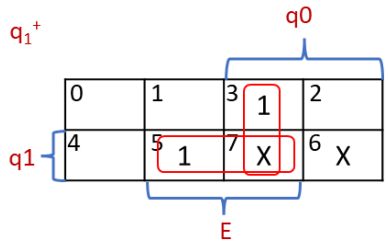
CSC 137 MOCK MIDTERM 2 SOLUTIONS

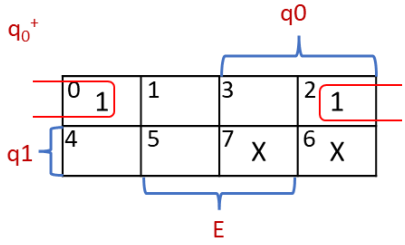
1) a) State transition table:

q_1	q_0	E	q_1^+	q_0^+
0	0	0	0	1
0	0	1	0	0
0	1	0	0	1
0	1	1	1	0
1	0	0	0	0
1	0	1	1	0
1	1	0	X	X
1	1	1	X	X

b) Boolean equations for the state variables:



$q_1^+ = q_1 E + q_0 E$



$q_0^+ = q_1' E'$

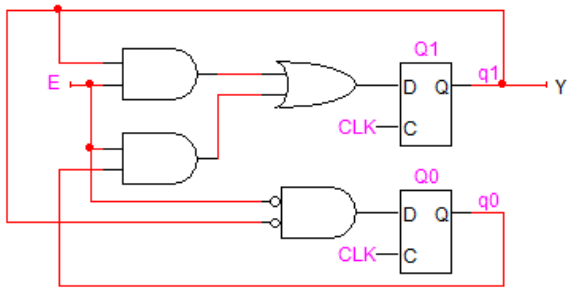
c) Output table:

q_1	q_0	Y
0	0	0
0	1	0
1	0	1
1	1	X

d) Boolean equation for the output:

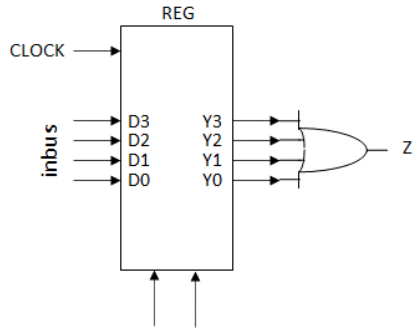
$Y = q_1$

e) Moore machine circuit:



RESET Omitted

2) a) The logic at the register output to generate the necessary Z signal:



b) The control signals that are necessary for each micro-operation:

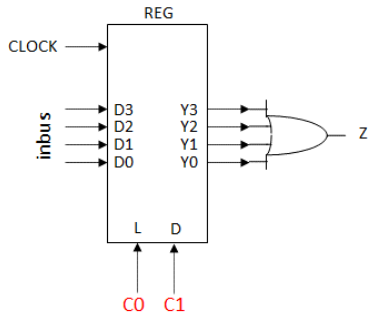


Table that shows which control signal will be generated at each RTL step:

Micro-operation	**Control Signal(s)**
Reg <- inbus	C0
Reg = Reg -1	C1
If Reg ≠ 0, goto Loop	No-op
goto End	No-op

c) The state transition diagram of the control unit:

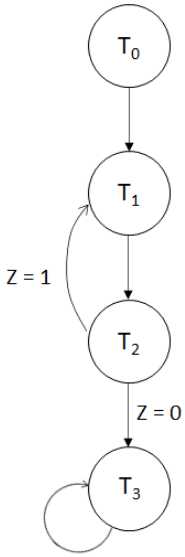


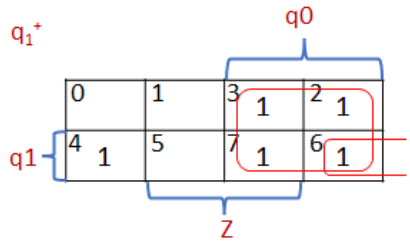
Table that shows which state corresponds to which micro-operation (i.e. RTL step):

State	Micro-operation	Control Signal(s)
T0	Reg <- inbus	C0
T1	Reg = Reg -1	C1
T2	If Reg ≠ 0, goto Loop	No-op
T3	goto End	No-op

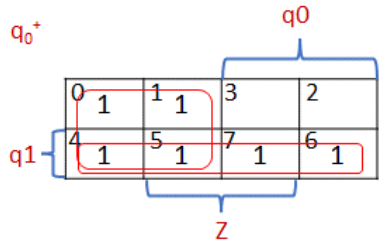
d) The state transition table for the control unit:

q_1	q_0	Z	q_1^+	q_0^+
0	0	X	0	1
0	1	X	1	0
1	0	0	1	1
1	0	1	0	1
1	1	X	1	1

e) The simplest Boolean equations for the state variables.



$q_1^+ = q_0 + q_1 Z'$



$q_0^+ = q_1 + q_0'$

f) The output table for the control unit:

q_1	q_0	C1	C0
0	0	0	1
0	1	1	0
1	0	0	0
1	1	0	0

g) The simplest Boolean equations for the outputs.

$C1 = q_1' q_0$
$C0 = q_1' q_0'$