ME 311 S2: Microprocessors and Automatic control

Tutorial 1 Problems

1. [2] Design a hall light circuit to the following specification. There is a switch at either end of a hall that controls a single light. If the light is off, changing the position of either switch causes the light to turn on. Similarly, if the light is on, changing the position of either switch causes the light to turn off. Write your assumptions, derive truth table, and describe how to implement this function in terms of logic gates or switching-networks. Is it done in this way at our homes??

2. [8] Design a combinational circuit with three data inputs D_2, D_1, D_0, two control points C_1, C_0 and two outputs R_1, R_0. R_1 and R_0 should be the remainder after dividing the binary number formed from D_2, D_1, D_0 by the number formed by C_1, C_0. For example if D_2, D_1, D_0 =111 and C_1, C_0 = 10 then R_1, R_0 =01 (that is remainder of 7 divided by 2 is 1). Note the division by zero will never be requested.
   a. Fill the truth tables for combinational logic with appropriate inputs and corresponding outputs (R_1 and R_0)
   b. Derive sum of product realizations of the binary expressions for outputs using the Karnaugh map
   c. Draw a circuit schematic that implements R_1 and R_0.

3. [7] Design a binary counter to count in the increasing direction 000 001 010... from any point as long as mode input m = 0 and opposite direction from any point when m changes to 1.
   a. Draw state transition diagram and fill in corresponding truth table
   b. Get expressions for output in terms of current state and inputs
   c. Draw circuit that implements the expressions in b using D-flip-flop

4. [3] A binary sequence is coming continuously every clock cycle on a pin. Design and develop sequential logic for detecting string 101 in the sequence. Output z goes high when the string 101 is detected