Islamic University of Technology (IUT)

Organization of Islamic Cooperation (OIC)

Department of Electrical and Electronic Engineering (EEE)

Report Submission Date: 21st May, 2018

Course: EEE 4308 (Digital Electronics Lab)

Experiment Name: Basic Calculator Design using Logic Gates.

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Section	:	C1
Course Name	:	Digital Electronics Lab.
Course No.	:	EEE 4308

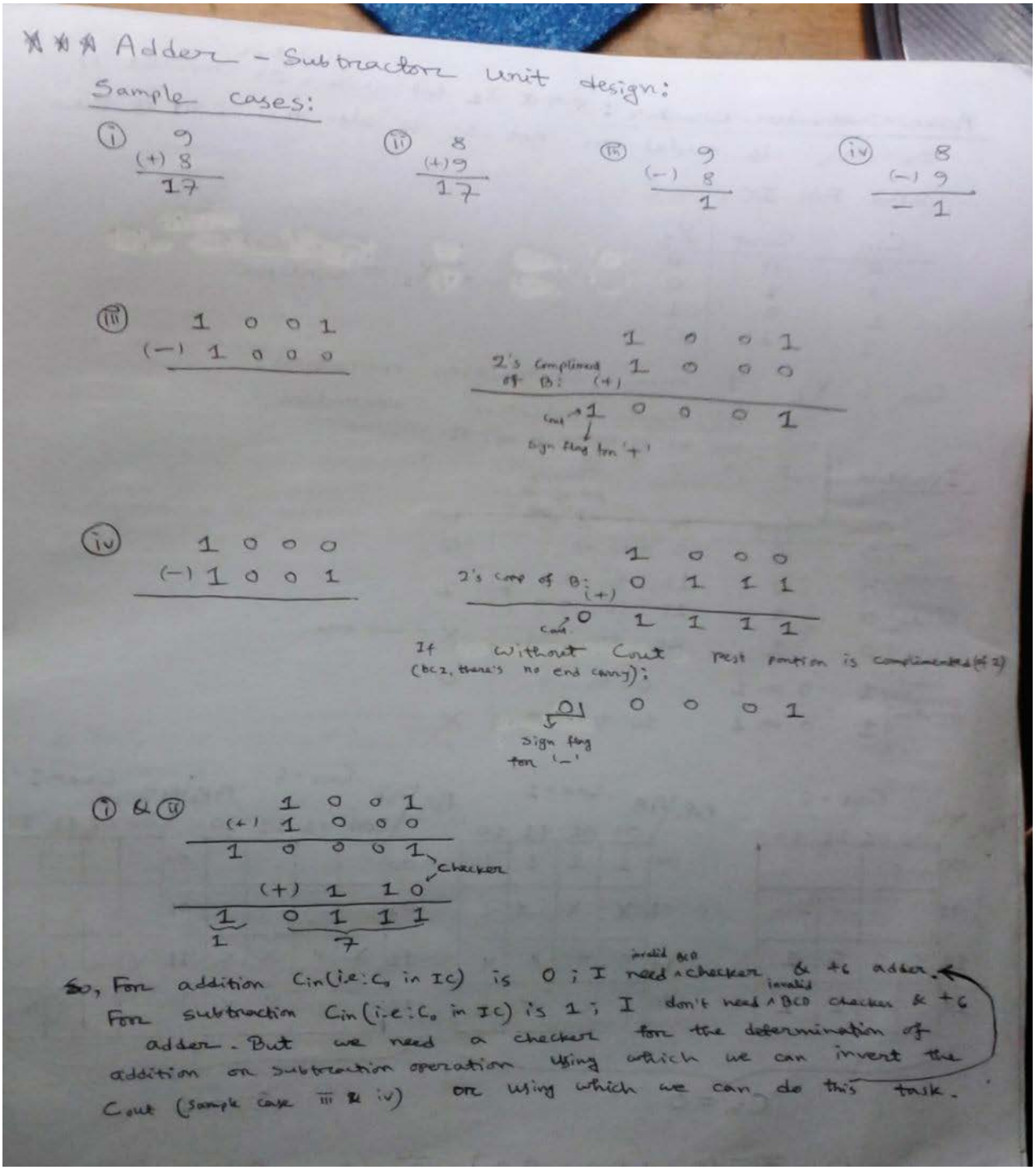
INTRODUCTION:

The project to be submitted is a simple calculator using only logic gates. For this, I designed some separate units for different action. They are:

1. Adder Subtractor unit
2. Multiplier unit
3. Divider unit
4. Input keyboard unit
5. Memory unit
6. Display unit

Adder-Subtractor Unit

In this unit the operations of addition and subtraction of single digit (4 bit Binary) decimal number, I used 2 Full Adders, 2 XOR gate IC, 1 Not gate IC, 1 AND gate IC, 1 OR gate IC. These are 1st logically derived in my note book.



Adder-Subtractor checker :

output X_1 will decide whether 2's compliment of $S_3S_2S_1S_0$ is needed or not. X_1 is also the C_{in1} of the 2nd F/A IC.

C_{in}	C_{out}	X_1
0	0	0
0	1	0
1	0	1
1	1	0

$\therefore X_1 = C_{in}\overline{C_{out}}$

C_{in} & X_1 '1' means subtraction operation.
'0' means addition operation

Invalid BCD checker :

	C_{in}	C_{out}	P_3 P_2 P_1 P_0	F
means addition operation	0	0	0 to 9	0
	0	0	10 to 15	1
	0	1	16 to 19	1
	0	1	20 to 31	X → don't care
means subtraction operation	1	0 or 1	0 to 9	0
	1	0 or 1	10 to 15	X

$C_{out} = 0$

P_3P_2 \ P_1P_0	00	01	11	10
00				
01				
11	1	1	1	1
10			1	1

$C_{out} = 1$

P_3P_2 \ P_1P_0	00	01	11	10
00	1	1	1	1
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$C_{in} = 0$

$C_{out} = 0$

P_3P_2 \ P_1P_0	00	01	11	10
00				
01				
11	X	X	X	X
10			X	X

$C_{out} = 1$

P_3P_2 \ P_1P_0	00	01	11	10
00				
01				
11	X	X	X	X
10			X	X

$C_{in} = 1$

$$\therefore F = \overline{C_{in}}\left(C_{out} + P_3P_2 + P_3P_1\right) = \overline{C_{in}}\left\{C_{out} + P_3(P_1 + P_2)\right\}$$

For MSB 7 Segment Display: Either 1 or – will be displayed. '1' in case of addition & '–' in case of subtraction (B>A). Truth table for active low converter design because Common anode 7 segment display is used.

	C_{in}	C_{out}	$Cond_d$	a	b	c	d	e	f	g
means addition	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	1	1	0	0	0	0
	0	1	0	0	1	1	0	0	0	0
	0	1	1	X	X	X	X	X	X	X
means subtraction	1	0	0	0	0	0	0	0	0	1
	1	0	1	X	X	X	X	X	X	X
	1	1	0	0	0	0	0	0	0	0
	1	1	1	X	X	X	X	X	X	X

$$b \,\&\, c = \overline{(C_{out} + Cond)\overline{C_{in}}}$$

$$= \overline{C_{out} + Cond + C_{in}}$$

$$= \overline{C_{out}} \cdot \overline{Cond} + C_{in}$$

Reffering to the sample cases: If 2's complement can be done in 2nd step; '–' comes in that step. So, checker for that step can be used for '–' display.

So, $g = \overline{X_1}$ bar for active low converter design.

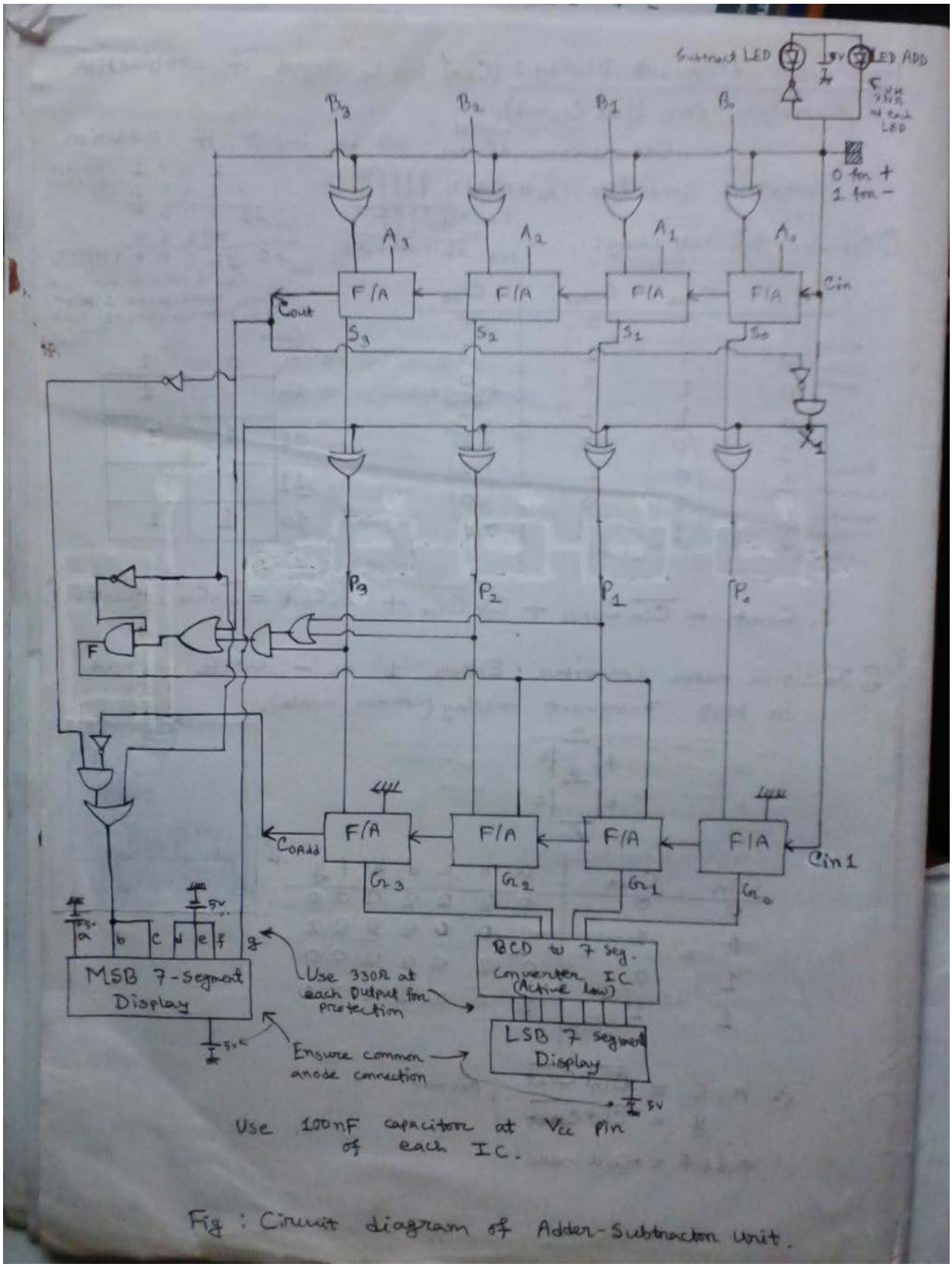
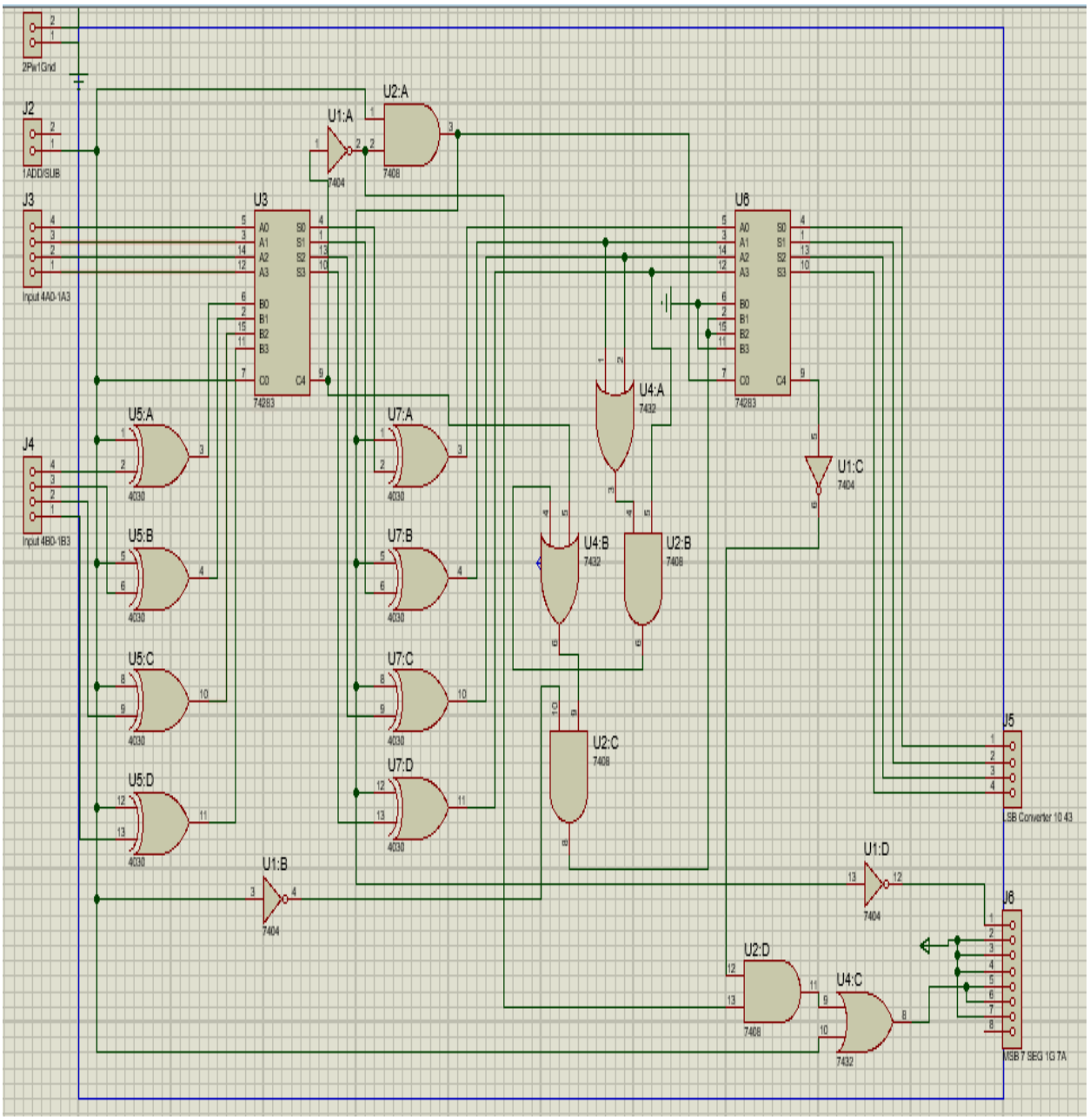
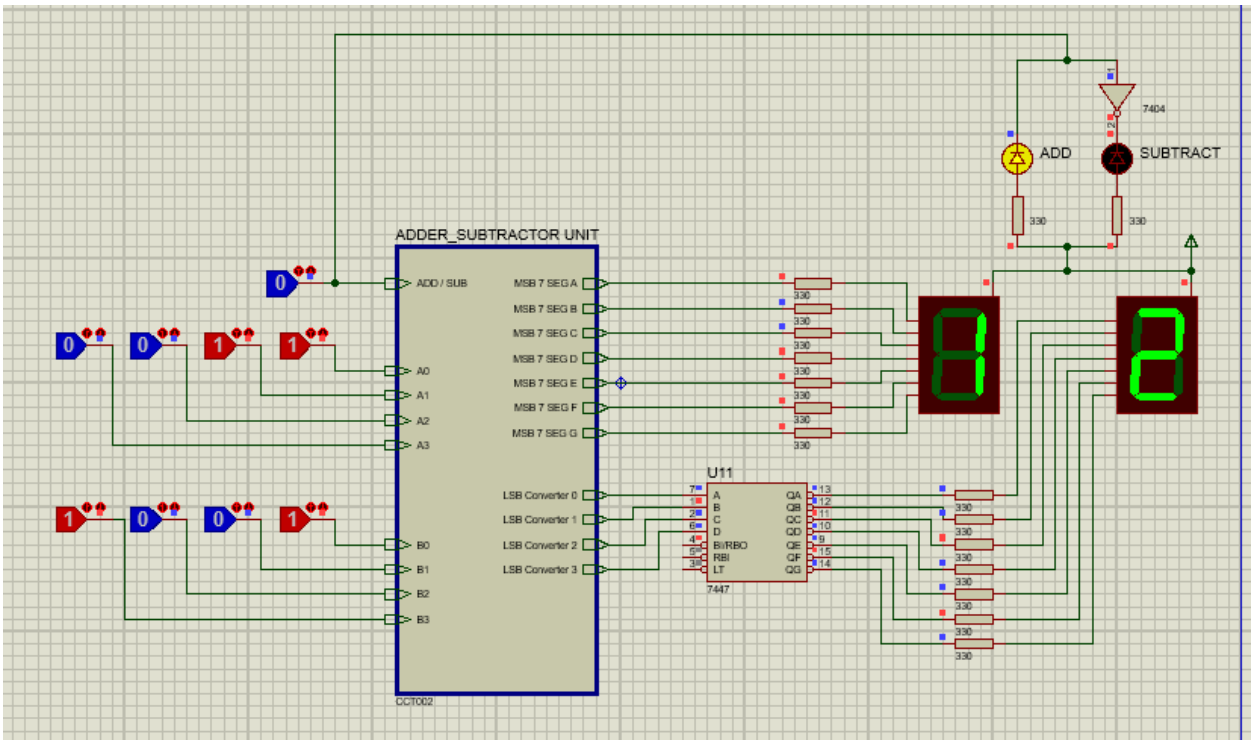


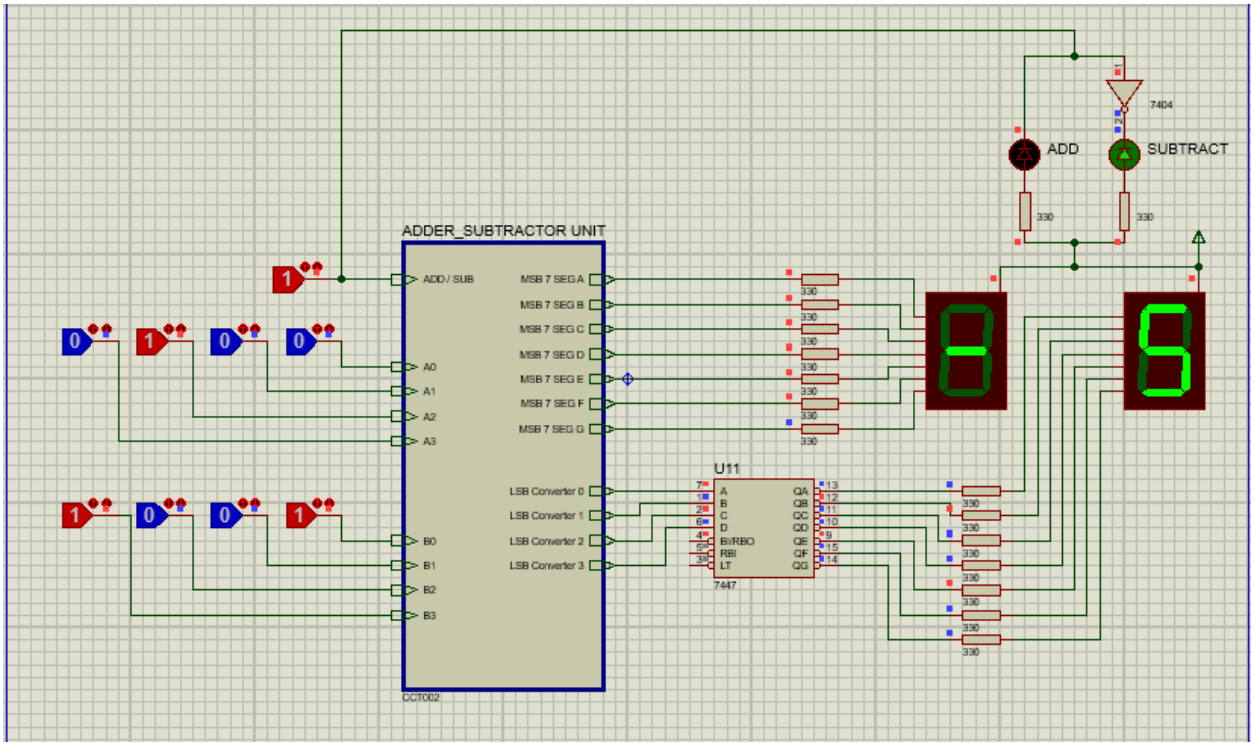
Fig : Circuit diagram of Adder-Subtractor Unit.

Then these were implemented in Proteus 8.

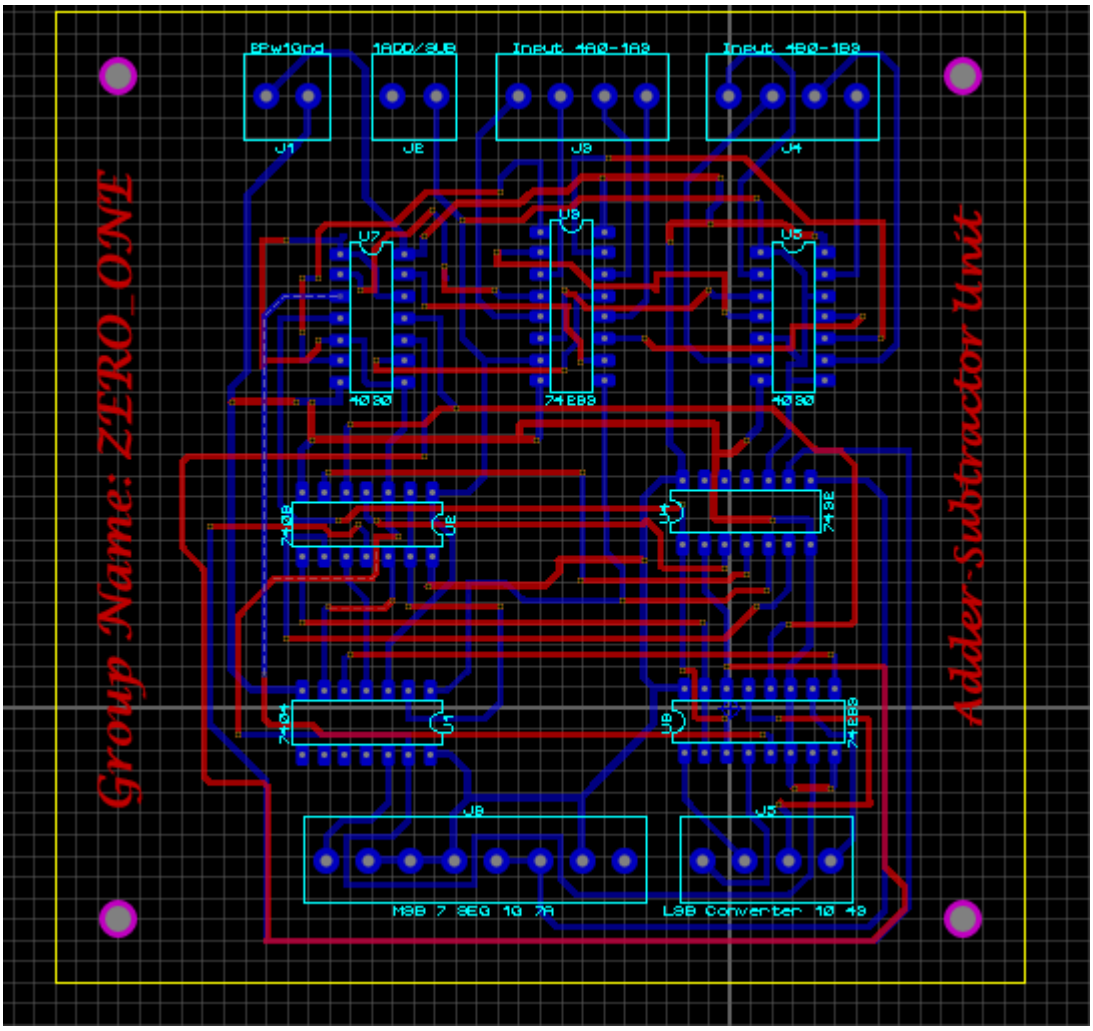


The output obtained as desired. The output are shown in 7 segment common anode display.

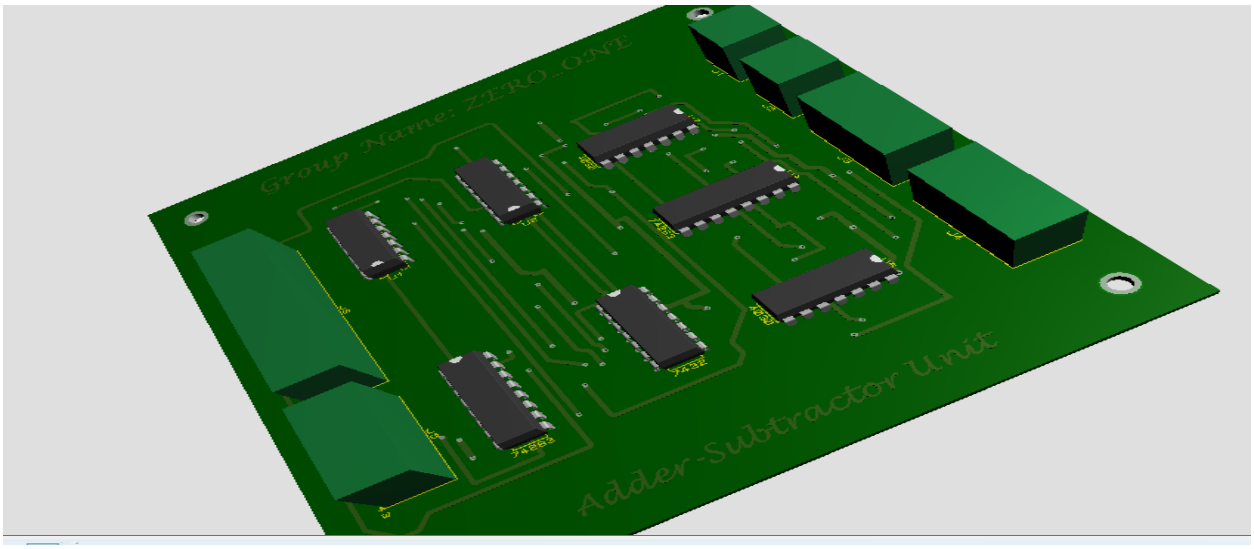


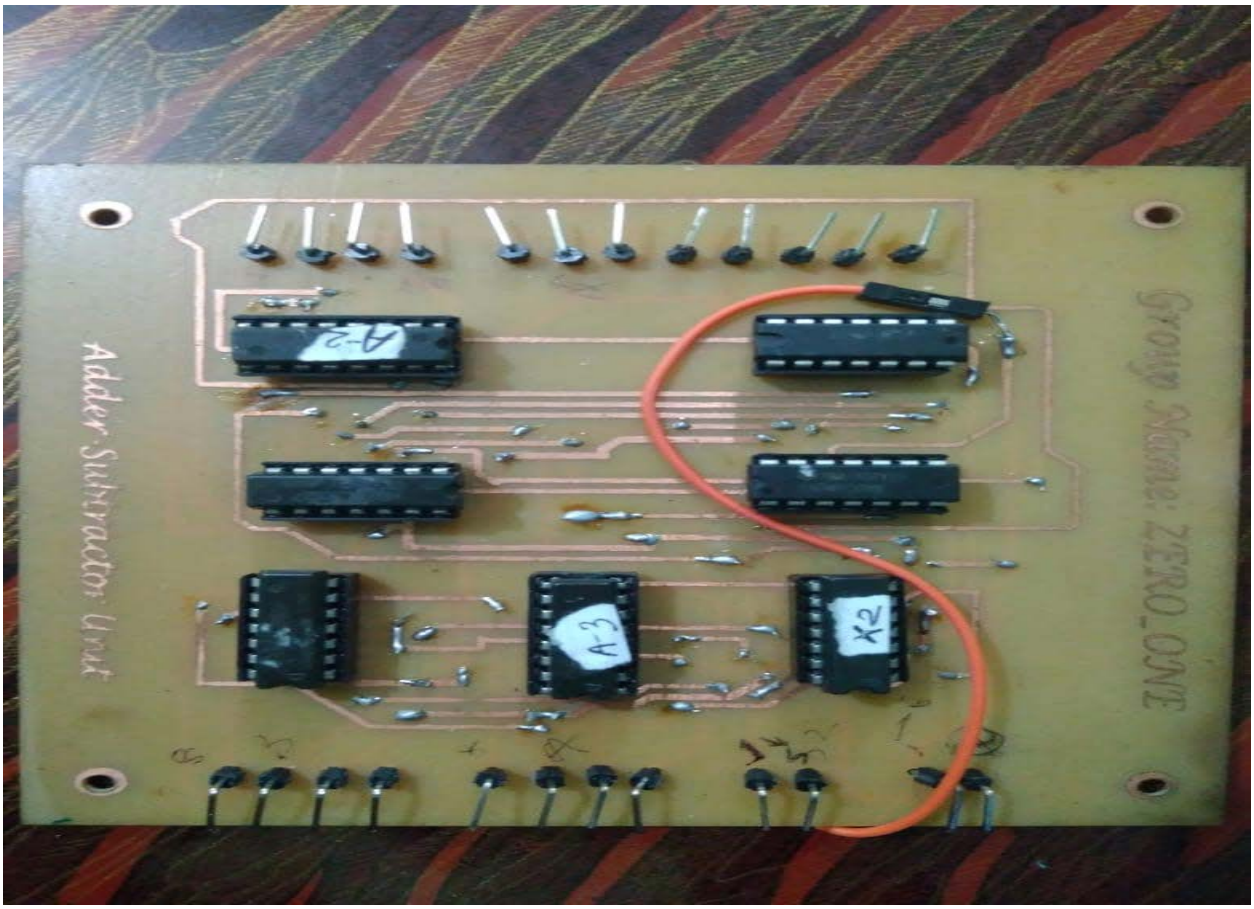


Then, I had done the PCB design. Here 1st I had to make slight changes to our design by adding terminal blocks instead of logic-states and logic-probes. Then this was used to design the final PCB layout. I processed the PCB to be double layered. So the remaining connections had to be done.



Finally the PCB design was completed. And the 3D design along with the original PCB in given below:


Group Name: ZERO_ONE
Adder-Subtractor Unit

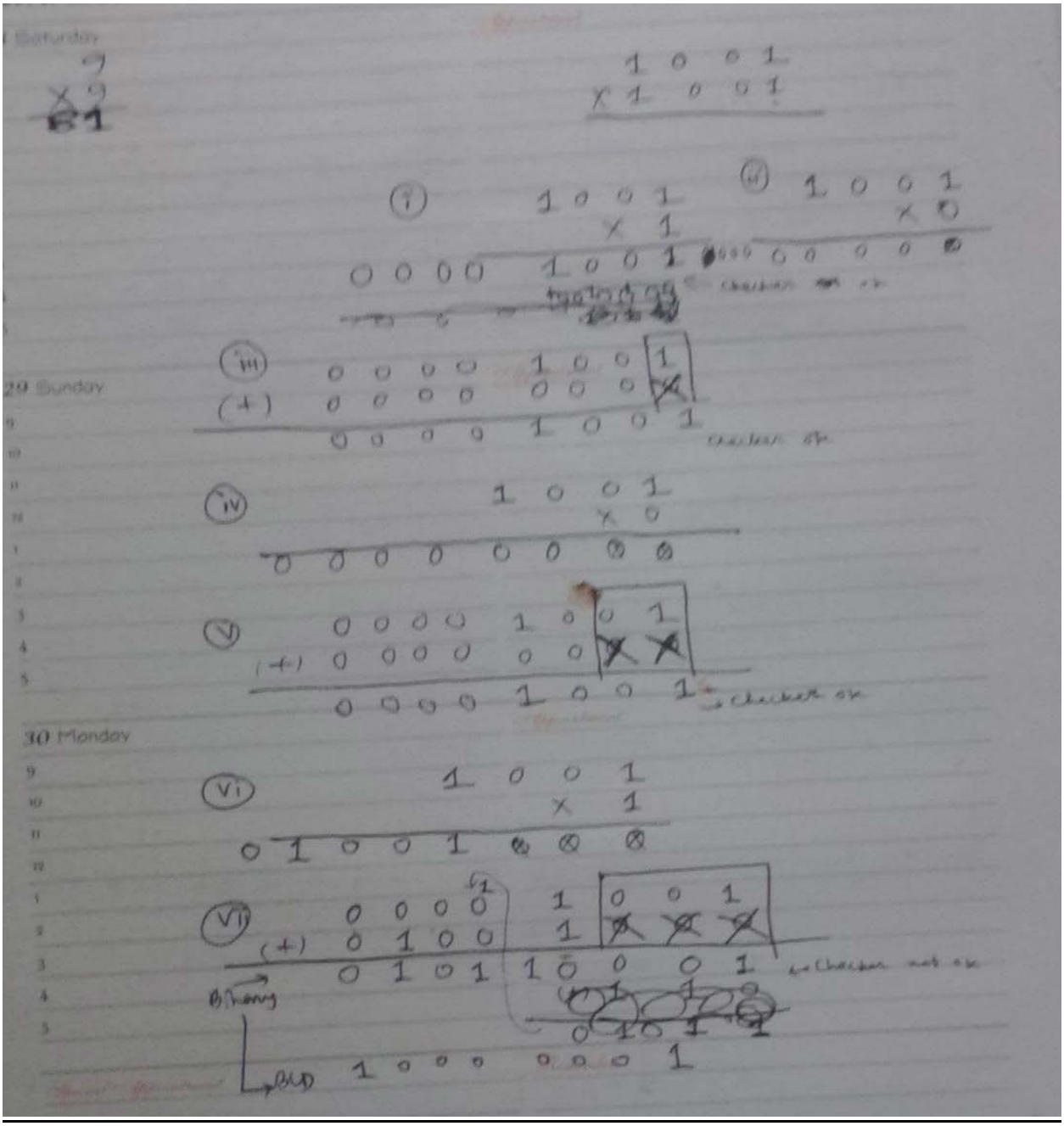

Adder Subtractor Unit
Group Name: ZERO_ONE
A-2
A-3
X2

Multiplier:

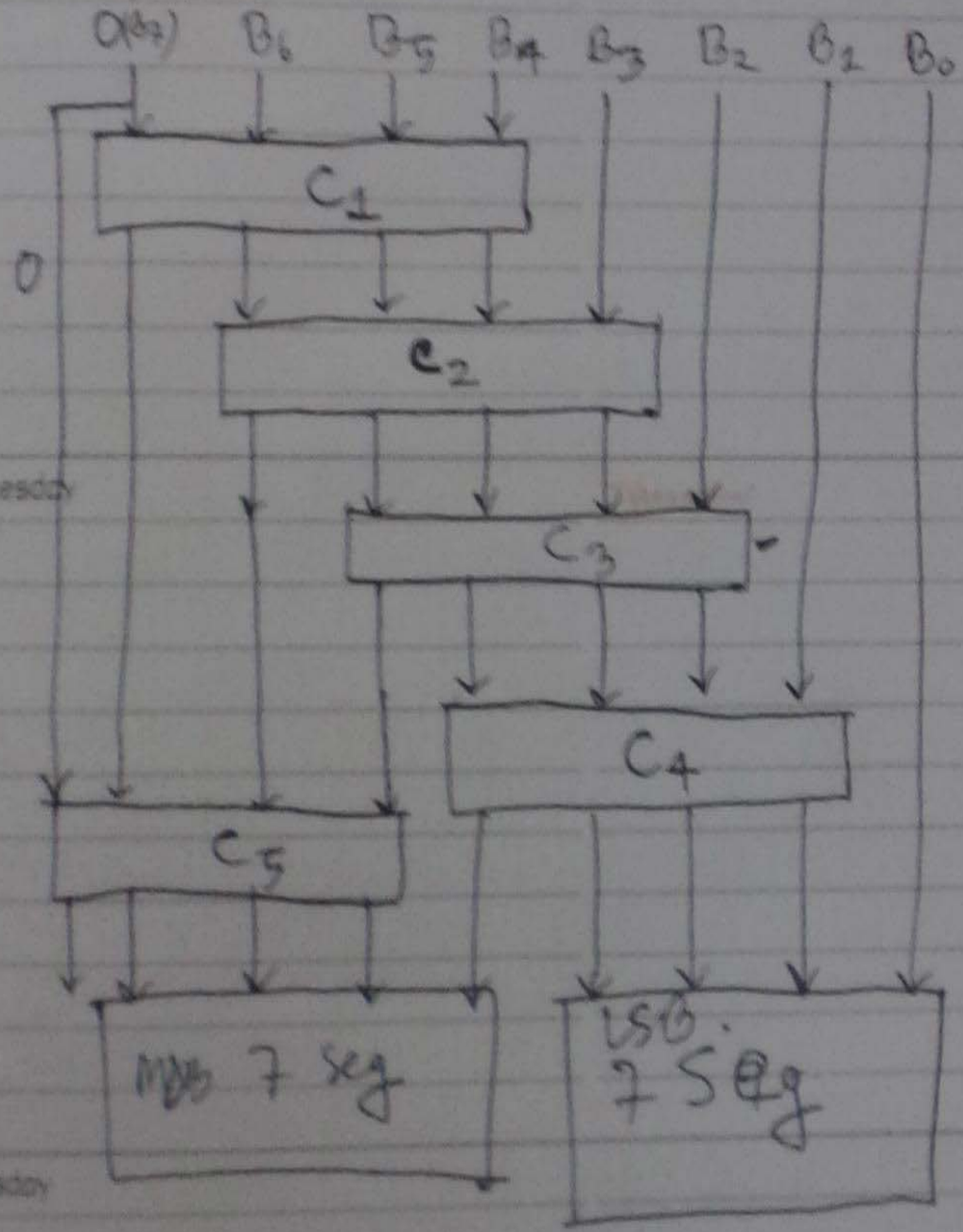
In this unit the operations of addition and subtraction of single digit, 4 bit decimal number. Here I used 7 AND gate IC, 8 full adders, 3 OR gate IC and an Encoder.

Then as before the steps are performed

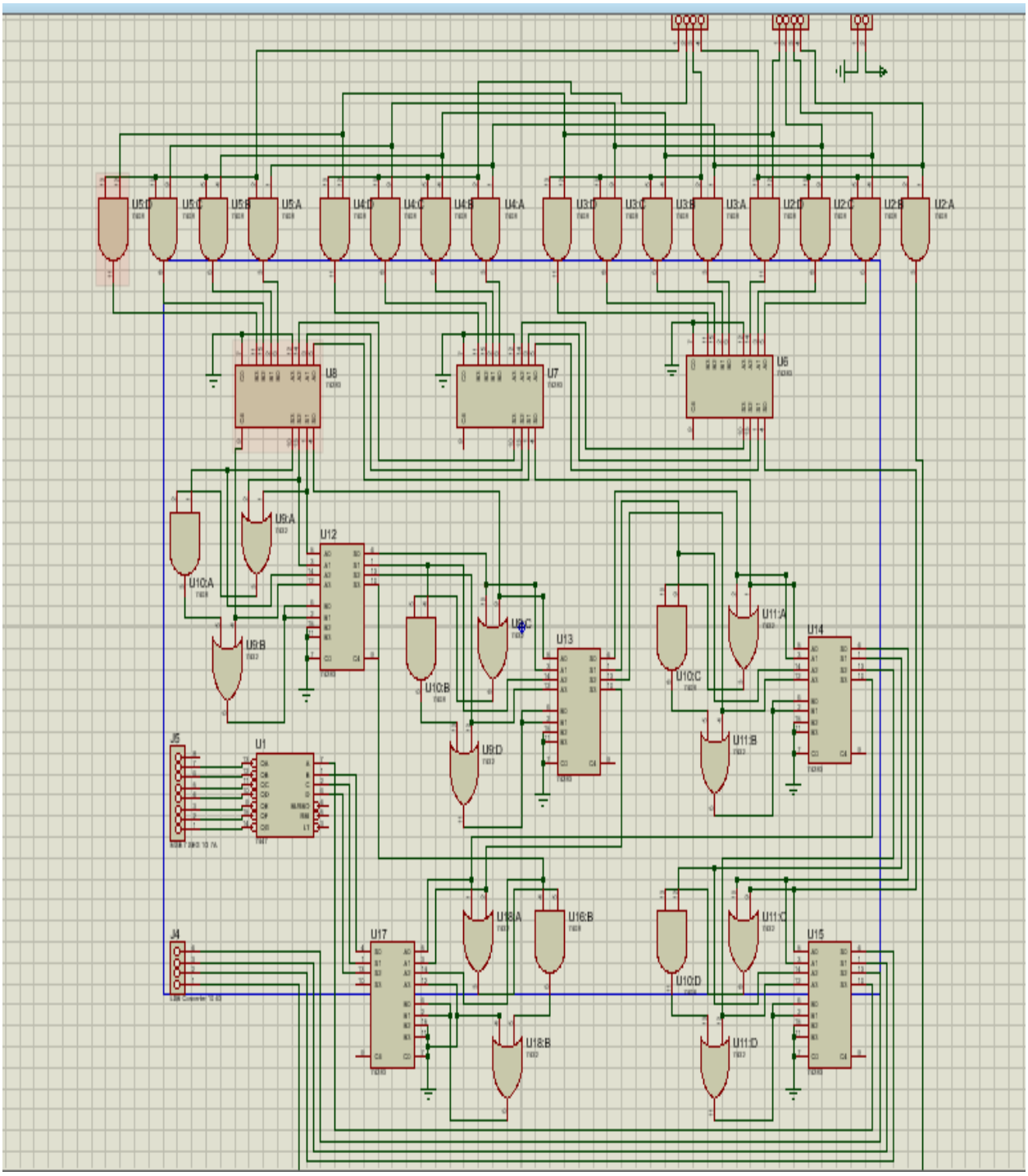
1st the written rough calculations:



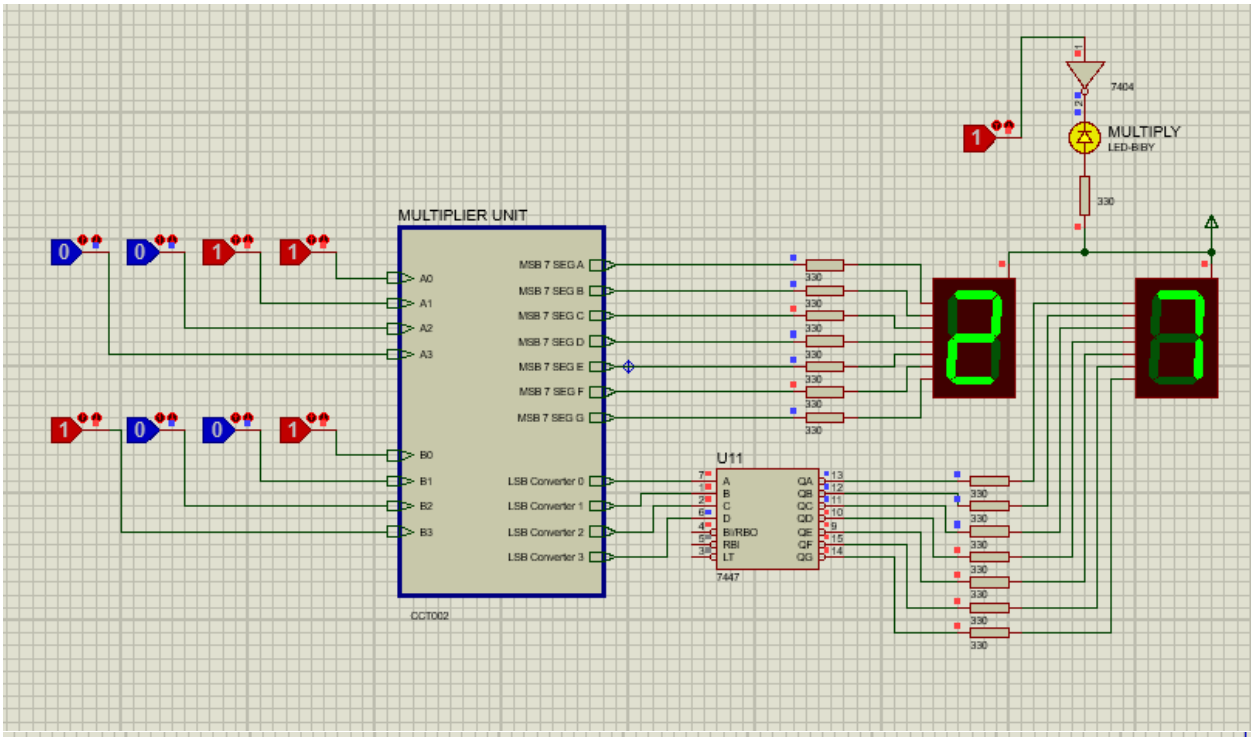
Binary to BCD Convert using Double-Dabble:

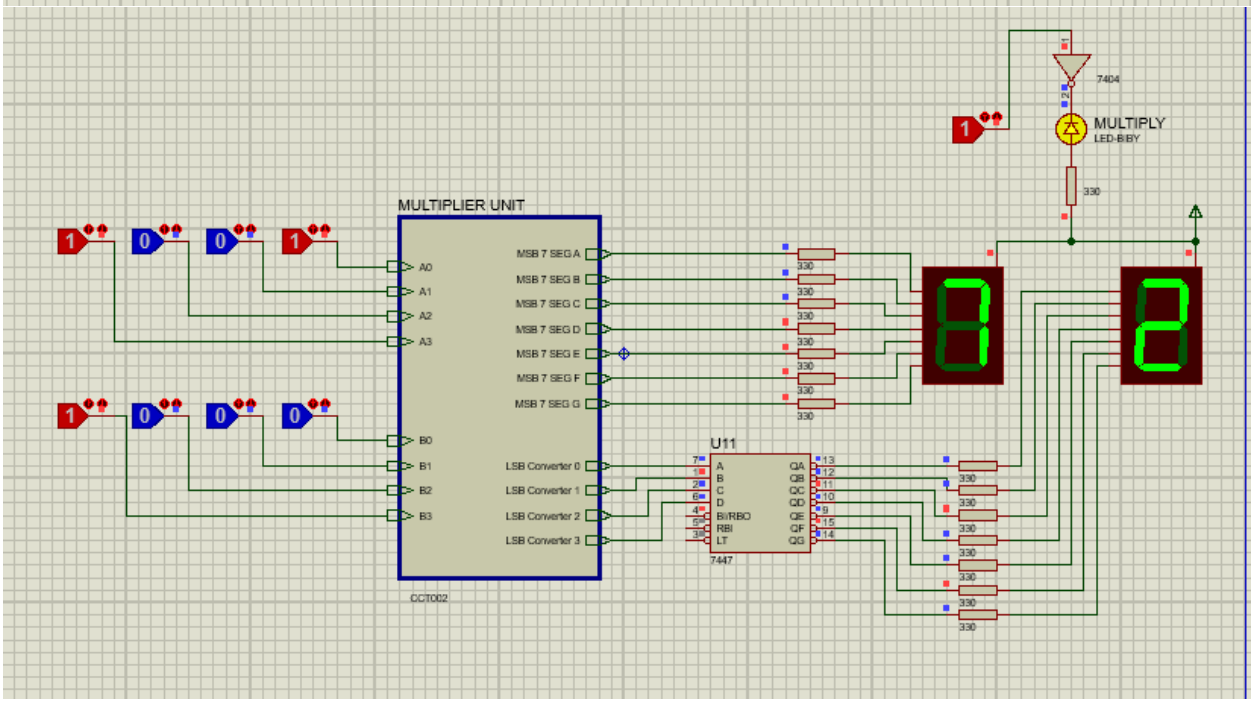


Then the proteus Implementation:

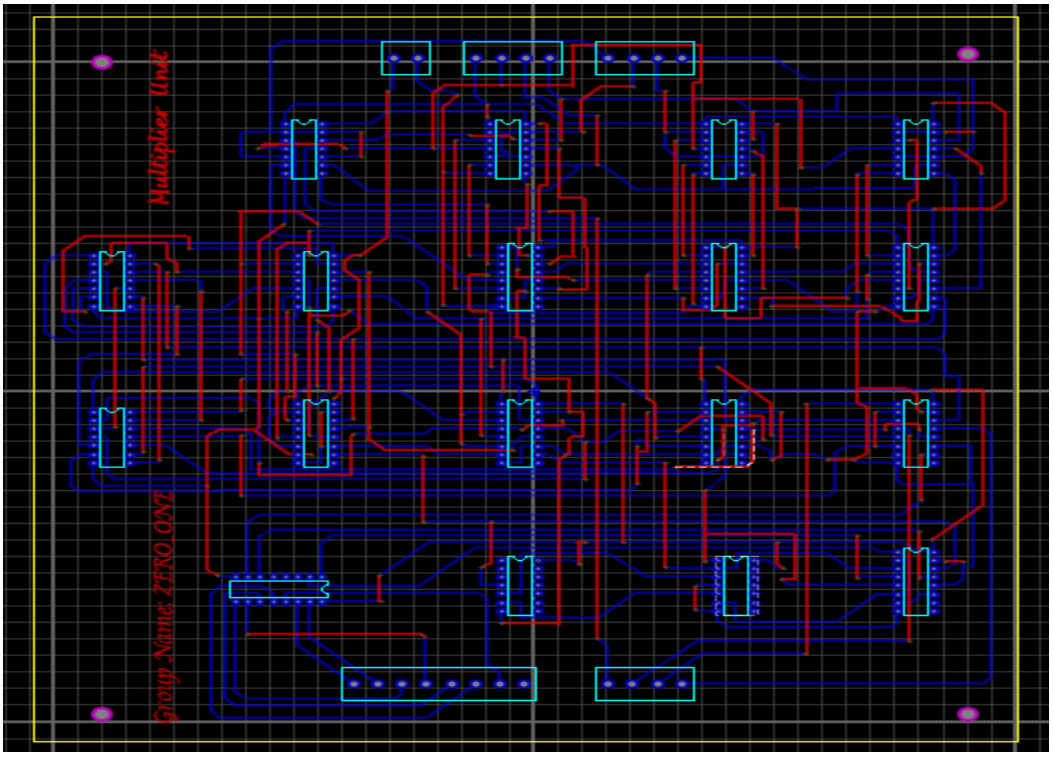


The outputs are checked and obtained as desired:





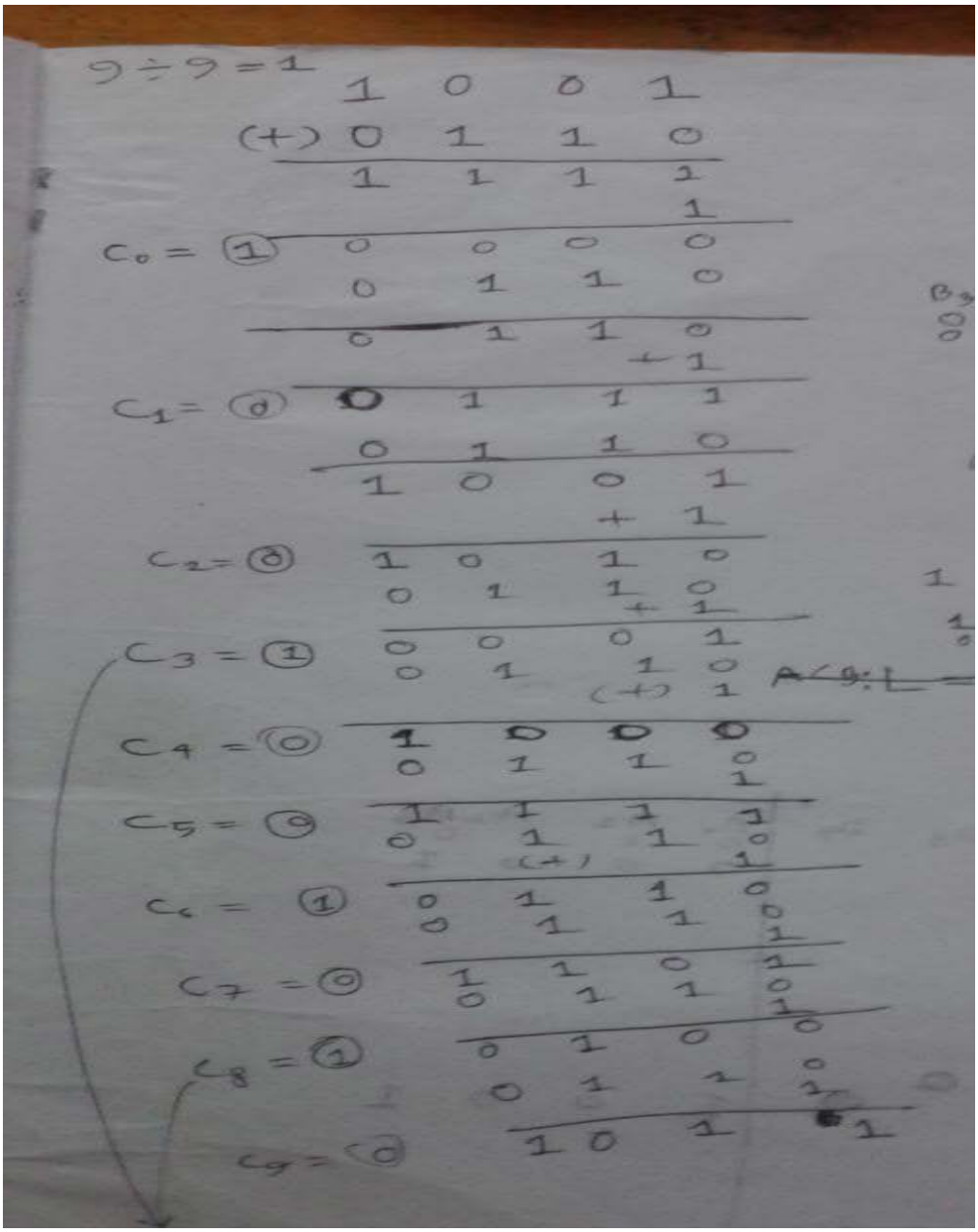
Then after adding the terminal blocks the PCB design was made and printed:

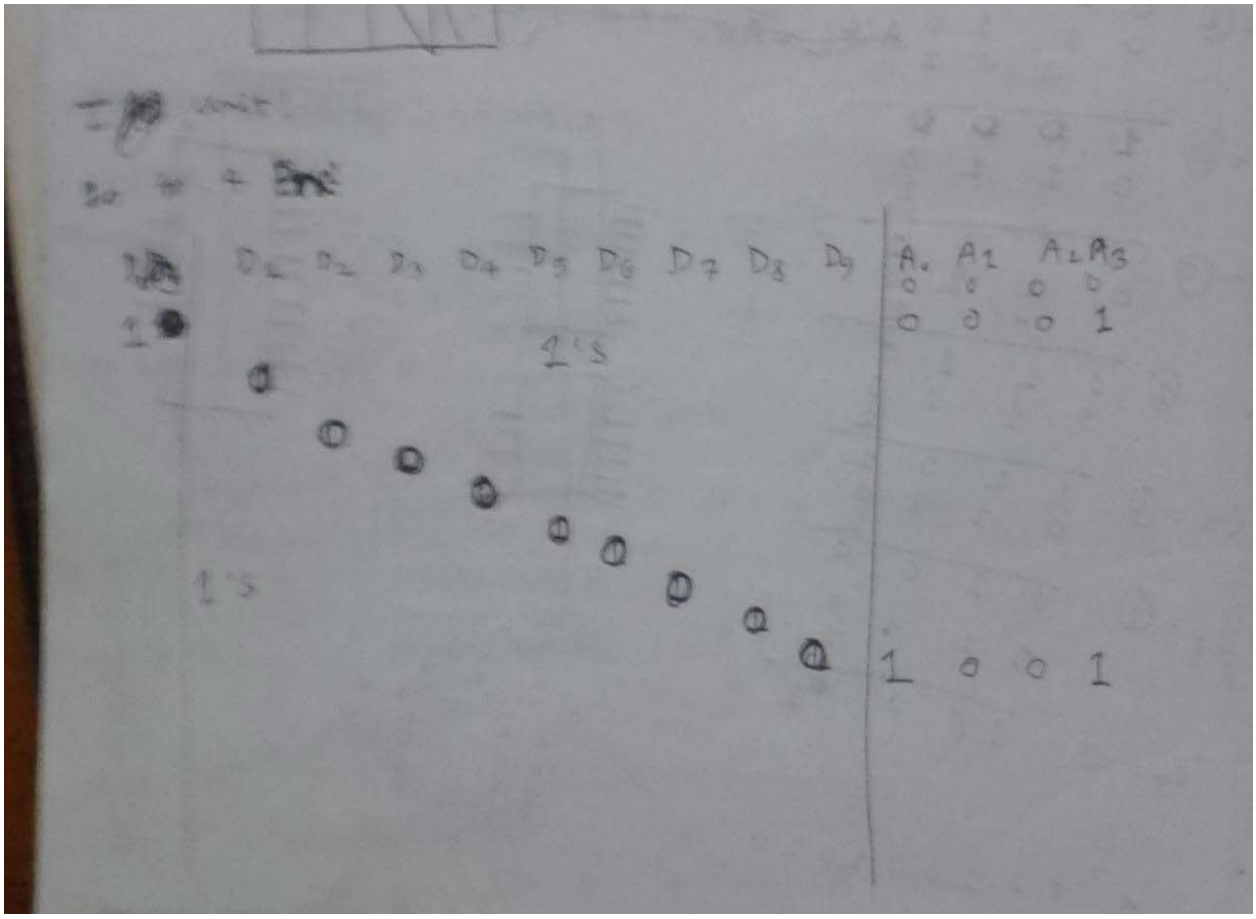


Divider Unit

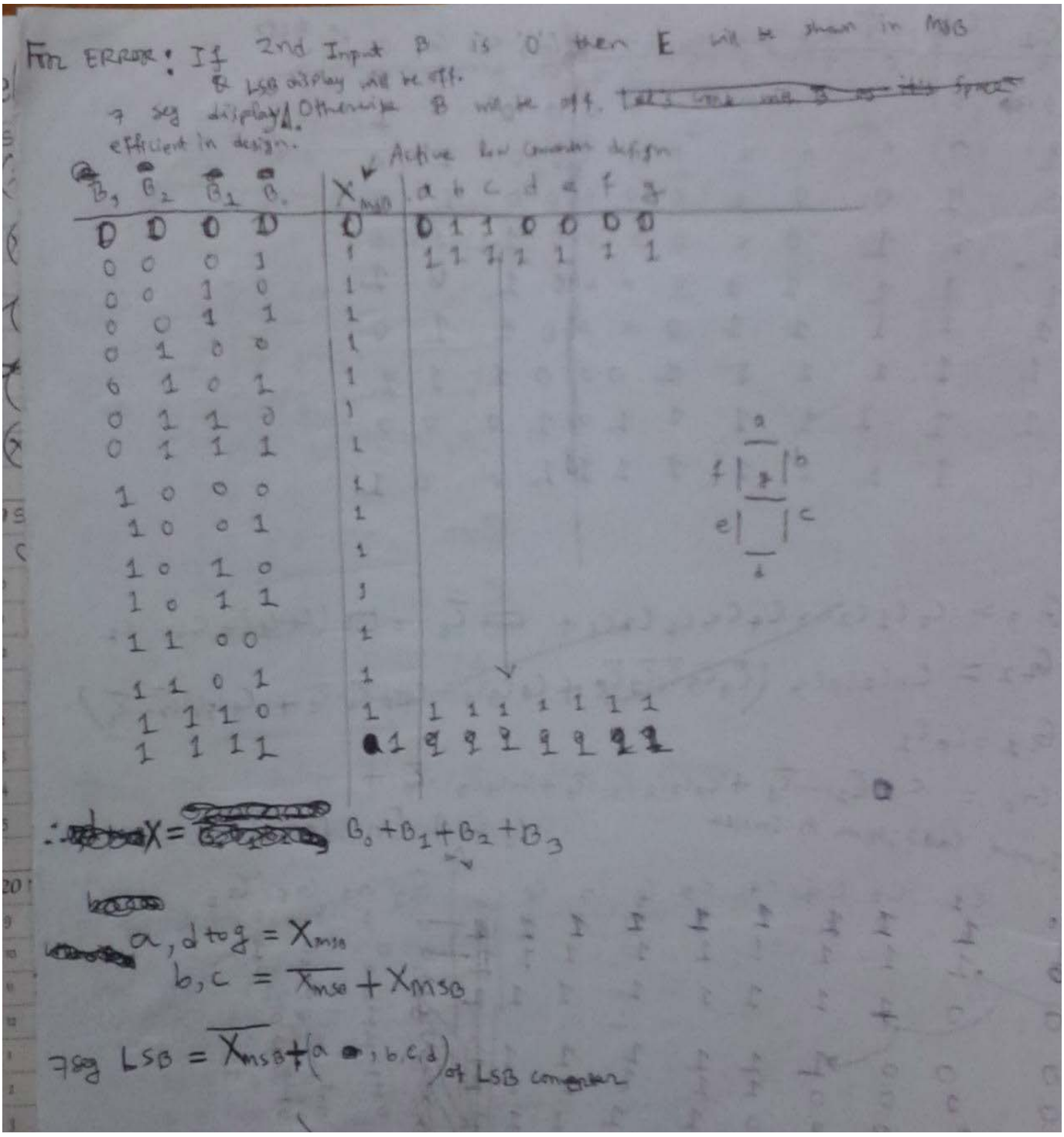
In this unit of the Division operation single digit (4 bit binary) decimal number is divided by another single digit Decimal number. But in this particular divider, the decimal places (i.e. Remainders) are not shown. Only the integer will be displayed. Here I used a total of 18 ICs including 9 Full adders, 4 Inverter IC, 2 OR gate IC, 2 AND gate IC and an 10 to 4 line Encoder.

As before the logical calculations and designs are done by hand calculation.



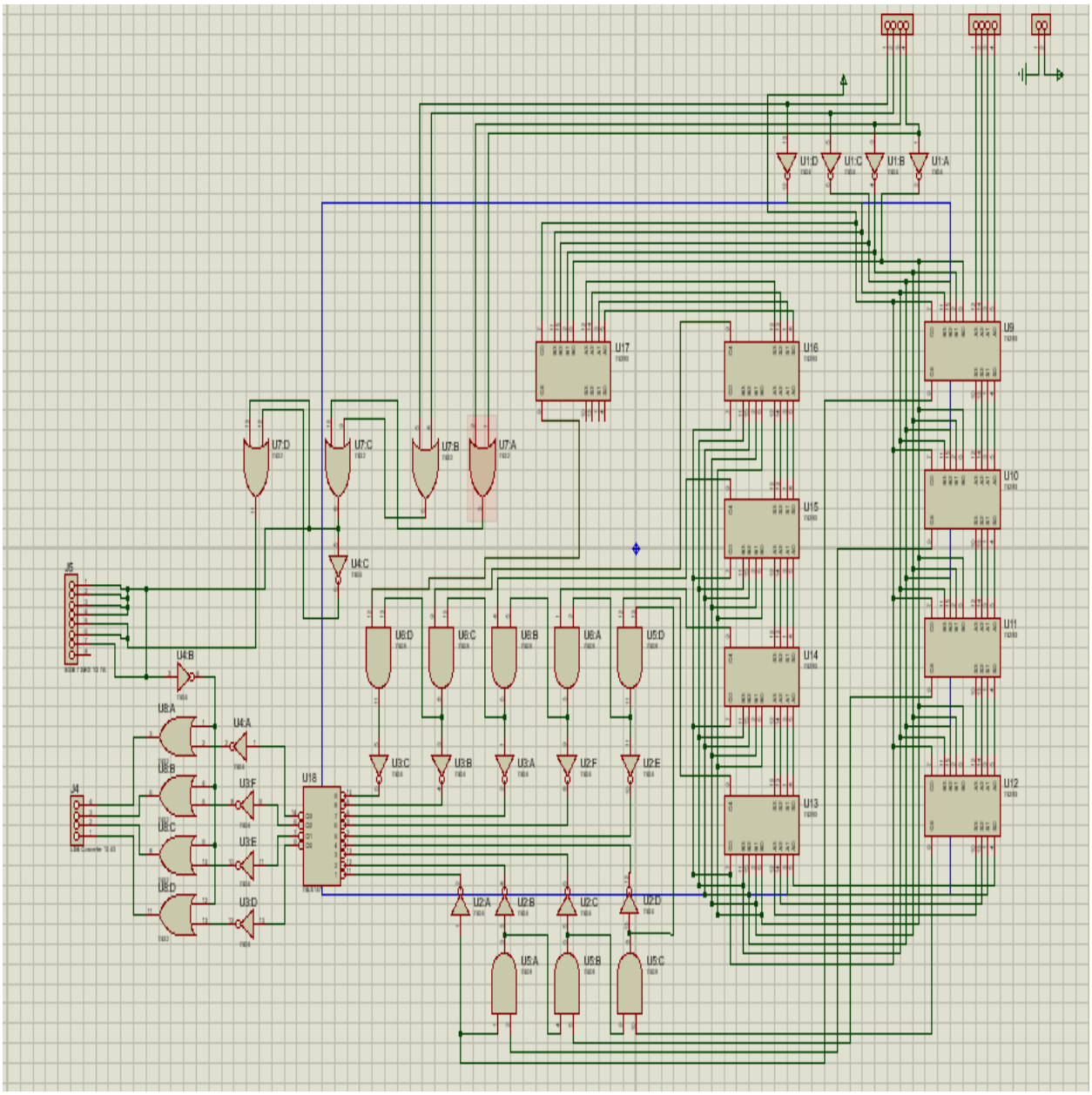


Truth table for 10 to 4 line Encoder used for summing up the required carry outs which is the quotient.



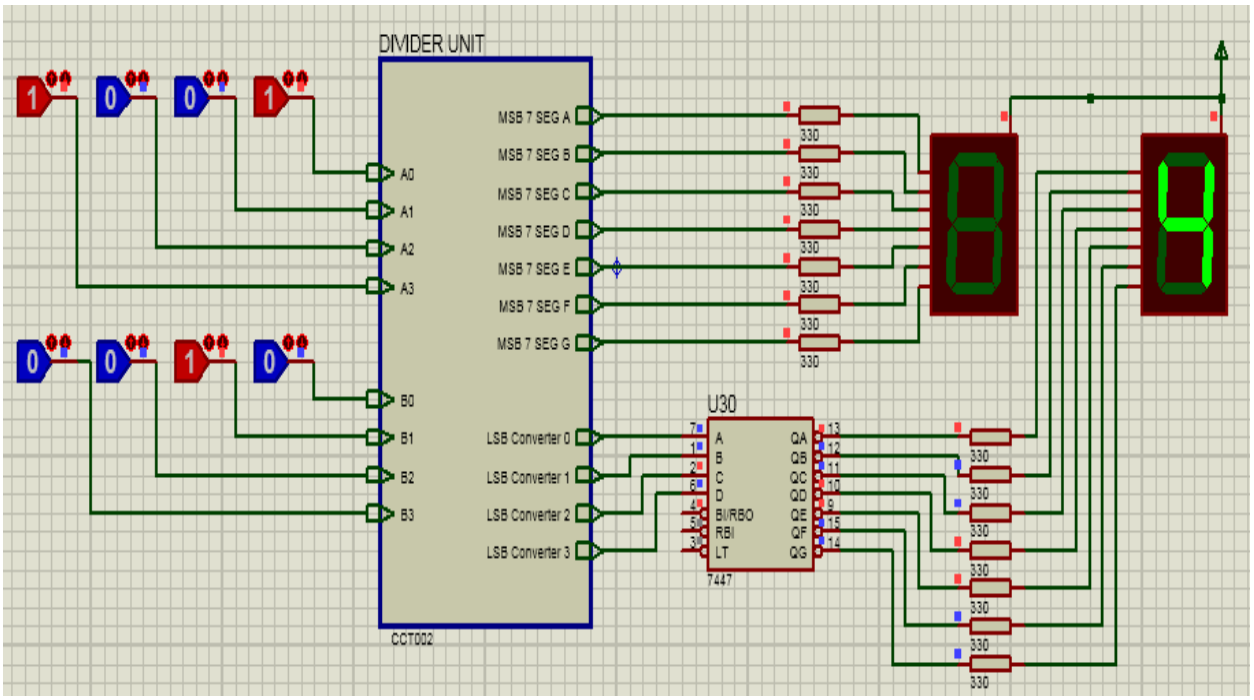
Truth table & Boolean Expression for Showing 'E' (Error) in case of any digit divided by zero.

Then done the Proteus Implementation and output generation.



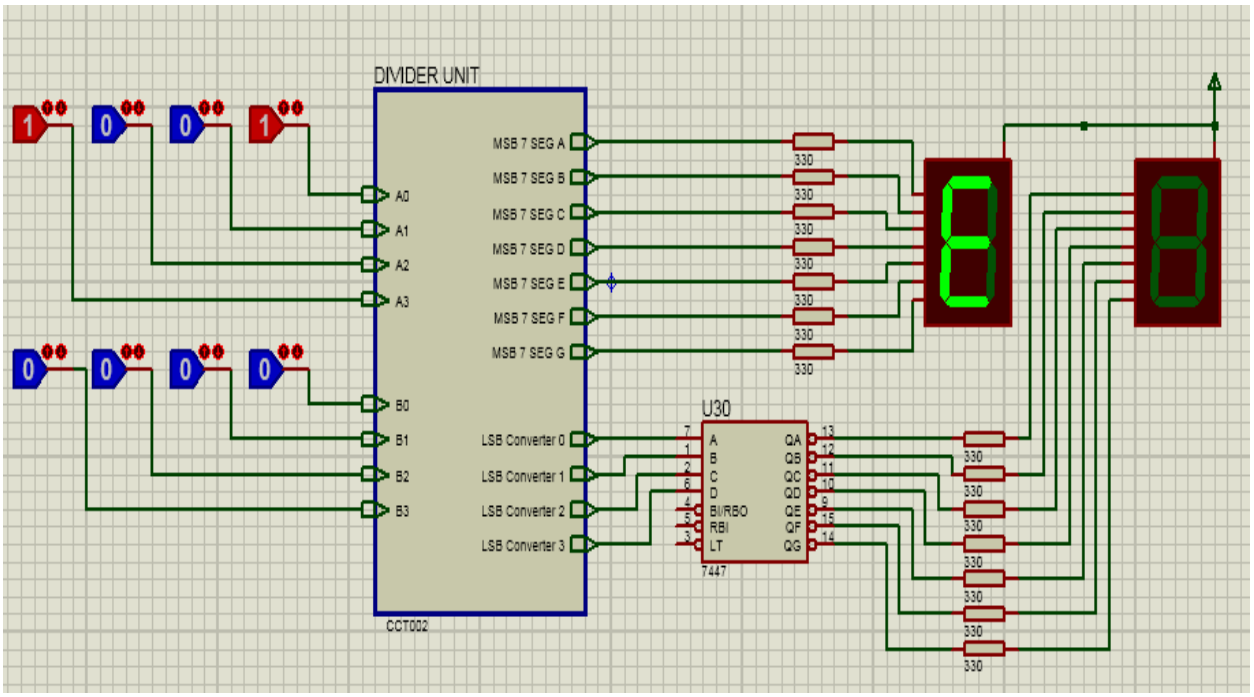
2nd input is subtracted 9 times from 1st input & successive differences. To make the undesired carry outs (if required subtraction is completed before 9th step) forcibly '0' I used AND gates.

To make required carry outs suitable for using in 10 to 4 line decoder they are inverted using NOT gates.

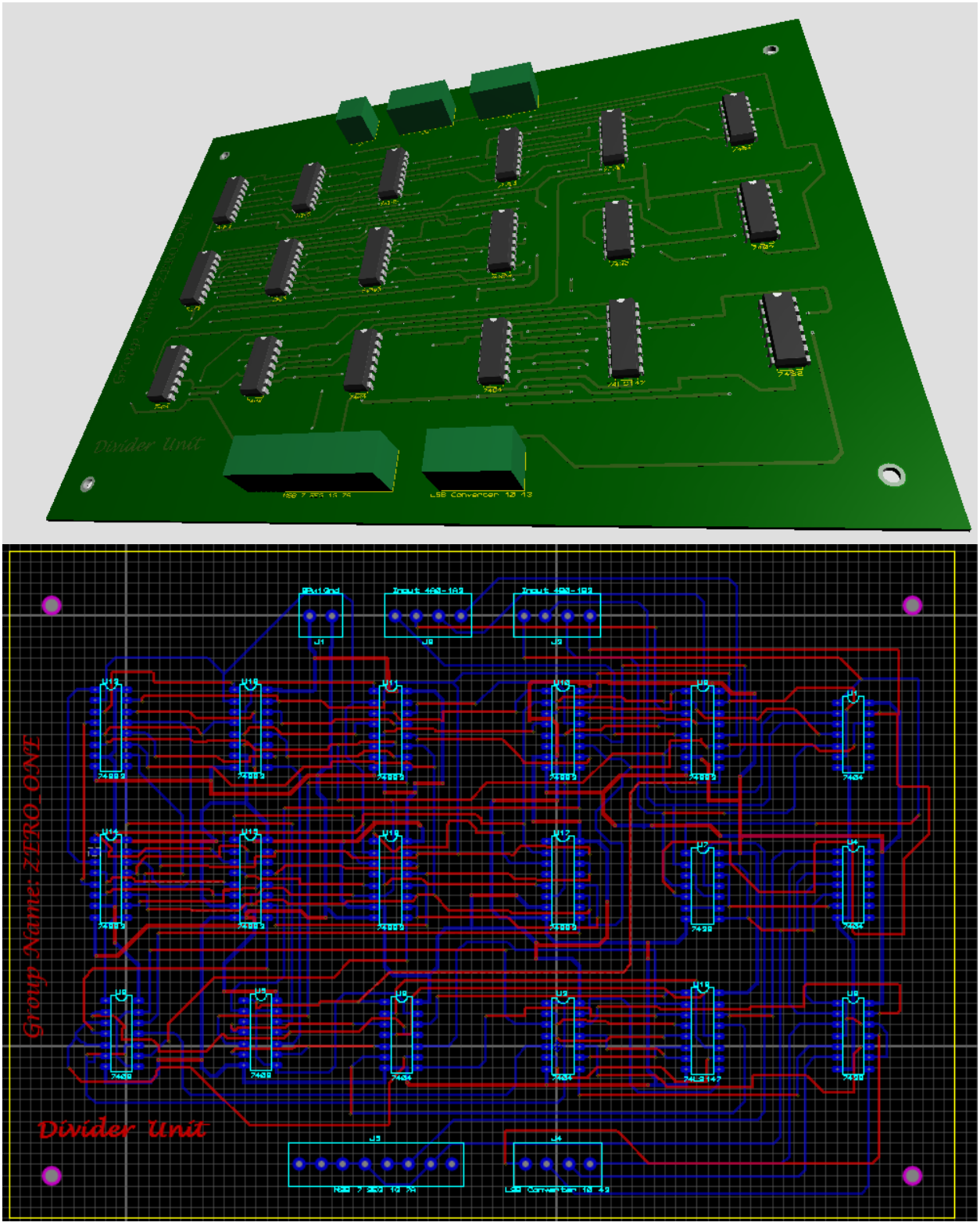


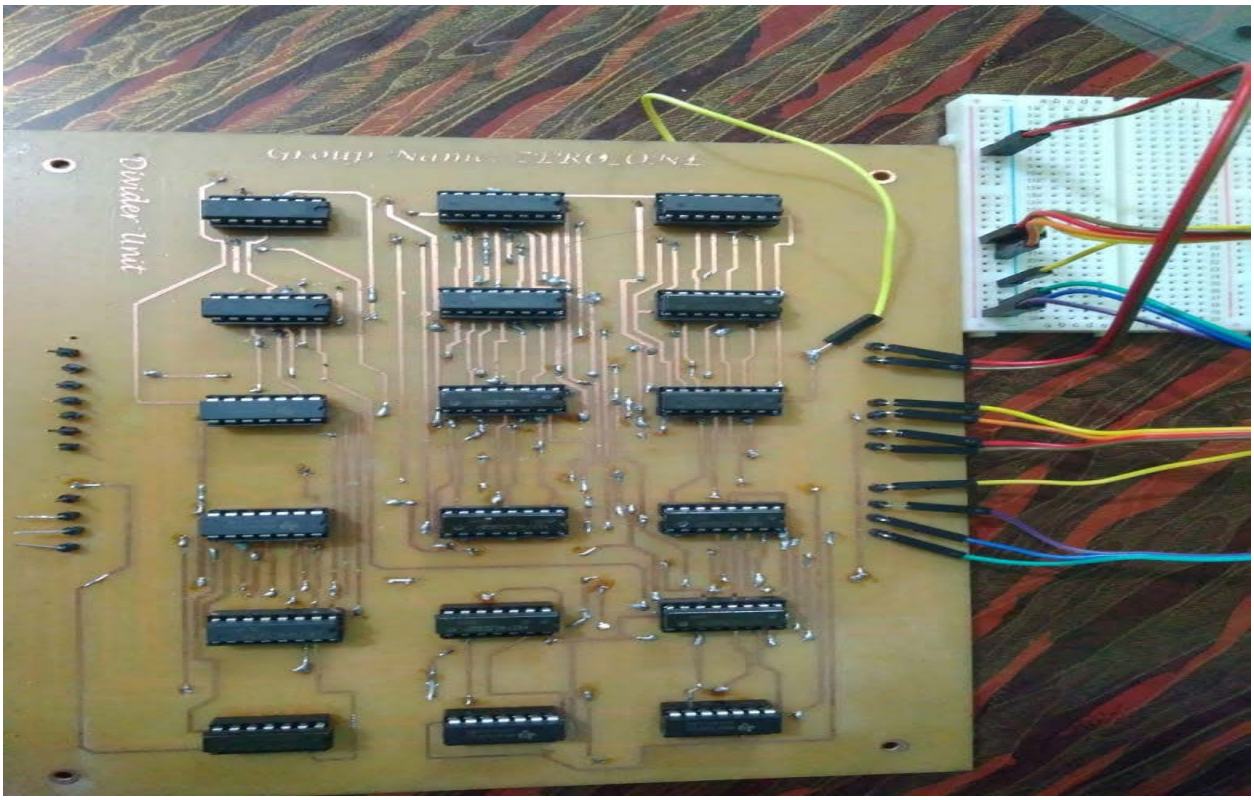
It’s designed such that ‘E’(Error) will be displayed if any digit is divided by 0

(e.g.: 9/0 in the following picture)

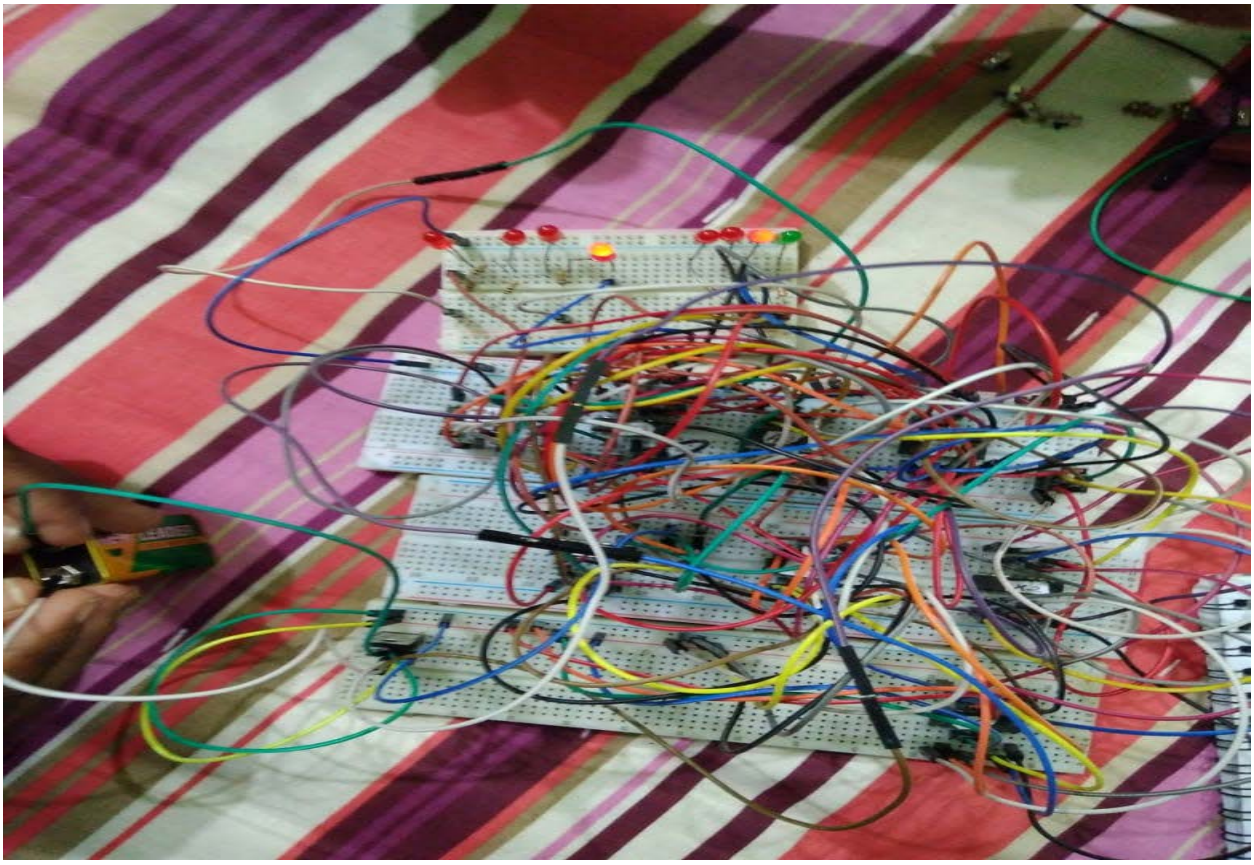


And finally the PCB design was done. The design and PCB print is given below:




Divider Unit

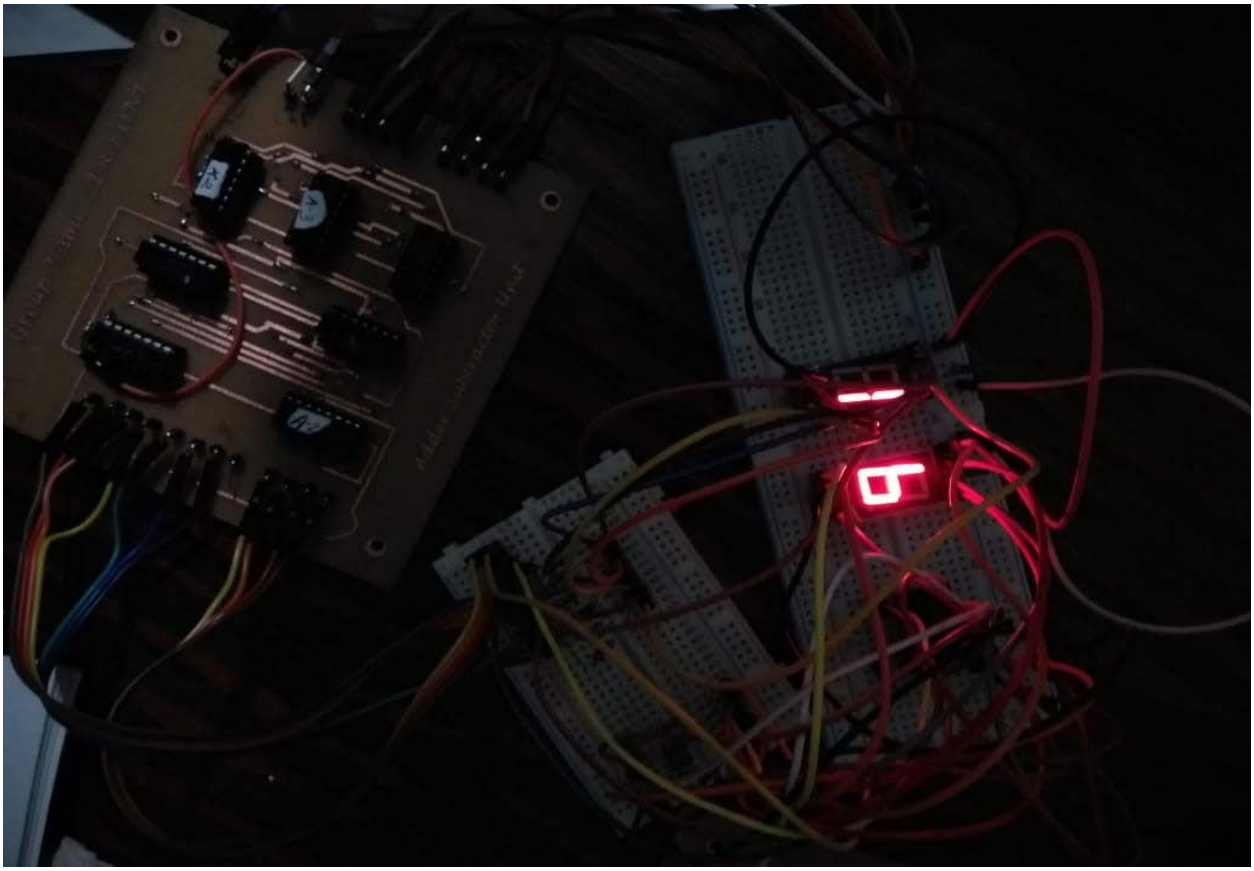
In case of adder-subtractor unit, I first implemented the circuit on breadboard and got the results in the form of binary outputs which Ire indicated by LEDs. LED on meant 1 and off meant 0.



Display Unit

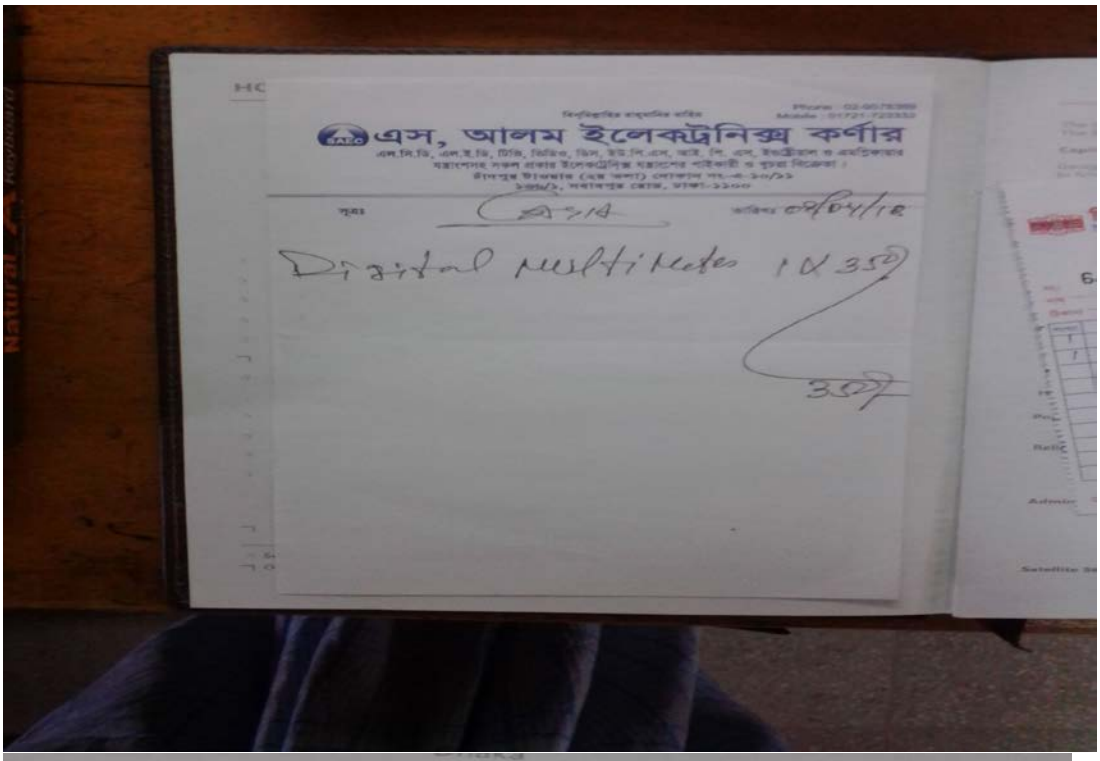
The display unit consists of 2 common anode 7 segment single digit displays, BCD to 7 seg converts and power supply. When the outputs came to be 0, any desired segment would light up.

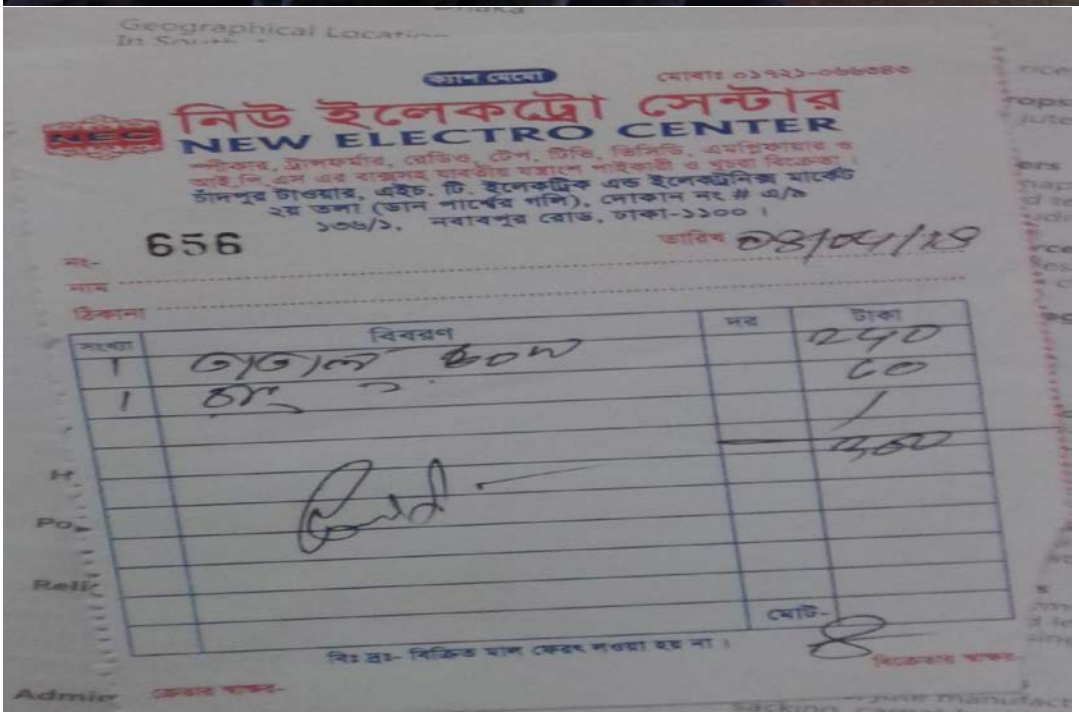
The output looked as below:

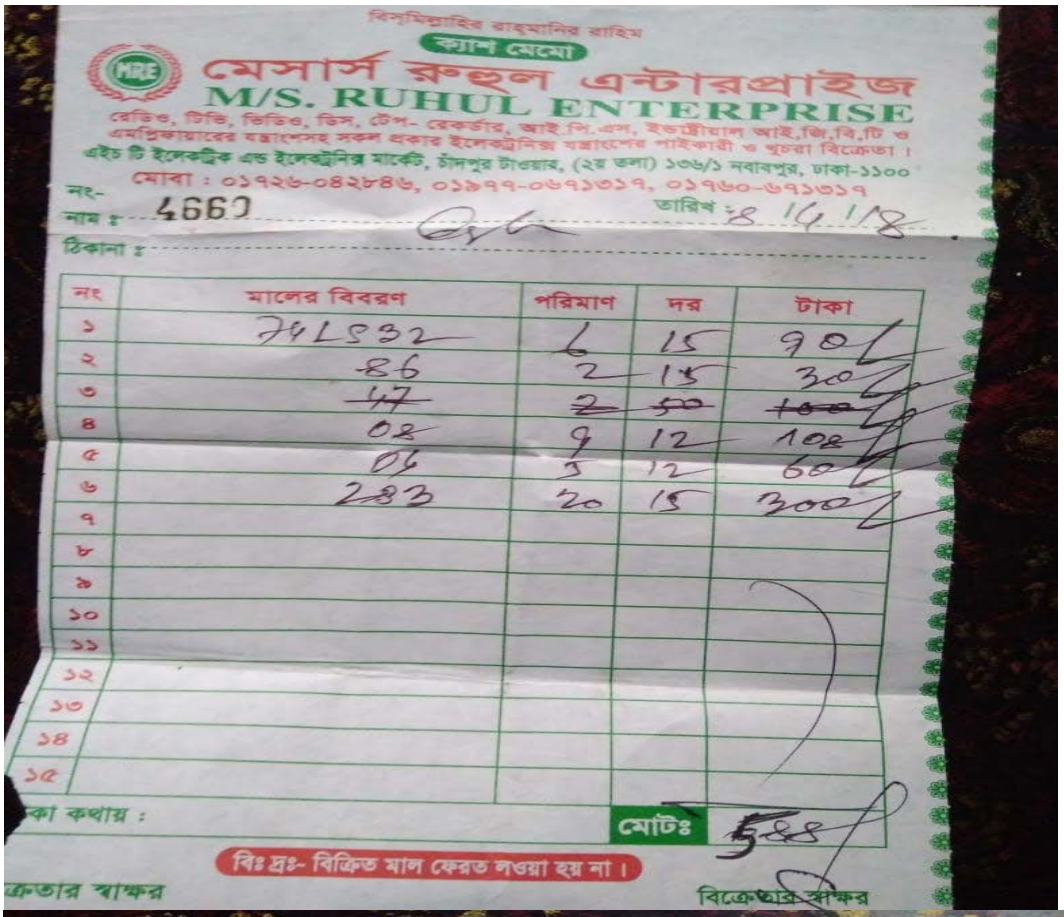


COSTINGS

The overall costing for buying the different components and accessories for the hardware implementation was BDT 3788 . And details of the costings are given below:







বিসমিল্লাহির রাহমানির রাহিম

ক্যাশ মেমো

মেসার্স রুহুল এন্টারপ্রাইজ
M/S. RUHUL ENTERPRISE

রেডিও, টিভি, ভিসিও, ডিস, টেপ- রেকর্ডার, আই.পি.এস, ইন্ডাস্ট্রীয়াল আই,জি,বি,টি ও এমপ্লিফায়ারের যন্ত্রাংশেসহ সকল প্রকার ইলেকট্রনিক্স যন্ত্রাংশের পাইকারী ও খুচরা বিক্রেতা।

এইচ টি ইলেকট্রিক এন্ড ইলেকট্রনিক্স মার্কেট, চাঁদপুর টাওয়ার, (২য় তলা) ১৩৬/১ নবাবপুর, ঢাকা-১১০০

মোবা : ০১৭২৬-০৪২৮৪৬, ০১৯৭৭-০৬৭১৩১৭, ০১৭৬০-৬৭১৩১৭

নং- 4660

নাম ঃ

তারিখ ঃ 8/6/18

ঠিকানা ঃ

নং	মালের বিবরণ	পরিমাণ	দর	টাকা
১	741532	6	15	90
২	86	2	15	30
৩	47	2	50	100
৪	02	9	12	108
৫	06	5	12	60
৬	283	20	15	300
৭				
৮				
৯				
১০				
১১				
১২				
১৩				
১৪				
১৫				

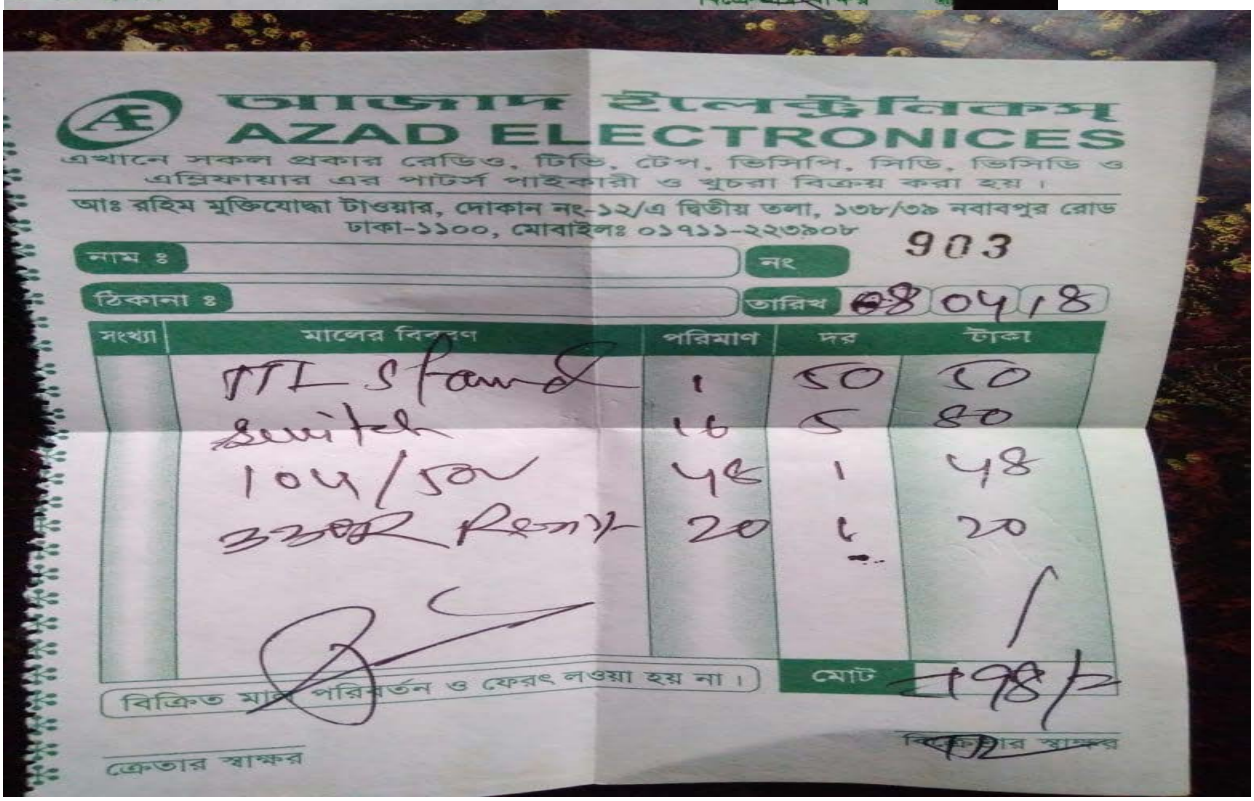
কা কথায় :

মোটঃ 588

বিঃ দ্রঃ- বিক্রিত মাল ফেরত লওয়া হয় না।

ক্রেতার স্বাক্ষর

বিক্রেতার স্বাক্ষর



আজাদ ইলেক্ট্রনিক্স
AZAD ELECTRONICES

এখানে সকল প্রকার রেডিও, টিভি, টেপ, ভিসিপি, সিডি, ভিসিডি ও এম্প্লিফায়ার এর পার্টস পাইকারী ও খুচরা বিক্রয় করা হয়।

আঃ রহিম মুক্তিযোদ্ধা টাওয়ার, দোকান নং-১২/এ দ্বিতীয় তলা, ১৩৮/৩৯ নবাবপুর রোড ঢাকা-১১০০, মোবাইলঃ ০১৭১১-২২৩৯০৮

নাম ঃ

নং 903

ঠিকানা ঃ

তারিখ 03/04/18

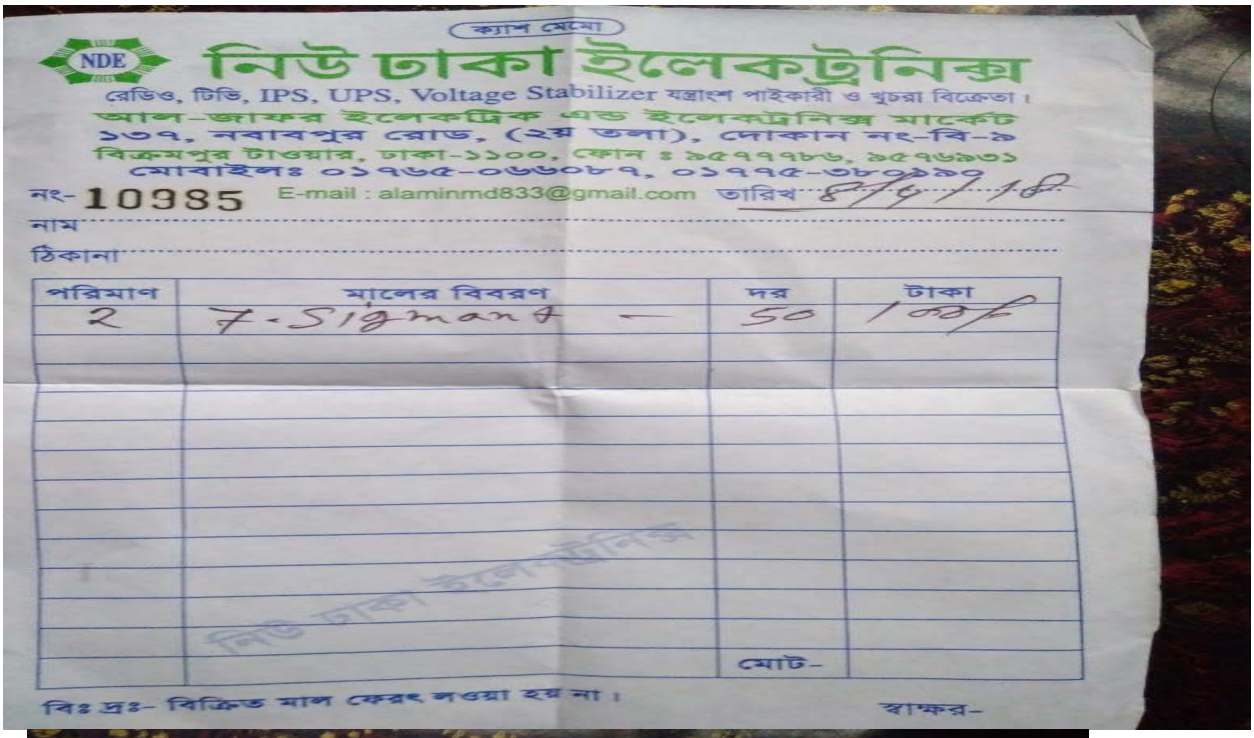
সংখ্যা	মালের বিবরণ	পরিমাণ	দর	টাকা
	TTL Board	1	50	50
	Switch	16	5	80
	104/50V	48	1	48
	330R Resistor	20	1	20

বিক্রিত মাল পরিবর্তন ও ফেরৎ লওয়া হয় না।

মোট 198/-

ক্রেতার স্বাক্ষর

বিক্রেতার স্বাক্ষর



ক্যাশ মেমো

নিউ ঢাকা ইলেকট্রনিক্স

রেডিও, টিভি, IPS, UPS, Voltage Stabilizer যন্ত্রাংশ পাইকারী ও খুচরা বিক্রেতা।

আল-জাফর ইলেকট্রিক এন্ড ইলেকট্রনিক্স মার্কেট

১৩৭, নবাবপুর রোড, (২য় তলা), দোকান নং-বি-৯

বিক্রমপুর টাওয়ার, ঢাকা-১১০০, ফোন : ৯৫৭৭৭৮৬, ৯৫৭৬৯৩১

মোবাইলঃ ০১৭৬৫-০৬৬০৮৭, ০১৭৭৫-৩৮৩৯৯৩

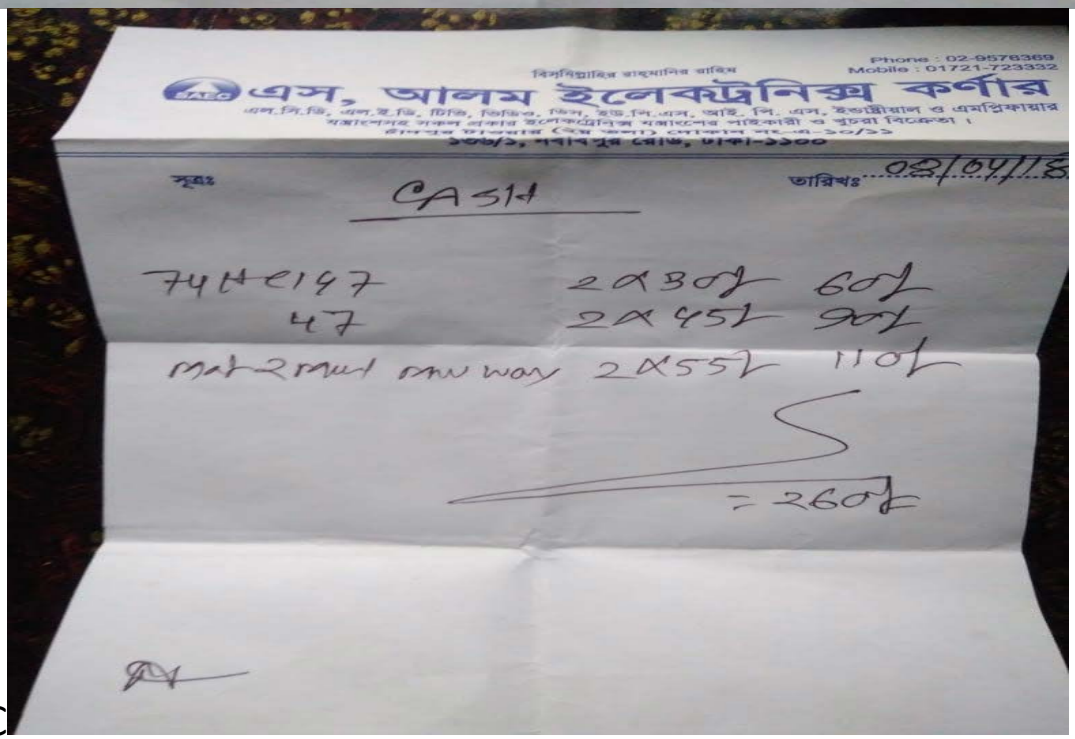
নং- 10985 E-mail : alaminmd833@gmail.com তারিখ 8/6/18

নাম

ঠিকানা

পরিমাণ	মালের বিবরণ	দর	টাকা
2	7-Sigmant —	50	100/-
		মোট-	

বিঃ দ্রঃ- বিক্রিত মাল ফেরৎ লওয়া হয় না। স্বাক্ষর-



বিশ্বস্ততার সাথে ব্যবসায়িক যাত্রায়

Phone : 02-9576369
Mobile : 01721-723332

এস, আলম ইলেকট্রনিক্স কর্ণার

এল.সি.ডি, এল.ই.ডি, টিভি, কিবোর্ড, ফ্যান, ইউ.পি.এস, আই, সি, এস, ইন্ডাস্ট্রিয়াল ও এমপ্রিফায়ার যন্ত্রাংশসহ সকল প্রকার ইলেকট্রনিক্স যন্ত্রাংশের পাইকারী ও খুচরা বিক্রেতা।

১৩৬/১, নবাব পুর রোড, ঢাকা-১১০০

সূত্রঃ CASH তারিখঃ 02/04/18

74HC147 2×30= 60/-

47 2×45= 90/-

Mat-2mul one way 2×55= 110/-

= 260/-

C

Total amount in Cash memo = 1796 BDT only.

PCB printing cost = 1992 BDT only

Total cost = 3788 BDT only