國立臺灣大學101學年度碩士班招生考試試題



**Problem 1 (20%)**

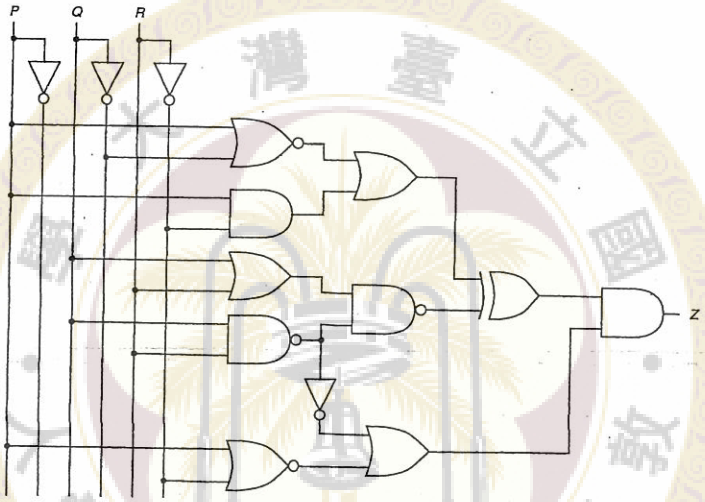
Determine the radix $r$ for the following equations.
(% is the remainder operator, e.g., 9 % 4 = 1.)

a. $21_r \times 13_r - 24_r = 245_r$

b. $(25_r \times 41_r)\,\%28_r = 21_r$

**Problem 2 (20%)**

Simplify the following circuit; use as few gates (AND, OR, and NOT) as possible.




**Problem 3 (20%)**

A Moore sequential circuit $M$ has one input $X$ and one output $Z$. $M$ behaves as follows.

1. When $Z = 0$ and the input sequence 010 occurs, $Z$ becomes 1 and remains 1 until the sequence 101 occurs in which case $Z$ returns to 0.
2. When $Z = 1$ and the input sequence 101 occurs, $Z$ becomes 0 and remains 0 until the sequence 010 occurs in which case $Z$ returns to 1.
3. At the beginning, $Z$ equals 0.

The following is an example.

```
X   11010010011001101101110001010101011110...
Z   00000000111111111000000000001110000000...
```

Derive and simplify the state graph of $M$.

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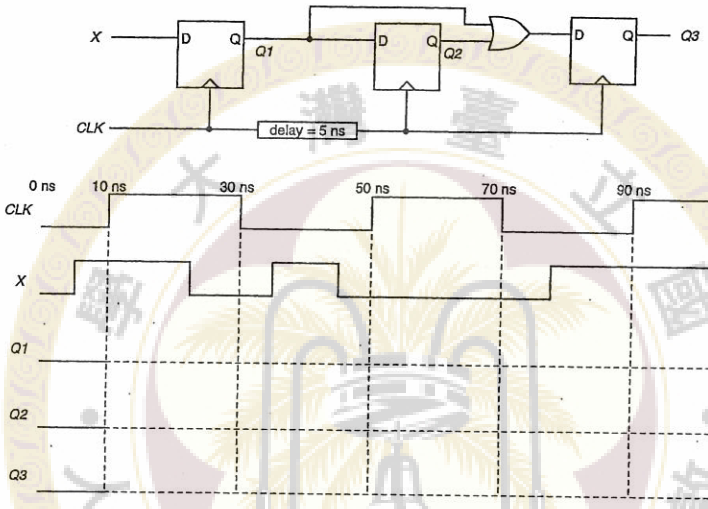
**Problem 4 (20%)**

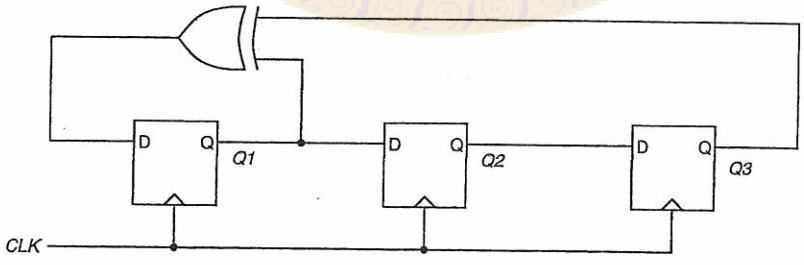
Complete the timing diagram for the given circuit. Assume that

1. the D flip-flop has a 2-ns propagation delay and zero setup/hold time,
2. the OR gate has a 1-ns propagation delay,
3. the delay element has a 5-ns propagation delay, and
4. the initial values of $Q1$, $Q2$, and $Q3$ are 0.




**Problem 5 (20%)**

1. What output sequence ($Q1Q2Q3$) does the counter below generate (assuming that the initial counter state is not all 0's)?
2. Modify the counter so that it repeatedly generates a sequence of all eight outputs, i.e., including $Q1Q2Q3 = 000$, without affecting the order of the original sequence.

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