2007 Paper 2 Question 1

Digital Electronics

(a) State De Morgan's theorems. [4 marks]

(b) Simplify the function

$$f = \bar{a}\bar{b}\bar{c}\bar{d} + \bar{a}b\bar{c}d + a\bar{b}\bar{c} + a\bar{b}\bar{d}$$

with don't care states $\bar{a}\bar{b}\bar{c}d$ and $\bar{a}\bar{b}c\bar{d}$ to give expressions in the following forms:

(i) sum of products; [3 marks]

(ii) product of sums. [3 marks]

(c) Simplify the function

$$f = (\bar{a} + \bar{b} + \bar{c}).(b + d)$$

to give an expression in the sum of products form. [6 marks]

(d) Implement with 2-level logic the function in part (c) using only

(i) NOR gates; [2 marks]

(ii) NAND gates. [2 marks]

Assume that complemented input variables are available.