National University of Computer & Emerging Sciences, Karachi

Spring -2022 CS-Department

Mid Term 1

11th March, 2022, 10:00 am –11:00 am

Course Code: EE1005	Course Name: Digital Logic Design (DLD)
Instructor Name / Names: Mr. Aamir , Mr Aashir , Mr. Behraj , Mr. Hamza, Ms. Rabia Tabassum, Ms. Rukhsar , Ms. Sumaiyah , Mr. Zakir	
Student Roll No:	Section No:

Instructions:

- Return the question paper.
- Read each question completely before answering it. There are **3 questions and 2 pages.**
- In case of any ambiguity, you may make assumption. But your assumption should not contradict any statement in the question paper.
- All the answers must be solved according to the sequence given in the question paper.
- This paper is subjective.

Time: 60 minutes. **Max Marks:** 45 points

Question 1: (Digital System) [18]

a) For the digital waveform shown in Fig.-1, determine the duty cycle and frequency of the waveform in Fig.-1 [2]

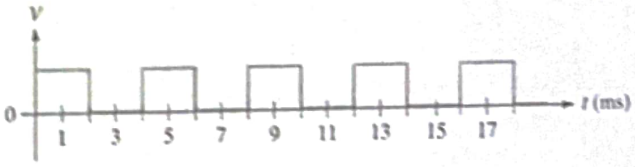


Fig-1

$T = 4\,sec^{m.}$

$f = \frac{1}{4m}\,Hz$

$f = 250\,Hz$

$DC = \frac{Pulse\ width}{T} \times 100$

$DC = \frac{2}{4} \times 100 = 50\%$

b) Express the decimal number (-98) in binary as an 8-bit sign-magnitude number, the 1's complement form, and 2's complement form. [6]

8 bit-sign-mag. +98 01100010 & -98 11100010

1's Complement 10011101

2's Complement 10011110

c) Perform the following 8-bit sign numbers operation: [2]

10001100 + 00111001

$$\begin{array}{r} 10001100 \\ 00111001 \\ \hline 11000101 \end{array}$$

d) Convert the following number in BCD [2]

(i) 10110101_2 (ii) 567_{10}

(ii) 567_{10}

(i) 10110101_2

$= 181_{10}$

0101 0110 0111 = BCD

BCD = 0001 1000 0001

e) Convert the following grey code in binary number (i)1011 (ii) 1100 [2]

(i) 1011 → Binary 1101 (ii) 1100 → Binary 1000

f) Solve the following operations in binary form: [4]
(i) $1101_2 \times 1010_2$ (ii) $1011_2 \div 11_2$

```
  1101
  1010
 ------
  0000
 1101x
 0000xx
1101xxx
--------
10000010
```

(i) 10000010

```
      11
   ------
11 | 1011
     1001
   ------
       10
```

(ii) 11 with remainder 10

Question 2: (Logic Gates and Its Applications) [7]

a) Your instructor teaches CS1005 to the students where some of them are registered and some of them are not, he asked you to design a logic diagram which will be used for checking if the student is allowed to sit in exam or not based on following scenario:
If the student is registered and his/her attendance is 80% then the student is allowed to sit in exam otherwise not.
The attendance of the student below 80% is represented by LOW signal and above 80% by HIGH signal.
Before drawing the logic diagram, you must write down the truth table and logic expression from the table as well. Your logic circuit will be connected to a RED light which will remain off if the student is allowed to sit in exam otherwise ON. [4]

Registration	Attendance	Allowed
0	0	1
0	1	1
1	0	1
1	1	0

$X = \overline{AB}$

b) Determine the output waveform in Fig-2 and draw the timing diagram with respect to given number (1 to 16) in answer sheet. [3]

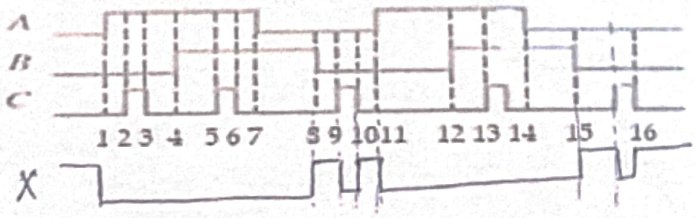


Fig-2

Question 3: (Boolean Algebra) [20]

a) Apply DeMorgan's theorems to the expression and simplfy it. [4]

$$\overline{\overline{A+B\bar{C}+\overline{(A+C)}D+\overline{AB}}}$$

$$\overline{\overline{A+B\bar{C}}+\overline{(A+C)}D}\cdot\overline{\overline{AB}}$$

$$\left[\left(\overline{\overline{A+B\bar{C}}}\right)\cdot\left(\overline{\overline{(A+C)}D}\right)\right]AB$$

$$\left[(A+B\bar{C})\left[\overline{(A+C)}+\bar{D}\right]\right]AB$$

$$\left[(A+B\bar{C})(A+C+\bar{D})\right]AB$$

$$\left[AA+AC+A\bar{D}+AB\bar{C}+B\bar{C}C+B\bar{C}\bar{D}\right]AB$$

$$\left[A+AC+A\bar{D}+AB\bar{C}+B\bar{C}\bar{D}\right]AB$$

$$=\left[A\left[1+C+\bar{D}\right]+AB\bar{C}+B\bar{C}\bar{D}\right]AB$$

$$\left[A+AB\bar{C}+B\bar{C}\bar{D}\right]AB$$

$$\left[A\left[1+B\bar{C}\right]+B\bar{C}\bar{D}\right]AB$$

$$\left[A+B\bar{C}\bar{D}\right]AB$$

$$AAB+ABB\bar{C}\bar{D}$$

$$AB+AB\bar{C}\bar{D}$$

$$AB\left[1+C\bar{D}\right]=AB$$

b) Simplify it using Boolean algebra. Also develop the turth table. [6]

$$\bar{A}C(\overline{\bar{A}BD})+\bar{A}B\overline{(C+D)}+A\bar{B}C$$

$$\bar{A}C\left[A+\bar{B}+\bar{D}\right]+\bar{A}B(\bar{C}\cdot\bar{D})+A\bar{B}C$$

$$\bar{A}AC+\bar{A}\bar{B}C+\bar{A}C\bar{D}+\bar{A}B\bar{C}\bar{D}+A\bar{B}C$$

$$0\quad\bar{A}\bar{B}C+\bar{A}C\bar{D}+\bar{A}B\bar{C}\bar{D}+A\bar{B}C$$

$$\bar{B}C(\bar{A}+A)+\bar{A}C\bar{D}+\bar{A}B\bar{C}\bar{D}$$

$$\bar{B}C+\bar{A}\bar{D}(C+B\bar{C})$$

$$\bar{B}C+\bar{A}\bar{D}(C+B)$$

$$\bar{B}C+\bar{A}C\bar{D}+\bar{A}\bar{D}B$$

c) Write the standard SOP and POS forms of the logic expression for the following circuits (Fig-3). [4]

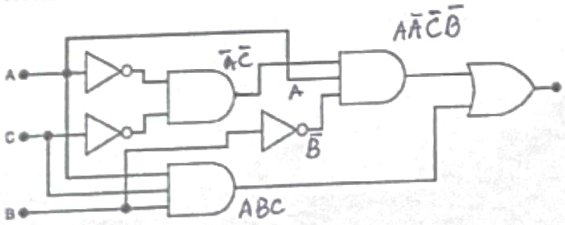


Fig-3

$X = A\bar{A}\bar{C}\bar{B}+ABC$

$X = ABC$ SOP.

$f(A,B,C)=\Sigma(7)$

POS $\Rightarrow f(A,B,C)=\Pi(0,1,2,3,4,5,6)$

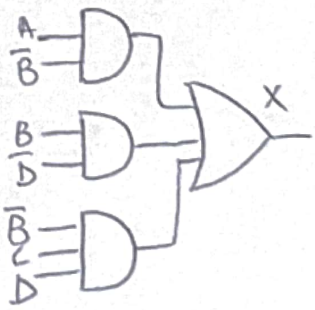
$(A+B+C)(A+B+\bar{C})(A+\bar{B}+C)(A+\bar{B}+\bar{C})(\bar{A}+B+C)(\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+C)$ = POS.

d) Use a Karnaugh map to simplify (in SOP form) the given Boolean functions. Implement the simplified form into circuit. [6]

$$F(A,B,C,D)=\prod(0,1,2,5,7,13,15)$$

AB \ CD	00	01	11	10
00	0	0	1	0
01	1	0	0	1
11	1	0	0	1
10	1	1	1	1

$X = A\bar{B}+B\bar{D}+\bar{B}CD$



BEST OF LUCK!