PASSAIC COUNTY TECHNICAL INSTITUTE

ELECTRONICS I

CURRICULUM GUIDE

JANUARY 2012

I. Course Description – Electronics I

Electronics I is an introductory level course designed to provide the student with skills and knowledge in the electronics industry and fundamentals of basic electricity. Course goals are to provide an understanding of practical applications of electrical/electronics concepts and principles, sound laboratory, history of inventors, safety procedures, and industry digital electronic systems in a growing technological society.

Students will be provided instruction on comprehensive theory, careers in the electronics industry, proper tool and equipment use, troubleshooting techniques, and employability skills. Lab activities are designed to reinforce problem solving, team building, Language Arts, Science, and Mathematics skills through real-life industry examples and procedures. Students will learn about the history, the current standards and the future trends of the electronics industry via visits to museums, universities, engineering firms, government agencies and technological fairs and competitions.

Preparation for students to obtain a Federal Communications Commission General Radiotelephone Operators License is also a core standard for electronic students. Successful candidates are then eligible for career opportunities in aeronautics, communications, printed circuit board design, radar technology, mobile and fuel cell technology and digital information technology careers.

II. Course Outline and Objectives

UNIT 1: ELECTRONICS SHOP SAFETY
(5.1.12.C.1, 5.1.4.D.3, 5.1.P.B.3)
Students will:

1. develop a clear understanding of things that conduct electricity
2. understand lab and electrical hazards
3. know the dangers of electricity and how it affects the human body
4. learn how to report lab hazards to school personnel
5. develop a positive attitude about safe environments
6. learn proper use of tools in a safe manner
7. operate test equipment safely and effectively
8. avoid and report obstructions in the lab which can lead to injury
9. identify elements in the lab which can potentially cause injury
10. create and document a personal safety plan
11. know where to access safety standards posted in the lab
12. learn to ask appropriate questions when concerned about safety
13. operate and maintain all lab computers and peripherals efficiently
14. wear hand and eye protection as instructed
15. pass the program safety test with a 100% score

UNIT 2: FUNDAMENTALS OF ELECTRONICS AND ELECTRICITY
(5.1.P.B.1, 8.2.4.A.1, 9.4.12.O. (2).1, 9.4.12.O. (2).2, 9.4.12.O. (2).3)

Students will:

1. understand how electronic technology meets our wants and needs
2. view electronics as both a science and a career path
3. identify different industries and opportunities in electronics
4. compare and contrast how our quality of life improves with technology
5. develop a general knowledge of the electronics industry
6. explore electron theory, structure of the atom, and electrical charges
7. learn how electricity flows through wires, metal and other substances
8. explore conductors and insulators of electricity
9. list personal experiences with electricity and electronics
10. learn about early inventors and innovators in electricity
11. research how electricity affects the human body
12. describe specifically how electricity is a science
13. discuss familiar terms such as current, voltage and resistance
14. learn contemporary practices which reflect a changing industry
15. learn the similarities and differences of electricity and electronics

The Science of Electricity

UNIT 1: HISTORY AND NATURE OF ELECTRICITY
(5.1.P.A.1, 8.2.8.A.1, 8.2.12.A.1, 9.4.12.O. (2).2)

Students will:

1. research early discoveries of electricity
2. find the origins of terms such as electronics and electricity
3. learn early applications of electrical concepts
4. list early pioneers who influenced electricity
5. describe how these pioneers utilized electricity
6. create a group timeline of early electrical events and innovations
7. document significant electrical discoveries
8. research electricity in the human body
9. learn about static electricity
10. list things which conduct electricity
11. document things which insulate or inhibit electrical flow
12. state how electricity serves our needs

UNIT 2: METHODS OF PRODUCING ELECTRICITY
(4.5 F, 8.2.8.A.1, 8.2.12.A.1, 9.4.12.O. (2).3)

Students will:

1. research friction, the static electricity we observe after walking across a rug and touching a doorknob
2. describe chemical reactions such as batteries
3. analyze mechanical motion such as alternators and generators
4. explain heat such as thermocouples
5. develop information on light such as solar cells
6. research pressure as in use of a microphone

UNIT 3: MAGNETISM (4.5 F, 5.1.4.B.2, 5.1.4.B.4, 8.2.8.A.1, 9.4.12.O. (2).4)

Students will:

1. develop a knowledge of how magnetism generates electricity
2. describe how the earth functions as a magnet
3. state the laws of magnetism and magnetic fields
4. explain magnetism based on the theory of atoms
5. describe magnetic flow of current in a conductor

UNIT 4: BASIC TERMS AND COMPONENTS IN ELECTRONICS
(5.1.P.B.2, 9.4.12.O. (2).1, 9.4.12.O. (2).2)

Students will:

1. research and describe electrical current measured in amps
2. research and describe resistance measured in ohms
3. research and describe voltage measured in volts
4. research and describe power measured in watts
5. research and describe atoms
6. research and describe circuits
7. research and describe inductance
8. research and describe capacitance
9. research and describe direct current
10. research and describe alternating current
11. research and describe resonance
12. research and describe semiconductors
13. research and describe diodes
14. research and describe transistors

Mathematics in Electricity

UNIT 1: CALCULATION OF ELECTRICAL UNITS OF MEASURE
(4.1.12 B, 4.1.12 B, 4.2.12 D, 4.5 F, 9.4.12.O. (2).5)

Students will:

1. develop a comprehensive understanding of Ohm's Law
2. calculate current, resistance and power in simple circuits
3. learn metric conversions
4. comprehend binary mathematics
5. implement basic scientific notation

UNIT 2: METERS USED FOR ELECTRICAL MEASUREMENTS
(4.1.12 B, 4.5 F, 5.1.8.A.2, 5.1.8.A.3, 9.4.12.O. (2).5)

Students will:

1. research the functions of multimeters
2. describe how a voltmeter is used in a circuit
3. describe how an ammeter is used in a circuit
4. describe how an ohmmeter is used in a circuit
5. analyze the use of oscilloscopes used to measure alternating current

Introduction to Direct Current

UNIT 1: DC CIRCUITS AND MEASUREMENTS (4.5 F, 5.1.8.A.2, 5.1.8.A.3)

Students will:

1. define direct current
2. use Ohm's law to calculate current, resistance and voltage
3. research series circuits
4. research parallel circuits
5. research series/parallel circuits and solve for unknown circuit values

UNIT 2: BREADBOARDING TECHNIQUES (5.1.8.A.2, 9.1.4.A.2)
Students will:

1. practice installing electronic components on a breadboard
2. learn to build simple series circuits on a breadboard
3. measure current, resistance and voltage measurements on a breadboard
4. fabricate series circuits on a breadboard
5. construct parallel circuits on a breadboard

Introduction to Alternating Current

UNIT 1: AC CIRCUITS AND MEASUREMENTS
(4.5 F, 5.1.8.A.2, 5.1.8.A.3, 9.1.4.A.2, 9.4.12.O. (2).6)

Students will:

1. define alternating current
2. learn methods of generating alternating current
3. build series AC circuits on a breadboard
4. create parallel AC circuits on a breadboard
5. fabricate series/parallel AC circuits on a breadboard
6. solve for unknown values in AC circuits
7. research power plants and methods of producing electricity

Introduction to Digital Electronics and Semiconductors

UNIT 1: DIGITAL SYSTEMS (4.5 F, 5.1.12.A.2, 8.2.2.A.1, 9.4.12.O. (2).6)

Students will:

1. research the initiation of semiconductor devices
2. identify materials that act as semiconductors
3. explain how current, voltage and resistance act in semiconductors
4. analyze how silicon acts in semiconductors
5. research how transistors and diodes act in circuits
6. document diode characteristics
7. finding open circuits
8. research the history of the transistor
9. analyze field effect transistors
10. describe the characteristics of thyristors
11. learn digital chips and integrated circuits
12. explain the importance of digital integrated circuits
13. create circuits in breadboards using digital integrated circuits
14. identify advantages and disadvantages of digital circuits
15. identify major components of digital integrated circuits
16. troubleshoot digital integrated circuits
17. learn the family of integrated circuits
18. analyze integrated circuit construction techniques
19. methods of removing faulty integrated circuits
20. research integrated circuit manufactures such as Intel, Motorola and NEC

UNIT 2: SOLDERING TECHNIQUES
(5.1.8.A.2, 5.1.12.A.2, 8.2.2.A.1, 8.2.8.A.1)

Students will:

1. learn the theory of quality soldering techniques
2. analyze metals used in soldering
3. identify soldering tools and materials
4. practice use of a soldering iron
5. learn common soldering errors
6. understand the importance of quality soldering
7. properly inspect soldering joints
8. learn tip tinning on a soldering iron
9. apply solder properly
10. learn to make visual inspections and quality control

UNIT 3: ELECTRONIC SYMBOLS AND SCHEMATICS
(5.1.P.B.2, 5.1.12.C.2, 9.1.4.B.1)
Students will:

1. draw a schematic for a series circuit
2. draw a schematic for a parallel circuit
3. draw a schematic for a series/parallel circuit
4. identify the schematic symbol for capacitors
5. identify the schematic symbol for earth ground
6. identify the schematic symbol for inductors
7. identify the schematic symbol for integrated circuits
8. identify the schematic symbol for diodes
9. identify the schematic symbol for resistors
10. identify the schematic symbol for power
11. identify the schematic symbol for batteries
12. identify the schematic symbol for generators

III. Methods of Student Evaluation

Students are evaluated using the following criteria:

1. Class participation
2. Attendance
3. Lab reports
4. Technical projects
5. Class modules and assignments

IV. Textbooks

REQUIRED TEXTBOOKS and MATERIALS:

Electricity & Electronics Gerrish/Dugger/Roberts 2004
PAD-234 Digital/Analog Trainer Kit
Dual Trace Oscilloscope
VOM/DMM

V. Instructional Strategies

Instructional methods for the course combine a traditional text, lecture, and theory based approach with hands on learning modules designed to create a self paced laboratory approach for the student. A strong emphasis is placed on research and problem solving techniques, where the learner is guided by the instructor and challenged to investigate solutions and draw reasonable conclusions. This translates into transferable skills used for troubleshooting, an important component for success in the industry. Student reasoning skills are developed in an effort to help students think logically and find innovative solutions. Handouts, class discussions, and group projects will be used to integrate Science and Mathematics which is deeply ingrained in electronic technology.

VI. Scope and Sequence Chart *Key I = Introduced D = Developed R = Reinforced*

SKILLS TO BE LEARNED	**9**	**10**	**11**	**12**
Define wants and needs	IDR			
Describe the benefits of life with technology	IDR			
Electronics lab safety initiatives	I			
Electrical safety concepts	I			
Describe the basic structure of an Atom	I D			
Methods of creating electricity	I D			
Research of the electronics industry	IDR			
Create a timeline of electrical milestones	I			
Define the coulomb unit of electrical charge	ID			
Define and give an example of a conductor, insulator, and semi-conductor	I			
Know the history and fundamentals of electricity	I			
Understand how to identify component symbols	IDR			
Learn how to read schematics	IDR			
Demonstrate proficiency in use of a breadboard	I D			
Comprehend the principles of Ohm's Law	IDR			
Understand the difference between a short and open circuit	ID			
State lab safety rules	IDR			
Learn how to troubleshoot analog circuits	IDR			
Utilize electronic controls and devices	IDR			
Understand how to use test equipment properly	IDR			
Differentiate between a potentiometer and a rheostat	I			

SKILLS TO BE LEARNED	**9**	**10**	**11**	**12**
Comprehend the laws of magnetism	ID			
Know basic terms and components of electronics	IDR			
Differentiate between fuses and circuit breakers	ID			
Understand how to design a printed circuit board	IDR			
Analyze series and parallel circuits	IDR			
Understand Kirchoff's Law	ID			
Technical Mathematics	IDR			
Basic circuits, loads and measurements	IDR			
Differentiate between transistors and diodes	ID			
Self management skills	IDR			
List safe use of tools and equipment	IDR			
Learn how to troubleshoot digital circuits	IDR			
Soldering skills	I			
Demonstrate correct handling of digital electronic components	I			
Correctly identify transistors and other digital semiconductors	I			
Identify advantages and disadvantages of digital circuits	ID			
Work effectively as a team member	IDR			
Methods of documenting work and parts replaced	IDR			
Communication with superiors	IDR			

VII. Pacing Chart

	DAYS 1-45 WEEK 1	**WEEK 2**	**WEEK 3**	**WEEK 4**	**WEEK 5**	**WEEK 6**	**WEEK 7**	**WEEK 8**	**WEEK 9**
MP 1	Shop safety and electrical hazards	Career opportunities in electronics	Creation of class posters on electricity	Group electricity timeline	Electricity and the human body	Effects of static electricity and friction	Electrical conductors and insulators	Production methods of electricity	Proficiency in electrical theory
	DAYS 46-90 WEEK 1	**WEEK 2**	**WEEK 3**	**WEEK 4**	**WEEK 5**	**WEEK 6**	**WEEK 7**	**WEEK 8**	**WEEK 9**
MP 2	Common dangers of electricity	Magnetism and electricity	Ohm's Law and mathematical circuit calculations	Basic atomic theory and Direct Current	Basic terms in electronics	Study of electrical current	Study of electrical voltage	Study of resistance in circuits	Proficiency in DC circuit analysis and soldering
	DAYS 91-135 WEEK 1	**WEEK 2**	**WEEK 3**	**WEEK 4**	**WEEK 5**	**WEEK 6**	**WEEK 7**	**WEEK 8**	**WEEK 9**
MP 3	Constructing circuits on a breadboard	Alternating current theory	Means of generating AC	Measuring AC wave forms	Methods to troubleshoot AC circuits	Comparisons of DC and AC circuits	Introduction to soldering	Combination circuits on breadboards	Proficiency in AC circuit analysis
	DAYS 136-180 WEEK 1	**WEEK 2**	**WEEK 3**	**WEEK 4**	**WEEK 5**	**WEEK 6**	**WEEK 7**	**WEEK 8**	**WEEK 9**
MP 4	Introduction to Digital electronics	Digital chips and components	Methods of handling Digital components	Advanced soldering techniques	Inspection and quality control of soldering	Methods to troubleshoot digital circuits	Measuring Digital pin signals	Digital component manufacturing techniques	Proficiency in digital circuit analysis

VIII. Student Handout/Proficiencies – Electronics I:

Electronics I is an introductory level course designed to provide the student with skills and knowledge in the electronics industry and fundamentals of basic electricity. Course goals are to provide an understanding of practical applications of electrical/electronic concepts and principles, sound laboratory, history of inventors, safety procedures, and industry digital electronic systems in a growing technological society.

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Students will:

1. develop a comprehensive understanding of electricity
2. handle tools of the trade and equipment correctly and safely
3. understand the history of electricity
4. explain methods of producing electricity
5. use effective time management skills in the production of projects
6. identify various types of circuits
7. learn correct handling of electronic components
8. comprehend the effects of magnetic fields
9. identify analog components such as resistors and capacitors
10. recognize transistors and other semiconductors
11. demonstrate proficiency in troubleshooting techniques
12. calculate electrical units of measure
13. apply the electrical mathematics of Ohm's Law
14. utilize and understand direct current
15. effectively take circuit measurements for voltage, current and resistance
16. comprehend alternating current
17. construct dc and ac circuits on a breadboard
18. draw schematic diagrams of circuits fabricated in class
19. learn fundamentals of digital chips and integrated circuits
20. practice effective team building skills
21. identify advantages and disadvantages of digital circuits
22. demonstrate effective problem solving techniques
23. categorize major components of digital integrated circuits
24. utilize technical communication methods
25. report and log tasks and assignments
26. explain the importance of digital integrated circuits
27. know leading semiconductor manufacturers such as Nec, Intel and Motorola
28. solder circuits in printed circuit boards using digital integrated circuits
29. troubleshoot electronics in information technology industries
30. utilize time in a productive manner
31. apply electronics knowledge to a career