

# ECE 662

## Homework #6

**Problem:**

1. Microprogrammed control is to be used for the Example Control Unit that was given in class. The format for the microinstructions is given as follows:

F1	F2	F3	F4	F5
F1 (1 bit)	F2 (3 bits)	F3 (3 bits)	F4 (2 bits)	F5 (2 bits)
0: Do not use BAG	000: No transfer	000: No transfer	00: No transfer	00: No action
1: Use BAG	001: OPC	001: IPC	01: IMAR	01: Read
	010: OAC	010: IAC	10: IMDR	10: Write
	011: OX	011: IX	11: IT1	
	100: OSP	100: ISP		
	101: OT1	101: IIR		
	110: OT2	110: IT2		
	111: OMDR			

F6	F7	F8	F9	F10	F11
P1 (1 bit)	COMP (1 bit)	IB (1 bit)	IA (1 bit)	IC/IV (1 bit)	IN/IZ (1 bit)

Assume that a **Read** or **Write** to memory only takes one clock cycle so that **Inhibit** is not needed. Also assume that states 8-10 have been modified as given in Homework #5.

- (a) Give the contents of the microprogram memory (control store) for locations 0 - 15.

<u>Memory location</u>	<u>Contents (HEX)</u>
0	0 2100
1	
.	
.	
.	
15	

- (b) Give the equations for the Branch Address Generator, accounting for the branches in the first 16 states of the control unit. No simplification of the equations is required.

$$\begin{aligned}
 BAG_4 &= \\
 BAG_3 &= \overline{IR}_{15} \overline{IR}_{14} \overline{IR}_{13} IR_{12} T_4 + \dots \\
 BAG_2 &= T_4 + \dots \\
 BAG_1 &= \overline{IR}_{15} \overline{IR}_{14} \overline{IR}_{13} IR_{12} T_4 + \dots \\
 BAG_0 &= \overline{IR}_{15} \overline{IR}_{14} \overline{IR}_{13} IR_{12} T_4 + \dots
 \end{aligned}$$

where

$$T_4 = \overline{\mu PC}_4 \overline{\mu PC}_3 \mu PC_2 \overline{\mu PC}_1 \overline{\mu PC}_0 .$$