1 Digital Electronics (ijw24)

(a) Show that

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

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

[5 marks]

(b) With the help of the results in Part (a) or otherwise, simplify the following Boolean expression for \(W\) into a product of sums (POS) form having 3 product terms, each having 3 literals

\[
W = (A + \overline{C} + \overline{F} + G). (A + \overline{C} + F + G). (A + B + \overline{C} + \overline{D} + G).
\]

\[
. (A + C + E + G). (\overline{A} + B + G). (B + \overline{C} + F + G)
\]

[10 marks]

(c) (i) Using a Karnaugh map, simplify the following Boolean expression for \(V\) into a product of sums (POS) form

\[
V = A.B.C.D + A.B.C.D + (A + B + C + D)
\]

(ii) Implement the simplified expression for \(V\) obtained in Part (c)(i) using only NOR gates. Assume 2 and 4 input gates are available. Also assume complemented input variables are available. [5 marks]