BETHLEHEM AREA VOCATIONAL-TECHNICAL SCHOOL
3300 CHESTER AVENUE BETHLEHEM PA 18020

Electronics Technology
Mr. Tyler Heft
610-866-8013 ext 148 heftt@bavts.org

Electronics Technology

Course Description:

Electronics Technology is an instructional program that prepares individuals to apply basic electronic principles and technical skills to the production, calibration, estimation, testing, assembling, installation and maintenance of electronic equipment**.** Emphasis is on passive components and solid-state devices; digital circuits; optoelectronic devices; operational amplifiers**,** Students will have the opportunity to earn college credit along with certification in both J-STD-001 ***(Requirements for Soldered Electrical & Electronic Assemblies)*** as well as IPC –A-610 ***(Acceptability of Electronic Assemblies)***. Electronic manufacturing companies as well as the Department of Defense recognize both certificates nationally and locally. This allows students to be employed as an Electronic Application Specialist in the field.

Average pay:

Bachelor's Degree (Four Year):	$76,000.00 / Year
Associates Degree (Two Year):	$56,000.00 / Year
Industry Credentials (H.S. Diploma):	$34,000.00 / Year

In Demand Careers: Electronic Assembler, Electronic/Manufacturing/Maintenance Technician, Electronic/Electrical/Process Engineer

Reference Materials:

Electricity Principles & Application (Fowler)
Electricity Lab Manual
Digital Electronics Principles & Applications (Tokeim)
Digital Electronics Lab Manual
Solid State Electronics Principles & Applications (Fowler)
Solid State Lab Manual
IPC-A-610 Acceptability of Electronic Assemblies Manual
IPC-JSTD-001 Requirements for Electrical and Electronics Assemblies
Miscellaneous Supportive IPC Certification Manuals

Classroom Tools:

Basic Hand Tools (Needle Nose Pliers, Wire Cutters, Bending Tools, Wire Strippers etc.)
Basic Power Tools (Band Saw, Drill Press, Drill, Drill Bits, Step Bits, Nibblers, Hole Punch, and Filers)
Hakko Soldering Irons (to solder both Through Hole and Surface Mount assemblies)
DC Power Supplies
Digital Multi-meters
100 Mhz Dual Trace Oscilloscopes
Frequency Generators
DC, AC, and Digital Electronics Trainers
Vision Engineering Stereo Microscopes
Pitsco Tetrix Robotic Sets
Arduino / Raspberry Pi Programing Systems

Course Syllabus Level 1

First Semester (First Marking Period)

Career Exploration:

Assignments & Assessments

Safety in Electronic Assembly (Video/Workbook)
Safety Quiz
Resistor color code identification
Bread boarding electronics circuits
Manufacture of an electronic assembly (Traffic Light)
    Component Preparation, Component Placement, Hand Soldering, Mechanical Assembly, and Inspection

Duty and Tasks Covered:

Safety

Identify, select, and demonstrate proper hand tool use for electronics work.
Interpret Safety Data Sheets (SDS).

Electrical Quantities and Components

Identify resistor values by color code and numerical markings.

Solder / Desoldering

Solder components to the circuit board.
Desolder components from the circuit board.

Career Exploration Outcomes: Students can make an informed decision about the Electronics Technology class and as a possible program choice.

First Semester (Second Marking Period)

Assignments & Assessments

Career Research Lessons #1 – 7
Career Research Poster
Electricity Book (Fowler)
    Chapter 1 **Basic Concepts**
        Terms & Definitions
        Labs 1-1, 1-2, 1-3
        Chapter Review Questions & Problems
        Chapter 1 Test

Chapter 2 **Electrical Quantities and Units**

- Terms & Definitions
- Labs 2-1, 2-2, 2-3, 2-4
- Chapter Review Questions & Problems
- Chapter 2 Test

Screaming Turkey Electronics Assembly

Chapter 3 **Basic Circuits, Laws, and Measurements**

- Terms & Definitions
- Resistance, Current, and Voltage Worksheets
- Labs 3-1, 3-2, 3-3, 3-4
- Ohms Law Assignment
- Chapter Review Questions & Problems
- Chapter 3 Test

3D Christmas Tree Electronic Assembly

Duty and Tasks Covered:

Electrical Quantities and Components

Describe electronic measurements and their applications.
Identify the fundamental SI units.
Apply proper scientific and engineering notation.
Identify resistor values by color code and numerical markings.
Identify component symbols used in electronic schematic diagrams.
Identify schematic symbols for various types of electrical and electronic components.
Measure the voltage output of sources of electricity.

Instrumentation

Utilize multi-meters, function generators, and frequency counters.
Use a power supply.
Make a circuit measurement to solve current requirements.
Make a circuit measurement to solve voltage requirements.
Make a circuit measurement to solve resistance requirements.

Ohms / Watt's Law

Apply the concept of Ohm's law to determine current, voltage, or resistance.
Identify the relationship between voltage, current, resistance, and power in DC using the 12 basic common formulas derived from Ohm's and Watt's Law Pie Chart.

Solder / Desoldering

Solder components to the circuit board.
Desolder components from the circuit board.

Second Semester (Third Marking Period)

Assignments/Assessments

Projects:

Electronics Component Identification

- Exercises 1,2,3,4
- Test (Through Hole Components)
- Test (Surface Mount Components)

Digital Dice or Voice Changer Electronic Assembly

- Open Ended Questions

Duty and Tasks Covered:

Electrical Quantities and Components

- Identify resistor values by color code and numerical markings.
- Identify component symbols used in electronic schematic diagrams.
- Identify schematic symbols for various types of electrical and electronic components.

Solder / Desoldering

- Solder components to the circuit board.
- Desolder components from the circuit board

Second Semester (Fourth Marking Period)

Assignments/Assessments

Electricity (Fowler)

Chapter 5 **Multiple Load Circuits**

- Terms and Definitions
- Labs 5-1 through 5-7
- Chapter Five Review Questions and Problems
- Series Circuit Practical
- Parallel Circuit Practical
- Series/Parallel Circuit Practical
- Chapter Five Test
- Level One Final Project

Duty and Tasks Covered:

Series Circuits

Apply Kirchhoff's Voltage Law in a series circuit.
Solve for equivalent resistance in a series circuit.
Analyze power consumption, dissipation and energy units in a series circuit.
Analyze the affects of open circuits and short circuits in series circuits.

Parallel Circuits

Solve for equivalent resistance in a parallel circuit.
Explain voltage in a parallel circuit.
Apply Kirchhoff's Current Law in a parallel circuit.
Analyze power consumption, dissipation and energy units in a parallel circuit.
Analyze the affects of open circuit and short circuit conditions in parallel circuits.

Series/Parallel Circuits

Solve for equivalent resistance in a Series-Parallel combination circuit.
Apply Kirchhoff's current and voltage law to a Series-Parallel Circuit.
Analyze and troubleshoot DC combination/complex circuits.

Solder / Desoldering

Solder components to the circuit board.
Desolder components from the circuit board.

Level 1 Outcomes: Demonstrate functions of DC circuits.
Demonstrate the manufacturing process of an electronic assembly.

Course Syllabus Level 2:

First Semester (First Marking Period)

Digital Electronics (Tokheim)

Assignments/Assessments

Chapter One **Digital Electronics**

- Terms and Definitions
- Labs 1-1, 1-2, 1-3
- Chapter Review Questions
- Chapter One Test

Chapter Two **Numbers We Use in Digital Electronics**

- Terms and Definitions
- Labs 2-1, 2-2, 2-3
- Chapter Review Questions
- Chapter Two Test

Chapter Three **Logic Gates**

- Terms and Definitions
- Labs 3-1 through 3-8
- Chapter Review Questions
- Chapter Three Test

NOCTI Pre-Test

Bench Top Project

Duty and Tasks Covered:

Basic Digital Electronics

Convert between numbering systems (decimal, binary, octal and hexadecimal).
Identify the operation and develop the truth tables for the seven basic logic gates.

Mechanical Design & Assembly

Measuring diameter and dimensions of components to make a mechanical drawling.
Learning the difference between different types of screws, washers, and nuts.
Learn the how to use power tools effectively and safely. (drill press, band saw, and powered drills)
Learn how to select the correct drill bit size and learn how to operate a step bit.

First Semester (Second Marking Period)

Digital Electronics:

Assignments/Assessments

Chapter Four **Combining Logic Circuits**
- Terms and Definitions
- Labs 4-1, 4-2, 4-4
- Chapter Review Questions
- Chapter Four Test

Chapter Six **Encoding, Decoding, and Seven Segment Displays**
- Terms and Definitions
- Labs 6-1, 6-2, 6-3, 6-4

MultiSim Electronic Simulation Software

Arduino Coding

Lab 1 through Lab 6

Duty and Tasks Covered:

Basic Digital Electronics

Connect combinational logic (multiplexer, demultiplexer, half-adder, full-adder).

Apply Boolean reduction and construct Karnaugh mapping for complex logic circuits.

Solder / Desoldering

Solder components to the circuit board.

Desolder components from the circuit board.

Basic Digital Arduino Coding

Turning physical gates to coded language gates.

Learning inputs/outputs.

Using an LCD to display information.

Analog to Digital converter (joystick).

Second Semester (Third Marking Period)

Assignments/Assessments

Chapter Seven **Flip Flops**
- Terms and Definitions
- Labs 7-1, 7-2, 7-4, 7-6
- Chapter Review Questions
- Chapter Seven Test

Chapter Eight - **Counters**
- Terms and Definitions
- Labs 8-1, 8-2, 8-3, 8-4, 8-6, 8-8
- Manufacturing Processes

Duty and Tasks Covered:

Basic Digital Electronics

Demonstrate the function of Flip Flops
Demonstrate the function of ripple and synchronous counter

Second Semester (Fourth Marking Period)

Basic Digital Electronics

Assignments/Assessments

Chapter 9 **Shift Register**

Terms and Definitions
Labs 9-1, 9-2, 9-3, 9-4, 9-5
Chapter Review Questions
Chapter Nine Test

Chapter 10 **Arithmetic Circuits**

Terms and Definitions
Labs 10-1, 10-2, 10-3, 10-4
Chapter Review Questions
Chapter Ten Test

NOCTI Improvement

Create Improvement Plan based on NOCTI Pre-Test Results

Duty and Tasks Covered:

Basic Digital Electronics

Demonstrate the function of ripple and synchronous counters
Identify the operation of shift registers
Demonstrate the function of adders, subtractors, multipliers, and dividers

Troubleshooting

Utilize the order of the troubleshooting process to detect failures in electrical and electronic circuits.
Analyze and troubleshoot failures in electrical and electronic circuits.

Level 2 Outcome: Completed Digital Electronics and demonstrate the assembly, function, programming, and testing of an electronic project. Analyze NOCTI Pre-Test results in order to identify areas of needs improvement.

Course Syllabus Level 3

First Semester (First Marking Period)

AC Circuit Analysis (Electricity Fowler)

Assignments/Assessments

Chapter 8 **Alternating Voltage and Current**

- Terms and Definitions
- Labs 8-1, 8-3, 8-4
- Chapter Review Questions & Problems
- Chapter 8 Test

Chapter 10 **Capacitance**

- Terms and Definitions
- Labs 10-1, 10-2, 10-3, 10-4
- Chapter Review Questions & Problems
- Chapter 10 Test

NOCTI Improvement Plan

Duty and Tasks Covered:

Alternating Current

- Calculate the period and frequency of the waveform.
- Determine the peak-to-peak, average and RMS values of a sine-wave.
- Explain various waveforms.

Oscilloscope

- Describe the basic sections of an oscilloscope.
- Measure voltage using an oscilloscope.
- Measure frequency using an oscilloscope.
- Measure phase relationships using an oscilloscope.

Capacitance / Capacitive Reactance

- Identify the effect of capacitance in AC and DC circuits.
- Solve for equivalent capacitance in series and parallel circuits.
- Calculate and measure RC time constants.
- Measure and calculate the effect of capacitive reactance on current.
- Measure and calculate the effect of change in frequency on circuit current.
- Identify phase (lead-lag) relationship between current and applied voltage in a series RC circuit.
- Calculate the total capacitive reactance in series and parallel circuits.

First Semester (Second Marking Period)

Assignments/Assessments

Electricity Book (Fowler)

Chapter 11 **Inductance**

- Terms and Definitions
- Labs 11-1, 11-2, 11-3, 11-4
- Chapter Review Questions & Problems
- Chapter Test

Chapter 13 **R,C,L Circuits**

- Terms and Definitions
- Labs 13-1, 13-2, 13-3
- Review Questions & Problems
- Chapter Test

NOCTI Review (On going through the marking period)

Duties and Tasks Covered:

Inductance / Inductive Reactance

- Measure and calculate the effect of a series resistive-inductive (RL) circuit on DC voltage and current.
- Measure and calculate the effect of a series resistive-inductive (RL) circuit on AC voltage and current.
- Calculate the total inductance of inductors connected in series or parallel.
- Measure and calculate the effect of inductive reactance on current.
- Measure and calculate the effect of change in frequency on current.
- Identify the phase (lead-lag) relationship between current and applied voltage in a series RL circuit.
- Calculate the total inductive reactance in series and parallel circuits.

Resistor Inductor (RL) Circuits in AC

- Use vectors to describe magnitude and direction of voltages.
- Use vectors in determining total current or voltage in series and parallel RL circuits.

Resistance Capacitance (RC) Circuits in AC

- Describe magnitude and direction of voltages using vectors.
- Determining total current or voltage in series and parallel RC circuits using vectors.

Resistance Inductance & Capacitance Circuits (RLC) Circuits

- Calculate total current in series RLC circuits.
- Calculate total current in parallel RLC circuits.

Resonance

Calculate and measure the resonant frequency of a series RLC circuit.
Calculate the "Q" of a series resonant circuit.
Calculate and measure the resonant frequency of a parallel RLC circuit.

Second Semester (Third Marking Period)

Electronics Book (Schuler)

Assignments and Assessments

Chapter 2 **Semiconductors**

Terms and Definitions
Labs 2-1, 2-2
Review Questions
Chapter Test

Chapter 3 **Diodes**

Terms and Definitions
Labs 3-1, 3-2, 3-4
Chapter Review Questions & Problems
Chapter Test

Chapter 4 **Power Supplies**

Terms and Definitions
Labs 4-1, 4-2, 4-4
Chapter Review Questions & Problems
Chapter Test

Chapter 5 **Transistors**

Terms and Definitions
Labs 5-1, 5-4
Review Questions & Problems
Chapter Test

Chapter 6 **Amplifiers**

Terms and Definitions
Lab 6-1

NOCTI Review

Duties and Tasks Covered

Diodes

Test diodes and identify the cathode and anode.
Analyze the voltage-current relationship of diodes by plotting the characteristic curve.
Distinguish the correct bias for the operation of a LED.
Compare the forward and reverse characteristics of a Zener diode.

Power Supplies

Identify common rectifier circuits (half-wave and full-wave).
Construct and analyze the operation of a rectifier circuit.
Investigate the cause and effect of power supply filtering, hum and common filter types.
Measure and calculate power supply ripple percentage and voltage regulation.
Measure and identify the regulation properties of a shunt type Zener regulator.

Transistor Characteristics

Identify base, emitter, and collector terminals of PNP and NPN transistors.
Locate the ratings, characteristics and operating parameters listed on a typical transistor specification sheet.
Determine the type of transistor, NPN or PNP, and operating condition.
Identify schematic symbols and uses for various types of transistors.
Compare FET and BJT devices.

Small Signal Amplifiers

Use biasing polarity of NPN or PNP transistors.
Calculate gain.
Distinguish between basic amplifier configurations.

Operational Amplifiers

Construct and analyze the phase shift between input and output of an inverting IC Op-Amp.
Construct and analyze the phase shift between input and output of a non-inverting IC Op-Amp.

Second Semester (Fourth Marking Period)

Assignments/Assessments

NOCTI Post Test (Written)
NOCTI Post Test (Practical)
IPC 610 Certification (Industry Credentialing)
- Modules 1-12 – Acceptability of Electronic Assemblies
- Certification Exams

IPC-JSTD-001 Certification (Industry Credentialing)
- Modules 1-5 – Requirements For Soldered Electrical and Electronic Assemblies
- Certification Exams
- Practicum
  - Terminals
  - Through Holes Components
  - Surface Mount Components

Duties and Tasks Covered

IPC 610 / J-STD-001 Application Specialist Certification

Describe the foreword.
Demonstrate an understanding of applicable documents.
Describe the handling of electronic assemblies.
Describe hardware used in electronic assemblies.
Identify and demonstrate the installation, wire placement, and soldering of terminals.
Identify and demonstrate the installation of components in supported and unsupported holes.
Demonstrate the soldering requirements of components in supported and unsupported holes.
Demonstrate the placement of surface mount components.
Demonstrate the soldering requirements of surface mount components.
Identify electronic component damage.
Identify printed circuit board requirements.
Identify requirements for discrete wiring.

Level 3 Outcomes: Demonstrate an understanding of Solid State Devices, NOCTI certification, industry credentialing.

Supplemental Learning Activities

Students who participate in this program will also have opportunities to participate in the following program and school-sponsored activities:

Industry Credentialing: Students enrolled in this program receive industry specific certifications demonstrating knowledge in the area of Electronic Assembly.

SkillsUSA: A CTE organization where students will compete in program specific and professional development competitions on the district, state and national level.

NTHS: Level II and Level III students who have received an "A" in their career and technical program as well as a "B" average at their sending school are eligible to become a member of the BAVTS Chapter of the National Technical Honor Society.

Cooperative Education: Students who have attended six quarters in their career and technical program are eligible to participate in a paid working experience during the PM session of BAVTS. Positions must be available and the students must be recommended by the CTE teacher to be eligible.

Job Shadowing: Students are eligible to visit business and industry partners for one or more days to view the day-to-day operations of this career area.

Internships: Students who have completed six or more quarters of their CTE program are eligible to work for a business and industry partner with the recommendation of the instructor and the availability of assignment.

Field Trips: Students in this program will on occasion attend field trips that expose them to educational experiences within the career field.

College Credit: Electronics Technology students are eligible for advanced credit through an Articulation Agreement between BAVTS and Northampton Community College.