

Jetic Gū

1. Handwritten submissions and proprietary formats (e.g. Pages or MS Word) **will not be graded**.
2. Late submission and resubmission policies are stated on the course webpage.
3. Mathematical expressions must be written entirely using LaTeX, otherwise **50%-100%** of marks will be deducted.
4. Circuits must be **tested** using switches/probs against a truth table. Untested circuits will receive 0.

Submission File structure:

```
submission.zip
  - answer.pdf
  - c5.cct
  - c6.cct
```

The circuit files are 2.5pt each, the PDF is worth 10pt.

## Lab 1

1. Work on the following boolean equations (2pt).
  - A. Use a truth table to prove:  $\overline{X + Y + Z} = \overline{X} \overline{Y} \overline{Z}$
  - B. Use DeMorgan's Theorem, express the following with only OR and complement (NOT):  $\overline{B}C + \overline{A} \overline{C}$
2. Use algebraic manipulation to prove (4pt).
  - A.  $\overline{X} \overline{Y} + \overline{X} Y + X Y = \overline{X} + Y$
  - B.  $Y + \overline{X} Z + X \overline{Y} = X + Y + Z$
  - C.  $W Y + \overline{W} Y \overline{Z} + W X Z + \overline{W} X \overline{Y} = W Y + \overline{W} X \overline{Z} + \overline{X} Y \overline{Z} + X \overline{Y} Z$
  - D.  $A \overline{D} + \overline{A} B + \overline{C} D + \overline{B} C = (\overline{A} + \overline{B} + \overline{C} + \overline{D})(A + B + C + D)$
3. Optimise the following boolean functions using K-maps (2pt).
  - A.  $F(A, B, C, D) = \Sigma m(0, 2, 4, 5, 8, 10, 11, 15)$
  - B.  $F(A_3, A_2, A_1, A_0) = \Sigma m(0, 1, 2, 4, 5, 6, 10, 11)$
4. The denotation of don't care condition is  $d(\dots) = \Sigma m(\dots)$  complimenting the boolean function  $F$ . Optimise the following Boolean function  $F$  together with the don't care condition  $d$  (2pt).
  - A.  $F(A, B, C) = \Sigma m(2, 4, 7), d(A, B, C) = \Sigma m(0, 1, 5, 6)$
  - B.  $F(A_3, A_2, A_1, A_0) = \Sigma m(4, 6, 7, 8, 12, 15), d(A_3, A_2, A_1, A_0) = \Sigma m(2, 3, 5, 10, 11, 14)$
5. Implement the following boolean expression in LogicWorks, save it as c5.cct (2.5pt).
 
$$F(A, B, C) = AB + A\overline{C} + B\overline{C}$$
6. Implement the following boolean expressions as a single circuit in LogicWorks, save it as c6.cct (2.5pt).
 
$$S(X, Y, Z) = X \oplus Y \oplus Z$$

$$C(X, Y, Z) = XY + (X \oplus Y)Z$$