ASSOCIATE C.E.T. (CETa)

BASIC ELECTRONICS CERTIFICATION

COMPETENCY REQUIREMENTS

The Associate Certified Electronics Technician (CETa) is designed for encompassing the basic electronics theory and applications used in all electronics disciplines. By doing so, the Associate is the foundation for journeyman/senior/master certification program. The CETa is designed for technicians having less than two years' experience or training in electronics.
The competencies listed below are considered the foundation of component based general electronics knowledge and skills.

1.0 Safety Precautions

- 1.1. Describe the physiological reactions electrical shock causes; list various degrees of current the human body can tolerate
- 1.2. Explain the First Aid concepts and its particular importance to workers in electric and electronics fields explaining precautions for the untrained
- 1.3. Explain what the National Electrical Code (NEC®) is describing various rules technicians must abide by
  - 1.3.1. Explain additional National Fire Protection Association (NFPA®) 70 rules describing how technicians comply with the NEC®
- 1.4. Describe fusing and circuit breaker rules and reasons for different type of fuses
- 1.5. Explain static causes, electrostatic discharge and CMOS damage prevention straps, mats and grounding
- 1.6. List tools hazards which are associated with technician activities in the workplace and in the field.
- 1.7. Describe lockout/tag out rules for potentially unsafe electrical or mechanical hazards
- 1.8. Explain RF transmitter and transmission hazards and precautions including MPE (maximum permissible exposure)
- 1.9. List optical fibers hazards to skin and eyes
- 1.10. Explain personal protection needed by technicians:
  - 1.10.1. Describe PPE (personal protection equipment) needs, i.e. NFPA Table 130.5(c)
  - 1.10.2. Describe MPE (maximum permissible exposure) in RF Safety (OSHA and ANSI)
  - 1.10.3. Describe other OSHA safety rules
- 1.11. List ladder handling and usage (ANSI A14) and OSHA working at heights safety rules
- 1.12. List service vehicle safety concerns such as ladder or transporting security and flying objects, driver screens inside the vehicle
- 1.13. Differentiate the classes of fires (A, B, C, D & K) and the types of extinguishers used to fight them
- 1.14. Explain emergency responses/treatments for the above safety issues

2.0 Electrical Theory

- 2.1. Describe atomic structure, the components of the atom, their charges and importance to electronics technology
- 2.2. Describe the principles of electromagnetism
  - 2.2.1. Explain the different types of magnetic fields
    - 2.2.1.1. Ferromagnetism (common magnetism, permanent magnets)
    - 2.2.1.2. Diamagnetism (repelled, repulsive force)
    - 2.2.1.3. Paramagnetism (weak attraction)
  - 2.2.2. Explain the direct relationship between electricity and magnetism
- 2.3. Explain uses for magnetism in electronics technology
- 2.4. Explain basic uses for electricity
- 2.5. Describe the basic methods of using electricity to operate a motor and how mechanical motion causes a generator to produce electrical current
- 2.6. Explain the differences between current, voltage and resistance
- 2.7. Differentiate between the types of resistive materials and how resistors are used in electronics
- 2.8. Show the different purposes for capacitors and list common types and construction
- 2.9. Explain how inductance relates to magnetism and describe coil construction, cores and usages
- 2.10. Comparison between reactance and resistance and describe current/voltage relationships

2.11. Compare impedance with reactance and resistance and explain the causes and effects of impedance, combined reactance
2.12. List voltage sources, AC and DC, batteries and natural generation
2.13. List Ohms law formulas for current, voltage, resistance and power.
    2.13.1. Explain how to calculate problems utilizing each formula
2.14. Explain how to calculate power consumption and requirements

3.0 Electronic Components

3.1. Identify resistor values from color code or other marks and list composition and reasons for different usages
3.2. Identify capacitor types; list common usages; methods of varying capacitance and explain the terms charge and coulomb
3.3. Identify inductor types and reasons for various core materials; how diameter and wire size affects the values
3.4. Identify common types of transformers and list uses for each; explain step up/down voltage methods; explain why laminations are used
3.5. Identify transistors as to type and usage, biasing and applications:
    3.5.1. Describe MOS, CMOS, FET applications
    3.5.2. Analyze biasing voltages for NPN & PNP bipolar transistors, JFETs, and MOSFETs
    3.5.3. Explain beta and alpha, enhance/depletion mode
3.6. Identify other semiconductors and explain their uses: Darlington pairs;
3.7. Compare thyristors with other semiconductors; identifying diacs, triacs and SCRs and explain their operation
3.8. Identify various diode types including Silicon, Schottky, germanium, LED, photo, Zener AND analyze their usage, voltage bias, current, and power consumption in a circuit
    3.8.1. Explain Zener diode ratings; describe usage in regulator circuits
3.9. List common optical devices (LEDs, LCDs, etc.);
3.10. Describe how photo-electronic components operate:
    3.10.1. photovoltaic cells are activated
    3.10.2. symbols for photo resistors, photodiodes and photo transistors
    3.10.3. materials from which these devices are made
3.11. Describe Identify integrated circuits types such as microprocessors and identify the basic components and pin-outs

4.0 Electronic Circuits: Series and Parallel

4.1. Identify and describe the operation of common DC circuits
4.2. Identify and describe the operation of common AC circuits
4.3. Explain how series circuits, R, L, C are used in electronics equipment
4.4. Explain how parallel circuits, R, L, C are used in electronics equipment, loads
4.5. Explain the purpose of oscillators: crystal
4.6. Differentiate between oscillators and multivibrators
4.7. Classify circuits as inductive, capacitive and resistive
4.8. Explain resonance and show how to calculate resonant frequency
4.9. Describe polar and rectangular presentations of L, R, C circuits
4.10. Explain Kirchhoff's law and its importance to electronics technicians
4.11. Explain the purposes and types of differentiator or integrator circuits
4.12. Describe the sections of a PLL (phase locked loop) circuit and PLL circuit use
4.13. Describe filter circuits, why and how they are used
4.14. Explain wave shaping circuits and explain their purposes
4.15. Describe the relationships between bandwidth and "Q" in an electronics circuit
4.16. Explain the piezo-electric effect
4.17. Describe exponential transients
4.18. Explain series and parallel calculations for resistive networks; voltage drop, etc

5.0 Soldering - Desoldering Tools

5.1. Describe solder safety as it pertains to burns and potential fires or damage to facilities or customer products
5.2. Explain the cause of solder fumes and the effects of lead poisoning
5.3. List causes and precautions to prevent or reduce solder splatter

5.4. Explain the reasons for flux usage and describe types
5.5. List types of solder and reasons for choosing each
5.6. Explain heat shunts, why and how they are used
5.7. Identify cold solder joints and explain causes
5.8. Describe the differences between good and bad mechanical and electrical solder connections
  5.8.1. Explain basic handling procedures of surface mount (SMT), ball grid array(BGA), gold finger contacts on a printed circuit board (PCB)
  5.8.2. Explain basic procedures for pad repairs (SMT, BGA), plated through hole (PTH), and PCB trace repair.
5.9. Describe proper care of solder and de-solder equipment and aids
5.10. Explain de-soldering principles
5.11. Describe various types of de-soldering equipment and how it is used
5.12. Demonstrate the use of braid-wick solder removers

6.0 Block Diagrams - Schematics - Wiring Diagrams

6.1. Describe common electrical/electronic symbols
6.2. Explain block diagrams use for troubleshooting and maintenance of electronics products
6.3. Explain the differences between wiring prints, schematics and block diagrams
6.4. Describe the purpose and use of test points and indicate their likely placement on schematics
6.5. Point out common drafting principles used for electronic and electrical drawings
6.6. Explain methods used for signal tracing
6.7. Describe basic building and house wiring concepts and explain why technicians need to be familiar with them
6.8. Explain schematics use to locate component and wiring failures in electronics products
6.9. Explain the methods of using flow diagrams/charts

7.0 Cabling

7.1. List wire types and construction
7.2. List wire gauges used for various purposes
7.3. Explain construction of coaxial cable and the impedance characteristics
7.4. List common identifications for copper cables in standards, such as #18 and #24 diameter in the American Wire Gauge (AWG) and UTP cable in ANSI/TIA 568
7.5. Explain major differences between copper, coaxial and fiber optic cables
7.6. Describe impedance and its causes; explain reasons for maintaining a cable's characteristics
7.7. Explain the effects of proper and improper termination
7.8. Explain the purposes of grounding and common conventions used in electrical / electronics work
7.9. Describe splicing knowledge and ability of coaxial and copper cable
  7.9.1. Explain two types of fiber splices
7.10. Briefly explain testing methods for all three types of cables and compare dB loss measurements and techniques
7.11. Compare the fittings and connectors used in cabling and list potential defects a technician may encounter
7.12. Describe proper crimping of communications wiring connectors
7.13. Explain how cable prep tools are used and demonstrate proper and improper crimping

8.0 Test Equipment and Measurements

8.1. Describe how volt-ohm-current meters operate
8.2. Explain meter construction and components
8.3. Identify meter protection, safety and usage
8.4. Explain care of equipment and test leads
8.5. List the purposes and types of signal generators
8.6. Describe meter loading and precautions
8.7. Explain the purposes of frequency counters and list their limitations
8.8. Explain what R-C-L substitution equipment is and its purposes; explain ESR capacitance measurement equipment
8.9. List the uses and precautions for logic test probes
8.10. Explain how logic pulsers are used
8.11. Describe oscilloscope uses; explain the purposes of each front panel control
8.12. List the uses for pattern generators

8.13. Define dummy load; show where and why used
8.14. Explain reasons for using rheostats, isolation transformers and variacs and why size matters
8.15. Explain how a potentiometer functions and it's use as a variable voltage divider

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
9.3. Explain how to calculate wavelength, frequency and power values
9.4. Convert binary, decimal, octal, hexadecimal number
9.5. Explain boolean algebra and its use in digital circuitry
9.6. Explain decibels and show reasons for using dBs in signal level, power and audio calculations
9.7. Explain how graphs are used to demonstrate electronics functions
9.8. Explain the International System of Units (SI) prefixes (metric) and conversions
    9.8.1. Define exponents (powers of 10) and their calculations

10.0 Power Supplies

10.1. Explain shock hazards when servicing power supplies in electronic equipment
10.2. Describe the differences between transformer powered supplies and line-connected supplies
10.3. Describe battery supplies and list common usages; also explain recharging principles
10.4. Explain the reasons for filtering, describe hum, and identify common filter types (pi, t, l, etc.)
10.5. Explain the reasons for power supply regulation and list common components used in regulated supplies
10.6. Explain the term 'Integrated high voltage transformer' supply and explain how it differs from direct or other power supply types
10.7. Explain how multiple output supplies are able to supply more than one voltage
10.8. Explain where fuses and circuit breakers are commonly and electrically located in circuits; approximate sizes for common circuits; house service box common fuses and circuit breaker configuration and precautions for replacement
10.9. Explain how to calculate DC voltages from power supply circuits
10.10. Identify and analyze rectifier circuits

11.0 Amplifiers

11.1. List common amplifier devices: such as power amps, audio preamps, video amps
11.2. Describe the purpose of each component in an amplifier circuit
11.3. List the usages and classes of amplifiers
11.4. Explain frequency response of an amplifier circuit and why it is important
11.5. Explain the words 'preamplifier' and 'line amplifier' and where these units are commonly used
11.6. Explain the uses of operational amplifiers and how they differ from other amplifiers
    11.6.1. Describe how to analyze op-amp circuits to determine gain
11.7. Explain how distortion occurs in amplifiers and list ways to reduce or eliminate it
11.8. Explain how inaccurate measurements can be experienced due to meter or scope loading.
    11.8.1. List ways to overcome loading problems
11.9. Describe specifications for broadband amplifiers as compared with common narrow band units
11.10. Explain how MMIC (monolithic microwave i.c.) and older high power electron tubes perform

12.0 Interfacing of Electronics Products

12.1. List input circuit signal levels which may be expected for various common electronics products or test equipment
12.2. List anticipated signal or voltage levels for output circuits in audio and video equipment
12.3. Explain the importance of impedance matching; list causes of mismatches
12.4. Explain the purposes of plugs and connectors and why it is necessary to use the proper ones
12.5. Explain grounding, proper and improper methods, and the results of power source mismatch
12.6. List potential signal conflict symptoms
12.7. Describe other electronic interfacing such as USB, Zigbee, I^2C (inter-integrated circuit)

13.0 Digital Concepts and Circuitry

13.1. Identify each basic digital gate
13.2. Construct truth tables for common gates
13.3. Explain how counters operate

13.4. Explain the purpose of flip flops and list common types
13.5. Explain the purpose of a digital bus and show how it is connected to various sections of a product
13.6. List types of display circuitry and describe how numbers and letters are activated digitally
13.7. Explain the purpose of computer clocks
13.8. Show how pulsers are used for digital signal tracing and how logic probes are used to verify states in digital equipment
13.9. Explain how to troubleshoot digital signals
13.10. Describe digital clock usage and circuitry
13.11. Explain voltages and logic families (TTL, CMOS)
13.12. Define microcontrollers and simple programming commands

14.0 Computer Electronics

14.1. Describe the major sections of a computer
14.2. Differentiate how the computer block diagram and flow charts are utilized
14.3. Describe the major blocks contained in a microprocessor chip and describe the purpose of each block
14.4. Describe different types of computer memory and how storage is accomplished
14.5. Explain programmable logic controls (PLCs) and list usages
14.6. Describe basic programming concepts
14.7. Describe the reasons for different computer languages and their relationships
14.8. Define the word ‘peripheral’ and list various types
14.9. Explain the reasons for using interface devices/chips/cards and name common types

15.0 Computer Applications

15.1. Explain knowledge of basic computer operation
15.2. Explain steps in installation/set up of a computer
15.3. Explain the reasons and choices used in configuring a computer
15.4. Describe proper loading and storage of common programs and applications
15.5. Explain basic and common utilities programs and list reasons for their use
15.6. List ways to backup data and the importance of doing so
15.7. Explain the causes of line surges and viruses and protection procedures against each
15.8. Explain how to access the Internet, cybersecurity best practices and common applications
15.9. Describe how to download a service or application, data or programs
15.10. Explain how to use the Internet to locate parts and service literature
15.11. Explain the differences between an individual computer and basic networking

16.0 Audio and Video Systems

16.1. Explain major components of the most common home entertainment products
16.2. Describe carbon versus condenser, MEMS, dynamic and ribbon microphone technology usage
16.3. Explain speaker construction and precautions
16.4. Explain basic recording and playback products operation, mechanical and electrical technology
16.5. Explain how alarm-security systems may be interfaced with entertainment/information products
16.6. Describe the differences between good quality and distorted sound and electronic/acoustical reasons for each
16.7. Explain how signals may conflict and the symptoms the conflict may produce
16.8. Explain how to isolate troubles between discrete equipment units

17.0 Optical Electronics

17.1. List common electronics display devices
17.2. Explain how LCD displays operate, their advantages and disadvantages
17.3. Explain the basics of electronic cameras and sensors
17.4. Describe how LED remote hand units work
17.5. Describe plasma technology and its uses in TV and computer displays
17.6. Explain why and list some locations or circuits in which opto-isolators are used
17.7. List uses for light activated controls and how photo devices are incorporated
17.8. Describe how broadband signal RF and optical links are used

18.0 Radio Communications Technology

18.1. Explain wave propagation and its importance to wireless communications
18.2. Describe the theory of how antennas work; list the types of transmission lines
18.3. Explain polarization, electromagnetic and electro-static fields and their relationships to each other
18.4. Differentiate between the signals/signaling of AM, FM radio/TV, LMR including CDMA, GSM, LTE
18.5. Differentiate usage of communications radios and commercial broadcast receivers
18.6. Describe the major radio receiver circuitry sections
18.7. List common frequency bands
18.8. Explain radio circuit tuning and adjustments
18.9. Explain the relationships between frequency and wavelength

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 communications principles
19.4. Describe wired data and voice communications network technology
19.5. Describe a basic telephone (POTS) circuit.
    19.5.1. List common wiring and splicing conventions for POTS

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, report generation
20.5. Explain how to 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 including test planning
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

End of Basic Electronics Competencies Listing (with 20 major Categories)

Notes:

ETA International and allied associations encourage the nation's school systems to adopt these competencies for their basic electronics courses.

Find an ETA approved school and approved test site: http://www.eta-i.org/test_sites.html

Additional suggested study materials and resources:

The Associate CET Study Guide, 6E, Second printing; ISBN 1-891749-07-2; ETA International; 2016; —Available through ETA at 800-288-3824, $60
EM Study Guide series; Karl Eilers; download through ETA at 800-288-3824 or www.eta-i.org
Electronics; Principles and Applications,8E; Schuler; ISBN 978-0077567705; McGraw Hill; 2012
Introduction to Electricity, Electronics, and Electromagnetics, 5E; ISBN 978-0130105738; Boylestad, Nashelsky; Prentice Hall; 2001
Teach Yourself Electricity and Electronics, 5E; ; Gibilisco ISBN 978-0071741354; McGraw-Hill / TAB Books; 2011
Contemporary Electronics: Fundamentals, Devices, Circuits, and Systems; ISBN 978- 0073373805; Frenzel; McGraw-Hill Education; 2013
Electronics Principles, 8E; Malvino, Bates; ISBN 978-0073373881; McGraw-Hill Higher Ed; 2015
Electricity & Electronics, 10E;, Gerrish, Dugger & Roberts; ISBN 978-159070-883-5, Goodheart-Wilcox; 2008

Electricity; Principles and Applications, 8E; Fowler; ISBN 978-0077567620; McGraw Hill, 2012
Arduino Electronics Blueprints; Wilcher; ISBN 978-1-7843-93606; Packt Publishing, 2015
Digital Electronics: Principles and Applications, 8E; Tokheim; ISBN 978-00733733775; McGraw Hill, 2013
Cabling: The Complete Guide to Copper and Fiber-Optic Networking, 5E; Oliviero & Woodward; ISBN 978-1-118-80732-3; Sybex, Inc.; 2014; Available through ETA at 800-288-3824 or www.eta-i.org
Introductory DC / AC Electronics, 6E; ISBN 978-0131139848; Cook; Prentice Hall; 2004
Electronic Devices and Circuit Theory, 11E; ISBN 978- 0132622264; Boylestad & Nashelsky ; Pearson; 2012
Electronic Communications, 6E; ISBN 978-0070571570; Shrader ; McGraw-Hill Co; 1990
How to Diagnose and Fix Everything Electronic; Geier; ISBN 978- 0071744225; McGraw-Hill/TAB Elec. 2011
Basic Electronics Theory With Projects & Experiments, 4E; ISBN 978-0830642007; Horn; McGraw-Hill/TAB Elec. 1993
The Soldering Handbook, 3E; ISBN 978-0871716187; Vianco; American Welding Society; 2000
Mastering Technical Mathematics, 3E; ISBN 978-0071494489; Gibilisco, Crowhurst; McGraw-Hill / TAB Electronics; 2007
Introduction to Electronics; ISBN 978-0534012434; Crozier; Breton Pub.; 1983
There Are No Electrons: Electronics for Earthlings; ISBN 978-0962781599; Amdahl; Clearwater Pub.; 1991
Becoming An Electronics Technician, 4E; ISBN 978-0130932198; Reis; Prentice Hall; 2001
Review **MasteringElectronicsDesign.com** website; RMS material**;** Adrian S. Nastase; 2013
Review **Electronics-notes.com** website; electronics material; Ian Poole; 2001, 2006 and refined in 2015
Review **AwesomeCube.com** website; electronics projects; Jeff LeSueur; 2013

Check online for NEETS module content: www.tpub.com/neets/index.htm
Please see the many other webpages and study materials educators and industry professionals use

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ETA certification programs are accredited through the ICAC, complying with the ISO/IEC 17024 standard.

