ET-540 – Introduction to Digital Computer

Homework 7 – *Counter Design*

Student's Name_____

Instructions:

- Show all work to receive full credit.

Design a synchronous counter that will display the following sequence and then repeat

0 ➔ 2 ➔ 6 ➔ 8 ➔ 7 ➔ 5 ➔ 3 ➔ 1 (repeat)

Step 1: Write and sketch the sequence of the synchronous counter (3 points)

Step 2: Determine the number of flip flops that you need and the module number (3 points)

Step 3 and 4: Construct a truth table of the transition state with the PRESENT state and the NEXT state, and complete the J-K input for each flip flop using sequence diagram from Step 1.

		PRESENT state			NEXT state			
Decimal	**D(MSB)**	**C**	**B**	**A (LSB)**	**D(MSB)**	**C**	**B**	**A (LSB)**
0	0	0	0	0				
1	0	0	0	1				
2	0	0	1	0				
3	0	0	1	1				
4	0	1	0	0				
5	0	1	0	1				
6	0	1	1	0				
7	0	1	1	1				
8	1	0	0	0				
9	1	0	0	1				
10	1	0	1	0				
11	1	0	1	1				
12	1	1	0	0				
13	1	1	0	1				
14	1	1	1	0				
15	1	1	1	1				
Circuit excitation table for sequence 0 ➔ 2 ➔ 6 ➔ 8 ➔ 7 ➔ 5 ➔ 3 ➔ 1								

	J-K State							
Decimal	**J_D**	**K_D**	**J_C**	**K_C**	**J_B**	**K_B**	**J_A**	**K_A**
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Step 5: Create a k-map table for each J and K input and find the SOP equation of each.

J_D

	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{D}\overline{C}$				
$\overline{D}$C				
DC				
D$\overline{C}$				

SOP :

J_C

	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{D}\overline{C}$				
$\overline{D}$C				
DC				
D$\overline{C}$				

SOP:

J_B

	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{D}\overline{C}$				
$\overline{D}$C				
DC				
D$\overline{C}$				

SOP:

J_A

	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{D}\overline{C}$				
$\overline{D}$C				
DC				
D$\overline{C}$				

SOP :

K_D

	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{D}\overline{C}$				
$\overline{D}$C				
DC				
D$\overline{C}$				

SOP:

K_C

	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{D}\overline{C}$				
$\overline{D}$C				
DC				
D$\overline{C}$				

SOP:

K_B

	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{D}\overline{C}$				
$\overline{D}$C				
DC				
D$\overline{C}$				

SOP :

K_A

	$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$
$\overline{D}\overline{C}$				
$\overline{D}$C				
DC				
D$\overline{C}$				

SOP:

Step 6: Complete and sketch the counter circuit using the SOP equation found in **step** 5