

Name:

Entry No.:

**Important points to note:**

- Stay concise and answer to-the-point.
- Clearly show, and explain (briefly), all the steps of your solution.
- There will be zero tolerance for dishonest means; offenders will get an F grade straight away.

1. [2 marks] Find 16's complement of B2FA.
2. [5 marks] Design a counter with T flip-flops that goes through the following repeated binary sequence: 0, 1, 3, 7, 6, 4. Show that when the binary states 010 and 101 are considered as don't care conditions, the counter may not operate properly. Find a way to correct the design.
3. [3 marks] Find all the prime implicants for the following Boolean function, and determine which are essential. Use this to simplify the Boolean function.

$$F(x, y, z, w) = \Sigma(0, 2, 3, 7, 8, 9, 10, 12, 13, 14, 15)$$

4. [3 marks] Show that a BCD ripple counter can be constructed from a four-bit binary ripple counter with asynchronous clear and a NAND gate.
5. [2 marks] A DRAM chip uses two-dimensional address multiplexing. It has 13 address pins, with the row address having one bit more than the column address. What is the capacity of the memory?
6. (a) [1 marks] How many parity check bits must be included with the data word to achieve single error correction and double-error detection when the data word contains 30 bits?  
(b) [3 marks] A 12-bit Hamming code word containing 8 bits of data and 4 parity bits is read from memory. What was the original 8-bit data word if the 12-bit word read out is 011101101111?
7. [3 marks] Implement the following Boolean function F, using the two-level forms *i)* NAND-AND, and *ii)* NOR-OR. Briefly explain the steps involved.

$$F(A, B, C, D) = \Sigma(0, 4, 8, 9, 10, 11, 12, 14)$$

8. [5 marks] Design a one-input, one-output serial 2's completer using D flip-flops. The circuit should accept a string of bits from the input, and generate the 2's complement of it at the output. You should be able to reset the circuit asynchronously to start and end the operation. Draw the state table, the state diagram, and the logic diagram of the circuit.
9. [3 marks] Tabulate the truth table for an  $8 \times 4$  ROM that implements the Boolean functions

$$\begin{aligned} A(x, y, z) &= \Pi(1, 2, 5, 7) \\ B(x, y, z) &= \Pi(2, 4, 5, 6) \\ C(x, y, z) &= \Pi(0, 2, 3, 4, 6, 7) \\ D(x, y, z) &= \Pi(2, 3, 6) \end{aligned}$$

Considering now the ROM as memory, specify the memory contents at addresses 2 and 5.