Marking Scheme

Exam Paper
BSc CE

Logic Circuits (630211)

Final Exam  First semester  Date: 28/01/2020
Section 1
Weighting 40% of the module total

Lecturer:  Dr. Qadri Hamarsheh
Coordinator:  Dr. Qadri Hamarsheh
Internal Examiner:  Eng. Anis Nazer
The presented exam questions are organized to overcome course material through 6 questions. The all questions are compulsory requested to be answered.

**Marking Assignments**

**Question 1** This question is attributed with 10 marks if answered properly; the answers are the following: **Identify the choice that best completes the statement or answers the question.**

1) The **binary** number 101110101111010 can be written in **octal** as ________.
   a) 51562₈ b) 56577₈ c) 56572₈ d) 65627₈

2) The **excess-3** code of decimal number 26 is:
   a) 01001101 b) 01001001 c) 10001001 d) 01011001

3) In the circuit shown below, which logic function does this circuit generate?
   a) OR b) AND c) NOR d) NAND

4) The **dual** of the Boolean function \( x + yz \) is:
   a) \( x(y + z) \) b) \( x(y + z) \) c) \( x + yz \) d) \( x + yz \)

5) Applying **DeMorgan's theorem** to the expression \((X + Y) + \overline{Z}\), we get ________
   a) \( (\overline{X} + \overline{Y})\overline{Z} \) b) \( (\overline{X} + \overline{Y})\overline{Z} \) c) \( (\overline{X} + \overline{Y})\overline{Z} \) d) \( (\overline{X} + \overline{Y})\overline{Z} \)

6) The K-map for a Boolean function is shown in the figure. The number of **essential prime implicants** for this function is
   a) 4 b) 5 c) 6 d) 8

7) **Any** combinational circuit can be built using
   1. NAND gates.  2. NOR gates.  3. EX-OR gates.  4. Multiplexers.
   Which of these are correct?
   a) 1, 2 and 3 b) 1, 3 and 4 c) 2, 3 and 4 d) 1, 2 and 4

8) Refer to the following figure, If \( S_1 = 1 \) and \( S_2 = 0 \) what will be the logic state at the output \( X \)?
   a) \( X = A \) b) \( X = B \) c) \( X = C \) d) \( X = D \)

9) **PRESET** and **CLEAR** inputs are normally **synchronous**.
   a) True b) False

10) When designing the circuit with the state table shown below using \( J \& K \) flip flops, then \( J_A = \ldots \) \( K_A = \ldots \)
Question 2 This question is attributed with 6 marks if answered properly; the answers are the following:

a) \[ J_A = B'.x', K_A = A' \]

b) \[ J_A = B.x, K_A = A \]

c) \[ J_A = B.X, K_A = A' \]

d) \[ J_A = B.x', K_A = B.x \]

Question 3 This question is attributed with 6 marks if answered properly; the answers are the following:

Solution

<table>
<thead>
<tr>
<th>Function</th>
<th>Minterm list</th>
<th>Maxterm list</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F )</td>
<td>( \sum XYZ (3; 5; 6; 7) )</td>
<td>( \sum XYZ (0; 1; 2; 4) )</td>
</tr>
<tr>
<td>( G )</td>
<td>( \sum XYZ (1; 2; 4; 7) )</td>
<td>( \sum XYZ (0; 3; 5; 6) )</td>
</tr>
</tbody>
</table>

Question 4 This question is attributed with 7 marks if answered properly; the answers are the following:
a) **Solution**

Truth table of half adder is as shown:

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
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<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

b) **Solution**

CLK

S

R

Q

\( \overline{Q} \)

time

(c) **Solution**

**HIGH**

FF0

\( C \)

FF1

\( C \)

FF2

\( C \)

CLK

\( Q_0 \) (LSB)

\( 0 \quad 1 \quad 0 \quad 0 \quad 1 \quad 0 \quad 1 \quad 0 \quad 1 \)

\( Q_1 \)

\( 0 \quad 0 \quad 1 \quad 1 \quad 0 \quad 0 \quad 1 \quad 0 \quad 1 \)

\( Q_2 \) (MSB)

\( 0 \quad 0 \quad 0 \quad 0 \quad 1 \quad 1 \quad 1 \quad 0 \quad 1 \)
**Question 5** This question is attributed with 5 marks if answered properly; the answers are the following:

**Solution**

- Equations
  - \( A(t+1) = BC \)
  - \( B(t+1) = B'C + BC' \)
  - \( C(t+1) = A'C \)

<table>
<thead>
<tr>
<th>( A )</th>
<th>( B )</th>
<th>( C )</th>
<th>( A'B'C' )</th>
<th>( Z )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0</td>
<td>0 0 1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0 0 1</td>
<td>0 1 0</td>
<td>0</td>
<td>0</td>
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<td>0 1 0</td>
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<td>1</td>
<td>0</td>
<td></td>
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</tbody>
</table>

**Question 6** This question is attributed with 6 marks if answered properly; the answers are the following:

**Solution**

- Quick table:
  - **Present-state**
    - \( Q_2 \) | \( Q_1 \) | \( Q_0 \)
    - 0 0 1
    - 0 1 0
    - 0 1 1
    - 1 1 0
    - 1 1 1
    - 1 0 1

  - **Next-state**
    - \( Q_{2^-} \) | \( Q_{1^-} \) | \( Q_{0^-} \)
    - 0 0 1
    - 0 1 0
    - 0 1 1
    - 1 1 0
    - 1 1 1
    - 1 0 0

- Full table:
  - **Present-state**
    - \( Q_2 \) | \( Q_1 \) | \( Q_0 \)
    - 0 0 0
    - 0 0 1
    - 0 1 0
    - 0 1 1
    - 1 0 0
    - 1 0 1
    - 1 1 0
    - 1 1 1

  - **Next-state**
    - \( Q_{2^0} \) | \( Q_{1^0} \) | \( Q_{0^0} \)
    - x 0 0
    - 0 0 1
    - 0 1 0
    - 0 1 1
    - 1 0 0
    - 1 0 1
    - 1 1 0
    - 1 1 1

- **Flip-flop input**
  - **Present-state**
    - \( Q_2 \) | \( Q_1 \) | \( Q_0 \)
    - 0 0 0
    - 0 0 1
    - 0 1 0
    - 0 1 1
    - 1 0 0
    - 1 0 1
    - 1 1 0
    - 1 1 1

  - **Next-state**
    - \( T_2 \) | \( T_1 \) | \( T_0 \)
    - 0 0 0
    - 0 0 1
    - 0 1 0
    - 0 1 1
    - 1 0 0
    - 1 0 1
    - 1 1 0
    - 1 1 1

  - **Flip-flop input**
    - \( T_2 \) | \( T_1 \) | \( T_0 \)
    - x 0 0
    - 0 0 1
    - 0 1 0
    - 0 1 1
    - 1 0 0
    - 1 0 1
    - 1 1 0
    - 1 1 1

\[ T_2 = Q_2'Q_0 + Q_2Q_1' \]
\[ T_1 = Q_2'Q_1 + Q_2Q_1Q_0 \]
\[ T_0 = Q_2Q_0' + Q_2Q_1Q_0' \]