National University of Computer & Emerging Sciences, Lahore
Department of Electrical Engineering (Spring 2024)

EE1005 – Digital Logic Design (BCS-2E, BCS-2F, BDS-2A)
Assignment#1
Due Date: February 20, 2024

Question#1: **CLO-01**

Convert the following numbers from the given base to the other three bases listed in the table:

Decimal	Binary	Octal	Hexadecimal
367.8125			
	101001101.0101		
			A7CF.D

Question#2: **CLO-02**

A) Draw logic diagram for the following Boolean functions:
$F_1 = CD + \bar{B}(\bar{A} + \bar{D}C)$
$F_2 = C(\bar{B} + A)$
$F_3 = \overline{AB(B + \bar{D})}\,\bar{B}C + \overline{AC}$
$F_4 = (CD + \bar{B})(\bar{A} + C)$
B) Find level of implementation of each logic circuit drawn in part (A).
C) Which of the Boolean functions are equivalent.

Question#3: **CLO-02**

Optimize the following Boolean expressions using algebraic manipulation.

a) $x + xyz + \bar{x}yz + wyx + \bar{x}y + \bar{w}xy$
b) $\bar{A}\bar{B}C + \overline{(A + B + \bar{C})} + \bar{A}\bar{B}\bar{C}D$
c) $(B + BC)(B + \bar{B}C)(B + D)$
d) $\bar{A}\bar{B}CD + \bar{A}BCD + BCD + AB$

Question#4: **CLO-02**

Optimize the following Boolean expressions using K-map:

a) $\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + AB\bar{C}\bar{D} + A\bar{B}\bar{C}D + ABCD$
b) $(A + B + C)(A + B + \bar{C})(A + \bar{B} + \bar{C})(A + \bar{B} + C)(\bar{A} + B + C)(\bar{A} + \bar{B} + C)$

Question#5: **CLO-02**

Use Karnaugh map to find both minimal SOP and POS expressions for the following Boolean functions:

a) $F(A,B,C,D) = \sum m(0,1,4,5,6,7,8,9,12,14)$
b) $F(w,x,y,z) = \prod M(1,3,9,11,12,14)$
c) $F(A,B,C,D) = \sum m(2,3,4,6,10,12)$, $d(A,B,C,D) = \sum m(0,5,8,11,13)$
d) $F(w,x,y,z) = \sum m(1,3,4,6,11,14,15)$

Question#6: **CLO-02**

A Careem Chauffeur Service has been started in Lahore. The company is promoting its service by providing limited amount of free credit to its clients in order to use its pick and drop service by opening an account. However, the free credit can be earned under certain conditions. Moreover, the credit may be 1000Rs, 350Rs, or 100Rs depending upon the fact that how the account has been created. The details are as under:

1) If the account is created without any reference of Careem's client then no credit will be given.
2) If the account is created using reference of Careem's client then 100Rs. credit will be given.
3) If first ride is requested by an account created through reference, but the reference was sent before January 10, 2016 then earned credit would be 1000Rs. otherwise the earned credit will be 350Rs.

You are required to design a digital system indicating what amount of free credit a Careem's client has earned.
Show all necessary steps to reach optimal design for the required system, from truth table to circuit diagram.
Hint: Choose appropriate binary code to represent each amount.

Question#7: **CLO-02**

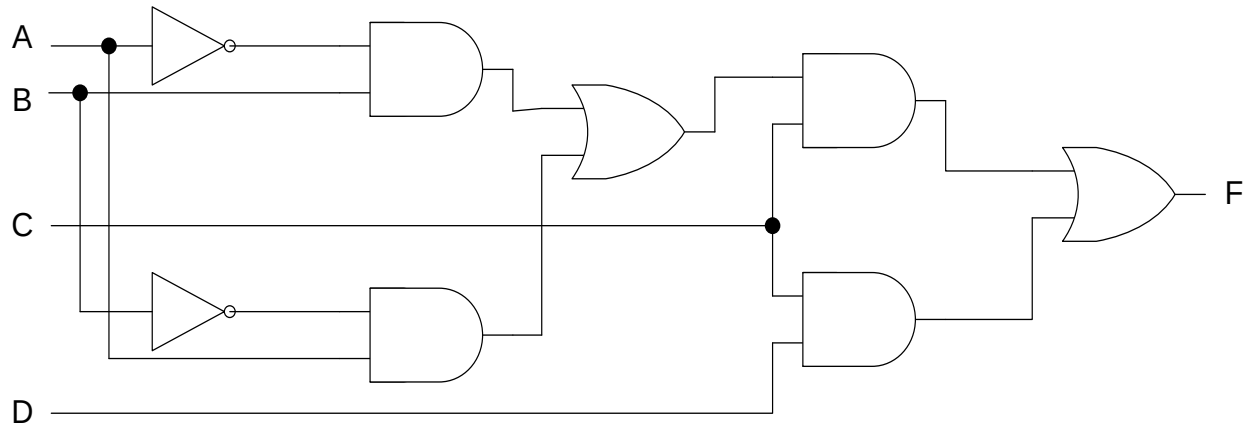
You are required to design a digital circuit that takes three numbers 'x' (1 bit) and 'y' (2 bit) and 'z' (1 bit) as input and checks that whether the applied input satisfies the following inequality equation or not.

$$2x + 3y + z \geq 5$$

Show all necessary steps to design the required system optimally, from truth table to circuit diagram.

Question#8: For the logic circuit given in the figure below do the following: **CLO-02**

a) Redraw the circuit using 2-input NAND gates only.
b) Redraw the circuit using 2-input NOR gates only.



Question#9: **CLO-02**

Design a combinational circuit with three inputs x, y and z and three outputs A, B and C. When the binary input (x,y,z) is 0, 1, 2 or 3, the binary output is two greater than the input. When the binary input is 4, 5, 6 or 7, the binary output is three lesser the input.

Question#10: **CLO-02**

A manufacturing plant needs to have a horn sound to signal quitting time. The horn should be activated when either of the following conditions is met:

1. It's after 5 o'clock and all machines are shut down.

2. It's Friday, the production run for the day is complete, and all machines are shut down.

Design a logic circuit that will control the horn. (Hint: Use four logic input variables to represent the various conditions)

Example:

An input X will be HIGH only when the time of day is 5 o'clock or later