

EE2000 Assignment 1 (Total 50 marks)

- Q1. Perform the subtraction with the following unsigned binary numbers by taking the 2's complement of the subtrahend and then add, in 6-bit 2's complement form. State if there is overflow or not for 6 bits:

$$(a) 1\ 0101 - 1010 \quad \text{and} \quad (b) 0\ 1010 - 1\ 0111 \quad [5 \text{ marks}]$$

- Q2. Show the bit configuration that represents 25_{10} :

$$(a) \text{ in unsigned binary} \quad \text{and} \quad (b) \text{ in BCD.} \quad [5 \text{ marks}]$$

- Q3. Use Boolean algebraic theorems to simplify the following logic expression in sum of product (SOP) form:

$$F(a, b, c, d) = (a \oplus b)(\bar{a} + c) + (\bar{c} + d)(a \oplus d) \quad [5 \text{ marks}]$$

- Q4. Find the minimum POS expression of the following Boolean function.

$$F(a, b, c, d) = \Sigma(1, 4, 5, 6, 7, 9, 11, 13) + \Sigma d(3, 10, 14, 15) \quad [5 \text{ marks}]$$

- Q5. A Boolean function expression in maxterm representation is given by

$$F(A, B, C, D) = \Pi(0, 2, 3, 7, 8, 9, 10, 13)$$

Use K-map to find the product of sum (POS) representation of $F(A, B, C, D)$ if minimum maxterm is required. Draw the circuit of your POS expression using NAND gates only.

[8 marks]

- Q6. Figure Q6 shows the block diagram of a circuit which has four inputs A, B, C, D and one output Y. It operates according to the following rules:

- (i) If the inputs A, B, C and D have more 0s than 1s, the circuit will generate an odd parity bit for the inputs.
- (ii) If the number of 0s and 1s of the inputs are equal, the machine will generate an even parity for the inputs.
- (iii) If there is only one 0, the output is equal to 1.
- (iv) The output of the remaining case(s) is (are) 1.

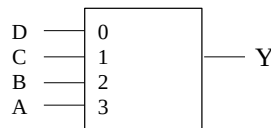


Figure Q6. Block diagram of a 4 inputs to 1 output circuit.

- (a) Tabulate the truth table of the circuit. [6 marks]
- (b) Give your answer in SOP forms. [6 marks]

Q7. A BCD-to-seven-segment decoder is a combinational circuit that converts a decimal digit in BCD format to an appropriate code for the selection of segments in a display indicator used for displaying the decimal digit in a familiar alphabet form (Fig. Q7a). The seven outputs of the decoder a, b, c, d, e, f and g select the corresponding segments in the display and the numeric designation chosen to represent the decimal digit are shown in Fig. Q7b.

Design a BCD-to-seven-segment decoder. A '1' on an output indicates the corresponding segment is on. The six invalid combinations ($10_{10}, 11_{10}, 12_{10}, 13_{10}, 14_{10}$ and 15_{10}) should result in a blank display. Express your design in the form of Boolean expressions for each output in the form of SOP terms. No need to draw the schematic diagrams.

Note: use A, B, C, D as the four BCD inputs, A be the MSB and D be the LSB.

[10 marks]

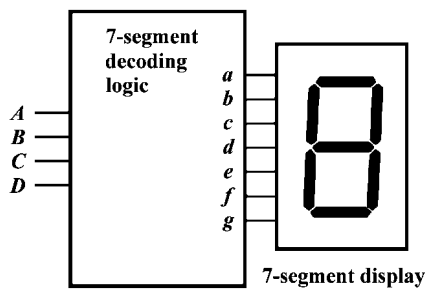


Fig Q7a

Seven-segment display format showing arrangement of segments.

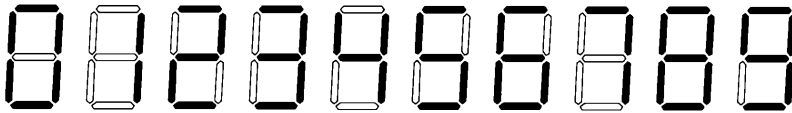
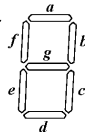


Fig Q7b

Date of submission: Week 8, lecture time.

Please note that late submission without valid reason will not be accepted.

END