

# DIGITAL BASICS (EM4)–of the Associate C.E.T.

## BASIC ELECTRONICS CERTIFICATION COMPETENCIES

(As suggested for segmenting the Associate CET Competencies into 6 BASIC areas: DC; AC; Analog; Digital; Comprehensive; and RF)



### 1.0 Digital Concepts

- 1.1 Explain the principles of digital electronics
- 1.2 Identify the fundamental differences between digital and analog
- 1.3 Define the term 'discrete levels' when applied to digital
  - 1.3.1 A representation of sequentially ordered values
  - 1.3.2 Voltage levels
  - 1.3.3 High/Low
  - 1.3.4 True/False
- 1.4 Explain the difference between an undefined transient state and a digital logic high or low.
- 1.5 Explain the functional concepts of an 'active high' and 'active low' state
- 1.6 Describe the meaning of the following:
  - 1.6.1 TTL – transistor-transistor logic
  - 1.6.2 CMOS – complementary metal oxide semiconductor
- 1.7 Describe proper supply voltage ranges for the following:
  - 1.7.1 TTL
  - 1.7.2 CMOS

### 2.0 Numbering Systems and Conversions

- 2.1 Identify numbering system characteristics
  - 2.1.1 Binary – base 2
  - 2.1.2 Octal – base 8
  - 2.1.3 Decimal – base 10
  - 2.1.4 Hexadecimal – base 16
- 2.2 Describe essential elements of the binary, octal and hexadecimal numbering systems
- 2.3 Convert decimal to binary, octal and hexadecimal
- 2.4 Convert octal to decimal, binary and hexadecimal
- 2.5 Convert hexadecimal to decimal, binary and octal
- 2.6 Explain the difference between Binary-Coded-Decimal and binary
- 2.7 Explain Boolean algebra:
  - 2.7.1 Rules, laws and DeMorgan's theorem for Boolean algebra
  - 2.7.2 Simplification of Boolean expressions for gate networks
  - 2.7.3 The Karnaugh map:
    - 2.7.3.1 Interpret
    - 2.7.3.2 Simplify
- 2.8 Explain the principle of Gray Code

### 3.0 Schematic and Wiring diagrams

- 3.1 Identify common digital electrical/electronic schematic symbols
- 3.2 Identify the purpose and use of test points
- 3.3 Explain the methods of using flow diagrams/charts
- 3.4 Explain how block diagrams are used for troubleshooting and maintenance of digital electronics

### 4.0 Test Equipment and Measurements

- 4.1 Explain how to properly use a digital multimeter when servicing digital electronics
- 4.2 List the uses and precautions for logic test probes
- 4.3 Explain how logic pulsers are used
- 4.4 Explain how to use a dual trace oscilloscope
- 4.5 Describe operating characteristics of a storage oscilloscope
- 4.6 Discuss the need and proper uses of a digital signal generator
- 4.7 Explain the functions of a logic analyzer

## 5.0 Safety Precautions

- 5.1 Define electrostatic discharge (ESD)
- 5.2 Identify common sources of ESD
- 5.3 Describe procedures to prevent ESD damage
  - 5.3.1 Wrist strap
  - 5.3.2 Anti-static mats
  - 5.3.3 Properly grounded workbenches
  - 5.3.4 Constant monitoring system

## 6.0 Theory of Digital Logic Functions and Circuitry

- 6.1 Describe ASCII code
- 6.2 Identify each basic digital gate
  - 6.2.1 Interpret truth tables
  - 6.2.2 Interpret Boolean equations
  - 6.2.3 Interpret timing diagrams
  - 6.2.4 Interpret schematics
- 6.3 Identify combinational logic devices
  - 6.3.1 Multiplexer
  - 6.3.2 Demultiplexer
  - 6.3.3 half-adder
  - 6.3.4 full-adder
- 6.4 Describe counter characteristics
  - 6.4.1 Serial counters
  - 6.4.2 Parallel counters
  - 6.4.3 Ring counters
  - 6.4.4 Mod counters
    - 6.4.4.1 Decade
- 6.5 Describe shift register characteristics
  - 6.5.1 Parallel-in/Serial-out registers
  - 6.5.2 Serial-in/Parallel-out registers
- 6.6 Explain the purpose of flip flops
  - 6.6.1 R-S
  - 6.6.2 D
  - 6.6.3 J-K
  - 6.6.4 Master-Slave J-K
- 6.7 Explain the purpose of digital electronic circuitry buses
- 6.8 List types of display circuitry and describe how numbers and letters are activated digitally
- 6.9 Explain the purpose of digital oscillator circuits
- 6.10 Describe digital clock usage and timing circuitry
- 6.11 Describe MOS, CMOS transistor logic functions
- 6.12 Explain the purpose of wave shaping in digital logic circuits
- 6.13 Explain Digital to Analog conversion (DA)
- 6.14 Explain Analog to Digital conversion (AD)

## 7.0 Computer System Electronics

- 7.1 Describe the major sections of a computer
- 7.2 Describe basic programming concepts
- 7.3 Describe the reasons for different computer languages and their relationships
- 7.4 Describe different types of computer memory
  - 7.4.1 Describe how storage is accomplished
- 7.5 Define the following:
  - 7.5.1 ROM
  - 7.5.2 RAM
  - 7.5.3 PROM
  - 7.5.4 EPROM
  - 7.5.5 EEPROM

- 7.5.6 EAPROM
- 7.6 Explain the importance of databuses
- 7.7 Describe bandwidth in correlation to various databuses
- 7.8 Define 'peripheral device' and list various types
- 7.9 Explain the reasons for using interface devices/chips/cards and name common types
- 7.10 Explain the importance of an arithmetic logic unit (ALU)
- 7.11 Describe the use of microcontrollers
- 7.12 Describe microprocessor functions

### End of DIGITAL BASICS Competencies Listing

**Notes:** The purpose in distributing the above Competencies list is to provide a detailed syllabus for electronics educational institutions and instructors. Also to go further and explain what the student should be able to do with each of the items included in the Categories and Competencies listings.

#### **Find An ETA Test Site:**

<http://www.eta-i.org/testing.html>

#### **Suggested study texts and materials:**

- The Associate CET Study Guide, 6E;** ISBN 1-891749-07-2; ETA International; 2012; —Available through ETA at 800-288-3824, [www.eta-i.org](http://www.eta-i.org). \$60
- Digital Electronics; Principles and Applications, 8E;** ISBN 978-0073373775; Roger L. Tokheim; McGraw Hill Higher Education, Feb.2013, pp. 576
- Study Guide for ETA International EM4 Digital Electronics;** Karl Eilers; self-published; Feb.2013, pp. 274; — **Will be available by March 2013**, through ETA at 800-288-3824, [www.eta-i.org](http://www.eta-i.org)
- Introduction to Basic Electricity and Electronics Technology;** ISBN 978-1133948513; Earl D. Gates; Delmar Cengage Learning; March 15, 2013, pp. 624.
- Mastering Technical Mathematics, 3E;** ISBN 978-0071494489; Gibilisco, Crowhurst; McGraw-Hill / TAB Electronics; 2007; pp. 627
- Electronics Principles, 7E;** ISBN 978-0073222776; Malvino, Bates; McGraw-Hill Higher Career Education; 2007; pp. 1116

[http://www.allaboutcircuits.com/vol\\_4/index.html](http://www.allaboutcircuits.com/vol_4/index.html)

NEETS Module 13 <http://electriciantraining.tpub.com/14185/index.htm>