.
    e. Identify different types of input devices used with robot controllers.
    f. Describe the characteristics of a robot that distinguish it from other types of automated machinery.

2. Demonstrate safety procedures used in the automated environment.
    a. Apply safety rules for personal and general shop safety including eye, ear, and body protection; general rules of shop conduct; and the use of safety color coding.
    b. Apply general safety rules for tool and equipment use including hand tools, air and electric power tools, and other shop equipment.
    c. Apply general safety rules associated with working on various robotics systems.
    d. Apply rules and procedures associated with fire safety including procedures for handling and storing flammable liquids and proper use of fire fighting devices.

3. Demonstrate the ability to operate robots.
    a. Evaluate robot performance.
    b. Apply basic programming skills.
    c. Identify and discuss end effectors.
    d. Identify and discuss visual and tactile sensors.
    e. Demonstrate basic troubleshooting techniques.

Course Number and Name: **EET 1363 Microcontrollers**

Description: This course begins with a brief overview of microprocessors as a precursor to microcontrollers. Next, a basic understanding of the use, terminology, and potential of microcontrollers are discussed. Programming skills and concepts taught in this course help students develop, execute, and debug programs for a microcontroller, A hands-on approach will teach the essential skills for creating a simple sensor-driven microcontroller system, and will be reinforced with interactive projects. .

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Understand Microprocessor basics
   a. Discuss the history of microprocessors.
   b. Explain and identify the internal architecture of microprocessors.
   c. Discuss the internal and external basic structure and operation.

2. Analyze Microcontroller Architecture to include:
   a. Evolution of microcontrollers
   b. Digital I/O Pins
   c. Analog Pins
   d. Memory
   e. Interrupts and timers
   f. Buses- I2C, serial, one/two wire, CAN, and SPI

3. Demonstrate appropriate microcontroller programming techniques such as:
   a. Programming logic and structures
   b. Object orientated programming (C#, Python, Java, etc.)
   c. Graphical programming tools such as LabView

4. Incorporate sensors, mechanical devices, and displays
   a. Analog and digital sensors (temperature, light, pressure, etc)
   b. Mechanical devices (servo, motors, actuator, etc)
   c. Displays (LCD, TFT, graphical)

5. Discuss latest trends in embedded systems to include:
   a. IoT devices
   b. PLC basics
   c. Various brands and manufacturers (Arduino, Raspberry Pi, Beagle Bone Black)

Course Number and Name: **EET 1413 Mathematics for Electronics**

Description: Coverage of those areas of arithmetic, algebra, geometry, and trigonometry that have applications in electronics

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate an understanding of fundamental arithmetic operations.
    a. Find the common denominator of two of more fractions.
    b. Add and subtract fractions.
    c. Multiply and divide fractions.
    d. Calculate percentages.
    e. Calculate the value of a number raised to a power.
    f. Use a calculator to calculate square roots and cube roots.

2. Demonstrate an understanding of systems of measurement.
    a. Express numerical values using scientific and engineering notation.
    b. Express measurements using the metric system.
    c. Express numerical values using engineering prefixes.

3. Demonstrate an understanding of basic algebraic concepts.
    a. Express numerical values using signed and unsigned numbers.
    b. Evaluate algebraic expressions using the algebraic hierarchy of operations.

4. Demonstrate an understanding of linear equations.
    a. Solve first-degree equations using algebraic methods.
    b. Describe the Cartesian coordinate system.
    c. Draw graphs of linear equations.

5. Demonstrate an understanding of polynomials.
    a. Multiply polynomials.
    b. Combine polynomials using addition and subtraction.
    c. Factor polynomials.

6. Demonstrate an understanding of second-degree equations.
    a. Solve second-degree equations by taking square roots.
    b. Solve second-degree equations by factoring.
    c. Solve second-degree equations by using the quadratic formula.
    d. Draw graphs of nonlinear equations.

7. Demonstrate an understanding of solid geometry.
    a. Calculate the volume of a sphere.
    b. Calculate the volume of a cone.
    c. Calculate the surface area of a sphere.
    d. Calculate the surface area of a cone.

8. Demonstrate an understanding of right-triangle trigonometry.

a. Calculate the length of any side of a right-triangle given the length of the other two sides using the Pythagorean formula.
b. Define the three primary trigonometric functions (sine, cosine, and tangent).
c. Calculate the trigonometric functions given the lengths of the sides of a right triangle.
d. Calculate the length of a side of a right triangle given the length of a known side and an angle.
e. Calculate an angle of a right triangle given the lengths of two sides.

9. Demonstrate an understanding of vectors.
    a. Describe the two components of a vector.
    b. Combine vectors to produce a resultant vector.

10. Demonstrate an understanding of complex numbers and phasors.
    a. Describe the imaginary value j.
    b. Express complex numerical values in rectangular form using real and imaginary values.
    c. Convert complex values from rectangular form to polar form.
    d. Convert complex values from polar form to rectangular form.
    e. Draw phasors using complex values.

Course Number and Name: **EET 1443 Fundamentals of Instrumentation**

Description: This course provides students with a general knowledge of instrumentation principles as they relate to the electrical industry. This course includes instruction in the basis of hydraulics and pneumatics and the use of electronic/electrical circuits in the instrumentation process.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate a working knowledge of instrumentation as it pertains to the electrical industry.
    a. Define terms associated with instrumentation.
    b. Discuss basic theory of hydraulics, pneumatics, and electromagnetic controls.
    c. Identify basic symbols used with hydraulics, pneumatics, and electromagnetic systems.

2. Identify the type of instrumentation input and output devices, and describe their applications.
    a. Describe control elements for pressure, flow, temperature, and level.
    b. Identify the types of input and output devices.
    c. Describe the input and output devices.

3. Identify the types of electrical signals used in instrumentation.
    a. Describe the transmission of information to include current, pressure, and frequency.
    b. Explain the principles of the transmission information input and output.

4. Describe fundamentals of electrical and electronic process controls.
    a. Label a block diagram of an open loop system and a closed loop system.
    b. Describe characteristics of an open loop and a closed loop system.

5. Design a preventive maintenance program for instrumentation systems.
    a. Describe the techniques and procedures for troubleshooting, calibrating, and repairing an instrumentation system.
b. Demonstrate the ability to sketch a piping and instrument drawing.

Course Number and Name: **EET 1613 Computer Fundamentals for Electronics/ Electricity**

Description: Basic computer science as used in electricity/electronics areas. Computer nomenclature, logic, numbering systems, coding, and operating system commands are covered.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate an understanding of essential microcomputer architecture.
    a. Discuss microcomputer architecture.
    b. Identify major differences of word length, size of directly addressable memory, and microprocessor speed.
    c. Draw and label the block diagram for a typical microcomputer indicating all major components.

2. Demonstrate an understanding of microcomputer components and peripherals.
    a. Discuss the features and concepts related to motherboards including microprocessors and expansion slots.
    b. Describe the concepts and installation of power supplies.
    c. Discuss memory concepts, installation, and setup.
    d. Describe the concepts and installation of peripheral input devices.
    e. Describe the concepts and management of mass storage devices.
    f. Discuss the concepts and installation of peripheral devices, such as printers and scanners.
    g. Discuss the concepts and installation of video monitors and adapters.
    h. Describe the concepts, installation, and setup of internal modems and sound cards.
    i. Demonstrate the power on self-test.

3. Demonstrate competency of operating system fundamentals.
    a. Format, read, and write to storage media.
    b. Modify the computer display, mouse parameters, and date/time configuration.
    c. Install and remove hardware and software.
    d. Explore the system information utility.
    e. Perform word processing using a word processing application.

ASSOCIATE C.E.T. (CETa) - COMPETENCY LISTING BASIC ELECTRONICS CERTIFICATION

15.0 Computer Electronics

15.1 Describe the major sections of a computer

15.2 Demonstrate how the computer block diagram and flow charts are utilized

15.3 Sketch the major blocks contained in a microprocessor chip and describe the purpose of teach block

15.4 Describe different types of computer memory and how storage is accomplished

15.8 Define the work “peripheral” and list various types

15.9 Explain the reasons for using interface devices/chips/cars and name common types

16.0 Computer Applications

16.1 Demonstrate knowledge of basic computer operation

16.2 Explain steps in installation/set up of a computer

16.3 explain the reason and choices used in configuring a computer

16.4 Demonstrate proper loading and storage of common programs and applications

16.5 Explain basic and common utilities programs and list reasons for their use

16.6 List ways to backup data and the importance of doing so

16.7 Explain the causes of line surges and viruses and protection procedures against each

16.8 Explain major components of the internet, how it is accessed and common applications

16.9 Demonstrate how to download a service or application, data or programs

16.10 Explain how to use the internet to locate parts and service literature

16.11 Explain the differences between an individual computer and basic networking

Course Number and Name: **EET 1713 Drafting for Electronics Technology**

Description: Preparation and interpretation of schematics, block diagrams, flow charts, and PCB prototyping.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate an understanding of drafting fundamentals.
    a. Explain the need for national drafting standards.
    b. Explain the need for drawing quality and standard drawing sizes.
    c. Explain the requirements for lettering and different line widths.
    d. Discuss computer aided design (CAD).

2. Demonstrate an understanding of electronic symbols, components, and references used in schematic and logic diagrams.
    a. Identify components by symbol
    b. Draw component and schematic symbols to drafting standards.
    c. Correctly use component references and values.
    d. Use symbols in schematic diagrams.
    e. Interpret logic symbols.
    f. Create formal drawings from an engineering sketch.

3. Demonstrate the ability to compose projections and diagrams.
    a. Define and identify a perspective drawing.
    b. Define and create orthographic drawings.
    c. Apply rules of good dimensioning to mechanical drawing.
    d. Create printed circuit board assembly drawings.
    e. Create block, flow, and single-line diagrams.
    f. Create schematic and logic diagrams.
    g. Create point-to-point and pictorial point-to-point diagrams.
    h. Create cable assemblies and interconnection diagrams.

4. Demonstrate an understanding of electronics drafting using CAD.
    a. Create electronic symbols to drafting standards.
    b. Insert symbols into drawings.
    c. Use CAD commands to create drawings and schematic diagrams.

ASSOCIATE C.E.T. (CETa) - COMPETENCY LISTING BASIC ELECTRONICS CERTIFICATION

Block Diagrams-Schematics- Wiring Diagrams

4.1 Draw common electrical/electronic symbols

4.2 Explain block diagrams use for troubleshooting and maintenance of electronic products

4.3 Explain the differences between wiring prints, schematics and block diagrams

4.4 Describe the purpose and use of test points and indicate their likely placement on schematics

4.5 Point out common drafting principles used for electronic and electrical drawings

4.6 Explain methods used for signal tracing

4.7 Describe basic building and house wiring concepts and explain why technicians need to be familiar with them.

4.8 Explain schematics use to locate component and wiring failures in electronics products

4.9 Explain the methods of using flow diagrams/charts

Course Number and Name: **EET 211 (3-6) Supervised Work Experience in Biomedical Equipment Repair Technology I**

Description: This cooperative program between the health-care facility and education is designed to integrate the student's technical studies with health-care experience. (NOTE: Biomedical equipment used in this course is for instructional purposes ONLY and not to be used in patients' care.) Variable credit is awarded on the basis of 1 semester hour per 45 health care contact hours.

Hour Breakdown:

Semester Credit Hours	Lecture	Externship	Contact Hours
3-6	0	9-18	135-270

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Analyze the operation and responsibilities of the clinical engineering department at the supervised work location.
    a. Analyze the functions and roles of personnel in the clinical engineering department.
    b. Describe how this department's services are related to the patients.
    c. Explain the end results desired from this department.

2. Discuss the various environmental health risks within the hospital.
    a. Explain precautions to be taken within the hospital.
    b. Explain the effects of various health risks.
    c. Develop and discuss preventive actions to be taken in case of a health emergency.

3. Examine the operation of the hospital electrical distribution system.
    a. Review the electrical layout prints, and locate the electrical distribution system control devices.
    b. Interpret the symbols and notations on the prints.

4. Read and interpret codes and standards as applied to hospitals.
    a. Locate codes and standards for various systems.
    b. Explain the purposes of codes and standards.
    c. Locate specific codes and standards as required for a particular work task.
    d. Repair equipment demonstrating utilization of codes and standards.
    e. Verify safety certification seals.

5. Perform basic preventive maintenance on biomedical equipment.
    a. Identify the equipment and its functions.
    b. Locate and interpret specifications for the equipment.
    c. Diagnose and repair equipment to manufacturer's specifications.
    d. Test and verify safety certification seals as required.

6. Conduct performance tests on biomedical equipment.
    a. Identify the equipment and its function.
    b. Locate and interpret specifications for the equipment.
    c. Test the performance of equipment according to manufacturer's specifications.
    d. Test and verify safety certification seals as required.

ASSOCIATE C.E.T. (CETa) - COMPETENCY LISTING BASIC ELECTRONICS CERTIFICATION

20.0 Technician Work Procedures

20.1 Explain major invoice and billing concepts for service businesses

20.2 Describe ways to procure service literature

20.3 Describe location/cross referencing of parts and product in catalogs

20.4 Explain the purposes and requirements for proper record keeping

20.5 Calculate individual and department productivity for a specific period

20.6 Describe contacting product maker help desks and service departments

20.7 Explain estimate concepts for service work

20.8 Describe field technician work procedures that may differ from in-shop routines

20.9 Explain project management and list steps to follow to achieve maximum results

Course Number and Name: **EET 222 (3-6) Supervised Work Experience in Biomedical Equipment Repair Technology II**

Description: Continuation of EET 211 (3-6) with advanced study in the repair and maintenance of biomedical equipment.

Hour Breakdown:

Semester Credit Hours	Lecture	Externship	Contact Hours
3-6	0	9-18	135-270

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Test and repair equipment within the respiratory therapy areas.
    a. Identify the equipment and its function.
    b. Locate and interpret specifications for the equipment.
    c. Diagnose and repair equipment to manufacturer's specifications.
    d. Test and verify safety certification seals as required.

2. Test and repair equipment within the dialysis laboratory.
    a. Identify the equipment and its function.
    b. Locate and interpret specifications for the equipment.
    c. Diagnose and repair equipment to manufacturer's specifications.
    d. Test and verify safety certification seals as required.

3. Test and repair equipment within the diagnostic laboratory.
    a. Identify the equipment and its function.
    b. Locate and interpret specifications for the equipment.
    c. Diagnose and repair equipment to manufacturer's specifications.
    d. Test and verify safety certification seals as required

4. Test and repair equipment within the radiological, nuclear, and ultrasound area.
    a. Identify the equipment and its function.
    b. Locate and interpret specifications for the equipment.
    c. Diagnose and repair equipment to manufacturer's specifications.
    d. Test and verify safety certification seals as required.

5. Test and repair laser equipment.
    a. Identify the equipment and its function.)
    b. Locate and interpret specifications for the equipment.
    c. Diagnose and repair equipment to manufacturer's specifications.
    d. Test and verify safety certification seals as required.

6. Utilize computers in clinical engineering.
    a. Apply basic rules for the operation and use of computers.
    b. Discuss the place for computers within the health center.
    c. Perform basic computer operations.

Course Number and Name: **EET 2233 Computer Servicing Lab II**

Description: This course is a continuation of Computer Servicing Lab I with increased emphasis on system analysis and diagnosis of board and component failures with emphasizes on laboratory experience with computer repair.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	0	6	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Maintain a service log on individual pieces of equipment.
    a. Identify components being repaired.
    b. Make a report of symptoms, repair procedures, and parts replaced.

3. Service peripherals and components.
    a. Explain the procedures for servicing peripherals and various components.
    b. Clean peripherals and various components.

4. Troubleshoot and service or replace computer components.
    a. Troubleshoot and service or replace a computer's central processing unit (CPU).
    b. Troubleshoot and service or replace computer memory circuits.
    c. Troubleshoot and service or replace computer video circuits.
    d. Troubleshoot and service or replace computer controller boards.
    e. Troubleshoot and service or replace computer power supply.
    f. Troubleshoot and service or replace computer keyboard problems.
    g. Troubleshoot and service or replace computer monitors and liquid crystal displays.
    h. Troubleshoot and service or replace computer printers.

Course Number and Name: **EET 2334 Linear Integrated Circuits**

Description: Advanced semiconductor devices and linear integrated circuits. Emphasis is placed on linear integrated circuits used with operational amplifiers, active filters, voltage regulators, timers, and phase-locked loops.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	3	2	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Analyze and demonstrate the effects of frequency on amplifiers.
    a. Define what is meant by frequency response.
    b. Determine the input and output capacitances of an amplifier.
    c. Discuss the characteristics of the frequency response of an amplifier.
    d. Identify the critical frequencies in the response of an amplifier.
    e. Analyze the effects of coupling and bypass capacitors at low frequency.
    f. Relate the upper limit of the frequency response at high frequencies to the internal capacitances of the amplifier's transistors.
    g. Define midrange gain of an amplifier.
    h. Define the term "roll off," and explain what factors determine it.
    i. Compare direct-coupled and capacitive coupled amplifiers in terms of their low frequency response.

2. Describe the principles, operation, and characteristics of an operational amplifier.
    a. Explain the operation of a basic differential amplifier.
    b. Use a circuit diagram to fabricate a differential amplifier and demonstrate its use in at least the following three modes: Single-ended input, differential input, or common mode input.
    c. Draw and label the schematic symbol of the basic operational amplifier (op-amp).
    d. Compare the ideal op-amp characteristics with the practical op-amp characteristics.
    e. Interpret manufacturer's specifications, including package type, pinouts, input offset voltage, input bias current, input impedance, input offset current, output impedance, common made range, open loop voltage gain, CMRR, and slew rate.
    f. Discuss positive and negative feedback and how it is used in amplifiers.
    g. Distinguish between the open-loop voltage gain and closed-loop voltage gain of an opamp.
    h. Define frequency response as it relates to op-amps.
    i. Define stability, and discuss the factors that affect the stability of an op-amp.

3. Describe and demonstrate the function and operational characteristics of op-amps in linear and nonlinear applications.
    a. Recognize and analyze inverting, non-inverting, and voltage follower op-amp configurations.
    b. Construct, troubleshoot, and demonstrate a circuit using an op-amp as an inverting, a non-inverting, and a voltage follower amplifier using the appropriate components with a circuit diagram.
    c. Explain the relationship of gain and frequency response in an op-amp circuit.
    d. Explain, recognize, and use each of the following circuits: Summing amplifier,

instrumentation amplifier, averaging amplifier, and scaling amplifier.
e. Explain, recognize, and use each of the following filters: Low-pass, high-pass, band pass and band-stop.
f. Construct, troubleshoot, and demonstrate A/D and D/A circuits.
g. Explain, recognize, and use the following circuits: Zero-level detection comparator, non-zero-level detection comparator, integrator, and differentiator.
h. Explain the function of a Schmitt trigger.
i. Explain the function of an oscillator.
j. List the conditions required to sustain oscillation in a circuit.
k. Illustrate the use of a 555 as an oscillator.
l. Explain, recognize, and use an op-amp configured to operate in each of the following types of oscillators: Wien-bridge, phase-shift, twin-T, Colpitts, Clapp, Hartley, and Armstrong.
m. Describe the use of a quartz crystal in an oscillator circuit.
n. Explain the use of an op-amp in a non-sinusoidal oscillator.
o. Explain the use of an op-amp in a voltage-controlled oscillator.

4. Describe the function and operating characteristics of voltage regulators.
   a. Explain the basic concept of voltage regulation.
   b. Differentiate between line and load regulation.
   c. Recognize a basic series voltage regulator circuit, and describe the circuit's operating characteristics.
   d. Recognize a basic shunt voltage regulator circuit, and describe the circuit's operating characteristics.
   e. Differentiate between linear and switching voltage regulators.
   f. Recognize typical IC linear and switching regulators.

ASSOCIATE C.E.T. (CETa) - COMPETENCY LISTING BASIC ELECTRONICS CERTIFICATION

12.0 Amplifiers

12.1 List common amplifier devices

12.2 Describe the purpose of each component in an amplifier circuit

12.3 List the usages and classes of amplifiers

12.5 Explain frequency response of an amplifier circuit and why it is important

12.6 Explain the words 'preamplifier' and 'line simplifier' and where these units are commonly used

12.7 Explain the uses of operational amplifiers and how they differ from other amplifiers

12.8 Show causes of distortion in amplifiers and list the ways to reduce or eliminate it

12.10 Describe specifications for broadband amplifiers as compared with common narrow band units

12.11 Explain the operation of high power electron tubes

Course Number and Name: **EET 2354 Solid State Motor Control**

Description: The course covers the principles and operation of solid state motor control as well as the design, installation, and maintenance of different solid state devices for motor control.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Apply general safety principles and safety requirements for working on and around electrical motors.
    a. Apply principles of safety in the use of electrical motors.
    b. Describe safety procedures to utilize during connecting and operating electric motors.

2. Troubleshoot solid state motor controls.
    a. Identify electronic and industrial symbols used to represent logic gates in solid state schematics.
    b. Describe the operation of the different types of industrial and electronic logic gates.
    c. Draw a solid state logic circuit to replace a manual control station.
    d. Troubleshoot and repair/replace solid state devices to include memory devices, flip/flops, adjustable time delays, starting and stopping sequences, and looping.

3. Operate AC and DC variable speed drives.
    a. Discuss the operation of a DC variable speed drive.
    b. Discuss the operation of an AC variable speed drive.
    c. Connect and operate DC and AC variable speed drives

Course Number and Name: **EET 2363 Programmable Logic Controllers**

Description: This course covers use of programmable logic controllers (PLCs) in modern industrial settings as well as the operating principles of PLCs and practice in the programming, installation, and maintenance of PLCs.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Explain principles of PLCs.
    a. Identify components and operational principles of PLCs.
    b. Differentiate between a PLC and a computer.

2. Identify different types of PLC hardware.
    a. Identify and wire different types of input and output modules.
    b. Identify different types of PLC processor modules, memory capabilities, and programming devices.

3. Explain numbering systems, encoding/decoding, and logical operations.
    a. Convert numbers from one system to another.
    b. Explain logical operations using truth tables and ladder logic diagrams.

4. Program all types of internal and discrete instructions.
    a. Program examine on and off instructions.
    b. Program on-delay and off-delay instructions.
    c. Program up-counter and down-counter instructions.
    d. Program sequencer instructions for real-world output devices.
    e. Program latch and unlatch instructions.

5. Demonstrate an understanding of configuring input/output connecting and terminating sensors and field devices.

6. Troubleshoot and maintain different programmable controller systems.
    a. Identify and troubleshoot the power supply.
    b. Identify and troubleshoot the inputs and outputs (I/O) cards.
    c. Identify and troubleshoot real-world inputs and outputs.

SMC ADVANCED MANUFACTURING CERTIFICATION LEVEL I BASIC©
Mechatronics Level I –Basic
Basic Programmable Controllers

- Demonstrate an understanding of PLC operation and memory organization.
- Install and field wire common PLC hardware.
    - Network Modules
    - Discrete I/O modules
    - Analog I/O Modules
    - Specialty Modules
- Explain various number systems and instructions present in current PLCs.

    - Binary
    - Octal
    - Decimal
    - Hexadecimal
    - Program all basic instruction common to all PLC platforms.
    - (Allen Bradley Examples)
    - XIC & XIO (input Instructions)
    - OTE, OTL, OUT (output Instructions)
    - TON, TOF, RTO (Timer Instructions)
- Troubleshoot a complex automated system that incorporates PLCs of different platforms communicating with each other.
- Discuss GRAFCETs (Functional Control Graph of Steps and Transitions).

Course Number and Name: **EET 2373 Programmable Logic Controllers Multi-Platform**

Description: This course covers use of programmable logic controllers (PLCs) in modern industrial settings as well as the operating principles of PLCs and practice in the accelerated programming across multiple PLC platforms, installation and maintenance of PLCs.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Explain principles of PLCs.
    a. Identify components and operational principles of PLCs.
    b. Differentiate between a PLC and a computer.
2. Identify different types of PLC hardware.
    a. Identify and wire different types of input and output modules.
    b. Identify different types of PLC processor modules, memory capabilities and programming devices.
3. Explain numbering systems, encoding / decoding, and logical operations.
    a. Convert numbers from one system to another.
    b. Explain logical operations using truth tables and ladder logic diagrams.
4. Program different types of internal and discrete instructions.
    a. Program examine on and off instructions.
    b. Program on-delay and off-delay instructions.
    c. Program up-counter and down-counter instructions.
    d. Program sequencer instructions for real-world output devices.
    e. Program latch and unlatch instructions.
5. Demonstrate an understanding of configuring inputs and outputs, connecting sensors, and reading and controlling field devices.
    a. Identify and troubleshoot the power supply.
    b. Identify and troubleshoot the inputs and outputs.
    c. Identify and troubleshoot real-world inputs and outputs.
6. Use program control instructions and subroutines to control program function.

7. Use math instructions to manipulate outputs of a program.

    a. Enter and edit a PLC program that uses the add instruction.

    b. Enter and edit a PLC program that uses the add instruction.

    c. Enter and edit a PLC program that uses the multiply instruction.

    d. Enter and edit a PLC program that uses the divide instruction.

    e. Enter and edit a PLC program that uses a data move instruction.

Course Number and Name: **EET 2374 Advanced Robotics**

Description: This course provides advanced instruction to microcontrollers and robotics, with a focus on the operation and execution of a robotic system. This course will be project and team based. Students will work in groups to design, program, and execute their robotic design. Students will present their designed robot, along with a PowerPoint presentation at the end of the course..

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	1	4	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate safety procedures used in the automated environment
    a. Apply safety rules for person and general shop safety including eye, ear, and body protection; general rules for shop conduct; and the use of safety color coding
    b. Apply general safety rules for tool and equipment use including hand tools, air, and electric power tools, and other shop equipment
    c. Apply general safety rules associated with working on various robotics systems

2. Students will build and program a robot of their design
    a. Come up with a real world application of the robot they would like to design
    b. Program robots with Robot C, Basic, or C+
    c. Design a PowerPoint presentation for the project
    d. Present their project at the end of the course

Course Number and Name: **EET 2383 Advanced Programmable Logic Controllers**

Description: Advanced PLC course that provides instruction in the various operations, installations, and maintenance of electric motor controls. Also, information in such areas as sequencer, program control, introduction to function blocks, sequential function chart, introduction to HMI, and logical and conversion instructions.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Program all types of high order instructions.

    a. Calculate and develop mathematical instructions to include addition, subtraction, multiplication, and division.

    b. Program and set up a chart for input and output sequencer combination.

    c. Program and set up an analog input and output card using PLC software.

    d. Explain the use of function block and sequential function blocks in a programmable logic controller.

    e. Demonstrate the ability to develop a basic Human to Machine Interface (HMI) project.

    f. Program and demonstrate how to set up a produce and consume tab/message.

2. Troubleshoot advanced PLC controls.

    a. Troubleshoot an analog input and output card.

    b. Troubleshoot communication devices used in networking.

Course Number and Name: **EET 2414 Electronic Communications**

Description: This course is designed to provide the student with concepts and skills related to analog and digital communications. Topics covered include amplitude and frequency modulation, transmission, and reception; data transmission formats and codes; and modulation demodulation of digital communications.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Explain the operation of the components of a communication system.
    a. Explain and demonstrate the operation of radio frequency (RF) amplifiers.
    b. Explain and demonstrate the operation of RF oscillators.
    c. Explain and demonstrate the operation of RF filters.
    d. Explain and demonstrate the operation of RF mixers.
    e. Explain and demonstrate the operation of a phase-locked loop.
    f. Demonstrate how these components are used together to implement a receiver and a transmitter.

2. Explain and perform signal and noise analysis.
    a. Convert between dB and voltage gain ratios and between dB and power gain ratios.
    b. Use dB and dBm to express the gain and power level of cascaded stages.
    c. Explain electrical noise and noise figures, and calculate noise figures for cascaded systems.
    d. Explain and calculate noise floor and signal to noise ratio for components and systems.
    e. Explain and use the power spectrum to represent RF signals.

3. Analyze and demonstrate the characteristics and operation of amplitude modulation (AM) systems.
    a. Explain and graph AM signals in time and frequency domains.
    b. Explain and calculate modulation index for AM.
    c. Explain AM generation and detection.
    d. Analyze and demonstrate an AM transmitter/receiver link.
    e. Explain and graph AM SSB signals in time and frequency domains.
    f. Explain AM SSB generation and detection.
    g. Analyze and demonstrate an AM SSB transmitter/receiver link.

4. Analyze and demonstrate the characteristics and operation of frequency modulation (FM) systems.
    a. Describe and graph FM signals in time and frequency domains.
    b. Explain and calculate modulation index for FM.
    c. Explain FM generation and detection.
    d. Explain stereo FM systems.
    e. Analyze and demonstrate an FM transmitter/receiver link.

5. Analyze and demonstrate the characteristics and operation of digital modulation.
    a. Analyze and explain pulse modulation systems.

b. Analyze and explain frequency shift keying systems.
c. Analyze and explain phase shift keying systems to include BPSK, QPSK, and higher orders.
d. Analyze and explain quadrature amplitude modulation systems to include higher orders.
e. Analyze and explain error correcting codes.

6. Analyze and explain the characteristics of wave propagation, antennas, and transmission lines.
a. Explain the characteristics of a transmission line, and represent it by an equivalent circuit.
b. Explain wave propagation through transmission lines.
c. Explain wave reflections and standing waves in transmission lines.
d. Analyze and demonstrate electromagnetic wave propagation.
e. Analyze and explain the characteristics of various types of antennas.

ASSOCIATE C.E.T. (CETa) - COMPETENCY LISTING BASIC ELECTRONICS CERTIFICATION

10.0 Radio Communications Technology

10.1 Explain wave propagation and its importance to wireless communications

10.2 Describe the theory of how antennas work; list the types of transmission lines

10.3 Explain polarization, electromagnetic and electro-static fields and their relationships to each other

10.4 Explain the differences between AM, FM radio and TV signals

10.5 Describe the differences in the usage of communications radios and commercial broadcast receivers

10.6 Describe the major radio receiver circuitry sections

10.7 List common frequency bands

10.8 Demonstrate radio circuit tuning and adjustments

10.9 Demonstrate the relationships between frequency and wavelength

17.0 Audio and Video Systems

17.1 Explain major components of the most common home entertainment products

17.2 Describe microphone technology and usage

17.3 Explain speaker construction and precautions

17.4 Explain basic recording and playback products operation, mechanical and electrical technology

17.5 Explain the difference between individual home entertainment products and the Home Theater concept

17.6 Explain how alarm security systems may be interfaced with entertainment/information products

17.7 Describe the differences between cable TV, off-air broadcast and telephone signals

17.8 Describe the differences between good quality and distorted sound and electronic/acoustical reason for each

17.9 Explain how signals may conflict and the symptoms the conflict may produce

17.10 Explain how to isolate troubles between discrete equipment units

19.0 Telecommunications Basics

19.1 Describe major types of two-way radio communications (avionics, land mobile, maritime, etc.)

19.2 Describe wireless telephone/video/data technology basics and list the TIA-EIA standard which applies

19.3 Describe satellite communi8cations principles

19.4 Describe wired data and voice communications network technology

Course Number and Name: **EET 2423 Fundamentals of Fiber Optics**

Description: Fiber-optic cable in modern industry applications

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Describe the history and advantages of fiber-optic systems.
    a. Describe the limitations of wire communications systems.
    b. Describe the technical developments making optical fiber communications feasible to include bandwidth capabilities.
    c. List the advantages of optical fiber communications over electrical wire communications.

3. Explain the operation and application of optical signal sources.
    a. Apply appropriate safety practices to optical signal sources.
    b. Explain the advantages and disadvantages of LEDs as optical signal sources.
    c. Describe the principle of operation of semiconductor lasers.
    d. Explain the advantages and disadvantages of lasers as optical signal sources.
    e. Explain the operation of modulator circuits for optical signal sources.

4. Explain the operation and application of fiber-optic system components.
    a. Describe the construction of optical fibers.
    b. Explain optical fiber cable specifications.
    c. Describe the operation of detectors used in fiber-optic systems.
    d. Explain the operating principle and purpose of transceivers and repeaters.

5. Explain the theory of light propagation in vacuum and in optical fiber.
    a. Explain the modes of optical fiber light transmission.
    b. Describe the light loss mechanisms that occur in optical fibers.
    c. Describe the use of Snell's law as it relates to fiber optics.
    d. Describe dense wavelength division multiplexing (DWDM).

6. Describe properties of different types of optical fibers.
    a. Differentiate between the properties and characteristics of plastic and glass optical fibers.
    b. Describe the effect of core size on efficiency and bandwidth.
    c. Describe fiber-optic cables available for indoor and outdoor installation.
    d. Prepare and complete a splice of fiber-optic cable following industry standards and safety procedures.
    e. Describe requirements for certification as a fiber-optic technician.

5.0 Cabling

5.5 Explain major differences between copper, coaxial and fiber optic cables

18.0 Optical Electronics

18.1 List common electronics display devices

18.2 Explain the operation of a kinescope

18.3 Explain how LCD displays operate, their advantages and disadvantages

18.4 Explain the basics of electronic cameras and sensors

18.5 Describe how LED remote hand units work

18.6 Describe plasma TV technology and its uses in TV and computer displays

18.7 Explain why and list some locations or circuits in which opto-isolators are used

18.8 List uses for light activated controls and how photo devices are incorporated

18.9 Describe how broadband signal RF and optical link are used

Course Number and Name: **EET 2433 Physics for Electronics**

Description: Coverage of those areas of physics that have applications in electronics

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate an understanding of vectors.
    a. Describe the two components of a vector.
    b. Combine vectors to produce a resultant vector.

2. Demonstrate an understanding of mechanics.
    a. Define velocity and acceleration.
    b. Define force.
    c. Describe Newton's laws of motion.
    d. Define work, energy, momentum, and power.
    e. Define friction.
    f. Calculate the centrifugal force on an object in circular motion.
    g. Define torque.

3. Demonstrate an understanding of the mechanical properties of matter.
    a. Describe the structure of matter.
    b. Describe the properties of solids, liquids, and gases.

4. Demonstrate an understanding of heat and thermodynamics.
    a. Define temperature.
    b. Describe methods for measuring heat.
    c. Describe the change of state of matter relative to temperature.
    d. Define heat conduction, convection, and radiation.
    e. Describe the refrigeration process.

Course Number and Name: **EET 2514 Interfacing Techniques**

Description: Data acquisition devices and systems including their interface to microprocessors and other control systems

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Digital Electronics

Student Learning Outcomes:

1. Describe interfacing standards organizations.
    a. Explain the role of organizations in U.S. Standards Development (i.e., EIA and TIA).
    b. Explain the role of organizations in Global Standards Development (i.e., ANSI).
    c. Explain the application of an RS232 interface.
    d. Explain the application of a GPIB interface.
    e. Explain the application of an HPIB interface.
    f. Explain the application of an IEEE488 interface.

2. Identify signals related to communication ports.
    a. Recognize serial interface standards such as RS232, USB, FireWire, and SATA.
    b. Recognize parallel port standards.
    c. Recognize wireless interfacing standards.

3. Identify signals related to computer peripheral communication ports.
    a. Explain the purpose, capabilities, and fundamental operation of display devices.
    b. Explain the purpose, capabilities, and fundamental operation of a modem.
    c. Explain the purpose, capabilities, and interface standards of storage devices.

4. Explain and demonstrate methods for converting physical variables and interfacing transducers.
    a. Describe and demonstrate the operation and interfacing of optical sensors, temperature sensors, strain gauges, flow sensors, proximity sensors, and Hall-effect sensors.
    b. Describe and demonstrate the operation and interfacing of digital to analog converters and analog to digital converters.

5. Use a microprocessor to evaluate data as a result of physical variables taking place.
    a. Describe D/A operation and parameters (resolution, setting time, accuracy, and linearity).
    b. Draw and connect circuits interfacing D/A with any number of bits to a microcomputer.
    c. Describe A/D operation and parameters.
    d. Draw and connect circuits interfacing A/D converters to a microcomputer.
    e. Describe how feedback is used in control loops.

Course Number and Name: **EET 2823 Digital Television Systems**

Description: Circuits and systems used in the production, transmission, and reception of video information to include color systems and computer-video interfacing

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Describe how a digital television signal is developed and broadcasted.
    a. Name and describe the signals transmitted by a television station.
    b. Explain frequency allocation and how it relates to television signals.
    c. Describe vestigial sideband transmission.
    d. List the channel allocations for VHF and UHF television.
    e. Explain the process whereby colors are differentiated within a video camera and are encoded into a digital bitstream.
    f. Draw the diagram of a typical television station, and describe the function of each block.

2. Describe digital encoding methods for video and audio.
    a. Describe how images are converted into digital bitstreams.
    b. List and describe video and audio compression systems.
    c. List and describe broadcast industry encoding standards.
    d. List and describe the different digital video quality signals, and state the bandwidth required for each type.
    e. Describe the types of subchannels that can be transmitted within terrestrial digital broadcast signals.

3. Describe the operation of a digital television receiver.
    a. Draw the block diagram of a digital television receiver.
    b. Explain the function of each block in the diagram of a digital television receiver.
    c. Explain the function and adjustment of the controls of a digital television receiver.
    d. Describe, analyze, and troubleshoot the power supply in a digital television receiver.
    e. Describe the operation of the tuner in a digital television receiver.
    f. Explain the operation of the digital signal processing section of a digital television receiver.
    g. Explain how the picture is developed on the display.

4. Explain the safety hazards inherent in a television receiver.
    a. Describe the shock hazards associated with high voltages.
    b. Explain when and how an isolation transformer should be used.
    c. Describe the safe way to discharge a high-voltage capacitor.
5. Explain the principles of computer logic applied to TV for producing special effects.
    a. List special effects provided by many TV sets.
    b. Explain how special effects are produced using digital technology.
6. Explain the operation of a video display system.

a. Explain picture quality and resolution.
b. List and describe the different aspect ratios, pixel dimensions, and scanning methods used in modern display systems.
c. List and describe the different methods for producing display images.
d. Explain the difference between vertical and horizontal resolution.
e. Explain why a comb filter contributes to good picture quality.

Course Number and Name: **EET 291 (1-3) Special Project**

Description: Practical application of skills and knowledge gained in other technical courses. The instructor works closely with the student to ensure that the selection of a project will enhance the student's learning experience.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
1-3	0	2-6	30-90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Develop a written plan that details the activities and projects to be completed.
    a. Utilize a written plan that details the activities and projects to be completed.
    b. Perform written occupational objectives in the special project.

2. Assess accomplishment of objectives.
    a. Prepare daily written assessment of accomplishment of objectives.
    b. Present weekly written reports of activities performed and objectives accomplished to the instructor.

3. Utilize a set of written guidelines for the special project.
    a. Develop and follow a set of written guidelines for the special project.

Course Number and Name: **EET 292 (1-6) Supervised Work Experience in Electronics Technology**

Description: This cooperative program between industry and education is designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of 1 semester hour per 45 industrial contact hours

Hour Breakdown:

Semester Credit Hours	Lecture	Externship	Contact Hours
1-6	0	3-18	45-270

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Apply technical skills needed to be a viable member of the workforce.
    a. Prepare a description of technical skills to be developed in the supervised work experience program.
    b. Develop technical skills needed to be a viable member of the workforce.

2. Apply skills developed in other program area courses.
    a. Perform skills developed in other program area courses in the supervised work experience program.

3. Apply human relationship skills.
    a. Practice human relationship skills in the supervised work experience program.

4. Apply and practice positive work habits and responsibilities.
    a. Perform assignments to develop positive work habits and responsibilities.

5. Work with the instructor and employer to develop written occupational objectives to be accomplished.
    a. Perform written occupational objectives in the supervised occupational experience program.

6. Assess accomplishment of objectives.
    a. Prepare daily written assessment of accomplishment of objectives.
    b. Present weekly written reports of activities performed and objectives accomplished to the instructor.

7. Utilize a set of written guidelines for the supervised work experience.
    a. Develop and follow a set of written guidelines for the supervised work experience.

Course Number and Name: **TCT 1114 Fundamentals of Telecommunications**

Description: History of voice/data communication, fundamental concepts of analog and digital communications, and basic telephone service

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	3	2	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Discuss the history and development of voice/data communications.
    a. Define telecommunications systems, and describe their identifying characteristics.
    b. Identify and describe the principal types of telecommunication systems available today.
    c. Explain the interrelationship between communications technology and computer technology and its effect upon both industries.
    d. Discuss historical telecommunications policy in the United States and the factors leading to its modification.
    e. Describe the restructuring of the telecommunications industry.
    f. Discuss education and career opportunities in telecommunications.
    g. Define and discuss common carriers.
    h. Discuss the origin and the present status of the interconnect industry.
    i. Discuss the origin and present status of specialized common carriers.
    3. Define, describe, and discuss all aspects of basic telephone service.
    a. Describe the principal parts of the telephone, and explain the function of each.
    b. Define central office, and explain its purpose.
    c. Describe the evolution of telephone switching equipment.
    d. Describe the characteristics of analog and digital signals.
    e. Describe the nationwide and worldwide numbering systems.
    f. Name and describe the principal types of telephone systems, telephone sets, and service features.
    g. Assemble/disassemble telephone sets.
    h. Perform functionality tests on a telephone set.

3. Define, describe, and discuss fundamental concepts of analog communications.
    a. Identify and describe the characteristics of analog signals.
    b. Identify and describe the characteristics of noise to include impulse noise and thermal noise.
    c. Identify bands in the electromagnetic spectrum.
    d. Identify and describe continuous wave (CW) transmission, amplitude modulation (AM) transmission, frequency modulation (FM) transmission, and phase modulation (PM) transmission.

e. Describe modulation index and sidebands for AM and FM signals.
f. Identify and describe the characteristics of transmission lines.

4. Define, describe, and discuss fundamental concepts of digital communications.
   a. Differentiate between analog and digital signals.
   b. Describe the major concepts of digital communications including modems, PAM, PWM, PPM, DM, PCM, PSK, FSK, QAM, and DSP.
   c. Discuss the basic modes of transmission and their relation to various types of transmission media.
   d. Define data communications systems, and explain their purpose.
   e. Discuss and distinguish between the different types of data processing.
   f. Discuss the interrelations of different technologies associated with local and long distance telephone services.
   g. Identify and locate data communications specific parts of a typical computer system.

5. Define, describe, and discuss telecommunications traffic engineering, management, and system implementation.
   a. Discuss traffic engineering as it relates to telecommunications.
   b. Discuss busy-hour traffic and peak traffic as it relates to the prediction of future telephone usage and needs.
   c. Describe the basic functions and skills required of a telecommunications manager.
   d. Describe and discuss telecommunications policy as it relates to telephone usage.
   e. Describe the role of the telecommunications manager.
   f. Describe the implementation of a new telephone system, and describe the function of a consultant in this process.

CTNS: Certified Telecommunications Network Specialist
Course 2206 Wireless Telecommunications

Course Number and Name: **TCT 2244 Fundamentals of Telephony**

Description: Understand telephone companies and the telephone network, regular telephone service, how calls are established end –to end, network equipment, the outside plant, loops , remotes, Cos and telephony jargon and buzzwords.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	3	2	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Explain and analyze all aspects of basic telephone service.
    a. Explain the principal parts of the telephone and the function of each.
    b. Explain central office and its purpose.
    c. Explain the evolution of telephone switching equipment.
    d. Analyze the characteristics of analog and digital signals.
    e. Explain the nationwide and worldwide numbering systems.
    f. Differentiate between landline and wireless telephone systems.
    g. Troubleshoot telephone sets.
    h. Differentiate between POTS and PSTN and describe their main components.
    i. Analyze the founding, break-up and re-emergence of AT&T in the US: TELUS and Bell Systems in Canada.

3. Explain and test the operation and installation of key systems.
    a. Describe the key system's advantages, components and their functions, voltages, and operation.
    b. Describe the uses and limitations of block diagrams as they relate to installation.
    c. Develop an installation plan to include results of the site survey, floor plans, set locations, equipment locations, list of materials, and cost.
    d. Locate, identify, and interpret blueprint symbols for telephone installation.
    e. Install a key system using the proper tools, following manufacturer's specifications, following proper grounding procedures, and following all applicable safety practices.
    f. Explain how and why remotes are used; and analyze how fiber is developed for neighborhoods.
    g. Identify malfunctions in the key system using approved troubleshooting procedures, and make repairs as necessary

4. Explain and test the operation and installation of digital key systems.
    a. Identify and describe the advantages, components and their functions, voltages, and operation.
    b. Describe the uses and limitations of block diagrams as they relate to installation.
    c. Explain and define the use and interconnection of data communications systems with a

digital key system including fiber interface, ISDN, and T-1's.
d. Explain and outline network protocol as it pertains to the digital key system interaction with data communications networks.
e. Develop an installation plan including results of the site survey, floor plans, set locations, equipment locations, list of materials, and cost.
f. Install a key system using the proper tools, following manufacturer's specifications, following proper grounding procedures, and following all applicable safety practices.
g. Identify malfunctions in the digital key system using approved troubleshooting procedures, and make necessary repairs.
h. Explain why telecom networks are divided into local access wiring and long-distance transmission.
i. Describe how and explain why the telephone system can limit frequencies to the voice band.

5. Explain and test the operation of a PBX system.
   a. Identify and explain the parts of a PBX system.
   b. Explain the function of PBX circuits.
   c. Explain PBX features.
   d. Inspect PBX circuits.
   e. Explain telephony using the Internet protocol (voice-over IP).
   f. Analyze examples of sophisticated call routing using SS7.
   g. Explain touch-tone dialing and how DTMF works.

Course Number and Name: **TCT 2354 Fundamentals of Wireless Technology**

Description: Theories and applications of digital communications and analog pulse modulation

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Explain, calculate, and measure the characteristics of purely digital communication.
    a. Explain and analyze why radio frequencies are in the Gigahertz range, used within frequency bands measured in the Megahertz wide range.
    b. Examine old-fashioned analog radio and TV, and analyze what most systems use today.
    c. Explain and calculate bit rate and bit time for baseband communication.
    d. Identify and explain digital encoding methods.
    e. Encode binary data using digital encoding methods.
    f. Identify and explain the characteristics and differences of asynchronous and synchronous data transmission.
    g. Identify and explain the characteristics and differences of error detection and correction methods used in data communications.
    h. Identify serial communication standards, and explain the digital encoding method, synchronization method, error detection method, typical media, and packet structure for each standard.

3. Define and analyze spectrum as it relates to radio frequencies allocated to the mobile industry and other sectors for communication over the airwaves.
    a. Differentiate between standardized bands of frequencies, and explain how they are allocated when it requires license for operation.
    b. Examine which bands are used for cordless phones, to WiFi, and cellular, including the new 700-MHz bands.
    c. Explain and perform experiments to compare ideal and practical band-limited systems.
    d. Compare and perform experiments to measure the relationship between noise power and noise bandwidth.

4. Explain, define, and measure and troubleshoot different radio transmission issues.
    a. Explain and analyze the radio propagation model and its characteristics.
    b. Define, explain, and analyze radio frequency penetration through physical barriers.
    c. Define, explain, and analyze fading and its variables in communications.
    d. Explain and perform experiments to generate pulse width modulation (PWM) and pulse position modulation (PPM) signals.
    e. Define, explain, and perform experiments to determine the effects of noise and band limiting

on PWM/PPM.
f. Troubleshoot the PWM/PPM communications system.
g. Troubleshoot the PWM/PPM communications system.

Course Number and Name: **TCT 2364 Wireless Telecommunications Technology**

Description: Theories and applications of digital modulation methods and digital pulse modulation methods

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Explain, define, and measure the cellular principles and AMPS (1G).
    a. Explain, define, and measure Coverage, capacity and cellular radio systems.
    b. Define mobility, spectrum, and FDM spectrum sharing; perform experiments to compare the relationship between frequency and time characteristics.
    c. Examine and explain spectrum-sharing technologies such as FDMA, TDMA, CDMA, and OFDM.
    d. Explain the basic ideas behind CDMA and its operation in relation to 1X vs. UMTS standards (3G Cellular CDMA).
    e. Define and analyze digital cellular operations and data communications as it relates to the use of RF modems and analyze the method of tethering using the antenna of a cell phone.
    f. Examine Steve Jobs OFDM basic principles of operations relative to the development of 4G Mobile Cellular LTE.
3. Explain, and analyze mobile network components, configuration, jargon and basic operations.
    a. Identify and explain handsets, base stations, air-link, handoffs, and connection wireline systems.
    b. Explain and differentiate between the basic principles of communication satellites in relation to geosynchronous and LEO.
    c. Identify and explain the basic principles of operation for 802.11 Wireless LANs, 802.11 standards, and frequency bands and limitations.

4. Explain, calculate, and measure the characteristics of digital communication methods used to convey analog signals.
    a. Analyze components and operation of a digital radio; microphone, codec, RF modem, and antennas.
    b. Explain, calculate, and measure the characteristics of purely analog communication.
    c. Identify and explain the characteristics and differences of analog and digital signals.
    d. Identify and explain the characteristics of noise.
    e. Explain, calculate, and measure the gain, decibel gain, bandwidth, and signal-to-noise ratio of amplifier circuits and filters.
    d. Identify bands in the electromagnetic spectrum.

5. Explain, calculate, and measure the characteristics of analog communication methods used to convey digital information.
    a. Identify and explain the methods used to digitally modulate analog carrier signals.
    b. Identify digital modulation constellations.
    c. Identify which digital modulation methods are used in wireless communications.
    d. Identify which digital modulation methods are used over wires.

e. Explain the operation of telephone modems.
f. Identify international telephone modem standards.
g. Configure a telephone modem.
h. Communicate over a telephone connection using the configured modem.
i. Identify cable modem standards and explain how cable modems communicate.
j. Explain digital subscriber line (DSL) communications.

Course Number and Name: **TCT 2414 Microwave and Satellite Systems**

Description: Theories and applications of microwave and satellite communications.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	3	2	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Identify and explain general wireless communications and microwave concepts.
    a. Explain and calculate period, frequency, and wavelength.
    b. Identify the standard frequency bands within the electromagnetic spectrum.
    c. Identify the frequency band within the microwave spectrum.
    d. Compare advantages and disadvantages of communicating with microwaves.
    e. Draw block diagrams of a typical microwave radio transmitter and receiver system, and explain the operation of each.

3. Identify and describe functions of microwave system components.
    a. Identify and explain the functions of discrete microwave electronic components.
    b. Identify and explain transmission lines and components made from microstrip and stripline.
    c. Calculate frequency values of microstrip and stripline circuit elements.
    d. Compare advantages and disadvantages of different types of microwave transmission lines.
    e. Identify and explain the use of the different types of microwave antennas.
    f. Explain the operation of different types of microwave oscillators and amplifiers.
    g. Identify and explain the operation of low-noise amplifiers in microwave receivers.

4. Identify and explain microwave applications.
    a. Explain the operation of terrestrial microwave communication systems.
    b. Explain the difference among terminal, junction, and point-to-point relay stations used in terrestrial microwave communication systems.
    c. Explain the operation of microwave satellite communication systems.
    d. Identify the types of satellite systems, and explain their functions and differences.
    e. Draw and explain block diagrams of up-link and down-link satellite systems.
    f. Draw and explain a block diagram of a typical communication satellite.
    g. Explain the basic principles of microwave satellite transmission and reception.
    h. Set up C-band and KU-band television receive only (TVRO) satellite systems.
    i. Troubleshoot a TVRO system.
    j. Explain the commercial applications of mobile and fixed TVRO downlinking.
    k. Explain the basic principles of RADAR.
    l. Identify the different types of RADAR systems in common use.

m. Calculate distances and speeds of RADAR targets given echo return times and frequency shifts.
5. Identify and discuss cellular telephone systems.
a. Draw and explain a block diagram of a cellular telephone system illustrating the process and equipment used in transmitting and receiving calls.
b. Describe the process by which cellular telephones are interfaced with the public switched system.

Course Number and Name: **TCT 2424 Network Systems**

Description: Networking fundamentals, voice networking, LANs, and the Internet. Also covered is upgrading of computers to support LAN technology.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate and practice general safety procedures in the school and work-site environments.
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards.

2. Discuss, describe, and apply network fundamentals and install network software.
    a. Discuss the history of telecommunication's networking.
    b. Discuss the handling and routing of calls.
    c. Discuss and/or define standards and terminology.
    d. Discuss network architectures and OSI.
    e. Discuss, define, and relate analog and digital signals to networking.
    f. Discuss, describe, and relate transmission media to networking.
    g. Prepare both network hardware and software for computer installation.
    h. Identify proper card slots for hardware installation.
    i. Identify computer RAM and hard drive capabilities for operation of network software.
    j. Discuss network security.

3. Discuss Internetworking devices.
    a. Explain multiplexers.
    b. Identify the uses of repeaters.
    c. Examine the uses of bridges and gateways.
    d. Describe the uses of routers and brouter.
    e. Analyze the uses of hubs and switches.
    f. Discuss wireless networking equipment.
    g. Explain the uses of CSU/DSU.

4. Discuss and describe voice networks, and troubleshoot network communications interface.
    a. Discuss the public and private switching telephone network.
    b. Discuss and describe voice processing and call distribution.
    c. Discuss and describe T1 networks.
    d. Discuss and describe virtual networks.
    e. Install network hardware and software.
    f. Troubleshoot a network communications interface
    g. Prepare both network hardware and software for computer installation.
    h. Identify proper card slots for hardware installation.
    i. Identify computer RAM and hard drive capabilities for operation of network software.

5. Discuss, describe, and identify wide area networks.

a. Discuss and diagram switched networks, frame relay, and ATM.
b. Discuss and diagram signaling system 7 and VOIP.
c. Discuss, operate, and troubleshoot an ISDN and SONET network media.

6. Discuss, install, and troubleshoot LANs.
    a. Discuss and describe LANs.
    b. Discuss network software.
    c. Install a LAN system and verify for operation.
    d. Discuss and define network protocols.
7. Access the Internet.
    a. Perform network experiments with e-mail.
    b. Discuss and interconnect with LANs.

Course Number and Name: **TCT 291(1-4) Special Project**

Description: Practical application of skills and knowledge gained in other telecommunications or telecommunications-related technical courses. The instructor works closely with the student to ensure that the selection of a project will enhance the student's learning experience.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
1-4	0	2-8	30-120

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Develop a written plan that details the activities and projects to be completed.
    a. Utilize a written plan that details the activities and projects to be completed.
    b. Perform written occupational objectives in the special project.

2. Assess accomplishment of objectives.
    a. Prepare daily written assessment of accomplishment of objectives.
    b. Present weekly written reports of activities performed and objectives accomplished to the instructor.

3. Utilize a set of written guidelines for the special project.
    a. Develop and follow a set of written guidelines for the special project.

Course Number and Name: **TCT 292 (1-6) Supervised Work Experience**

Description: This cooperative program between industry and education is designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of 1 semester hour per 45 industrial contact hours.

Hour Breakdown:

Semester Credit Hours	Lecture	Externship	Contact Hours
1-6	0	3-18	45-270

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Apply technical skills needed to be a viable member of the workforce.
    a. Prepare a description of technical skills to be developed in the supervised work experience program.
    b. Develop technical skills needed to be a viable member of the workforce.

2. Apply skills developed in other program area courses.
    a. Perform skills developed in other program area courses in the supervised work experience program.

3. Apply human relationship skills.
    a. Practice human relationship skills in the supervised work experience program.

4. Apply and practice positive work habits and responsibilities.
    a. Perform assignments to develop positive work habits and responsibilities.

5. Work with the instructor and employer to develop written occupational objectives to be accomplished.
    a. Perform written occupational objectives in the supervised occupational experience program.

6. Assess accomplishment of objectives.
    a. Prepare daily written assessment of accomplishment of objectives.
    b. Present weekly written reports of activities performed and objectives accomplished to the instructor.

7. Utilize a set of written guidelines for the supervised work experience.
    a. Develop and follow a set of written guidelines for the supervised work experience.

RECOMMENDED TOOLS AND EQUIPMENT

CAPITALIZED ITEMS

1. Cable tester (CAT-5 and coax) (1 per 2 students)
2. Computer with software (1 per 2 students)
3. Digital communications trainer CAI/breadboard (1 per 2 students)
4. Locking storage cabinet
5. Microwave communications trainer CAI/breadboard (1 per 2 students)
6. Printer for computer (1 per 4 stations)
7. Oscilloscope (1 per 2 students
8. Spectrum analyzer (1 per lab)
9. Student tool kit (1 per 2 students) to include the following:
    a. Digital multi-meter
    b. Optical power meter
    c. Punch-down tool (66 and 110 blocks)
    d. Crimping tool, coax
    e. Adjustable wrench
    f. Drill bit set: 14 pieces
    g. Flashlight
    h. Hammer: Claw
    i. Pliers: Bent-nose, diagonal, long-nose, needle-nose, locking, and slip-joint
    j. Nut driver set
    k. Screwdriver sets: Offset, Phillips, slotted, jewelers, and torx
    l. Wire stripper
    m. Coax cable stripper
    n. Socket set: Metric and standard
    o. Tape measure: 25-ft
    p. Wrench set: Metric and standard
    q. Safety goggles
    r. Telephone test set (butt set)
    s. Tone generator (1)
    t. Crimping tool, RJ 11/RJ 45
    u. Tool box
10. Telephone communications trainer CAI/breadboard (1 per 2 students)
11. Time domain reflectometer (TDR) (1 per program)
12. Work benches (1 per 2 students)
13. LCR meter (1 per lab)
14. Soldering iron (1 per station)
15. PCB prototyping equipment (1 per lab)
16. Thermal imaging camera

NON-CAPITALIZED ITEMS

1. Dummy load, microwave (1 per station)
2. Electric drill (1)
3. SWR meter (1 per station)
4. Telephone analyzer (1)
5. Vacuum cleaner (wet/dry) (1 per program)

RECOMMENDED INSTRUCTIONAL AIDS

It is recommended that instructors have access to the following items:

1. Computer for computer-aided instruction (printers, cables, A/B box, etc.) (1)
2. Monitor (1)
3. DVD player and cart (1)
4. Data projector
5. Smart Board system (1)

CURRICULUM DEFINITIONS AND TERMS

- Course Name – A common name that will be used by all community colleges in reporting students

- Course Abbreviation – A common abbreviation that will be used by all community and junior colleges in reporting students

- Classification – Courses may be classified as the following:
    - Career Certificate Required Course – A required course for all students completing a career certificate.
    - Technical Certificate Required Course – A required course for all students completing a technical certificate.
    - Technical Elective – Elective courses that are available for colleges to offer to students.

- Description – A short narrative that includes the major purpose(s) of the course

- Prerequisites – A listing of any courses that must be taken prior to or on enrollment in the course

- Corequisites – A listing of courses that may be taken while enrolled in the course

- Student Learning Outcomes – A listing of the student outcomes (major concepts and performances) that will enable students to demonstrate mastery of these competencies

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
    - Additional competencies and objectives within the course related to topics not found in the state framework, including activities related to specific needs of industries in the community college district
    - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
    - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised
    - Activities that include integration of academic and career–technical skills and course work, school-to-work transition activities, and articulation of secondary and postsecondary career–technical programs
    - Individualized learning activities, including work-site learning activities, to better prepare individuals in the courses for their chosen occupational areas

- Sequencing of the course within a program is left to the discretion of the local college. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors. Programs that offer an Associate of Applied Science Degree must include all of the required Career Certificate courses, Technical Certificate courses **AND** a minimum of 15 semester hours of General Education Core Courses. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester. Each community college specifies the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college.

- In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:

    - Adding new student learning outcomes to complement the existing competencies and suggested objectives in the program framework
    - Revising or extending the student learning outcomes
    - Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the Mississippi Community College Board [MCCB] of the change)

COURSE CROSSWALK

Course Crosswalk Electronics and Related Engineering Technology CIP 15.0303 Electrical, Electronic, and Communications Engineering Technology CIP 15.0305 Telecommunications Technology CIP 47.01010 Biomedical Equipment Repair Technology CIP 47.0105 Industrial Electronics Technology/ Technician					
Note: Courses that have been added or changed in the 2017 curriculum are highlighted.					
Existing			**Revised**		
2011 MS Curriculum Framework			**2017 MS Curriculum Framework**		
Course Number	**Course Title**	**Hours**	**Course Number**	**Course Title**	**Hours**
CET 1113	Satellite Systems	3		Deleted	
CET 2223	Diagnostics and Troubleshooting Lab	3		Deleted	
CET 2323	Video Recording Systems Lab	3		Deleted	
CET 2823	Video System Repair Lab	3		Deleted	
CET 291 (1-3)	Special Project	(1-3)		Deleted	
CET 292 (1-6)	Supervised Work Experience	(1-6)		Deleted	
CPT 1113	Fundamentals of Microcomputer Applications	3		Deleted	
EET 1114	DC Circuits	4	EET 1114	DC Circuits	4
EET 1123	AC Circuits	3	EET 1123	AC Circuits	3
			EET 1143	Commercial and Industrial Wiring	3
			EET 1145	DC/AC Circuits	5
EET 1133	Electrical Power	3	EET 1133	Electrical Power	3
EET 1143	Commercial and Industrial Wiring	3			
EET 1153	IT Foundations	4		Deleted	
EET 1154	Equipment Maintenance, Troubleshooting, and Repair	4	EET 1154	Equipment Maintenance, Troubleshooting, and Repair	4
EET 1163	Motor Maintenance and Troubleshooting	3	EET 1163	Motor Maintenance and Troubleshooting	3
EET 1174	Fluid Power	4	EET 1174	Fluid Power	4
EET 1192	Fundamentals of Electricity	2	EET 1192	Fundamentals of Electricity	2
EET1214	Digital Electronics	3	EET1214	Digital Electronics	3
EET 1233	Computer Servicing Lab I	3	EET 1233	Computer Servicing Lab I	3
EET 1243	Operating Platforms	3	EET 1243	Operating Platforms	3
EET 1253	Systems Maintenance	3	EET 1253	Systems Maintenance	3
EET 1311	Orientation to Biomedical Equipment Repair	1	EET 1311	Orientation to Biomedical Equipment Repair	1
EET 1324	Microprocessors			Replaced with EET 1363 Microcontrollers	
EET 1334	Solid State Devices and	4	EET 1334	Solid State Devices and Circuits	4

	Circuits				
EET 1343	Motor Control System	3	EET 1343	Motor Control System	3
EET 1353	Fundamentals of Robotics	3	EET 1353	Fundamentals of Robotics	3
			EET 1363	Microcontrollers	3
EET 1413	Mathematics for Electronics	3	EET 1413	Mathematics for Electronics	3
EET 1443	Fundamentals of Instrumentation	3	EET 1443	Fundamentals of Instrumentation	3
EET 1613	Computer Fundamentals for Electronics/ Electricity	3	EET 1613	Computer Fundamentals for Electronics/ Electricity	3
EET 1713	Drafting for Electronics/ Electrical Technology	3	EET 1713	Drafting for Electronics/ Electrical Technology	3
EET 211 (3-6)	Supervised Work Experience in Biomedical Equipment Repair Technology I	1-6	EET 211 (3-6)	Supervised Work Experience in Biomedical Equipment Repair Technology I	1-6
EET 222 (3-6)	Supervised Work Experience in Biomedical Equipment Repair Technology	3-6	EET 222 (3-6)	Supervised Work Experience in Biomedical Equipment Repair Technology	3-6
EET 2233	Computer Servicing Lab II	3	EET 2233	Computer Servicing Lab II	3
EET 2334	Linear Integrated Circuits	4	EET 2334	Linear Integrated Circuits	4
EET 2354	Solid State Motor Control	4	EET 2354	Solid State Motor Control	4
EET 2363	Programmable Logic Controllers	3	EET 2363	Programmable Logic Controllers	3
			EET 2373	Programmable Logic Controllers Multi-Platform	3
			EET 2374	Advanced Robotics	4
			EET 2383	Advanced Programmable Logic Controllers	3
EET 2414	Electronic Communications	4	EET 2414	Electronic Communications	4
EET 2423	Fundamentals of Fiber Optics	3	EET 2423	Fundamentals of Fiber Optics	3
EET 2433	Physics for Electronics	3	EET 2433	Physics for Electronics	3
EET 2514	Interfacing Techniques	4	EET 2514	Interfacing Techniques	4
EET 2823	Digital Television Systems	3	EET 2823	Digital Television Systems	3
EET 291 (1-3)	Special Project	1-3	EET 291 (1-3)	Special Project	1-3
EET 291 (1-6)	Supervised Work Experience in Electronics Technology	1-6	EET 291 (1-6)	Supervised Work Experience in Electronics Technology	1-6
EET 292 (1-6)	Supervised Work Experience in Electronics Technology	1-6	EET 292 (1-6)	Supervised Work Experience in Electronics Technology	1-6
TCT 1114	Fundamentals of Telecommunication	4	TCT 1114	Fundamentals of Telecommunication	4
TCT 2214	Telephone Systems	4	TCT 2214	Telephone Systems	4
TCT 2224	PBX System	4	TCT 2224	PBX System	4
			TCT 2244	Fundamental of Telephony	4
TCT 2314	Digital Communication I	4	TCT 2354	Fundamentals of Wireless Technology	4
TCT 2324	Digital Communication II	4	TCT 2364	Wireless Telecommunications Technology	4
TCT 2414	Microwave and Satellite Systems	4	TCT 2414	Microwave and Satellite Systems	4
TCT 2424	Network Systems	4	TCT 2424	Network Systems	4
TCT 291	Special Project	(1-4)	TCT 291 (1-	Special Project	(1-4)

(1-4)			4)		
TCT 292 (1-6)	Supervised Work Experience	(1-6)	TCT 292 (1-6)	Supervised Work Experience	(1-6)