Department of Electrical and Computer Engineering
Concordia University

DIGITAL DESIGN, COEN 212 Instructor: Asim J. Al-Khalili, P.Eng.

Time Allowed 3:00 hrs. Final December, 2015, 2 pages

No materials are allowed

Question 1

Design a circuit that adds two BCD digits together with an input carry from the previous stage. You may assume to have 4-bit binary adders if needed. Give design details.

Question 2

Design a synchronous BCD counter. Use T-Flip Flops for your implementation. Give design details starting with state diagram.

Question 3

a) **Design** a network that will add either 1 or 2 to a 3-bit binary number N. Let the inputs N_2, N_1, N_0 represent N. The input K is a control signal. The network should have outputs M= M2, M1, M0, which represent the 3-bit binary number M. When
K = 0, M = N + 1
K = 1, M = N + 2
Assume that the inputs for which $M > 111_2$ will never occur.

b) Implement M_2 using a 4-t0-1 multiplexer with minimum external logic.

Question 4

a) Using Boolean Algebra, show that the two functions **f_1 and f_2** are equal:
$f_1(a,b,c) = a'c + b'c' + ab$
$f_2(a,b,c) = a'b' + bc + ac'$

b) Using Boolean Algebra, minimize the following function:
$f(a,b,c,d) = ac' + ab'd + a'b'c + a'cd' + b'c'd'$

c) Give the maxterm equivalent of the following function:
$f(a,b,c,d) = bd$

d) Represent the following by a Boolean equation.
The air conditioner, (A), should be turned on if the temperature(TE) is greater than 75^0F, the time is between 8 a.m. and 5 p.m (TI). and it is not a holiday (H) (letters in the bracket represent the variables).

Question 5

Design a clocked sequential network for a communication circuit which will investigate an input sequence X and will produce an output Z = 1 for any input sequence ending in 1101 or 011.

Example: X = 0 0 1 1 0 1 1 0 1 0 1 1 0 1 0
Z = 0 0 0 1 0 1 1 0 1 0 0 1 0 1 0

Question 6

Analyze the following circuit