1 Digital Electronics (IJW)

(a) A four-variable Boolean function is given by

\[ F = A.B.C + B.C.D + A.C.D \]

where \( A.\overline{B}.C.D \), \( A.\overline{B}.C.D \) and \( \overline{A}.\overline{B}.C.D \) are don’t-care states. Using a Karnaugh map or otherwise:

(i) Find the simplest sum of products expression for \( F \).  [3 marks]

(ii) Design a circuit to implement \( F \) using NAND gates only.  [3 marks]

(iii) Design a circuit to implement \( F \) using NOR gates only.  [4 marks]

(b) Define static 1 and static 0 hazards.  [4 marks]

(c) Consider the following multi-level Boolean function.

\[ Y = A.B.C + (A + D)(\overline{A} + C) \]

(i) Determine with the aid of a Karnaugh Map, or otherwise, a minimised sum of products expression for \( Y \) that does not possess static 1 hazards.  [3 marks]

(ii) Show with the aid of a Karnaugh map, or otherwise, that your proposed solution in part (c)(i) does not possess static 0 hazards.  [3 marks]