



COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

FINAL EXAMINATION PAPER-PENSTER 2 - 2014

CERTIFICATE IV IN ELECTRONICS ENGINEERING

EEE417: DIGITAL ELECTRONICS 1B

DAY: TIME: VENUE:

INSTRUCTIONS TO STUDENTS:

1. You are allowed **10 minutes** extra **reading time** during which you are **NOT** to write.
2. Begin each answer on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with a string.
5. For all sheets of paper on which rough/draft work has been done, cross each one through and attach these to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Answers to all questions must be written in ink on the answer sheets.
9. Use of programmable calculator(s) is prohibited.
10. Attempt **ALL** questions.

- 1) An *input* of +1.5V to a TTL IC (+5V supply) would be considered a _____ logic level.
 - A) high
 - B) low
 - C) undefined
 - D) none of the above

- 2) The general name for an electronic device that translates from decimal to binary is a (n) _____.
 - A) encoder
 - B) decoder
 - C) comparator
 - D) multiplexer

- 3) The design of circuitry that translates voltages and currents between devices (such as TTL and CMOS) is called _____.
 - A) interlacing
 - B) sinking
 - C) boundary scanning
 - D) Interfacing

- 4) A ROM is:
 - A) Volatile memory
 - B) Non-volatile memory
 - C) Read/write memory
 - D) Electrically erasable memory

- 5) The functional capacity for ULSI devices is _____.
 - A) 12 to 99 gates.
 - B) Over 100,000 gates.
 - C) 100 to 10,000 gates.
 - D) more than 10,000 gates.

- 6) The nematic fluid sandwiched between the glass plates of a LCD is also called _____.
 - A) green phosphor
 - B) metalized segments
 - C) liquid crystal
 - D) plasma

- 7) Two types of RAM semiconductor memories are the DRAM and _____.
 - A) SRAM
 - B) TRAM
 - C) BRAM
 - D) None of the above

- 8) A binary-weighted resistor used in a digital-to-analog converter (DAC) is only practical up to a resolution of _____.
 - A) 10 bits
 - B) 2 bits
 - C) 8 bits
 - D) 4 bits

9) Which of the following is not a TTL circuit?

- A) 74AL00
- B) 74HC00
- C) 74F00
- D) 74AS00

10) A(n) _____ converts an analog input to a digital output.

- A) DAC
- B) ADC
- C) bipolar converter
- D) flash converter

11) The smallest change in the analog voltage that can be represented by a digital word is known as the _____ of an ADC or DAC.

- A) resolution
- B) linearity
- C) conversion time
- D) sampling rate

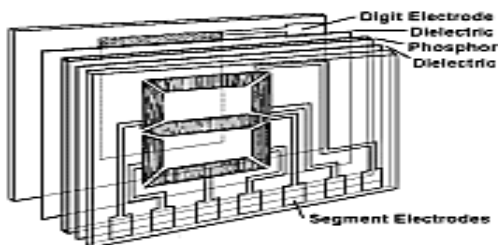
12) A troubleshooter should expect all voltage levels in a TTL circuit to be

- A) 12 V dc
- B) Between 0.4 and 2.4 dc
- C) Less than 0.4 or greater than 2.4 V dc
- D) 240 V ac or zero

13) For a common-anode seven segment display, when the segments a, b and c are lit, the display will show the number:

- A) 1
- B) 7
- C) 4
- D) 3

14) Identify which display is illustrated in the diagram below?



- A) LED display
- B) Plasma display
- C) Electroluminescent display
- D) Incandescent Filament display

- 15) A LCD consists of how many plates of glass, sealed around the perimeter, with a layer of liquid crystal fluid between them.
- A) 2
 - B) 3
 - C) 4
 - D) 5
- 16) LEDs are made out of _____.
- A) silicon.
 - B) germanium.
 - C) gallium.
 - D) silicon and germanium, but not gallium.
- 17) The storage element for a static RAM is the _____.
- A) diode
 - B) capacitor
 - C) resistor
 - D) flip-flop
- 18) Select the statement the best describes Read-only memory (ROM).
- A) Nonvolatile, used to store information that changes during system operation
 - B) Nonvolatile, used to store information that does not change during system operation
 - C) Volatile, used to store information that changes during system operation
 - D) Volatile, used to store information that does not change during system operation
- 19) What two functions does a DRAM controller perform?
- A) address multiplexing and data selection
 - B) data selection and the refresh operation
 - C) address multiplexing and the refresh operation
 - D) data selection and CPU accessing
- 20) Which type of ROM can be erased by UV light?
- A) EPROM
 - B) ROM
 - C) EEPROM
 - D) mask ROM

1. Which type of transistor do you find in a:
 - a. TTL IC and
 - b. CMOS IC?

(2 marks)

2. What are the three performance characteristics to identify any TTL IC.

(3 marks)

3. Refer to the table below and make your analysis on the three types of gates in terms of their speed, power consumption, noise margin, fan-in and fan-out. While comparing, state which one is best to use.

(5 marks)

| Type of Gate | Fan-in | Fan-out | Propagation delay (ns) | Noise margin (V) | Power consumption (mW) |
|--------------|--------|---------|------------------------|------------------|------------------------|
| TTL | 8 | 10 | 9 | 0.4 | 40 |
| CMOS | 8 | 50 | 30 | 1.5 | 1 |
| ECL | 5 | 50 | 1.1 | 0.4 | 30 |

4. Using the attached datasheet, determine:
 - a) What DM74LS02 mean?

(2 marks)
 - b) Nominal V_{CC} .

(1 mark)
 - c) Power dissipation, P_D

(3 marks)
 - d) High-level noise margin, V_{NH}

(2 marks)
 - e) Low-level noise margin, V_{NL}

(2 marks)

DATA SHEET - 1

DM74LS02

Absolute Maximum Ratings (Note 1)

| | |
|--------------------------------------|-----------------|
| Supply Voltage | 7V |
| Input Voltage | 7V |
| Operating Free Air Temperature Range | 0°C to +70°C |
| Storage Temperature Range | -65°C to +150°C |

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

| Symbol | Parameter | Min | Nom | Max | Units |
|----------|--------------------------------|------|-----|------|-------|
| V_{CC} | Supply Voltage | 4.75 | 5 | 5.25 | V |
| V_{IH} | HIGH Level Input Voltage | 2 | | | V |
| V_{IL} | LOW Level Input Voltage | | | 0.8 | V |
| I_{OH} | HIGH Level Output Current | | | -0.4 | mA |
| I_{OL} | LOW Level Output Current | | | 8 | mA |
| T_A | Free Air Operating Temperature | 0 | | 70 | °C |

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ (Note 2) | Max | Units |
|-----------|-----------------------------------|---|-----|--------------|-------|-------|
| V_I | Input Clamp Voltage | $V_{CC} = \text{Min}, I_I = -18 \text{ mA}$ | | | -1.5 | V |
| V_{OH} | HIGH Level Output Voltage | $V_{CC} = \text{Min}, I_{OH} = \text{Max}, V_{IL} = \text{Max}$ | 2.7 | 3.4 | | V |
| V_{OL} | LOW Level Output Voltage | $V_{CC} = \text{Min}, I_{OL} = \text{Max}, V_{IH} = \text{Min}$ | | 0.35 | 0.5 | V |
| | | $I_{OL} = 4 \text{ mA}, V_{CC} = \text{Min}$ | | 0.25 | 0.4 | |
| I_I | Input Current @ Max Input Voltage | $V_{CC} = \text{Max}, V_I = 7V$ | | | 0.1 | mA |
| I_{IH} | HIGH Level Input Current | $V_{CC} = \text{Max}, V_I = 2.7V$ | | | 20 | μA |
| I_{IL} | LOW Level Input Current | $V_{CC} = \text{Max}, V_I = 0.4V$ | | | -0.40 | mA |
| I_{OS} | Short Circuit Output Current | $V_{CC} = \text{Max}$ (Note 3) | -20 | | -100 | mA |
| I_{COH} | Supply Current with Outputs HIGH | $V_{CC} = \text{Max}$ | | 1.6 | 3.2 | mA |
| I_{COL} | Supply Current with Outputs LOW | $V_{CC} = \text{Max}$ | | 2.8 | 5.4 | mA |

Note 2: All typicals are at $V_{CC} = 5V, T_A = 25^\circ\text{C}$.

Note 3: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Switching Characteristics

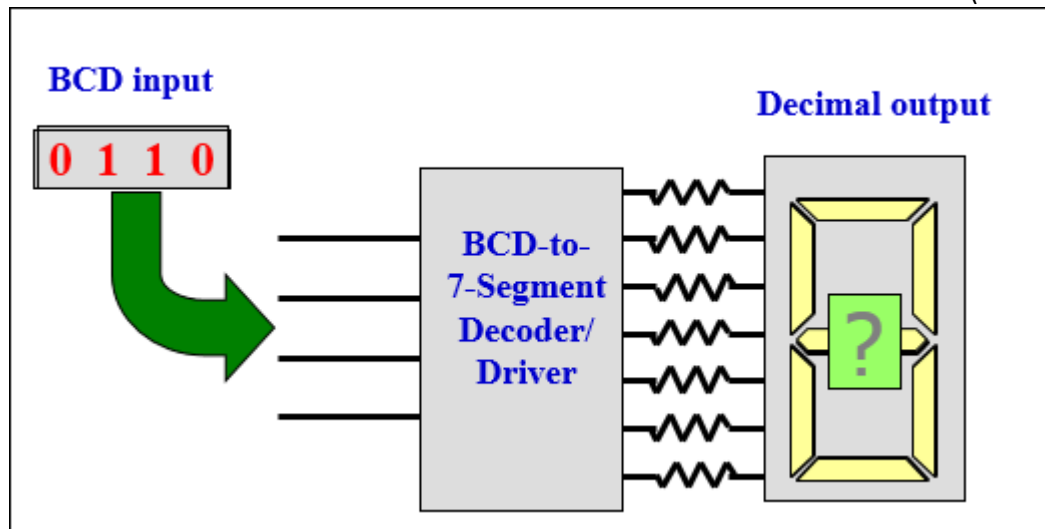
at $V_{CC} = 5V$ and $T_A = 25^\circ\text{C}$

| Symbol | Parameter | $R_L = 2 \text{ k}\Omega$ | | | | Units |
|-----------|--|---------------------------|-----|-----------------------|-----|-------|
| | | $C_L = 15 \text{ pF}$ | | $C_L = 50 \text{ pF}$ | | |
| | | Min | Max | Min | Max | |
| t_{PLH} | Propagation Delay Time LOW-to-HIGH Level Output | | 13 | | 18 | ns |
| t_{PHL} | Propagation Delay Time HIGH-to-LOW Level Output | | 10 | | 15 | ns |

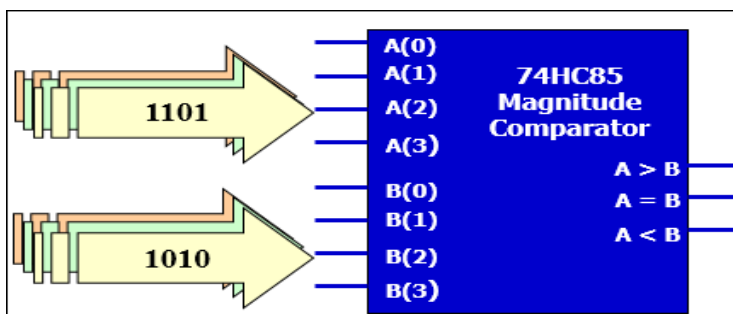
For each of the following statements, write “True” or “False”

1. If a logic circuit has a fan-out of 5, the circuit has 5 outputs.
2. The high-state noise margin is the difference between $V_{IH}(\min)$ and $V_{OH}(\min)$.
3. A logic family with $t_{pd}(\text{avg})=12\text{ns}$ and $P_D(\text{avg})=15\text{mW}$ has a greater speed-power product than one with 8ns and 30mW.
4. The basic function of a comparator is to compare the magnitude of two binary quantities to determine the relationship of those quantities.
5. An encoder is a combinational logic circuit that essentially performs the “reverse” decoder function. ^^^^^
6. The basic function of a decoder is to detect the presence of a specified combination of bits (code) on its input and to indicate that presence by a specified output level.
7. A Multiplexer has a single input but many outputs.
8. A DeMultiplexer is a device that allows digital information from several sources to be routed into a single line for transmission over that line to a common destination.
9. A DAC is used to convert a digital input word into an analogue output voltage or current.
10. The majority of Light-Emitting Diodes are either Gallium Phosphide (GaP) or Gallium Arsenide Phosphide (GaAsP) devices.
11. There are two classes of liquid crystal known respectively as Neumatic and Smetic, but only the latter is used to display devices.
12. Seven segment displays are generally employed as indicators of decimal numbers and consist of a number of LEDs arranged in seven segments.
13. If Alphanumerical characters are to be displayed, either a 16 segment, or a dot matrix display is required.
14. A TSM7752B is a 16 segment display driver module.

1. Refer to the diagram below and answer the following questions.
 - i) What is the decimal output from the decoder that appears on the 7-segment display? (1 mark)
 - ii) If the BCD input is 0010, what segments will be illuminated? (1 mark)
 - iii) What special name is given to the resistors that are added between the decoder and the display? (1mark)



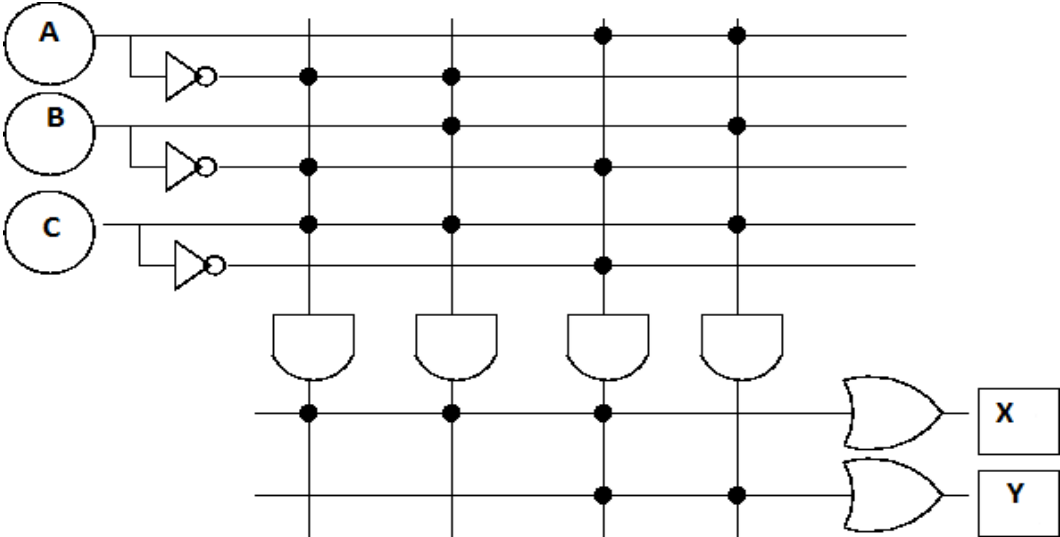
2. A programmable logic device (PLD) is an IC that can be programmed by the user to execute a complex logic function. There are various types of PLD's available. What do the following acronyms stand for: (3 marks)
 - i) PAL
 - ii) GAL
 - iii) FPL
3. What is the function of a multiplexer (MUX) and also draw the logic symbol for 1-of-4 multiplexer. (4 marks)
4. Which output of the comparator IC will be activated with these two 4-bit binary numbers as inputs? (2 marks)



5. What is the purpose of the following:
 - i) Decoder (1 mark)
 - ii) Encoder (1 mark)
 - iii) Demultiplexer (1 mark)

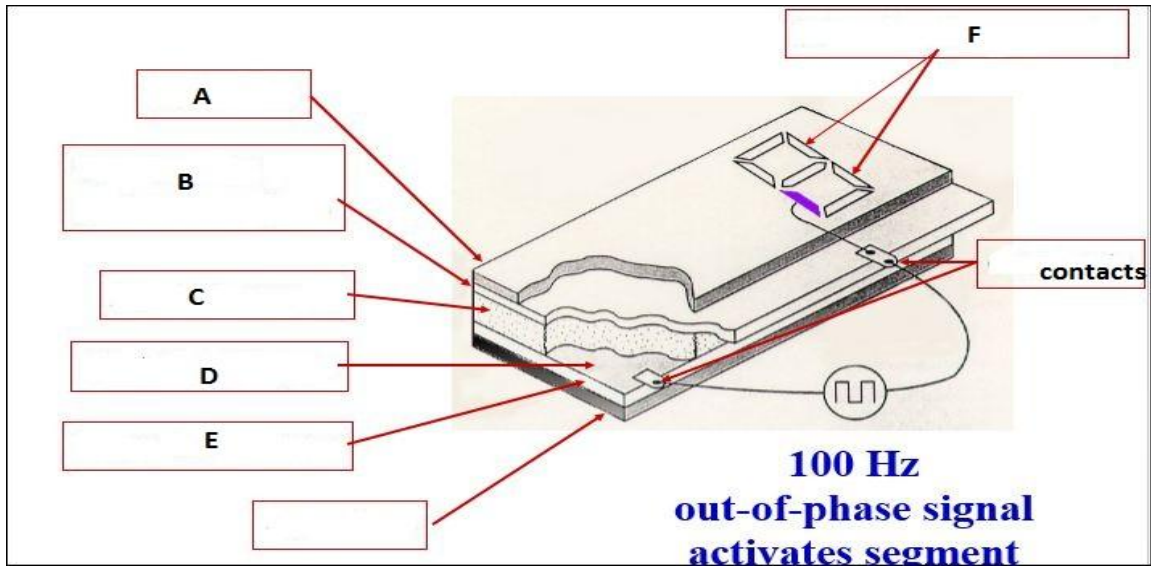
6. Determine the Boolean equation for the given programmable logic array.

(5 marks)



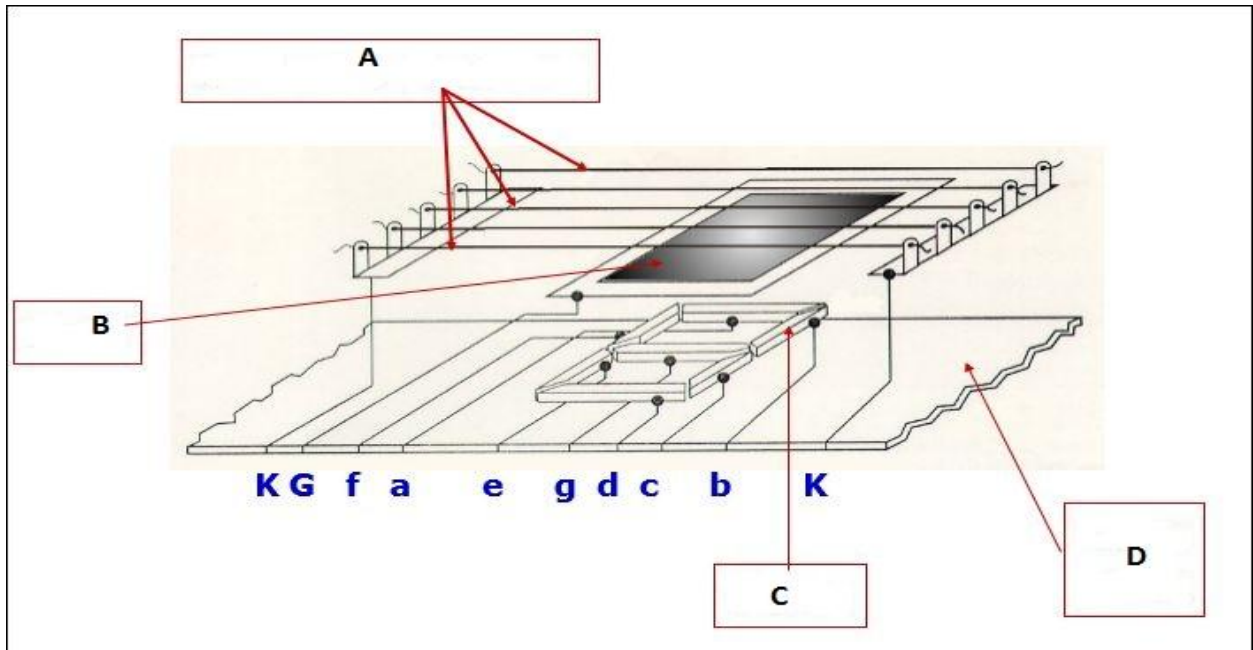
1. Identify the following displays and label them.
i)

(7 marks)



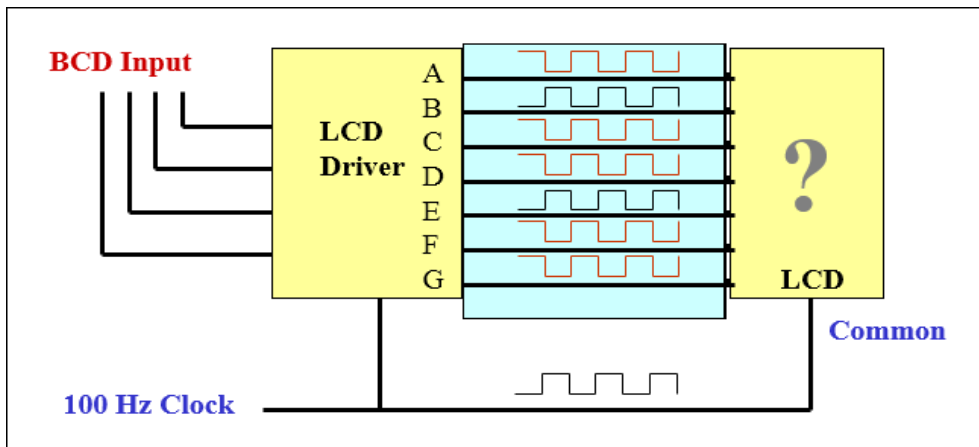
- ii)

(5 marks)



2. What will be the output on the LCD display?

(2 marks)



3. Name 3 display devices apart from LED, LCD and VFD.

(3 marks)

4. Use the data sheet where necessary to answer the following questions:

DATA SHEET - 2

| 7-SEGMENT LEDs | | | | | | | | | | |
|------------------------|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|--------|-------------------|-------------------|------------------|
| | LTS312AR Z 4117 | LTS313AR Z 4103 | LTS5303AR Z 4150 | LTS5503AE Z 4151 | LTS546AR Z 4145 | LTS313AG Z 4105 | 30240A | LSD5115 Z 4118 | LSD5114 Z-4130 | LSD5365 Z4146 |
| Characteristics | | | | | | | | | | |
| Common Terminal Pol. | Anode | Cathode | Cathode | Cathode | Anode | Cathode | Anode | Cathode | Cathode | Anode |
| Digit Size | 7.6mm | 7.6mm | 14.2mm | 14.2mm | 13.2mm | 7.6mm | 7.6mm | 13.1mm | 14.2mm | 14.2mm |
| Colour | Red | Red | Red | Orange | Red | Green | Red | red | Orange | Red |
| Av. Fwd. Seg. Current | 25mA | 25mA | 25mA | 25mA | 25mA | 25mA | 25mA | 25mA | 25mA | 25mA |
| Segment Voltage | 1.7 | 1.7 | 1.7 | 2.1 | 1.7 | 2.1 | 2.0 | 1.7 | 2.0 | 1.7 |
| Min. Rev. Brkdn. Volt. | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Max. Rev. Current | 100uA | 100uA | 100uA | 100uA | 100uA | 100uA | 100uA | 10uA | 10uA | 10uA |
| Seg. Intensity (typ.) | 450ucd | 450ucd | 500ucd | 2200ucd | 500ucd | 2000ucd | 750ucd | 6000ucd | 4500ucd | 8500ucd |
| Max. Seg. Dissipation | 55mW | 55mW | 55mW | 75mW | 55mW | 75mW | 85mW | 110mW | 100mW | 110mW |
| Connections | | | | | | | | | | |
| Seg. A | 1 | 10 | 7 | 7 | 7 | 10 | 1 | 7 | 7 | 7 |
| Seg. B | 13 | 9 | 6 | 6 | 6 | 9 | 13 | 6 | 6 | 6 |
| Seg. C | 10 | 8 | 4 | 4 | 4 | 8 | 10 | 4 | 4 | 4 |
| Seg. D | 8 | 5 | 2 | 2 | 2 | 5 | 8 | 2 | 2 | 2 |
| Seg. E | 7 | 4 | 1 | 1 | 1 | 4 | 7 | 1 | 1 | 1 |
| Seg. F | 2 | 2 | 9 | 9 | 9 | 2 | 2 | 9 | 9 | 9 |
| Seg. G | 11 | 3 | 10 | 10 | 10 | 3 | 11 | 10 | 10 | 10 |
| Dec. Pt. | 9 | 7 | 5 | 5 | 5 | 7 | 6,9 | 5 | 5 | 5 |
| Common | 3,14 | 1,6 | 3,8 | 3,8 | 3,8 | 1,6 | 3,14 | 3,8 | 3,8 | 3,8 |

(a) Calculate the value of the safety resistor to display a digit 3 using a Z 4117 display.

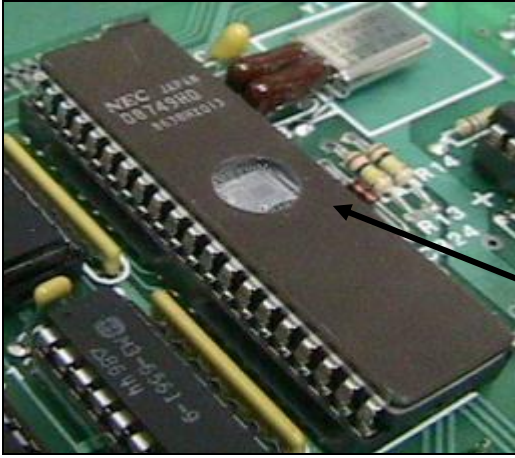
(3 marks)

SECTION-F

[15 Marks]

1. What do the following terms stand for: (7 marks)
 - (a) SRAM
 - (b) DRAM
 - (c) ROM
 - (d) EPROM
 - (e) PROM
 - (f) SIMM
 - (g) DIMM
2. What is volatile and non-volatile memory? (2 marks)
3. Which two units make up the central processing unit? (1 mark)
4. Identify the following labels: (5 marks)





(v)

DATA SHEET-3

Low-power Schottky

Core part number

Logic families or subfamilies

Marking on a typical digital IC

Decoding the part number on a typical IC

Commercial grade

CMOS ICs

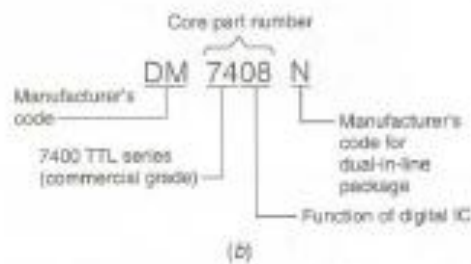


Fig. 3-34 (a) Marking on a typical digital IC. (Courtesy of National Semiconductor Corporation.) (b) Decoding the part number on a typical IC.

Instruments. On this unit, the suffix "J" stands for a ceramic DIP packaging. This is typically referred to as the *commercial grade*. The core part number of the IC in Fig. 3-35 is 74LS08. This is similar to the 7408 quadruple two-input AND gate IC discussed earlier. The let-

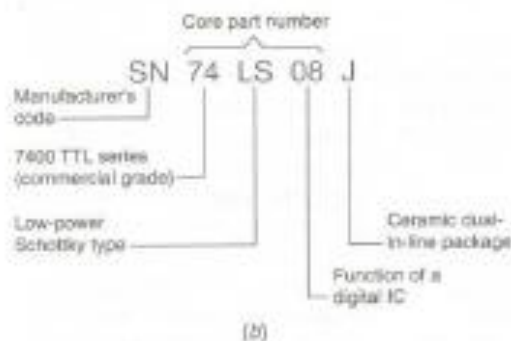
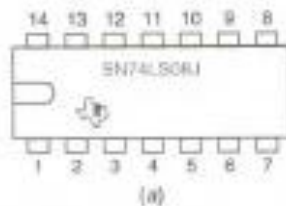


Fig. 3-35 (a) Markings on a Texas Instruments digital IC. (b) Decoding the part number of a typical low-power Schottky IC.

ters "LS" in the center of the core number designate the type of TTL circuitry used in the IC. In this case "LS" stands for *low-power Schottky*.

The internal letter(s) in a core part number of a 7400 series IC tell something about the *logic family or subfamily*. Typical internal letters used are:

- AC = FACT Fairchild Advanced CMOS Technology logic (a newer advanced family of CMOS)
- ACT = FACT Fairchild Advanced CMOS Technology logic (a newer family of CMOS with TTL logic levels)
- ALS = advanced low-power Schottky TTL logic (a subfamily of TTL)
- AS = advanced Schottky TTL logic (a subfamily of TTL)
- C = CMOS logic (an early family of CMOS)
- F = FAST Fairchild Advanced Schottky TTL logic (a new subfamily of TTL)
- FCT = FACT Fairchild Advanced CMOS Technology logic (a family of CMOS with TTL logic levels)
- H = high-speed TTL logic (a subfamily of TTL)
- HC = high-speed CMOS logic (a family of CMOS)
- HCT = high-speed CMOS logic (a family of CMOS with TTL inputs)
- L = low-power TTL logic (a subfamily of TTL)
- LS = low-power Schottky TTL logic (a subfamily of TTL)
- S = Schottky TTL logic (a subfamily of TTL)

The internal letters give information about the speed, power consumption, and process technology of digital ICs. Because of these speed and power consumption differences, manufacturers usually recommend that exact part numbers be used when replacing digital ICs. When the letter "C" is used inside a 7400 series part number, it designates a CMOS and not a TTL digital IC. The internal letters "HC," "HCT," "AC," "ACT," and "FCT" also designate CMOS ICs.

Data manuals from manufacturers contain much valuable information on digital ICs. They contain pin diagrams and packaging information. Data manuals also contain details on part

DATA SHEET-4



August 1986
Revised March 2000

DM74LS00 Quad 2-Input NAND Gate

DM74LS00 Quad 2-Input NAND Gate

General Description

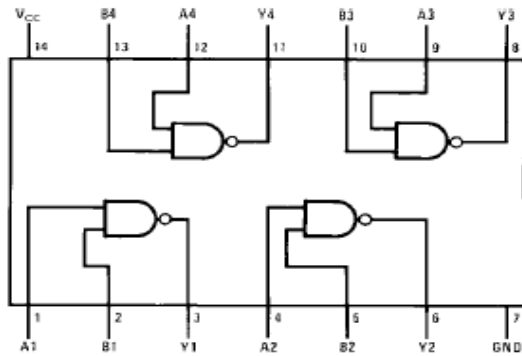
This device contains four independent gates each of which performs the logic NAND function.

Ordering Code:

| Order Number | Package Number | Package Description |
|--------------|----------------|---|
| DM74LS00M | M14A | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150 Narrow |
| DM74LS00SJ | M14D | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide |
| DM74LS00N | N14A | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Connection Diagram



Function Table

$$Y = \overline{AB}$$

| Inputs | | Output |
|--------|---|--------|
| A | B | Y |
| L | L | H |
| L | H | H |
| H | L | H |
| H | H | L |

H = HIGH Logic Level
L = LOW Logic Level

