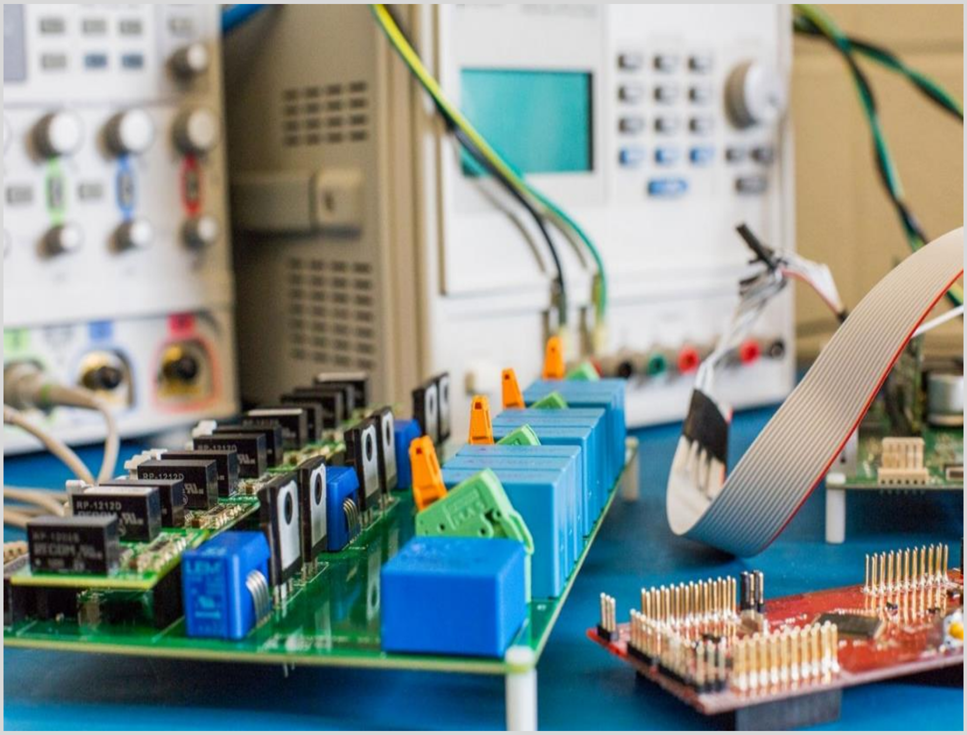
COURSE TITLE: APPLIED SDLC AND SOFTWARE TESTING

PROJECT TITLE

VIRTUAL ELECTRONICS LAB



TEAM 12

ICONICS

OUR TEAM MEMBERS

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Detailed Folder Structure

Folder	Contents
Requirements	1. Features 2. Ageing time 3. Ageing Cost/Feature Evolution 4. 4W and H 5. Swot Analysis 6. Theory 7. High Level Requirements 8. Low Level Requirements
Design	1. High Level Design 2. Low Level Design • Contains both Structural and Behavioral Design.
Implementation	1. Test 2. Unity 3. inc 4. src 5. Make file
Test plan	1. Integrated Test Plan 2. Unit Test Plan • High Level Test Plan • Low Level Test Plan

Requirements

Features

1. Fast calculation of the required parameters.

2. Accuracy of calculated value almost near the original expected value.

3. Cheap device which can be used by anyone.

4. No need of calibration as in case of hardware instrument when used alone.

Ageing Time

The ageing time of our system is lifetime till a better a system comes to replace our system.

Ageing Cost/ Feature evolution

It started with Ohm's law where only we could calculate resistance. But as time progressed, we can get develop system where we can find out color coding, series and parallel value of resistances along with color coding. We know also perform KVL and KCL to find current and voltage in individual loops.

Earlier we had just binary to decimal conversion and vice versa. But in the modern system we can perform many conversions like binary to n hexadecimal, binary to octal, binary to gray code and vice versa.

Key Requirements

We require a system which measures:

1. Current

2. voltage

3. Resistance

4. Series and parallel resistances

5. Color coding of resistors

We require a system which performs conversion of:

1. Binary to gray and vice versa
2. Binary to decimal and vice versa
3. Binary to hexadecimal and vice versa
4. Binary to octal and vice versa
5. Binary to excess 3 and vice versa

4W AND H

WHO

The Virtual Labs Project started as an initiative from the Ministry of Human Resource and Development (MHRD)

WHERE

IIT Kharagpur INDIA

WHAT

to create online interactive media which would help students learn difficult concepts in various domains. As a part of this initiative, a virtual laboratory for Basic Electronics has been developed. The objective of this lab is to perform experiments in the Basic Electronics labs virtually, and yet have close to real life experience

WHEN

2010

HOW

All Virtual Labs can be accessed through a common website which we create further in app development. At the user end, a PC and broadband connectivity enables the user to access Virtual Labs.

SWOT ANALYSIS

Voltage Definition

Voltage is known as the electric potential difference between two points.

The Si unit for voltage is volts.

The difference in electrical potential is oftentimes caused by electric charge, electric current, or magnetic fields.

Sometimes, it’s decided by all three of those parameters.

How is voltage measured?

To measure voltage a voltmeter is used.

This is connected to two opposite points along with a device, and the voltage drop across the device is known as the difference.

When using one of these reference points as ground, it provides the total voltage at that point.

Voltage Formula

$$V = I * R$$

Where V is the voltage (unit Volts)

I is the current (unit Amperes)

R is the resistance (unit ohms)

Current Definition

Electric Current is the rate of flow of electrons in a conductor. The magnitude of electric current is measured in coulombs per second.

The SI unit of electric current is Ampere and is denoted by the letter A. Ampere is defined as one coulomb of charge moving past a point in one second.

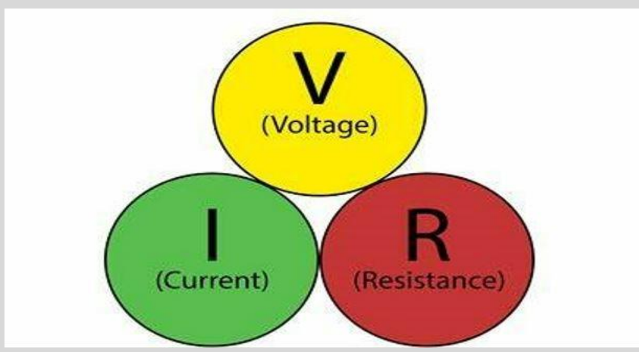
If there are 6.241 x 1018 electrons flowing through our frame in one second then the electrical current flowing through it is ‘One Ampere.’

Current Formula

I=V/R

Where V is the voltage

R is the resistance



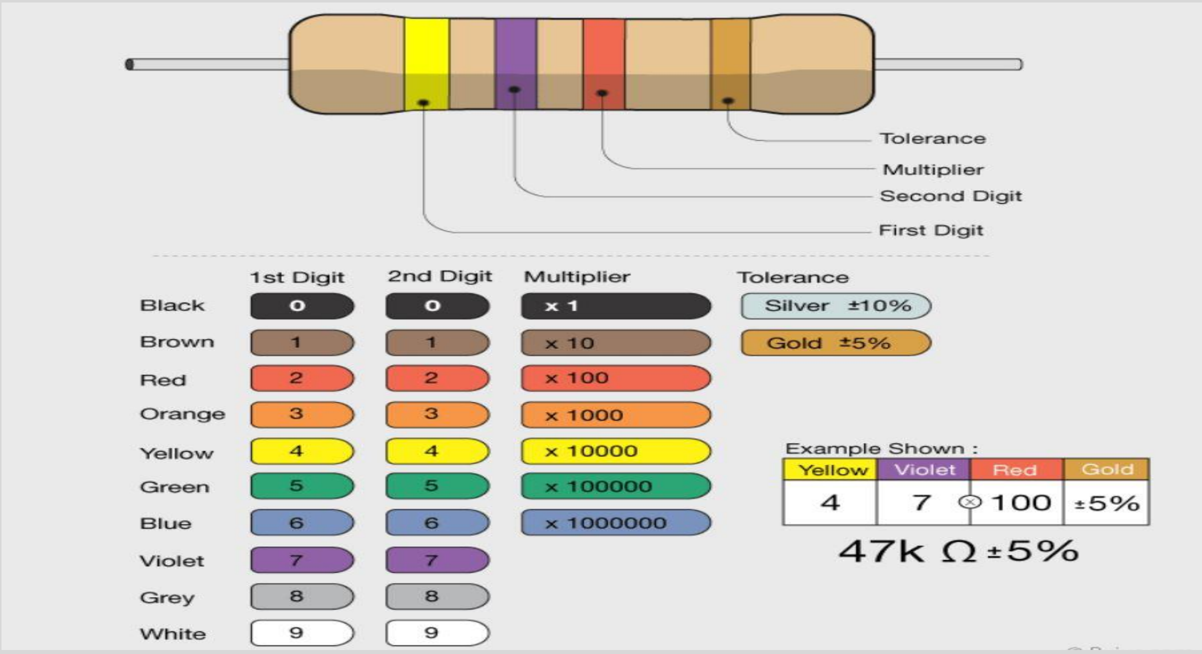
What is Resistor Color Code?

Resistors are usually very tiny, and it is challenging to print resistance values on them.

So, color bands are printed on them to represent the electrical resistance.

These color bands are known as resistor color code. The resistor color code was invented in the 1920s by the Radio Manufacturers Association (RMA).

Resistor Color Reading



All leaded resistors with a power rating up to one watt are marked with color bands.

They are given by several bands and together they specify the resistance value, the tolerance rate and sometimes the reliability or failure rates.

The number of bands present in a resistor varies from three to six.

The first two bands indicate the resistance value and the third band serves as a multiplier.

Resistor Colour Table

Colour	Digit	Multiplier	Tolerance
Black	0	1	
Brown	1	10	± 1%
Red	2	100	± 2%
Orange	3	1000	
Yellow	4	10,000	
Green	5	100,000	± 0.5%
Blue	6	1,00,000	± 0.25%
Violet	7	10,000,000	± 0.1%
Grey	8		± 0.05%
White	9		
Gold		0.1	± 5%
Silver		0.01	± 10%

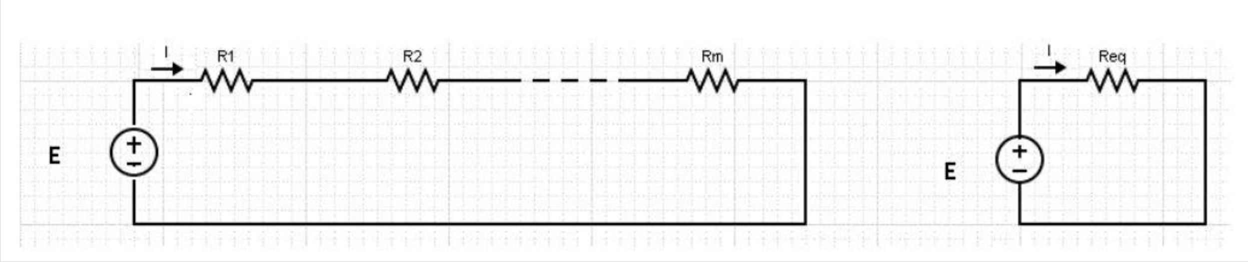
Resistors in Series

The resistors R1, R2 ...., Rm in the circuit on the left side are said to be in series because the same current passes through them.

They behave in the same way as the circuit on the right of resistance Req given by the sum of the resistances R1, R2 and R3.

Req = R1 + R2 .... + Rm

I = E / Req

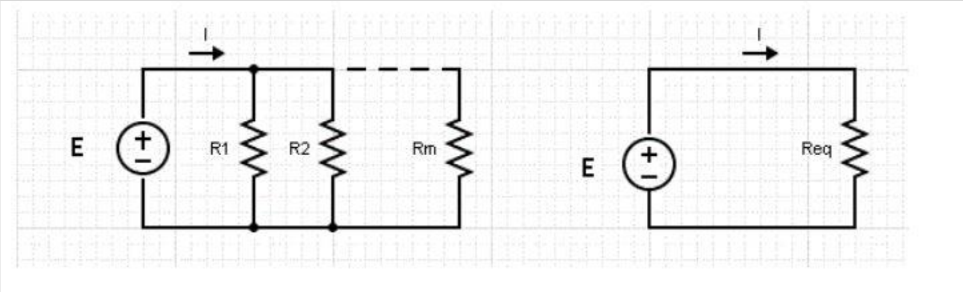


Resistors in Parallel

The voltage across each of the resistors R1, R2 ...., Rm in the circuit on the left is the same and therefore these resistors are said to be in parallel.

They behave in the same way as the circuit on the right of resistance Req that is given by the equation:

1 / Req = 1 / R1 + 1 / R2 + ... + 1 / Rm



Resistors combined [series and parallel]

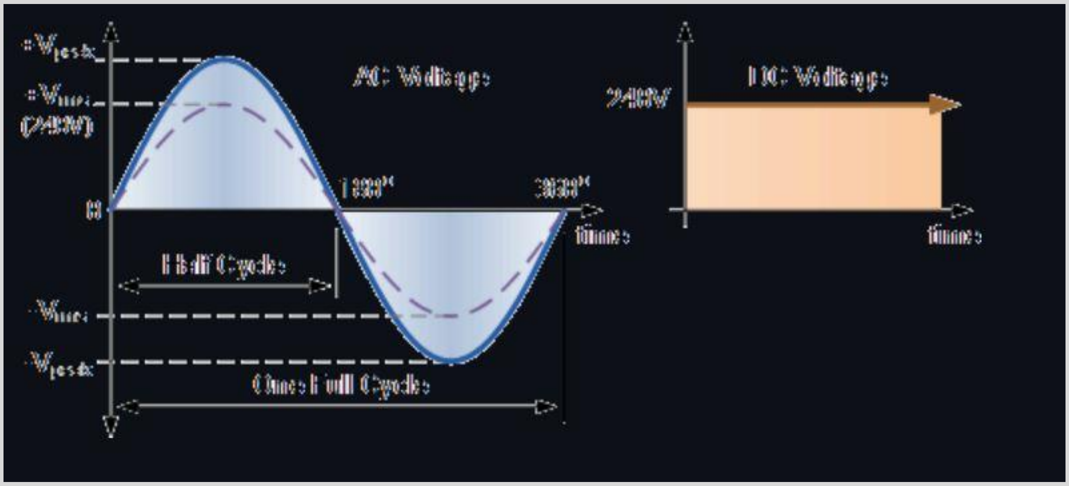
Resistors can be connected together in 'n' number of series and parallel combinations to form complex resistive circuits and simplify the same.

RMS Value of Current and Voltage

Definition: The RMS value is the effective value of a varying voltage or current. It is the equivalent steady DC (constant) value which gives the same effect.

For example: For example, a lamp connected to a 6V RMS AC supply will shine with the same brightness when connected to a steady 6V DC supply.

Waveform



RMS Formula

RMS Voltage= peak voltage * 0.707

DC Power

Electric power is the rate, per unit time, at which electrical energy is transferred by an electric circuit. The SI unit of power is the watt, one joule per second.

Power Formulas in DC Circuits

P = V x I

P = I2 x R

P = V2 / R

Average Value

The average of all the instantaneous values of an alternating voltage and currents over one complete cycle is called Average Value.

Average Current

Definition:

If we convert the alternating current (AC) sine wave into direct current (DC) sine wave through rectifiers, then the converted value to the DC is known as the average value of that alternating current sine wave

Formula:

$I_{avg} \times (\pi/\omega) = (2I_m/\omega)$

$I_{avg} = (2I_m / \pi)$

$I_{avg} = 0.637 I_m$

The average value of AC sinusoidal current or voltage is equal to 0.637 times of its peak value.

Waveform:

Average Voltage

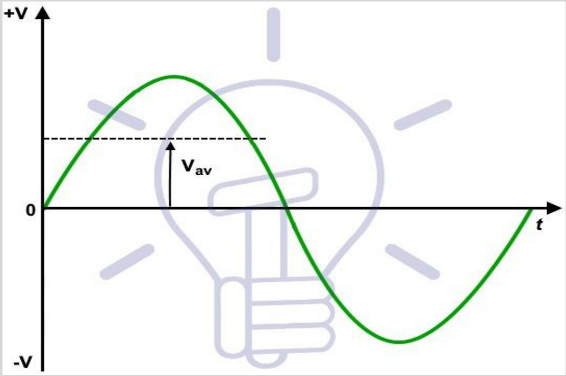
Definition:

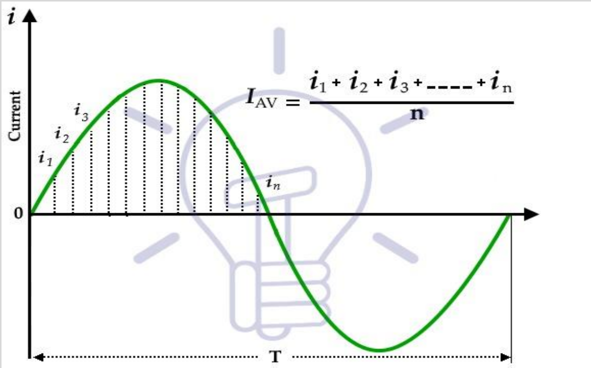
The average voltage (or current) of a periodic waveform whether it is a sine wave, square wave or triangular waveform is defined as: “the quotient of the area under the waveform with respect to time”.

Formula:

Average Value of Voltage = EAV = 0.637 EM

Waveform



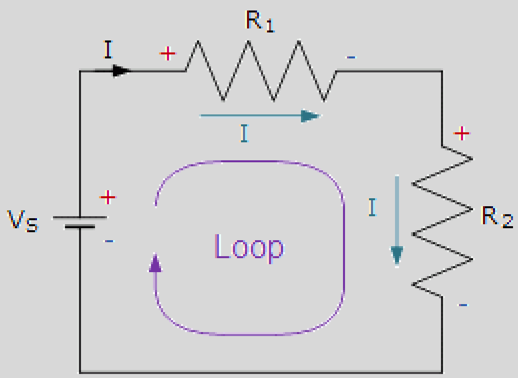


Kirchhoff Voltage Law (KVL)

Gustav Kirchhoff’s Voltage Law (KVL) is the second of his fundamental laws we can use for circuit analysis.

Definition

For a closed loop series path the algebraic sum of all the voltages around any closed loop in a circuit is equal to zero ($\Sigma V = 0$). This is because a circuit loop is a closed conducting path so no energy is lost.



For the above circuit, we get the following equation after applying KVL:

$Vs - IR1 - IR2 = 0$

For obtaining the loop currents in the circuit KVL is applied.

Number system conversion:

1. BINARY TO DECIMAL.

2. DECIMAL TO BINARY.

3. BINARY TO GRAY.

4. GRAY TO BINARY.

5. BINARY TO HEXADECIMAL

6. HEXADECIMAL TO BINARY

7. BINARY TO OCTAL

8. OCTAL TO BINARY

DECIMAL NUMBER SYSYTEM - The decimal, base-10 (den) or denary numbering system, each integer number column has values of units, tens, hundreds, thousands, etc. as we move along the number from right to left. Then each position to the left of the decimal point indicates an increased positive power of 10.

BINARY NUMBER SYSYTEM - The Binary Numbering System is the most fundamental numbering system in all digital and computer-based systems and binary numbers follow the same set of rules as the decimal numbering system. But unlike the decimal system which uses powers of ten, the binary numbering system works on powers of two giving a binary to decimal conversion from base-2 to base-10.

HEXADECIMAL NUMBER SYSTEM - In the hexadecimal number system (hex) the numbers are represented with base 16, Just like the binary number and decimal number whose base representation are 2 and 10, respectively. the hexadecimal conversion is also possible to other number system and vice versa.

GRAY CODE NUMBER SYSTEM - A Grey code is an encoding of numbers so that the adjacent numbers have a single digit differing by one.

OCTAL CODE NUMBER SYSTEM - Octal Number System has a base of eight and uses the number from 0 to 7. The octal numbers, in the number system, are usually represented by binary numbers when they are grouped in pairs of three.

High Level Requirements:

ID	Description	Status
HL1	Electrical Parameters calculation	Implemented
HL2	Digital Conversion	Implemented
HL3	Electronics Parameters calculation	Implemented
HL4	Option selection	Implemented

Low Level Requirements:

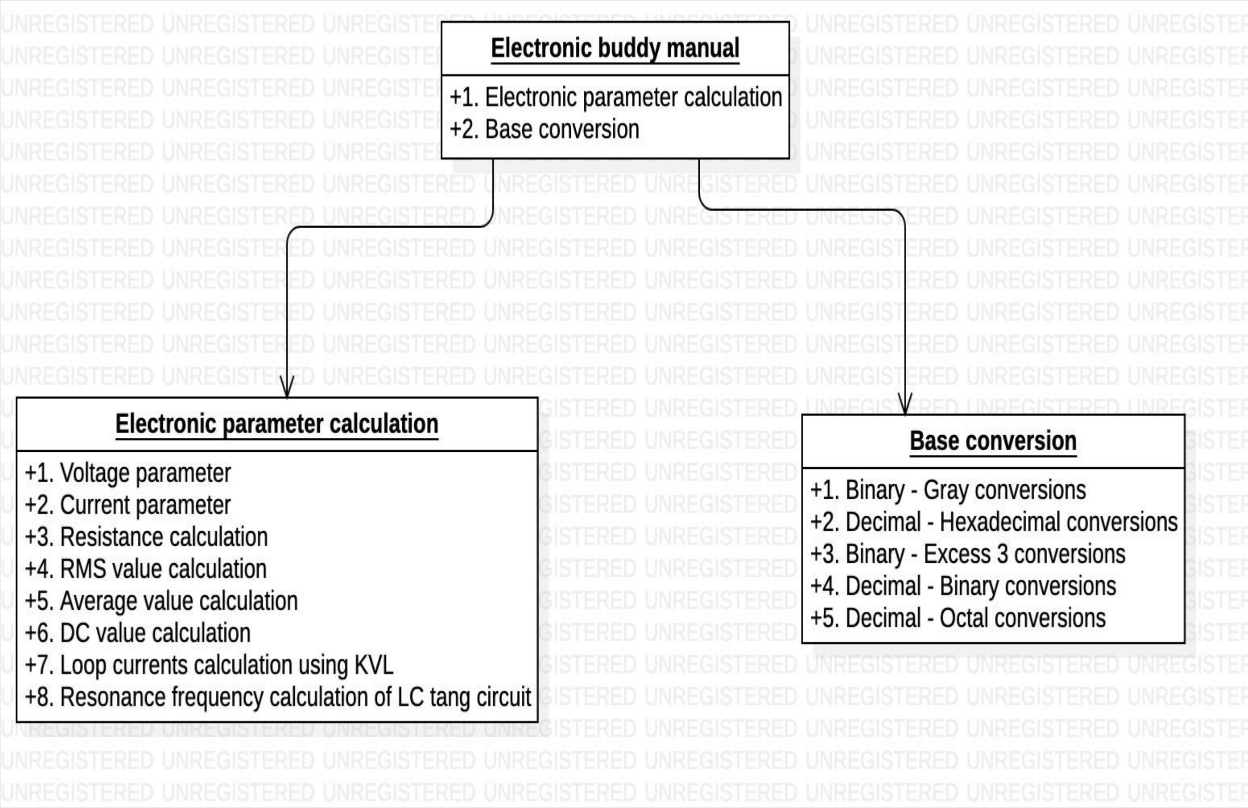
ID	Description	Status
HL1_L1	Voltage calculation	Implemented
HL1_L2	Current calculation	Implemented
HL1_L3	Resistance calculation	Implemented
HL1_L4	Series resistance calculation	Implemented
HL1_L5	Parallel resistance calculation	Implemented
HL1_L6	RMS value of Voltage calculation	Implemented
HL1_L7	RMS value of Current calculation	Implemented
HL1_L8	Average value of voltage calculation	Implemented
HL1_L9	Average value of current calculation	Implemented
HL1_L10	DC value of voltage calculation	Implemented
HL1_L11	DC value of current calculation	Implemented
HL1_L12	8-bit binary code to 4 bits gray code	Implemented
HL1_L13	8-bit binary code to 8 bits gray code	Implemented
HL1_L14	8-bit gray code to 4-bit Binary code	Implemented
HL1_L15	8-bit gray code to 8-bit Binary code	Implemented

HL1_L16	Decimal number to Hexadecimal number	Implemented
HL1_L17	Hexadecimal number to Decimal number	Implemented
HL1_L18	Binary to Excess 3	Implemented
HL1_L19	Energy and Time Constant	Implemented
HL1_L20	Binary to Decimal	Implemented
HL1_L21	Decimal to Binary	Implemented
HL1_L22	Loop currents calculation	Implemented
HL2_L23	Decimal to Octal conversion	Implemented
HL2_L24	Octal to Decimal conversion	Implemented

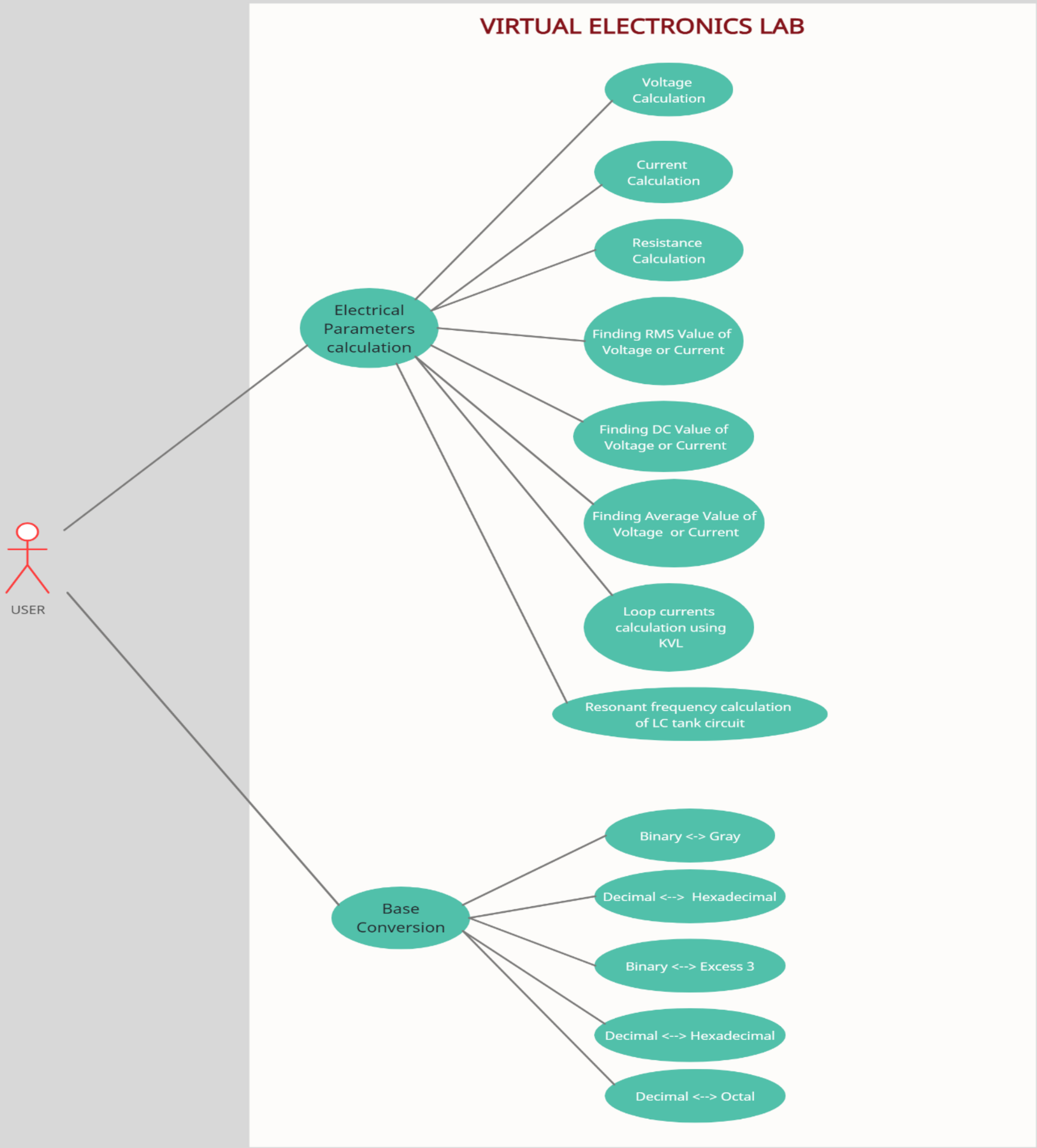
Design

High Level Design

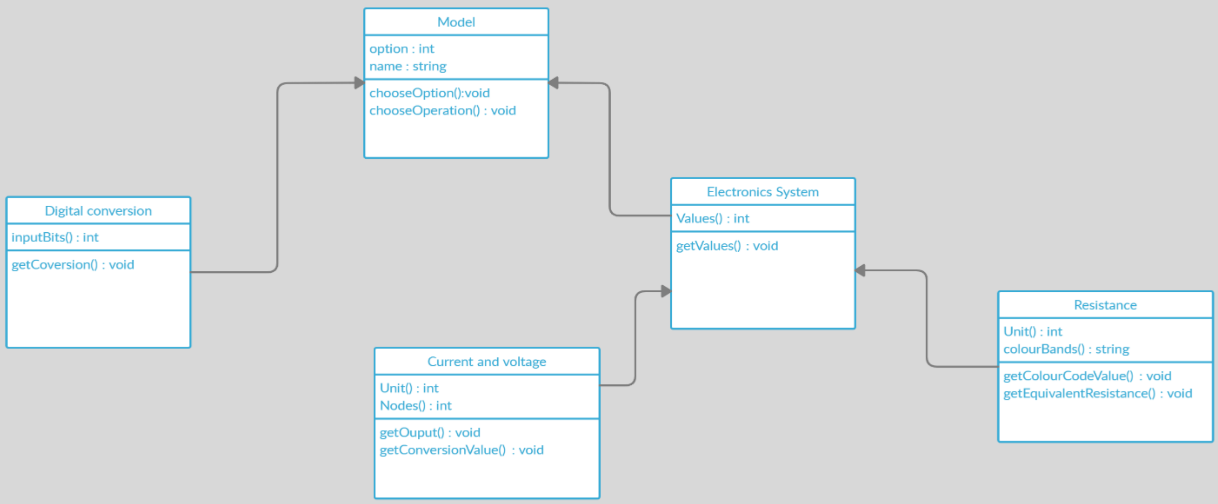
Object Diagram



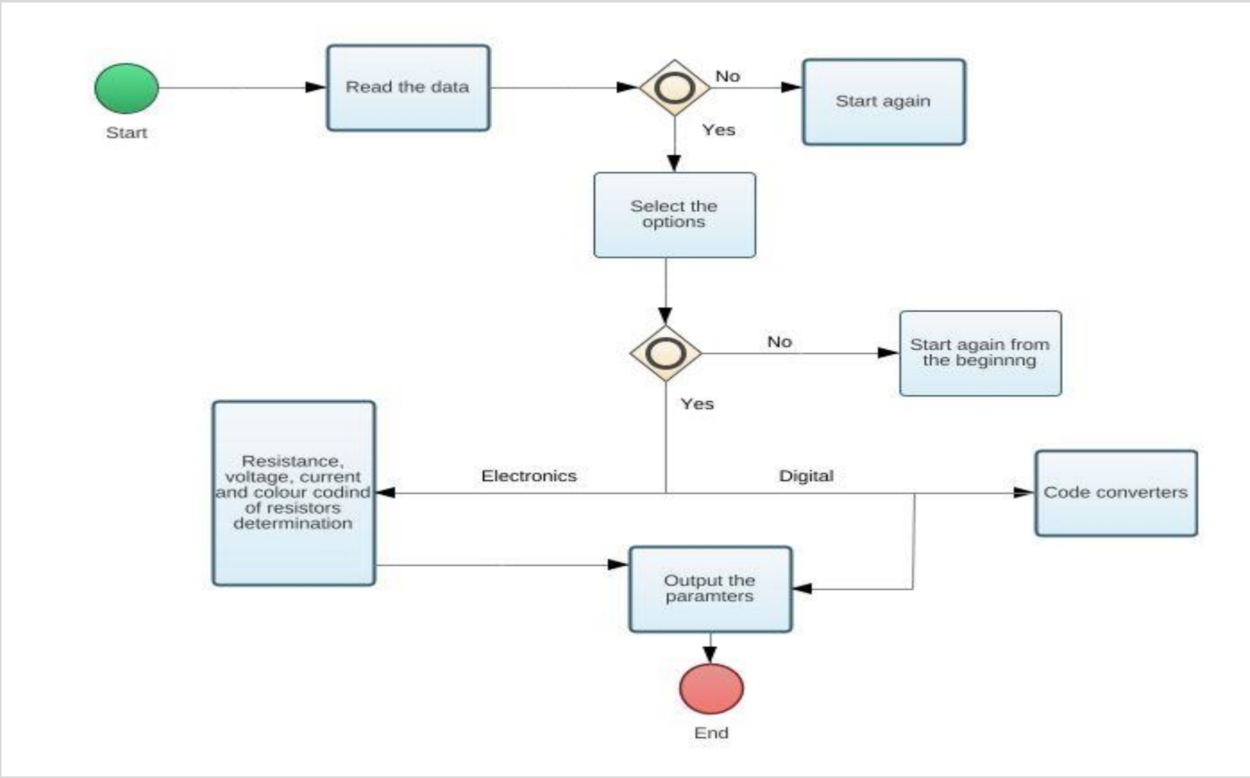
Use Case Diagram



Class Diagram:

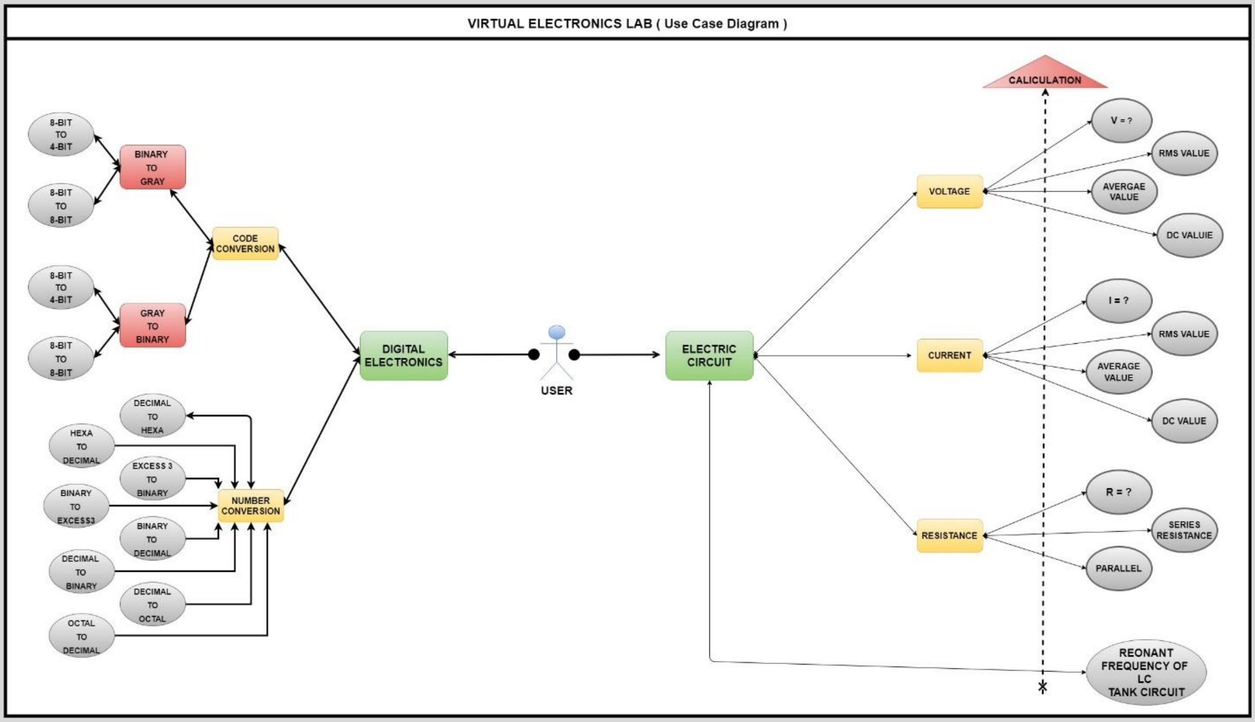


Activity Diagram

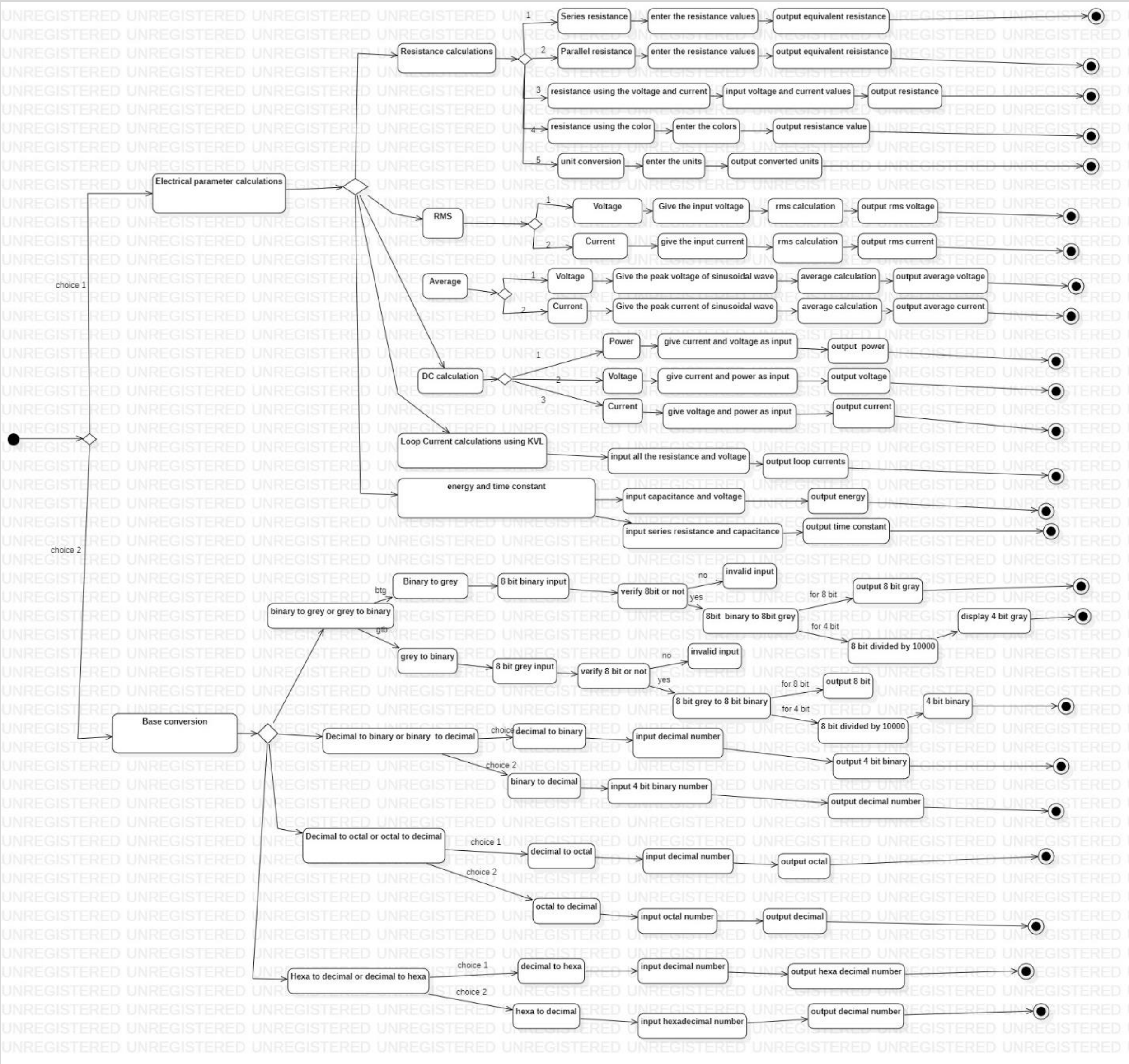


Low Level Designs

Use case diagram



Activity diagram



Test Plans:

Integrated Test plan:

Test ID	Description	Purpose	Test cases
T_01	Check all the operations are selected as written in the code	To check if all choices are getting executed	Passed
T_02	Checking for invalid inputs condition	|To check whether non test cases-based values are getting executed or not	Passed
T_03	Checking whether all the operations are getting executed as per the order	To check if the entire code integrated is working or not	Passed

Unit Test Plan:

High Level Test Plan

Test ID	Description	Type Of Test	Status
H_01	Check the required test plans inputs and verifying the outputs	Requirement based	Implemented
H_02	Check the test plans inputs for particular cases or needs, assuming it is given by the client	Scenario based	Future implementation
H_03	Checking the output for the boundary values and	Boundary based	Implemented

	boundary conditions		

Low Level Test Plan

Test ID	Description	Exp I/P	Exp O/P	Actual Out	Type Of Test	status
L_01	Suppose we want to find the exact resistance through a device	V = 5v, I = 1mA	5 KILO OHMS	5 KILO OHMS	Requirement based	Passed
L_02	Suppose a company asks to design two 20 kilo ohms resistors in series	R1 = 20KILO OHMS, R2 = 20 KILO OHMS	40 KILO OHMS	40 KILO OHMS	Scenario based	Passed
L_03	Boundary when set between 1ohms and 100 MEGA ohms. Suppose there are two 300 MEGA ohms resistors in parallel	R1 = 300 MEGA OHMS, R2 = 300 MEGA OHMS	150 MEGA OHMS	150 MEGA OHMS	Boundary based	Failed
L_04	Testing whether the DecToOct conversion function is outputting correct value	18 (in dec)	22 in octal	22 in octal	Requirement based	Passed
L_05	Testing whether the DecToOct conversion function is	289175461 (in dec)	2117073645(in oct)	2117073645(in oct)	Boundary based	Failed

	outputting correct value for boundary value (extreme cases). The range is between 1 to 3000000000					
L_06	Testing whether the OctToDec conversion function is outputting correct value	22 (in oct)	18(in dec)	18(in dec)	Requirement based	Passed
L_07	Testing whether the Oct to Dec conversion function is outputting correct value for boundary value (extreme cases)	2117073645 (in oct)	289175461(in dec)	289175461 in decimal	Boundary based	Failed
L_08	Testing whether the Frequency function is outputting correct value	L = 200(in mH), C = 10(in pF)	112.5 KHz	112.5 KHz	Requirement based	Passed
L_09	Testing whether the Frequency conversion function is outputting	L = 200000(in mH), C = 0.01(in F)	0.1125	0.1125	Boundary based	Passed

	correct value for boundary value (extreme cases)					
L_10	Finding the 8 bit Gray from 8 bit binary code	10101010	11111111	11111111	Requirement based	Passed
L_11	Suppose we must require 8 bit Gray code for a project	10110010	11101011	11101011	Scenario based	Passed
L_12	Suppose someone enters a value larger than the permitted value	100000000	Please Enter a Valid 8 bit Binary Number	Please Enter a Valid 8 bit Binary Number	Boundary based	Passed
L_13	Finding the 4 bit Gray from 8 bit binary code	10101010	1111	1111	Requirement Based	Passed
L_14	Suppose we must require 4 bit Gray code for a project	10110010	1110	1110	Requirement Based	Passed
L_15	Suppose someone enters a value larger than the permitted value	100000000	Please Enter a Valid 8 bit Binary Number	Please Enter a Valid 8 bit Binary Number	Boundary Based	Passed
L_16	Finding the 8 bit Binary from 8 bit Gray code	10101010	11001100	11001100	Requirement Based	Passed

L_17	Suppose we must require 8 bit Binary code for a project	10110010	11011100	11011100	Scenario Based	Passed
L_18	Suppose someone enters a value larger than the permitted value	100000000	Please Enter a Valid 8 bit Binary Number	Please Enter a Valid 8 bit Binary Number	Boundary Based	Passed
L_19	Finding the 4 bit Binary from 8 bit Gray code number	10101010	1100	1100	Requirement Based	Passed
L_20	Suppose we must require 4 bit Binary code for a project	10110010	1101	1101	scenario based	Passed
L_21	Suppose someone enters a value larger than the permitted value	100000000	Please Enter a Valid 8 bit Binary Number	Please Enter a Valid 8 bit Binary Number	Requirement Based	Passed
L_22	Finding the excess-3 code for given BCD code	0001	0100	0100	Requirement Based	Passed
L_23	Finding the BCD code from the given excess-3 code	0111	0100	0100	Requirement based	Passed
L_24	In case of excess-3 to BCD	0000	XXXX	No Input	Boundary based	Passed

	conversion the number should be greater than 2					
L_25	Finding BCD code for the given Decimal number	5	0101	0101	Requirement Based	Passed
L_26	Finding Decimal number from the given BCD code	1100	12	12	Requirement Based	Passed
L_27	Finding the excess-3 number from the given binary number	1110	01000111	01000111	Requirement Based	Passed
L_28	Finding the binary number from the given excess-3 number	01011001	11010	11010	Requirement based	Passed
L_29	Suppose a company asks for Binary to excess-3 and vice versa for a given number 4	0100	0111	0111	Scenario based	Passed
L_30	Finding the decimal number from the given binary number	9	1001	1001	Requirement Based	Passed

L_31	Finding the binary number from the given decimal number	0111	7	7	Requirement based	Passed
L_32	Suppose a company asks to convert a decimal number larger than the base numbers	16	10000	10000	Requirement based	Passed
L_33	Finding the binary number from the given Hexadecimal number	1E	30	30	Requirement based	Passed
L_34	Suppose we must use Decimal for a project from a Hexadecimal code	A9	169	169	Scenario Based	Passed
L_35	Finding Hexadecimal number from the Decimal number	140	8c	8c	Requirement Based	Passed
L_36	Suppose we must use Hexadecimal code for a project instead of	650	28A	28A	Scenario Based	Passed

	Decimal code					
L_37	Finding the rms value of input voltage	V=10V	7.07V	7.07V	Requirement based	Passed
L_38	Finding the rms value of input current	I=2A	1.41A	1.41A	Requirement based	Passed
L_39	suppose the company asks for the rms voltage of greater than 20 volt	V=30V	21.21V	21.21V	Scenario based	Passed
L_40	Finding the average voltage value of sinusoidal wave	V=4.5V	2.86V	2.86V	Requirement based	Passed
L_41	Finding the average current value of sinusoidal wave	I=10.28mA	6.84mA	6.84mA	Requirement based	Passed
L_42	suppose the company asks for the avg current of greater than 20 amps	i=30.84mA	20.52mA	20.52mA	Scenario based	Passed