1 Digital Electronics (ijw24)

(a) Show using Boolean algebra

(i) $\overline{X}.Y \oplus X.\overline{Y} = \overline{X}.Y + X.\overline{Y}$

(ii) $\overline{X}.\overline{Y} \oplus X.Y = \overline{X}.\overline{Y} + X.Y$

[4 marks]

(b) Using the results in Part (a) or otherwise, express the four-variable function

$$F(A, B, C, D) = \overline{A}.\overline{B}.\overline{C} + \overline{A}.\overline{C}.\overline{D} + \overline{A}.B.C.D + A.B.\overline{C}.D + A.C.\overline{D} + A.\overline{B}.C$$

as the Exclusive OR of three 2-variable AND terms, i.e., $F = X_1.X_2 \oplus X_3.X_4 \oplus X_5.X_6$ where each X_i is either one of the four variables or its complement.

[4 marks]

(c) (i) Simplify the four-variable function

$$G(A, B, C, D) = \sum(0, 2, 6, 7, 8, 9, 10, 13, 15)$$

using the Quine-McCluskey (Q-M) method. The numbers in the summation are the decimal representations of the minterms of G (where A represents the most-significant bit of the equivalent binary representation).

[9 marks]

(ii) How many equal-complexity solutions exist in total? Justify your answer.

[3 marks]