Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2016/2017

| | |
|---|---|
| COURSE NAME | : DIGITAL TECHNIQUES |
| COURSE CODE | : BEF 12302 |
| PROGRAMME CODE | : BEV |
| EXAMINATION DATE | : JUNE 2017 |
| DURATION | : 2 HOURS |
| INSTRUCTION | : 1. ANSWER **ALL** QUESTIONS<br>2. ATTACH **APPENDIX A** AND **B** WITH YOUR ANSWER BOOKLET |



THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

**Q1** (a) List **four (4)** disadvantages of digital system.

(4 marks)

(b) Assuming that all numbers can be represented using 8-bit binary, complete the missing entries which are not shaded in the **Table Q1(b)**. (No mark will be given for this question unless all the solutions are shown).

(8 marks)

(c) American Standard Code for Information Interchange (ASCII) is a character encoding standard which represent text in computers, telecommunications equipment, and other devices. What are the real bit that are send by a computer with a message TRY, using ASCII with odd parity? The ASCII table is given in **Table Q1(c)**.

(6 marks)

(d) A 4-bit binary number is represent by $A_3\ A_2\ A_1\ A_0$ with $A_3\ A_2\ A_1$ and $A_0$ are the individual bits and $A_0$ is the LSB. Draw a minimal combinational logic circuit which produce these two conditions:

(i) An output is HIGH when the $A_3\ A_2\ A_1\ A_0$ should be at least $1_{10}$ and above and less than $8_{10}$.
(ii) An output can be either HIGH or LOW when $A_3\ A_2\ A_1\ A_0$ are $12_{10}$ and $13_{10}$.

(7 marks)

**Q2** (a) By using De Morgan Theorem, simplify the Boolean expression for Z in **Figure Q2(a)**.

(5 marks)

(b) **Table Q2(b)** shows a truth table of a four-input and two-output logic function. Use Karnaugh maps, formulate:

(i) The minimal sum-of-product (MSOP) of expression for Y.

(5 marks)

(ii) The minimal product-of-sum (MPOS) of expression for Z.

(5 marks)

(c) A NAND gate is known as a universal gate as it can be configured into any basic logic gate.

(i) Illustrate how a NAND gate can be used as NOR gate.

(3 marks)

(ii) Implement the function $Z = \overline{A}\overline{B} + \overline{D} + B\overline{C}$ using only a 2-input NAND gates.

(7 marks)

**Q3** (a) Explain the operation of the following functional combinational logic circuit. You may use appropriate diagram to aid your explanation.

(i) Encoder.

(2 marks)

(ii) Demultiplexer.

(2 marks)

(b) Analyze the 8 inputs multiplexer shown in **Figure Q3(b)**.

(i) Draw the truth table.

(4 marks)

(ii) Find the simplest Boolean expression for the output Z.

(3 marks)

(c) Implement the following Boolean expression using IC 74LS138 (3-to-8 decoder) in **APPENDIX A**. Symbol for IC 74LS138 is shown in **APPENDIX A** for the internal circuitry and pins assignment of 74LS138 (3-to-8 decoder).

$$Z = \overline{\bar{A} + \bar{B}C}$$

(8 marks)

(d) Analyze the flip-flop circuit in **Figure Q3(d)** and sketch output waveform.Complete the timing diagram for Q in **APPENDIX B** and assume that initially Q=0.

(6 marks)

**Q4** (a) Explain **one (1)** advantage and **two (2)** disadvantages of a synchronous counter compared to asynchronous counter.

(3 marks)

(b) Explain the difference between Moore and Mealy state machine.

(4 marks)

(c) Design a synchronous counter that counts in the sequence of 000, 010, 101, 110 and repeat. The undesired states 001, 011, 100, and 111 must always go to 000 on the NEXT clock pulse. Include in your solutions with:

(i) State transition diagram.

(1 mark)

(ii) The excitation table for this state machine. Use JK flip flops.

(6 marks)

(iii) The simplest Boolean expression for the circuit using Karnaugh map.

(6 marks)

(iv) Circuit to implement the design.

(3 marks)

(d) Explain the operation of the Serial In Parallel Out register (PISO) register. You may use appropriate diagram to aid your explanation.

(2 marks)

**- END OF QUESTIONS-**

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## Table Q1(b) : Set numbers in numerical representation

| | Binary | Hexadecimal | Unsigned Decimal | Signed Decimal | Gray |
|---|---|---|---|---|---|
| Set number 1 | ? | | 81 | | ? |
| Set number 2 | | D4 | ? | ? | |

## Table Q1(c) : ASCII table

| Dec | Hx | Oct | Char | Dec | Hx | Oct | Chr | Dec | Hx | Oct | Chr | Dec | Hx | Oct | Chr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 000 | NUL (null) | 32 | 20 | 040 | Space | 64 | 40 | 100 | @ | 96 | 60 | 140 | ` |
| 1 | 1 | 001 | SOH (start of heading) | 33 | 21 | 041 | ! | 65 | 41 | 101 | A | 97 | 61 | 141 | a |
| 2 | 2 | 002 | STX (start of text) | 34 | 22 | 042 | " | 66 | 42 | 102 | B | 98 | 62 | 142 | b |
| 3 | 3 | 003 | ETX (end of text) | 35 | 23 | 043 | # | 67 | 43 | 103 | C | 99 | 63 | 143 | c |
| 4 | 4 | 004 | EOT (end of transmission) | 36 | 24 | 044 | $ | 68 | 44 | 104 | D | 100 | 64 | 144 | d |
| 5 | 5 | 005 | ENQ (enquiry) | 37 | 25 | 045 | % | 69 | 45 | 105 | E | 101 | 65 | 145 | e |
| 6 | 6 | 006 | ACK (acknowledge) | 38 | 26 | 046 | & | 70 | 46 | 106 | F | 102 | 66 | 146 | f |
| 7 | 7 | 007 | BEL (bell) | 39 | 27 | 047 | ' | 71 | 47 | 107 | G | 103 | 67 | 147 | g |
| 8 | 8 | 010 | BS (backspace) | 40 | 28 | 050 | ( | 72 | 48 | 110 | H | 104 | 68 | 150 | h |
| 9 | 9 | 011 | TAB (horizontal tab) | 41 | 29 | 051 | ) | 73 | 49 | 111 | I | 105 | 69 | 151 | i |
| 10 | A | 012 | LF (NL line feed, new line) | 42 | 2A | 052 | * | 74 | 4A | 112 | J | 106 | 6A | 152 | j |
| 11 | B | 013 | VT (vertical tab) | 43 | 2B | 053 | + | 75 | 4B | 113 | K | 107 | 6B | 153 | k |
| 12 | C | 014 | FF (NP form feed, new page) | 44 | 2C | 054 | , | 76 | 4C | 114 | L | 108 | 6C | 154 | l |
| 13 | D | 015 | CR (carriage return) | 45 | 2D | 055 | - | 77 | 4D | 115 | M | 109 | 6D | 155 | m |
| 14 | E | 016 | SO (shift out) | 46 | 2E | 056 | . | 78 | 4E | 116 | N | 110 | 6E | 156 | n |
| 15 | F | 017 | SI (shift in) | 47 | 2F | 057 | / | 79 | 4F | 117 | O | 111 | 6F | 157 | o |
| 16 | 10 | 020 | DLE (data link escape) | 48 | 30 | 060 | 0 | 80 | 50 | 120 | P | 112 | 70 | 160 | p |
| 17 | 11 | 021 | DC1 (device control 1) | 49 | 31 | 061 | 1 | 81 | 51 | 121 | Q | 113 | 71 | 161 | q |
| 18 | 12 | 022 | DC2 (device control 2) | 50 | 32 | 062 | 2 | 82 | 52 | 122 | R | 114 | 72 | 162 | r |
| 19 | 13 | 023 | DC3 (device control 3) | 51 | 33 | 063 | 3 | 83 | 53 | 123 | S | 115 | 73 | 163 | s |
| 20 | 14 | 024 | DC4 (device control 4) | 52 | 34 | 064 | 4 | 84 | 54 | 124 | T | 116 | 74 | 164 | t |
| 21 | 15 | 025 | NAK (negative acknowledge) | 53 | 35 | 065 | 5 | 85 | 55 | 125 | U | 117 | 75 | 165 | u |
| 22 | 16 | 026 | SYN (synchronous idle) | 54 | 36 | 066 | 6 | 86 | 56 | 126 | V | 118 | 76 | 166 | v |
| 23 | 17 | 027 | ETB (end of trans. block) | 55 | 37 | 067 | 7 | 87 | 57 | 127 | W | 119 | 77 | 167 | w |
| 24 | 18 | 030 | CAN (cancel) | 56 | 38 | 070 | 8 | 88 | 58 | 130 | X | 120 | 78 | 170 | x |
| 25 | 19 | 031 | EM (end of medium) | 57 | 39 | 071 | 9 | 89 | 59 | 131 | Y | 121 | 79 | 171 | y |
| 26 | 1A | 032 | SUB (substitute) | 58 | 3A | 072 | : | 90 | 5A | 132 | Z | 122 | 7A | 172 | z |
| 27 | 1B | 033 | ESC (escape) | 59 | 3B | 073 | ; | 91 | 5B | 133 | [ | 123 | 7B | 173 | { |
| 28 | 1C | 034 | FS (file separator) | 60 | 3C | 074 | < | 92 | 5C | 134 | \ | 124 | 7C | 174 | \| |
| 29 | 1D | 035 | GS (group separator) | 61 | 3D | 075 | = | 93 | 5D | 135 | ] | 125 | 7D | 175 | } |
| 30 | 1E | 036 | RS (record separator) | 62 | 3E | 076 | > | 94 | 5E | 136 | ^ | 126 | 7E | 176 | ~ |
| 31 | 1F | 037 | US (unit separator) | 63 | 3F | 077 | ? | 95 | 5F | 137 | _ | 127 | 7F | 177 | DEL |

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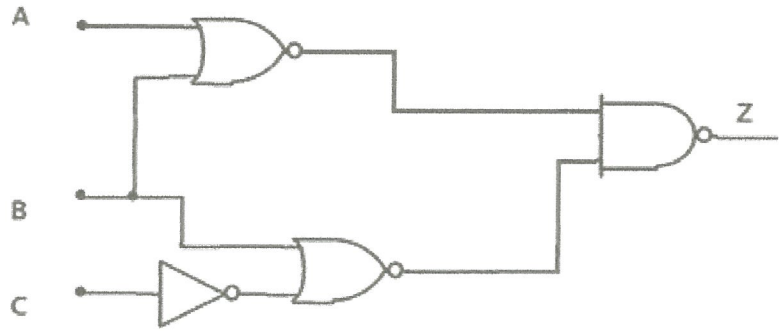


**Figure Q2(a)**

**Table Q2(b)**

| INPUT | | | | OUTPUT | |
|---|---|---|---|---|---|
| A | B | C | D | Y | Z |
| 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 | X |
| 0 | 0 | 1 | 1 | 0 | X |
| 0 | 1 | 0 | 0 | X | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | X | 1 |
| 1 | 0 | 1 | 0 | 0 | X |
| 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | X |
| 1 | 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | X | 0 |

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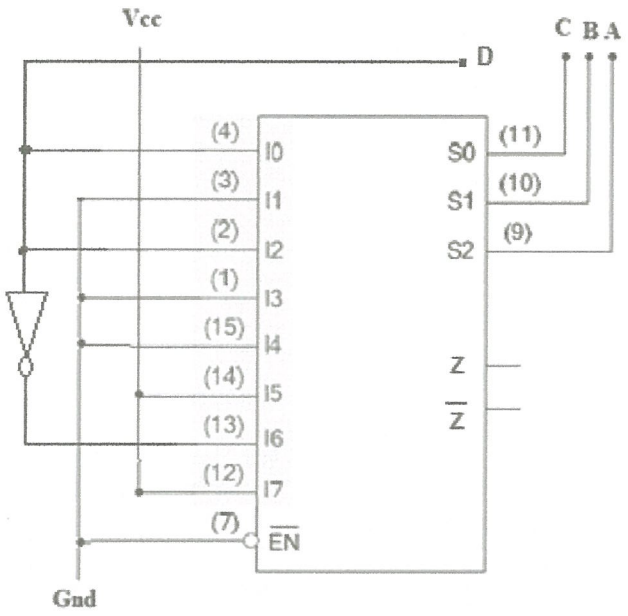


**Figure Q3(b)**

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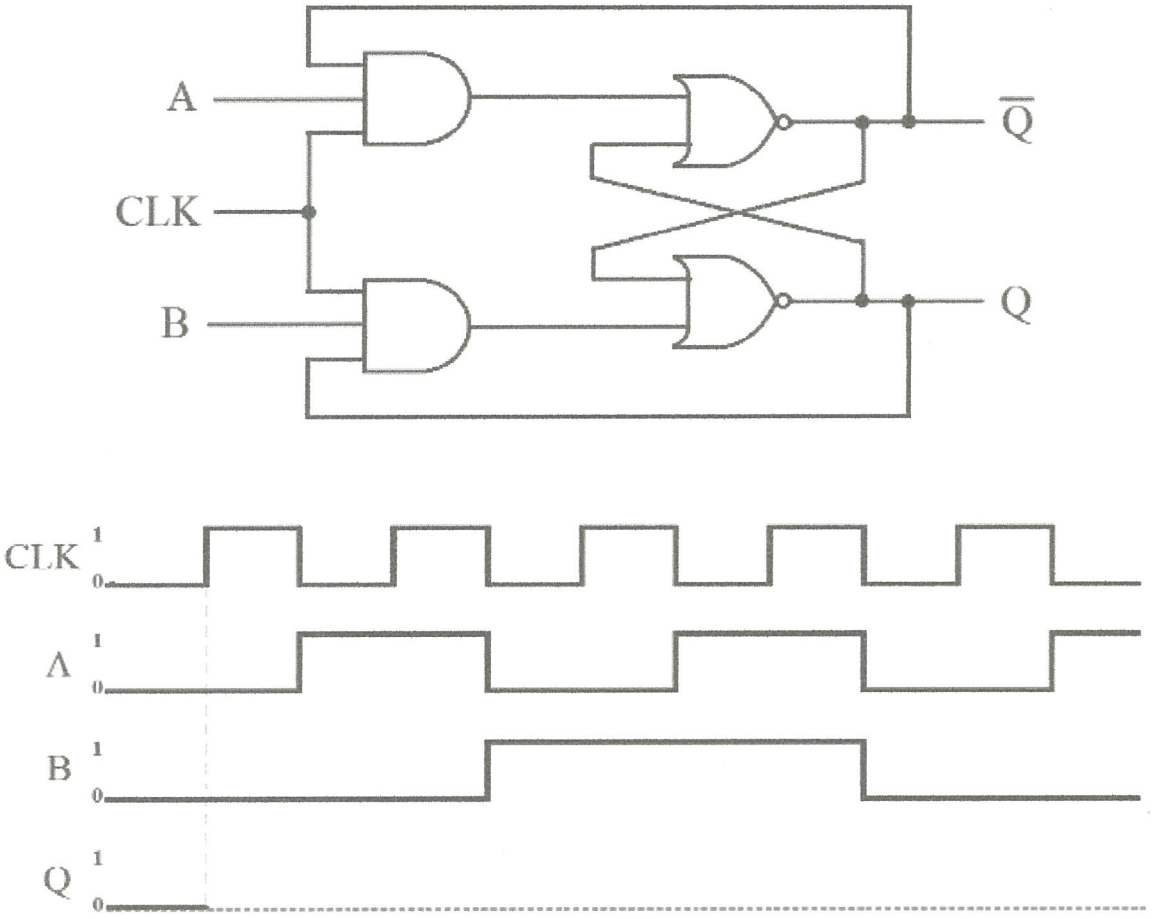


**Figure Q3(d)**

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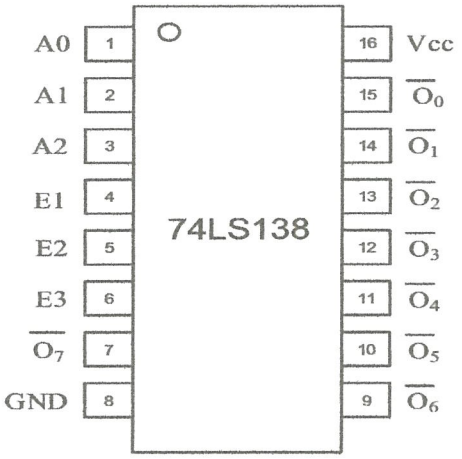
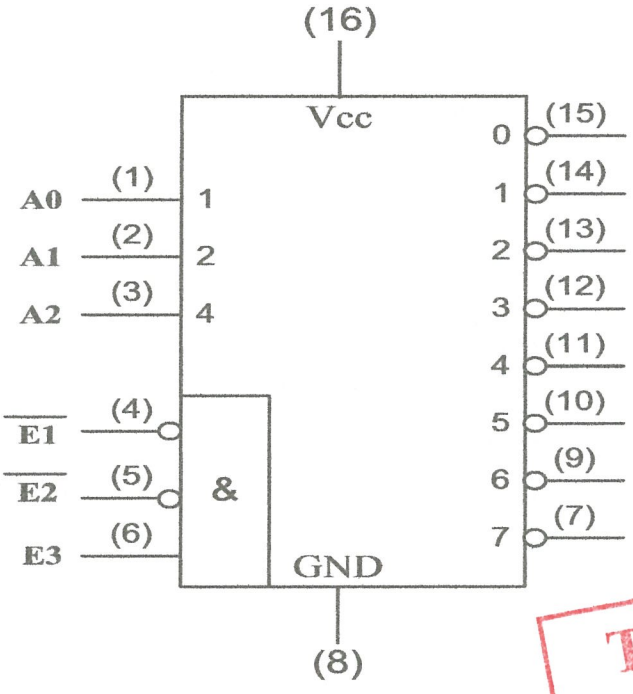
# APPENDIX A

## PIN ASSIGNMENT AND INTERNAL CIRCUITRY

**74LS138 (3-to-8 Decoder)**



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# APPENDIX B