EEL 3701C - Digit Logic & Computer Systems

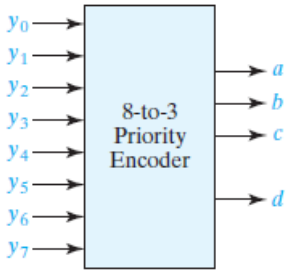
Homework 3

Due November 27, 2022

72 pts

Problem I (Encoder, Decoder, 11pts)

1) Show how to make the 8-to-3 priority encoder representing the picture below using two 4-to-2 priority encoders and any additional necessary gates **(5 pts)**



y_0	y_1	y_2	y_3	y_4	y_5	y_6	y_7	a	b	c	d
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1
X	1	0	0	0	0	0	0	0	0	1	1
X	X	1	0	0	0	0	0	0	1	0	1
X	X	X	1	0	0	0	0	0	1	1	1
X	X	X	X	1	0	0	0	1	0	0	1
X	X	X	X	X	1	0	0	1	0	1	1
X	X	X	X	X	X	1	0	1	1	0	1
X	X	X	X	X	X	X	1	1	1	1	1

2) Realize a full subtracter using a 3-to-8 line decoder with inverting outputs and
   a) two NAND gates **(3 pts)**
   b) two AND gates **(3 pts)**

Problem II (Memory, 15 pts)

1. Using a graphic explain the following memory technology: mask-programmed ROM, PROM, EPROM, EEPROM, EEPROM, FLAS, RAM, SRAM, DRAM **(9 pts)**
2. Sketch the internal design of a 8 × 3 ROM with the following: value 2 is stored at address 1, value 5 store at address 5, value 1 store at address 0 and value 0 stored at all remaining addresses. **(2 pts)**
3. Compose 1kx8 ROM's into an 8kx8 ROM **(2 pts)**
4. Show how to use a 1kx8 ROM to implement a 512x6 ROM **(2 pts)**

Problem III (**Arithmetic**, **14 pts**)

1. Use the shift and add algorithm to perform the following multiplications
   - 15x66 **(2 pts)**
   - (-55) x (-35) **(3 pts)**
   - 40 x (-16) **(3 pts)**
2. Use the restoring algorithm to perform the following divisions
   - 58/13 **(3 pts)**
   - 85/27 **(3 pts)**

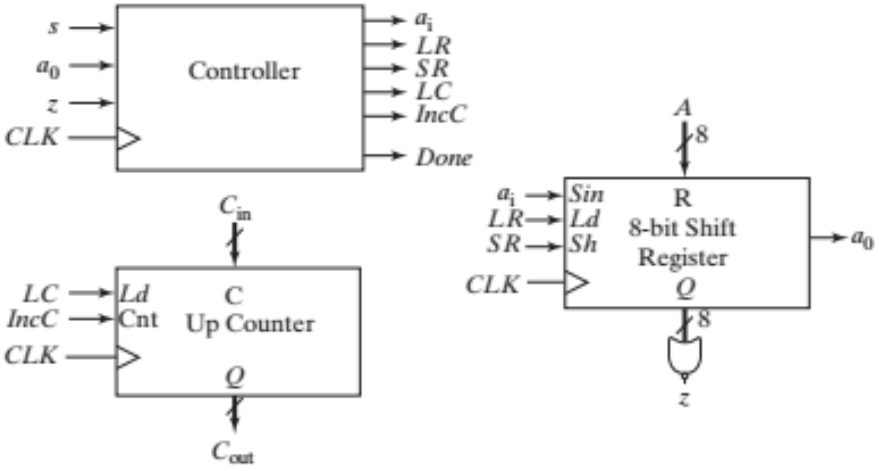
Problem IV (Microprogramming, 17 Pts)

The circuit below counts the number of 1's in an input A. Assume A is available when a start signal s becomes 1; A is loaded into a parallel loading shift register. At the same time a value is loaded into an up-counter C. After completing the count of 1's, the controller generates a signal Done until s has returned to 0. (Note that the serial input to R, ai, can be a constant value.)

For the shift register: For a right shift *Sh = 1*, Ld = 0. For a left shift*, Sh = 0 , Ld = 0*

For the counter: Load *Ld = 1, IncC = 1* count up

1) Specify the value to be loaded into C **(2 Pts).**
2) Design the controller as microprogrammed unit **(15 Pts)**.



Problem V (Assembler Programing with SPIM, 15 Pts)

Use the SPIM simulator to compile and run your assembler program of Exercise 6. A guide for executing and debugging programs in the SPIM environment is provided on canvas.