DIGITAL TECHNOLOGY SKILL ASSESSMENT TEST

INTRODUCTION

The materials in this review booklet are designed to assist you in preparing for the Digital Technology Skill Assessment Test (DT-SAT) by giving you some insight into the content of the test and the types of questions you will see on the actual test. This should also help focus your review of the basic skills needed to do well in each area of the test.

The DT-SAT consists of 100 multiple-choice questions. There are four timed sections of the test:

Section I: Electrical Principles and Basic Electronics (25 minutes)

Section II: Digital Systems (25 minutes)

Section III: Digital Logic (30 minutes)

Section IV: Number Systems and Conventions (25 minutes)

Each of the above test parts is described in this guide. Summaries of the types of test questions, as well as sample test questions, are provided. A reading list of useful references addressing the areas covered by the test is also contained in the last section of this booklet.

DIGITAL TECHNOLOGY SKILL ASSESSMENT TEST

PART ONE - ELECTRICAL PRINCIPLES AND BASIC ELECTRONICS

What is tested

This section tests your knowledge of the basic principles and terms of electricity, the basic concepts of electrical circuitry, common electrical and electronic symbology, and electrical transmission and waveforms.

What you should know

- You should have an understanding and working knowledge of basic electrical concepts and terms, including, but not necessarily limited to:

electrical circuit	open circuit	closed circuit
short circuit	current	grounding
alternating current	direct current	potential differences
electrical current	conductance	capacitance
electrical power	electrical resistance	electrostatic discharge
wave forms	distortion	amplification
impedance	inductance	insulation
electron flow	gain	phase
negative charge	positive charge	

- You should have a knowledge of the units of measurement used in electricity and the letter symbols used to represent these measurements, including, but not necessarily limited to:

amps	volts	watts
ohms	amplitude	frequency

- You should be familiar with the function of the following basic electrical and electronic components and be able to identify the symbols for the following among a group of electrical symbols:

fuse	transformer	rectifier
amplifier	diode	resistor
capacitor	battery	ground
conductor	transistor	switch
rectifier	wires	connected wires

Sample Questions in Section I

There are three types of questions in Section I of the test. All are multiple-choice questions with four possible answers. Your job is to choose the best answer among those that are available. Examples of these three types of questions are shown below. Some of the actual test questions may be more difficult than these examples; some may be less difficult.

- Written definitions and concepts. Some test items will describe an electrical principle, measure, or concept. Your job will be to identify, from among the four choices that are presented, the term that best describes this principle, measure, or concept. The following is an example of such a question:

Which of the following would you use to describe a measure of the electric power of a circuit?

a. hertz
b. volts
c. ohms
d. watts

The watt is a unit of electrical power (hertz is a measure of cycles per second, volts is a unit of potential difference, ohms is a unit of resistance). So you would mark item "d" on your test answer sheet for watts.

Other items in this section consist of questions with slightly longer answers. In some cases you are asked to define a term or function of a basic electrical component. The following is an example of such a question:

A transformer is a device used primarily to:

a. step-up or step-down voltage on an ac circuit
b. increase or decrease power on a dc line
c. lower amperage on a high-power circuit
d. transform dc into ac and visa versa

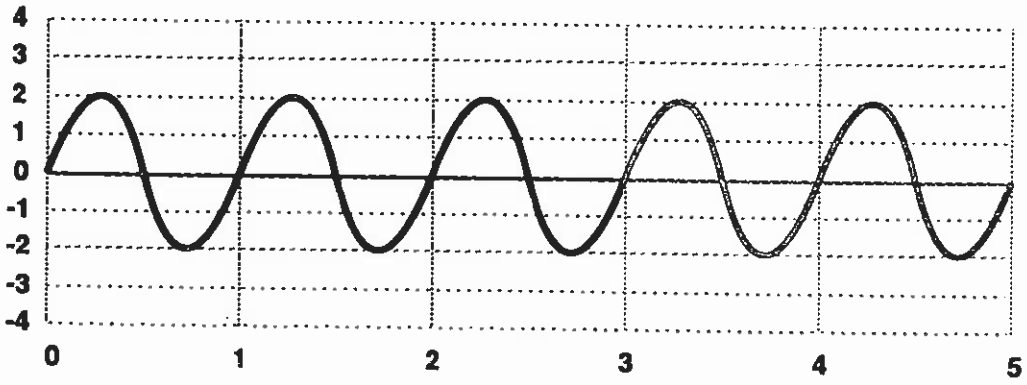
A transformer is a device that is normally used to step-up or step-down voltage on an ac (alternating current) circuit, so the correct answer is "a".

- Circuits and waveforms. Some test items are intended to measure your knowledge about the most basic kinds of circuits and electrical waveforms. For example, some items illustrate a battery, a light bulb, and simple circuit configurations. You may be asked to demonstrate your knowledge of such things as short circuits, closed circuits, open circuits, series circuits, and parallel circuits.

  You may also be asked to examine graphic representations of waveforms. You should be able to determine the frequency of a waveform and the wave amplitude, as well as identify the most basic kinds of distortion of a waveform. The following is an example of such a question:

The following figure shows a typical ac waveform with seconds as the time unit and volts as the voltage unit. What is the frequency of this waveform?

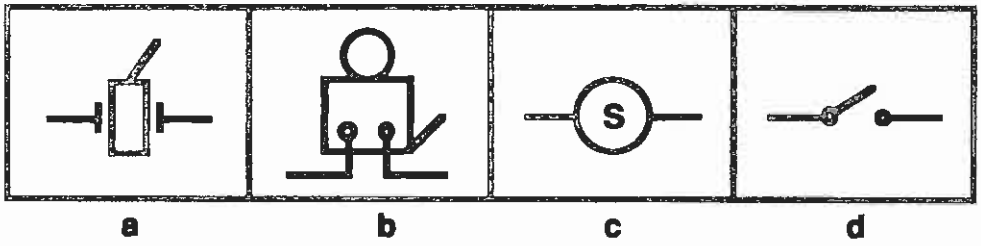
a. 60 Hz
b. 1 Hz
c. 2 Hz
d. .3 Hz



As in most charts of this type, this figure presents time along the horizontal axis and volts along the vertical axis. Each step on the horizontal axis equals one second, as indicated in the question. The waveform completes a cycle each second. Hz means cycles per second, so there is one cycle per second. The correct answer is "b" for 1 Hz.

- Circuit symbols. Some of the items in this section are designed to assess your skill at identifying the symbols used to represent common circuit elements. These questions require you to identify the symbol that is most often used to represent a specific component or feature. The following is an example of such a question.

Which of the following circuit symbols represents a switch?



The symbol used to represent a switch is above "d", so "d" would be the correct answer. The other symbols are not commonly used to represent a switch.

DIGITAL TECHNOLOGY SKILL ASSESSMENT TEST

PART TWO - DIGITAL SYSTEMS

What is tested

This section tests your knowledge of the principles used in digital communication and digital transmission. It also tests your knowledge about basic computer concepts.

What you should know

- You should have an understanding of the fundamental principles of digital signals. The topics include, but are not necessarily limited to:

digital vs analog	digital advantages	digital disadvantages
analog advantages	analog disadvantages	bits
bytes	digital signals	digital signal types

- You should have a knowledge of the basic concepts of digital signal transmission and transmission in general. The topics include, but are not necessarily limited to:

bit stream	bit frame	voice bandwidth
error checking	regeneration	Pulse Code Modulation
line encoding	signal filtering	Pulse Amplitude Modulation
dynamic range	transmission rate	digital/analog conversion
fiber optics	multiplexing	microwave transmission

- You should be familiar with the most basic computer concepts and terms, including, but not necessarily limited to:

types of memory	types of data storage	bits and bytes
basic hardware	types of languages	character coding
integrated circuit components		

Sample Questions in Section II

All of the questions in Section II of the test are multiple choice. Your job is to choose the best answer among those that are available. Examples of the types of questions contained in Section II are provided below. Some of the actual test questions may be more difficult than these examples; some may be less difficult.

- Application of basic knowledge. Some test items in this section will ask a question about a fundamental part of a digital transmission system. Your job will be to identify, from among the four choices that are presented, the answer to this question. Two examples of this type of question are shown below:

A laser is often used to generate the digital signal transmitted over which of the following media?

a. microwave
b. coax cable
c. copper wire
d. optical fiber

A laser generates light that is transmitted over optical fiber, so the correct answer to this question is "d". Another question of this type is presented below.

Which of the following best describes a digital signal waveform in which 1s alternate positive and negative voltages and 0s are zero voltage?

a. unipolar signal
b. bipolar signal
c. polar signal
d. equatorial signal

The correct answer is "b". A bipolar signal is a digital signal waveform in which 1s alternate positive and negative voltages and 0s are zero voltage. You would mark "b" on the answer sheet.

- Application of digital systems knowledge. Some test items measure your understanding of the fundamental principles of digital transmission. Some of these items ask you a question and require you to select the most appropriate answer from the four alternatives. Other items are of the fill-in-the-blank type. Your job is to select the response that most appropriately fits in the blank in the sentence. The

following is an example of such an item.

Digitally encoded speech from a single voice must be _____ prior to its use on a standard telephone

a. demuxed for output
b. amplified to audio frequencies
c. demodulated for signal input
d. decoded to an analog signal

A standard telephone uses an analog signal to carry the speaker's voice. Therefore, a digitally encoded signal must be "decoded to an analog signal" prior to use on a standard telephone. The correct answer to this item is therefore "d".

- Recognition and identification of basic computer parts and terms. Some test items measure your understanding and ability to apply terms about basic computer parts and concepts. These question are intended to measure your basic understanding of these concepts and skill at communicating with others about basic computer operations. The following is an example of such an item.

Which of the following is not one of the three primary elements of most digital computer circuits?

a. solenoids
b. switches
c. relays
d. diodes

The three primary elements of most digital computer circuits are relays, switches, and diodes, so the correct answer is solenoids. You would mark item "a" on your answer sheet because solenoids are less likely than the other three elements to be found on most digital computer circuits .

DIGITAL TECHNOLOGY SKILL ASSESSMENT TEST

PART THREE - DIGITAL LOGIC

What is tested

This section tests your knowledge of basic digital logic concepts and your skill at applying these concepts to problems. All of the items in this section are presented as problems which you must solve in order to find the correct answer. As with other items in the test, you are to choose the correct answer from the four options that are presented with each problem.

What you should know

- First, you should have a good understanding of the five major types of binary logic gates used to describe the basic operation of a digital system. Each type of gate receives one or more binary inputs, performs an operation, and produces a single binary output. The types of gates you should understand are the AND Gate, the OR Gate, the NOT Gate, the NAND Gate, and the NOR Gate. Understanding the operation performed by each of these basic types of gates will help you work through the problems in this section. The function of each type of gate is summarized below:

AND Gate: generates a 1 output only when all inputs are 1

OR Gate: generates a 1 output when any input is 1

NOT Gate: generates an output opposite of the input

NAND Gate: generates an output that is the opposite of an AND Gate's output

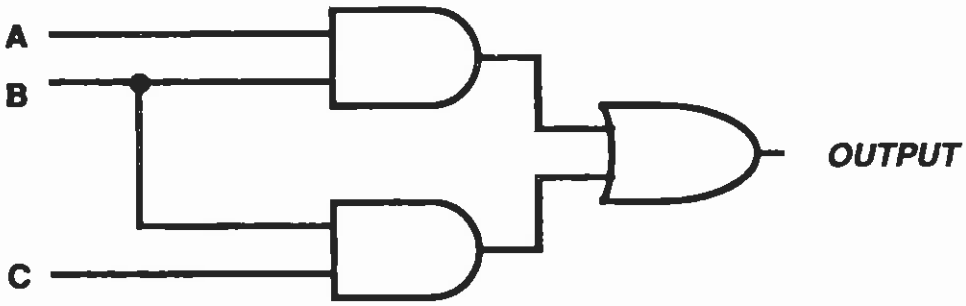
NOR Gate: generates an output that is the opposite of an OR Gate's output

- Second, you should be familiar with the organization and operation of a truth table. A truth table summarizes the function of a logic gate by showing various

combinations of binary inputs and their associated binary outputs.

- Third, you should be familiar with the concept of the bit stream and the use of a parity bit to check for parity errors in the stream.

- Fourth, you should be able to "read" a simple logic diagram including inputs, paths, connected paths, gates, and outputs. An example of a simple logic diagram including these elements is shown below.



These diagrams are usually read from left to right. They often have multiple inputs (A, B, and C in this example), multiple paths, multiple types of gates, and one or more outputs.

Sample Questions in Section III

All of the problems in Section III of the test have four possible answers. Your job is to work through the problem and choose the best answer among those that are available. Examples of the types of questions contained in Section III are provided below. Some of the actual test questions may be more difficult than these examples; some may be less difficult.

- Truth tables. Some test items in this section will ask you to identify a specific type of truth table. You will be given a type of truth table to identify, and then asked to review four truth tables and find the one that matches the operation specified. An example of this type of question is shown below:

Which of the following truth tables represents the output from an AND gate with two binary inputs and one binary output?

a

TRUTH TABLE		
INPUTS		OUTPUT
A	B	C
0	0	0
0	1	0
1	1	1
1	0	0

b

TRUTH TABLE		
INPUTS		OUTPUT
A	B	C
1	1	1
0	1	0
1	0	0
0	0	1

c

TRUTH TABLE		
INPUTS		OUTPUT
A	B	C
1	1	0
0	1	1
1	0	1
0	0	0

d

TRUTH TABLE		
INPUTS		OUTPUT
A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

An AND Gate generates a 1 output only when all inputs are 1. After reviewing all four tables, it can be seen that only in table "a" does the output equal 1 when inputs A and B equal 1. This output is 0 when A and B are any other combination of 1 and 0. Only table "a" represents the operation performed by an AND Gate. You would therefore mark "a" on your answer sheet for this question.

- Parity bit generation. Some test items in this section measure your knowledge of the "parity bit" and your skill at determining the appropriate parity bit or identifying a parity error. A parity bit generator creates another bit - - a parity bit - - to make the bit stream "odd" or "even." The parity bit is the basic building block of error-checking systems in digital transmission equipment. Some of these questions are

like the item below, in which four bit streams, labeled 1, 2, 3, and 4, are presented. Your task in this particular problem is to determine the appropriate odd-parity output for each stream. The sample question is as follows:

In the following, four digital bit streams are fed into an odd parity-bit generator circuit. What is the expected output of the parity bit generator circuit for Streams 1 through 4 based on the transmission input bits?

a	b	c	d
Stream 1: 1	Stream 1: 0	Stream 1: 0	Stream 1: 1
Stream 2: 1	Stream 2: 1	Stream 2: 0	Stream 2: 1
Stream 3: 0	Stream 3: 1	Stream 3: 1	Stream 3: 0
Stream 4: 0	Stream 4: 0	Stream 4: 0	Stream 4: 1

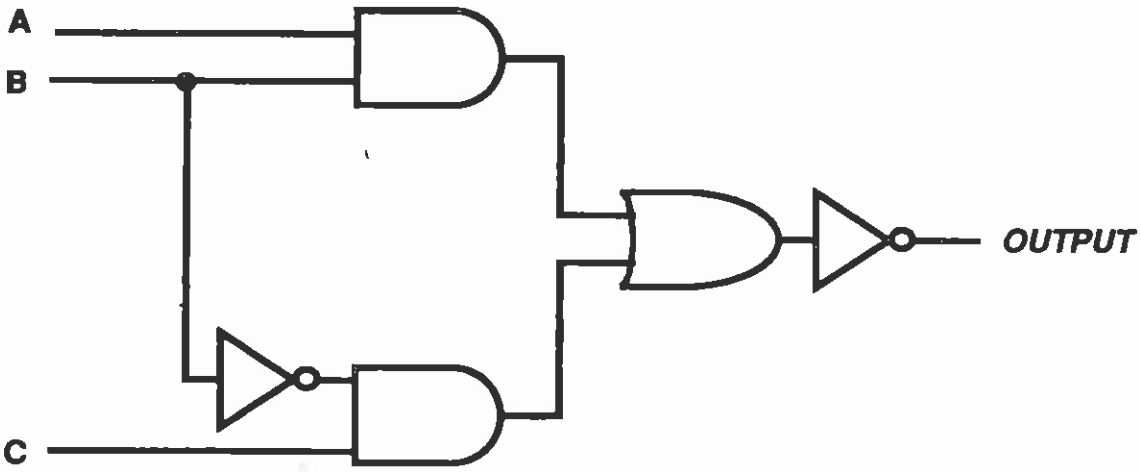
	INPUT BITS				PARITY
	D	C	B	A	OUTPUT
Stream 1	1	0	1	0	?
Stream 2	0	0	1	1	?
Stream 3	1	0	0	0	?
Stream 4	1	0	1	1	?

An odd parity bit generator would produce a 1 for bit stream 1, a 1 for bit stream 2, a 0 for bit stream 3, and a 0 for bit stream 4. Answer "a" lists the appropriate parity bits for each of the four streams. None of the other answers, b, c, or d, list a parity bit for each of the four streams that make the entire stream "odd." You would mark answer "a" on your answer sheet.

- Logic diagrams. A number of test items in Section III are based on logic diagrams that employ AND Gates, OR Gates, NOR Gates, NOT Gates, and NAND Gates. These problems illustrate a circuit with one or more binary inputs and a single binary output. They flow generally from left to right. An example of one such problem is presented below:

Which of the following binary inputs for A, B, and C would result in a 0 (but not a 1) for an output?

a. A=0 B=1 C=1
b. A=0 B=0 C=0
c. A=1 B=0 C=0
d. A=0 B=0 C=1



The correct answer is "d". When input A is 0, input B is 0, and input C is 1 the output is 0. This is not the case with the other inputs listed under choices "a", "b", or "c".

What is tested

Section IV section tests your knowledge of numbering systems and conventions, and your skill at solving related problems.

What you should know

- Numerical prefixes. You should have a working knowledge of the meaning and use of numerical prefixes. These prefixes should include, but not necessarily be limited to, the following: nano, micro, milli, centi, deci, deka, hecto, kilo, mega, and giga.

- Exponents. You should have a working knowledge of the meaning and use of numerical exponents . This includes negative (e.g., 10^{-6}) as well as positive (e.g., 10^{6}) exponents.

- Numbering systems. You should have a thorough understanding of four numbering systems, these being decimal (base 10), binary (base 2), octal (base 8) and hexadecimal (base 16).

- Number system conversions. You should be able to convert numbers from one numbering system to another numbering system.

Sample Questions in Section IV

There are four types of questions in Section IV of the test. These match the four areas listed above. All are multiple-choice questions with four possible answers. Your job is to choose the best answer among those that are available. Examples of these four types of questions are shown below. Some of the actual test questions may be more difficult than these examples; some may be less difficult.

- Numerical Prefixes. The following is an example of one type of question about numerical prefixes. Some of these questions require you to determine a value based on a given prefix; some of these questions require you to determine the prefix that matches a number. In this particular example, you must demonstrate your knowledge of both prefixes and exponents.

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PART FOUR - NUMBER SYSTEMS AND CONVENTIONS

The metric prefix milli (m) is express as:

a. 10^{-3}
b. 10^{3}
c. 10^{5}
d. 10^{-5}

The prefix "milli" represents thousandths, which, in turn, is represented by the number 10^{-3}. The correct answer is therefore "a". You would mark "a" for this item on your answer sheet.

- Exponents. The following is an example of one type of question that deals with exponents. Although the above example deals with both exponents and prefixes, this example deals only with knowledge of exponents.

The expression 10^{-3} is equal to:

a. 0.0001
b. 1,000
c. 0.003
d. 0.001

The expression 10^{-3} is equal to 0.001, so the correct answer is "d". You would mark "d" on your answer sheet for this item.

- Numbering systems and conversions. There are a number of problems in this section of the test that require you to convert a number from one numbering system to another. This might include conversion from decimal to binary, binary to decimal, decimal to octal, octal to decimal, decimal to hexadecimal, hexadecimal to decimal, binary to hexadecimal, hexadecimal to binary, octal to hexadecimal, and so forth. You will be provided with an octal to decimal conversion chart and a hexadecimal to decimal conversion chart should you require them. Following are two problems that represent the questions on numbering systems.

Which decimal number is equivalent to the binary number 10001?

a. 33
b. 49
c. 24
d. 17

The binary number 10001 is equal to the decimal number 17 because the first digit on the right has a decimal value of 1 and the 5th value (from the right) has a decimal value of 16. The correct answer is therefore "d", which you would indicate by marking "d" on the answer sheet.

Which octal number is equivalent to the decimal number 364? You may use the accompanying octal to decimal conversion chart.

a. 244
b. 49
c. 307
d. 554

OCTAL TO DECIMAL CONVERSION CHART

6		5		4		3		2		1	
OCT.	DEC.	OCT.	DEC.	OCT.	DEC.	OCT.	DEC.	OCT.	DEC.	OCT.	DEC.
0	0	0	0	0	0	0	0	0	0	0	0
1	32768	1	4096	1	512	1	64	1	8	1	1
2	65536	2	8192	2	1024	2	128	2	16	2	2
3	98304	3	12288	3	1536	3	192	3	24	3	3
4	131072	4	16384	4	2048	4	256	4	32	4	4
5	163840	5	20480	5	2560	5	320	5	40	5	5
6	196608	6	24576	6	3072	6	384	6	48	6	6
7	229376	7	28672	7	3584	7	448	7	56	7	7

The decimal number 364 is equivalent to the octal number 554, so you would mark choice "d" on your answer sheet for this item.

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SELF-STUDY RESOURCES

How to obtain the knowledge and skill measured by the DT-SAT

There are a number of ways to obtain the knowledge and skill measured by the Digital Technology Skill Assessment Test. Some individuals will have acquired this knowledge and skill on the job, while others may have taken technical classes on these topics. Completing classes and courses on these topics may be one of the better ways in which to obtain this knowledge and skill.

Many people will have, at one time or another during their education or career, studied and applied the knowledge covered by the test. If you are one of these people, it may be helpful to review your education, training, or reference material on these topics.

For individuals who do not currently possess this knowledge, who are unable to take classes, or who need to brush up on these subjects, it is possible to organize a self-paced course of study and review. The following references are provided to help you undertake a personal study program. The topics addressed by the DT-SAT are covered to a very high degree by these references. Most of these references - - or their equivalent - - should be available at a public library or bookstore.

Bellamy, J. (1991), Digital Telephony. New York: John Wiley & Sons.

Chapter 1: Background and Terminology
Chapter 2: Why Digital
Chapter 3: Voice Digitization
Chapter 4: Digital Transmission and Multiplexing

Gussow, M. (1983), Shaum's Outline of Theory and Problems of Basic Electricity. New York: Shaum's Outline Series, McGraw-Hill, Inc.

Chapter 1: The Nature of Electricity
Chapter 2: Electrical Standards and Conventions
Chapter 3: Ohm's Law and Power

Miller, R. (1988), Electronics the Easy Way (second edition). Hauppauge, New York: Barron's Educational Series, Inc.

Chapter 2: Introduction to Electronics
Chapter 3: Inductance, Capacitance, and Alternating Current
Chapter 6: Semiconductors (sections on transistors, integrated circuits)
Chapter 18: Computers (includes logic, gates, etc.)

The Bureau of Naval Personnel (1970), Basic Electricity (second revised and enlarged edition). New York: Dover Publications, Inc.

Chapter 2: Fundamental Concepts of Electricity

Chapter 4: Series D-C Circuits (sections on simple electric circuit, schematic representation, power capacity of electrical devices, energy, series circuit characteristics, open and sort circuits)

Appendix XI: Laws of Exponents

Tokheim, R. L. (1988), Shaum's Outline of Theory and Problems of Digital Principles (second edition), New York: Shaum's Outline Series, McGraw-Hill, Inc.

Chapter 1: Numbers used in Digital Electronics

Chapter 2: Binary Codes

Chapter 3: Basic Logic Gates

Chapter 4: Other Logic Gates