Virtual University

Digital Logic Design (CS302)
Assignment # 01
Spring 2022

Total marks = 20
Deadline
16th of June, 2022

Please carefully read the following instructions before attempting the assignment.

RULES FOR MARKING

It should be clear that your assignment would not get any credit if:

- The assignment is submitted after the due date.
- The submitted assignment does not open or the file is corrupt.
- Strict action will be taken if the submitted solution is copied from any other student or the internet.

You should consult the recommended books to clarify your concepts as handouts are not sufficient.
You are supposed to submit your assignment in Doc or Docx format.
Any other formats like scan images, PDF, ZIP, RAR, PPT, BMP, etc. will not be accepted.

Topic Covered:

- Number Systems
- Logic Gates
- Boolean Algebra
- K-Maps

Lecture # 01 till Lecture # 17

NOTE

No assignment will be accepted *after the due date via email in any case* (whether it is the case of load shedding or internet malfunctioning etc.). Hence refrain from uploading assignments in the last hour of the deadline. It is recommended to upload the solution file at least two days before its closing date.

If you people find any mistake or confusion in the assignment (Question statement), please consult with your instructor before the deadline. After the deadline, no queries will be entertained in this regard.

For any query, feel free to email at:
cs302@vu.edu.pk

Question No 01 **Marks (10)**

The stated number is represented as a positive decimal number, you are required to represent it as a Binary Floating-Point Number having 1 Sign bit, 8-bit Exponent, and 23 bits Mantissa.

490.286468506

Solution

So, we have 490.286468506. We can divide it into two parts. As the given number is Positive, so the sign bit will be considered as **0.**

First, we will convert the 490 into Binary Number.

2	490	-	0
2	245	-	1
2	122	-	0
2	61	-	1
2	30	-	0
2	15	-	1
2	7	-	1
2	3	-	1
	1		

So, 490_{10} will be $(1\ 1110\ 1010)_2$.

No, we will convert the decimal/fraction part (**0.286468506**) into binary equivalent.

0.286468506	0.286468506	X 2	=	0.572937012	→	0
0. 572937012	0. 572937012	X 2	=	1.145874024	→	1
0.145874024	0.145874024	X 2	=	0.291748048	→	0
0.291748048	0.291748048	X 2	=	0.583496096	→	0
0.583496096	0.583496096	X 2	=	1.166992192	→	1
0.166992192	0.166992192	X 2	=	0.333984384	→	0
0.333984384	0.333984384	X 2	=	0.667968768	→	0
0.667968768	0.667968768	X 2	=	1.335937536	→	1
0.335937536	0.335937536	X 2	=	0.671875072	→	0
0.671875072	0.671875072	X 2	=	1.343750144	→	1
0.343750144	0.343750144	X 2	=	0.687500288	→	0
0.687500288	0.687500288	X 2	=	1.375000576	→	1
0.375000576	0.375000576	X 2	=	0.750001152	→	0
0.750001152	0.750001152	X 2	=	1.500002304	→	1
0.500002304	0.500002304	X 2	=	1.000004608	→	1

So, 0.286468506 will become $(0.\ 010010010101011)_2$.

Now, we had converted both 490 and 0.286468506 into a Binary Number, we can rewrite the number as:

$490.286468506 = (1\ 1110\ 1010.\ 0100\ 1001\ 0101\ 011)_2$

Now, we will normalize the obtained binary number. As we have:

1 1110 1010. 0100 1001 0101 011 -> 1. 1110 1010 0100 1001 0101 011 x 2^8

By rearranging the number, we can write it as:

1. 1110 1010 0100 1001 0101 011 x 2^8

So, mantissa will be **1110 1010 0100 1001 0101 011**

Mantissa = 1110 1010 0100 1001 0101 011

As we have Exponential term = 2^8

So, Binary Exponent will be 8 + 127 = 135 = (**1000 0111**)$_2$

Exponent = 1000 0111

As the given number was positive (**490.286468506**), so Sign Bit will be 0.

Sign = 0

So, finally, the binary equivalent of **490.286468506** will be:

0 10000111 11101010010010010101011

Question No 02 **Marks (10)**

Simplify the stated 5 Variable Boolean Expression using Karnaugh Map.

$$F(A,B,C,D,E) = \sum(1,\ 2,\ 3, 14,\ 20\ , 21,\ 22,\ 23,\ 27,\ 28)$$

With the following **Don't Care** Conditions

$$F(A,B,C,D,E) = \sum(6,\ 7, 11, 12, 16, 26, 30)$$

Solution

First, we had to plot all the **Minterm** and **Don't Cares.**

$\overline{A} = 0$

$BC\backslash DE$		$\overline{D}\overline{E}$ **00**	$\overline{D}E$ **01**	DE **11**	$D\overline{E}$ **10**
$\overline{B}\overline{C}$	**00**	0	1	3	2
$\overline{B}C$	**01**	4	5	7	6
BC	**11**	12	13	15	14
$B\overline{C}$	**10**	8	9	11	10

$A = 1$

$BC\backslash DE$		$\overline{D}\overline{E}$ **00**	$\overline{D}E$ **01**	DE **11**	$D\overline{E}$ **10**
$\overline{B}\overline{C}$	**00**	16	17	19	18
$\overline{B}C$	**01**	20	21	23	22
BC	**11**	28	29	31	30
$B\overline{C}$	**10**	24	25	27	26

$\overline{A} = 0$

$BC\backslash DE$		$\overline{D}\overline{E}$ **00**	$\overline{D}E$ **01**	DE **11**	$D\overline{E}$ **10**
$\overline{B}\overline{C}$	**00**	0	1	1	1
$\overline{B}C$	**01**	0	0	X	X
BC	**11**	X	0	0	1
$B\overline{C}$	**10**	0	0	X	0

$A = 1$

$BC\backslash DE$		$\overline{D}\overline{E}$ **00**	$\overline{D}E$ **01**	DE **11**	$D\overline{E}$ **10**
$\overline{B}\overline{C}$	**00**	X	0	0	0
$\overline{B}C$	**01**	1	1	1	1
BC	**11**	1	0	0	X
$B\overline{C}$	**10**	0	0	1	X

Now, we will make grouping considering 1's and X's in a best possible way only.

So, we had made five (5) different groups.

1, 3	$\overline{A}\overline{B}\overline{C}E$
2, 3, 6, 7	$\overline{A}\overline{B}D$
11, 27	$\overline{B}CDE$
12, 14, 28, 30	$BC\overline{E}$
20, 21, 22, 23	$A\overline{B}\overline{C}$

So, the Final Simplified Boolean Expression will be:

$$F(A, B, C, D, E) = \overline{ABC}E + \overline{AB}D + B\overline{C}DE + BC\overline{E} + A\overline{B}C$$