

## COMPUTER SCIENCE TRIPOS Part IA – 2013 – Paper 2

### 1 Digital Electronics (IJW)

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

$$F = A.B.C + B.C.D + A.\bar{C}.D$$

where  $A.B.\bar{C}.\bar{D}$ ,  $A.\bar{B}.C.D$  and  $\bar{A}.\bar{B}.C.D$  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.

$$Y = A.B.C + (A + D).(\bar{A} + \bar{C})$$

- (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]