Texas CTE

Digital Electronics

Knowledge and skills. DIGELC

1 **The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:** DIGELC.1

- A apply mathematics to problems arising in everyday life, society, and the workplace; DIGELC.1A
- B use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; DIGELC.1B
- C select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems; DIGELC.1C
- D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate; DIGELC.1D
- E create and use representations to organize, record, and communicate mathematical ideas; DIGELC.1E
- F analyze mathematical relationships to connect and communicate mathematical ideas; and DIGELC.1F
- G display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication. DIGELC.1G

2 **The student demonstrates the skills necessary for success in a technical career. The student is expected to:** DIGELC.2

- A distinguish the differences between an engineering technician, engineering technologist, and engineer; DIGELC.2A
- B identify employment and career opportunities; DIGELC.2B
- C identify industry certifications; DIGELC.2C
- D discuss ethical issues related to engineering and technology and incorporate proper ethics in submitted projects; DIGELC.2D
- E identify and demonstrate respect for diversity in the workplace; DIGELC.2E
- F identify and demonstrate appropriate actions and identify consequences relating to discrimination, harassment, and inequality; DIGELC.2F
- G explore electronics engineering careers and preparation programs; DIGELC.2G

Skip to main content

H explore career preparation learning experiences, including job shadowing, mentoring, and apprenticeship training; and DIGELC.2H

I discuss Accreditation Board for Engineering and Technology (ABET) accreditation and implications. DIGELC.2I

3 The student participates in team projects in various roles. The student is expected to: DIGELC.3

A explain the importance of teamwork in the field of electronics; DIGELC.3A

B apply principles of effective problem solving in teams to practice collaboration and conflict resolution; and DIGELC.3B

C demonstrate proper attitudes as a team leader and team member. DIGELC.3C

4 The student develops skills for managing a project. The student is expected to: DIGELC.4

A implement project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project; DIGELC.4A

B develop a project schedule and complete work according to established criteria; DIGELC.4B

C participate in the organization and operation of a real or simulated engineering project; and DIGELC.4C

D develop a plan for production of an individual product. DIGELC.4D

5 The student practices safe and proper work habits. The student is expected to: DIGELC.5

A master relevant safety tests; DIGELC.5A

B comply with safety guidelines as described in various manuals, instructions, and regulations; DIGELC.5B

C identify governmental and organizational regulations for health and safety in the workplace related to electronics; DIGELC.5C

D identify and classify hazardous materials and wastes according to Occupational Safety and Health Administration (OSHA) regulations; DIGELC.5D

E dispose of hazardous materials and wastes appropriately; DIGELC.5E

F perform maintenance on selected tools, equipment, and machines; DIGELC.5F

G handle and store tools and materials correctly; and DIGELC.5G

H describe the results of improper maintenance of material, tools, and equipment. DIGELC.5H

6 The student explores the fundamentals of analog and digital electronics. The student uses appropriate notation and understands the logic of circuit design and logic gates. The student is expected to: DIGELC.6

Skip to main content

A use scientific notation, engineering notation, and Systems International (SI) notation to conveniently write very large or very small numbers frequently encountered when working with electronics; DIGELC.6A

B describe the process of soldering and how it is used in the assembly of electronic components; DIGELC.6B

C explain the different waveforms and distinctive characteristics of analog and digital signals; DIGELC.6C

D identify the voltage levels of analog and digital signals; DIGELC.6D

E determine whether a material is a conductor, an insulator, or a semiconductor based on its atomic structure; DIGELC.6E

F analyze the three fundamental concepts of voltage, current, and resistance; DIGELC.6F

G define circuit design software and explain its purpose; DIGELC.6G

H identify the fundamental building block of sequential logic; DIGELC.6H

I identify the components of a manufacturer's datasheet, including a logic gate's general description, connection diagram, and function table; DIGELC.6I

J categorize integrated circuits by their underlying circuitry, scale of integration, and packaging style; DIGELC.6J

K describe the advantages and disadvantages of the various sub-families of transistor-transistor logic (TTL) gates; DIGELC.6K

L explain that a logic gate is depicted by its schematic symbol, logic expression, and truth table; DIGELC.6L

M evaluate the different functions of input and output values of combinational and sequential logic; DIGELC.6M

N explain combinational logic designs implemented with AND gates, OR gates, and INVERTER gates; and DIGELC.6N

O identify the fundamental building block of sequential logic. DIGELC.6O

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7 **The student understands and uses multiple forms of AND-OR-Invert (AOI) logic. The student is expected to:** DIGELC.7

A develop an understanding of the binary number system and its relationship to the decimal number system as an essential component in the combinational logic design process; DIGELC.7A

B translate a set of design specifications into a truth table to describe the behavior of a combinational logic design by listing all possible input combinations and the desired output for each; DIGELC.7B

C derive logic expressions from a given truth table; DIGELC.7C

D demonstrate logic expressions in sum-of-products (SOP) form and products-of-sum (POS) form; DIGELC.7D

Skip to main content

E explain how all logic expressions, whether simplified or not, can be implemented using AND gates and INVERTER gates or OR gates and INVERTER gates; and DIGELC.7E

F apply a formal design process to translate a set of design specifications into a functional combinational logic circuit. DIGELC.7F

8 **The student understands, explains, and applies NAND and NOR Logic and understands the benefits of using universal gates. The student is expected to:** DIGELC.8

A apply the Karnaugh Mapping graphical technique to simplify logic expressions containing two, three, and four variables; DIGELC.8A

B define a "don't care" condition and explain its significance; DIGELC.8B

C explain why NAND and NOR gates are considered universal gates; DIGELC.8C

D demonstrate implementation of a combinational logic expression using only NAND gates or only NOR gates; DIGELC.8D

E discuss the formal design process used for translating a set of design specifications into a functional combinational logic circuit implemented with NAND or NOR gates; and DIGELC.8E

F explain why combinational logic designs implemented with NAND gates or NOR gates will typically require fewer integrated circuits (IC) than AOI equivalent implementations. DIGELC.8F

9 **The student understands combinational logic systems, including seven-segment displays, Exclusive OR and Exclusive NOR gates, and multiplexer/de-multiplexer pairs. The student understands the relative value of various logic approaches. The student is expected to:** DIGELC.9

A use seven-segment displays used to display the digits 0-9 as well as some alpha characters; DIGELC.9A

B identify the two varieties of seven-segment displays; DIGELC.9B

C describe the formal design process used for translating a set of design specifications into a functional combinational logic circuit; DIGELC.9C

D develop an understanding of the hexadecimal and octal number systems and their relationships to the decimal number system; DIGELC.9D

E explain the primary intended purpose of Exclusive OR (XOR) and Exclusive NOR (XNOR) gates; DIGELC.9E

F describe how to accomplish the addition of two binary numbers of any bit length; DIGELC.9F

G explain when multiplexer/de-multiplexer pairs are most frequently used; DIGELC.9G

H explain the purpose of using de-multiplexers in electronic displays that use multiple seven-segment displays; DIGELC.9H

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I identify the most commonly used method for handling negative numbers in digital electronics; DIGELC.9I

J discuss the use of programmable logic devices and explain designs for which they are best suited; and DIGELC.9J

K compare and contrast circuits implemented with programmable logic devices with circuits implemented with discrete logic. DIGELC.9K

10 The student understands and describes multiple types of sequential logic and various uses of sequential logic. The student is expected to: DIGELC.10

A explain the capabilities of flip-flop and transparent latch logic devices; DIGELC.10A

B discuss synchronous and asynchronous inputs of flip-flops and transparent latches; DIGELC.10B

C explore the use of flip-flops, including designing single event detection circuits, data synchronizers, shift registers, and frequency dividers; DIGELC.10C

D explain how asynchronous counters are characterized and how they can be implemented; DIGELC.10D

E explore the use of the asynchronous counter method to implement up counters, down counters, and modulus counters; DIGELC.10E

F explain how synchronous counters are characterized and how they can be implemented; DIGELC.10F

G explore the use of the synchronous counter method to implement up counters, down counters, and modulus counters; DIGELC.10G

H describe a state machine; DIGELC.10H

I identify common everyday devices that machines are used to control such as elevator doors, traffic lights, and combinational or electronic locks; and DIGELC.10I

J discuss various ways state machines can be implemented. DIGELC.10J

11 The student explores microcontrollers, specifically their usefulness in real-world applications. The student is expected to: DIGELC.11

A demonstrate an understanding of the use of flowcharts as graphical organizers by technicians, computer programmers, engineers, and other professionals and the benefits of various flowcharting techniques; DIGELC.11A

B develop an understanding of basic programming skills, including variable declaration, loops, and debugging; DIGELC.11B

C identify everyday products that use microcontrollers such as robots, garage door openers, traffic lights, and home thermostats; DIGELC.11C

D describe a servo motor; DIGELC.11D

E explore the way microcontrollers sense and respond to outside stimuli; DIGELC.11E

F explain why digital devices are only relevant if they can interact with the real world; DIGELC.11F

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G explain the importance of digital control devices, including microcontrollers in controlling mechanical systems; and DIGELC.11G

H demonstrate an understanding that realistic problem solving with a control system requires the ability to interface analog inputs and outputs with a digital device. DIGELC.11H