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This assignment is due on 26 June 2020

Please remember to write your name and student number.

You must complete the following assignment and submit a PDF of relevant questions. Handwritten submissions and proprietary formats (e.g. Pages or MS Word) will not be accepted. You will also need to upload LogicWork circuit design file. Then upload a single ZIP file to Moodle.

Submission File structure:

```
submission.zip
    — answer.pdf
    — circuit1-1.cct
    — circuit1-2.cct
    — circuit1-3.cct
    — circuit1-4.cct
    — circuit1-5.cct
    — circuit2-1.cct
    — circuit2-2.cct
    — circuit2-3.cct
    — circuit2-4.cct
    — circuit3.cct
    — circuit4.cct
    — circuit5.cct
    — lib.clf
```

The first 4 circuit files (1-1, 1-2, 1-3, 1-4) are 0.5pt each, the rest are 1pt each.

Lab 2

1. Save the library and circuit files we created in class containing the following designs in the final ZIP file:

   1. 2-to-4 Decoder (`circuit1-1.cct`);

   2. 3-to-8 Decoder implemented using the 2-to-4 Decoder (`circuit1-2.cct`);

   3. 4-to-2 priority encoder with validity bit (`circuit1-3.cct`);

   4. 4 channel 1bit Multiplexer implemented using the 2-to-4 Decoder (`circuit1-4.cct`);

   5. 4 channel 4bit Multiplexer implemented using the 4 channel 1bit Multiplexers (`circuit1-5.cct`);

   6. Include the above designs in your library file (`lib.clt`), I must be able to use these components in your library file, or 50% of the points will be lost.

2. Save the library and circuit files we created in class containing the following designs in the final ZIP file:

   1. 1-bit binary adder (`circuit2-1.cct`);

   2. 4-bit binary adder (`circuit2-2.cct`);

3. 4-bit binary adder-subtractor with XOR and Adder (`circuit2-3.cct`);

4. 4-bit binary plus 1 incrementer (`circuit2-4.cct`);

5. Include the above designs in your library file (`lib.clt`), I must be able to use these components in your library file, or 50% of the points will be lost.

3. Implement the following Boolean function with an 4-to-1 1bit multiplexer and optionally, a single inverter:

$$F(A, B, C) = \Sigma m(2,4,6)$$

You must ONLY use value-fixing and the components stated above. Save the circuit as `circuit3.cct` .

4. You are commissioned to design the light controller for a Mr. Rob Banks. Mr. Rob Banks' house has a proximity sensor (`S1`) near the entrance controlling the light (`L1`) there, 2 switches (`S2`, `S3`) inside the house controlling (`L2`, `L3`). In addition, a master switch `M` can be used to turn both `L2` and `L3` off, regardless of the states of `S2` and `S3`.

A. Perform formulation and optimisation, include the truth table and boolean expressions in the PDF (2.5pt).

B. Perform Technology mapping. Use `binary switches` in LogicWorks for `S1`, `S2`, `S3`, and `M`, use `binary probs` as `L1`, `L2`, `L3`, save the circuit as `circuit4.cct` .

5. You are commissioned to design a simple petrol gauge for Mr. Rob Banks' volume controller. Volume control is realised though the use of a turning wheel, and you need to convert the degree of rotation to a binary integer indicating volume levels. As the user rotates the wheel into fixed positions, **one** of the inputs `I0`, `I1`, `I2`, `I3` will receive a positive signal, while the rest remain 0. Your output `O1 O0` should be a binary number, indicating the current level, with 00 being Min, 11 being Max.

A. Perform formulation and optimisation, include the steps in the PDF (2.5pt).

B. Perform Technology mapping using a priority encoder, save as `circuit5.cct`