INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY								
I Semester: CSE (AI&ML) / IT / AERO / MECH / CIVIL **II Semester:** CSE / CSE(DS) / CSE(CS)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AEED03	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	2	1	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Nil								

I. COURSE OVERVIEW:
This course **serves** as a foundation course on electrical engineering. It **covers** a broad range of fundamental electrical circuits and devices. The **concepts** of current, voltage, power, basic circuit elements, electrical and electronic devices and their **application** in more complex electrical systems are to be imparted to the students.

II. COURSES OBJECTIVES:
The students will try to learn:

I. The basic laws for different circuits.
II. The elementary experimental and modeling skills for handling problems with electrical machines in the industries and domestic applications to excel in professional career.
III. The intuitive knowledge needed to test and test and analyze the performance leading to design of electric machines by conducting various tests and calculate the performance parameters.
IV. The semiconductor devices like diode and transistor.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO1	Solve an electric circuit by providing laws and solving theorems.
CO2	Analyze the performance characteristics of DC shunt machine at various loading conditions
CO3	Examine the performance of induction motors by conducting a suitable test.
CO4	Acquire basic knowledge on the working of diodes to plot their characteristics
CO5	Identify transistor configuration and their working to deduce its working.
CO6	Use of the two port parameters to be measured easily, without solving for all the interna voltages and currents in the different networks.

Dos
1) For safety purpose the students should compulsory wear leather shoes.
2) Students should come in uniform prescribed.
   i. For boys, half sleeve shirts, tucked in trousers
   ii. For ladies, half sleeve overcoat, hair put inside the overcoat
3) After giving connections, staff members should be asked to verify the circuit connections.
4) Before staring the circuit connections check whether the circuit breaker is in OFF condition.
5) Circuit should be switched ON only after getting permission from the staff member.
6) To be careful with moving parts in the machine.
7) To come prepared with procedure relevant to the experiment.
8) Unplug electrical equipment after use.

Dont's

1) Don't assume that the power is disconnected.
2) Don't attempt to repair electrical equipment.
3) Don't come with any ornaments when working with electrical machines.
4) Don't use an earth connection as a neutral.
5) Don't touch any parts unnecessarily.
6) Don't keep any fluids and chemicals nearing instruments and circuits.

IV. COURSE CONTENT:

EXERCISES FOR ELECTRICAL AND ELECTRICAL ENGINEERING LABORATORY

Note: Students are encouraged to bring their own laptops for laboratory practice session

1. Getting Started Exercises

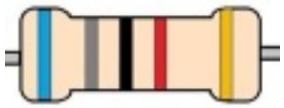
1.1 Introduction to electrical circuits

1. Understand the basic electrical equipment's used in the laboratory.
2. Become familiar with the operation and usage of basic DC electrical laboratory devices, namely DC power supplies and digital multimeter's.
3. Learn the measurement of resistance values using colour code and digital multimeter.
4. Learn the basics of circuit design using Simulink.

Try

1.Calculate the resistance value of Resistor – 1, Resistor – 2 and Resistor – 3 using colour code and verify using a digital multimeter.

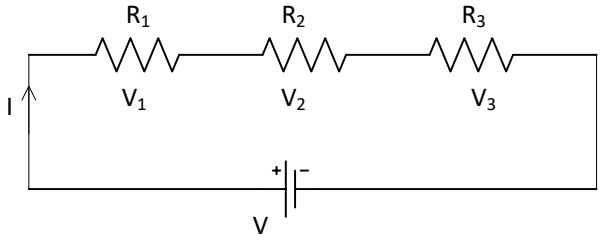
Resistor – 1



Resistor – 2

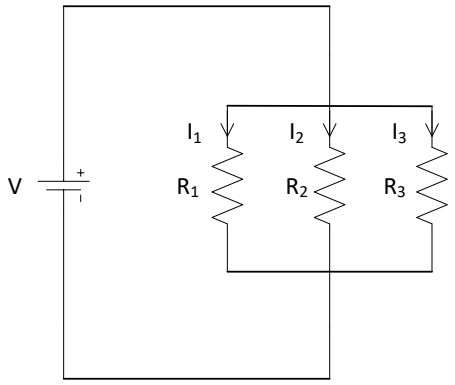
Resistor – 3

2. Design Circuit – 1 using Simulink and find the voltages V_1, V_2, V_3 and Current I. Where V_s = 6 V, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω.



Circuit – 1

3. Design Circuit – 2 using Simulink and find the currents I_1, I_2 and I_3. Where V_s = 6 V, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω.

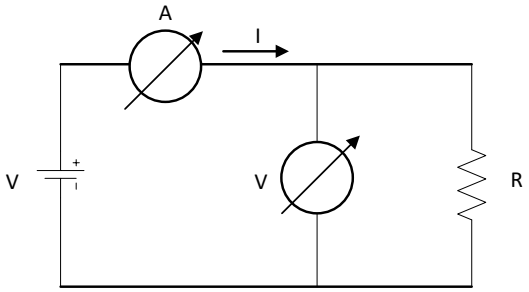


Circuit – 2

2. Exercises on Basic Electrical Circuit Law's

2.1 Ohm's law

1.Examine Ohm's law of Circuit – 3 and draw the V-I characteristic of linear resistors R = 1k Ω



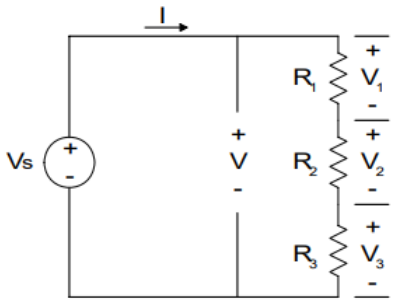
Circuit - 3

Try

1. Verify Ohm's law of Circuit – 3 using Simulink and draw the V-I characteristics of a linear resistor R = 470 k Ω
2. An electric heater takes 1.48 kW from a voltage source of 220 V. Find the resistance of the heater.

2.2 Kirchhoff's voltage law

1. Examine Kirchhoff's voltage law using basic series DC Circuit - 4 with resistors. Where V_s = 6 V, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω.



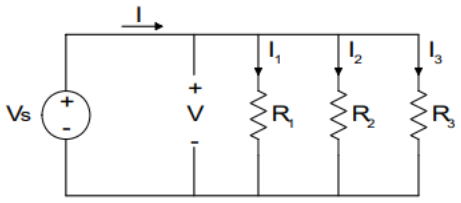
Circuit – 4

Try

1. Design and Verify Kirchhoff's voltage law for Circuit – 4 using Simulink.
2. Determine the voltage V_2 by replacing the resistor R_2 = 150 Ω.
3. Find the total current I flowing through the Circuit – 4.

2.3 Kirchhoff's current law

1. Examine Kirchhoff's current law using basic parallel DC Circuits - 5 with resistors. Where V_s = 6 V, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω



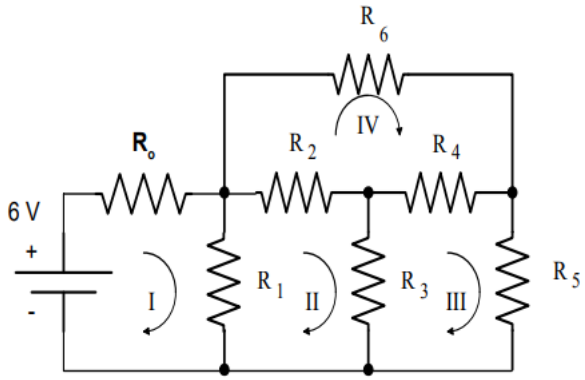
Circuit – 5

Try

1. Design and Verify Kirchhoff's current law for Circuit – 5 using Simulink.
2. Determine the voltage I_2 by replacing the resistor R_2 = 150 Ω.

3. Exercises on Mesh Analysis

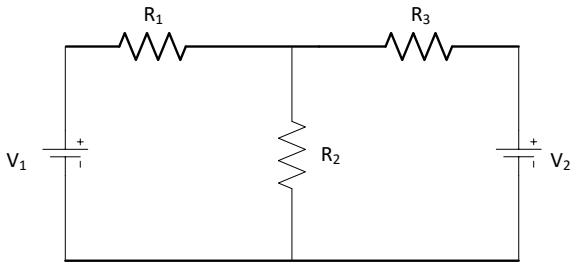
1.Determine mesh currents in the complex electrical Circuit - 6 by using principles of basic electrical circuits. Where R_0 = 47Ω, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω, R_4 = 150 Ω, R_5 = 82 Ω, R_6 = 100 Ω.



Circuit – 6

Try

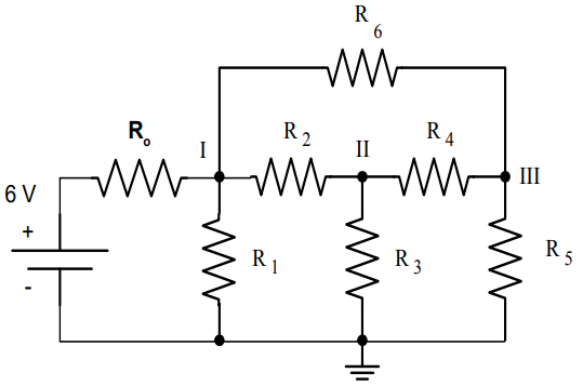
1. Use Simulink to simulate the Circuit – 6 for determining the current flowing through each resistor and compare these values to those you obtained from your experiments.
2. Find the current flowing through the resistor R_2 and R_3 by replacing the values of the resistors R_2 = 100 Ω, R_3 = 470 Ω.
3. Find the current flowing through the resistor R_3 for Circuit – 7 using mesh analysis when V1 = 10V, V_2 = 6V, R_1 = 100 Ω, R_2 = 220 Ω and R_3 = 1k Ω.



Circuit – 7

4. Exercises on Nodal Analysis

1. Determine nodal voltages in complex electrical Circuit – 8 by using principles of basic electrical circuits. Where R_0 = 47Ω, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω, R_4 = 150 Ω, R_5 = 82 Ω, R_6 = 100 Ω.



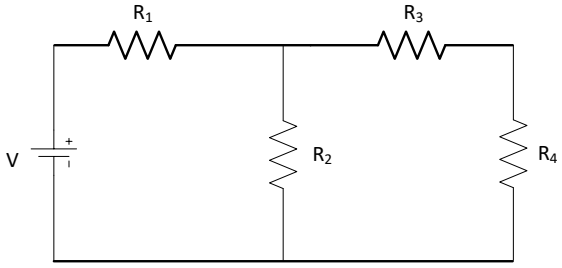
Circuit – 8

Try

1. Use Simulink to simulate the Circuit – 8 for determining the voltage across each resistor and compare these values to those you obtained from your experiments
2. Determine the voltage at node - II by replacing the resistor R_2 = 150 Ω
3. Find the voltage V_1 for Circuit – 7 using nodal analysis when V1 = 10V, V_2 = 6V, R_1 = 100 Ω, R_2 = 220 Ω and R_3 = 1k Ω.

5. Exercises on Thevenin's Theorem

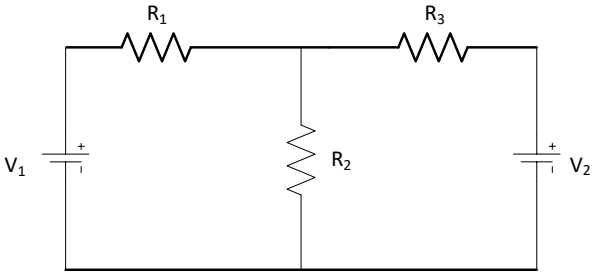
1. Determine Thevenin's equivalent voltage (V_{th}) and resistance (R_{th}) at the load terminals by applying Thevenin's theorem for Circuit – 9.
2. Determine load or unknown current through a R_4 resistor using Thevenin's equivalent circuit. Where V = 10V, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω and R_4 = 150 Ω



Circuit – 9

Try

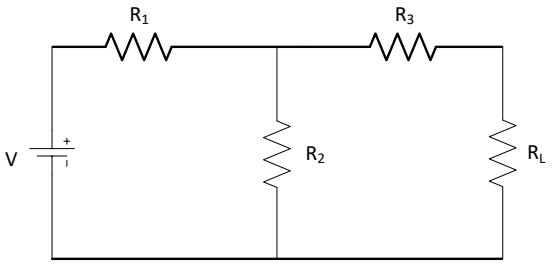
1. Use Simulink to simulate the Circuit – 13 for determining the current thought R_4 resistor using Thevenin's theorem and compare this value to those you obtained from your experiment.
2. Find the current thought R_4 resistor using any circuit reduction technique and verify this value to those you obtained from Thevenin's theorem.
   Find the current flowing through R_2 resistor in Circuit – 10 using Thevenin's theorem for the below circuit. Where V_1 = 10V, V_2 = 5V, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω



Circuit – 10

6. Exercises on Norton's Theorem

1. Find Norton equivalent current (I_N) and resistance (R_N) by considering R_L = 150 Ω resistor for the Circuit – 15 by applying Norton's theorem.
2. Find load or unknown current through R_L resistor using Norton's equivalent circuit. Where V = 10V, R_1 = 100 Ω, R_2 = 220 Ω and R_3 = 1k Ω.



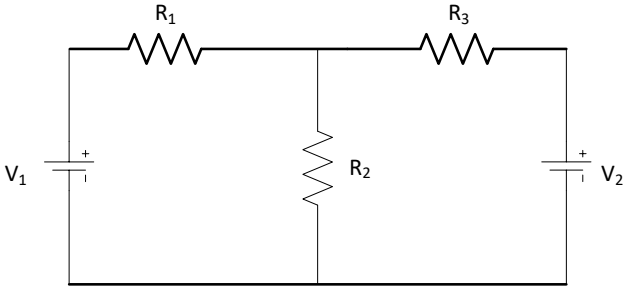
Circuit – 11

Try

1. Use Simulink to simulate the Circuit – 11 for determining the current through R_L resistor and compare this value to those you obtained from your experiment
2. Find the current thought R_L using any circuit reduction technique and verify this value to those you obtained from Norton's theorem.

7. Exercises on Superposition Theorem

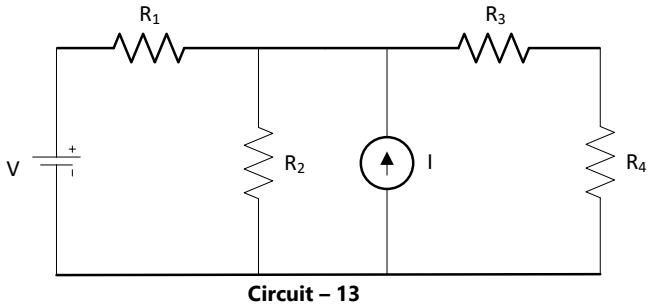
1. Investigate the current thought R_2 resistor using superposition theorem to multiple DC source Circuit - 16



Circuit – 12

Try

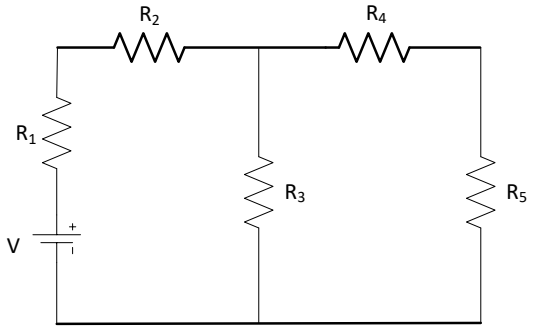
1. Use Simulink to simulate the Circuit – 12 for determining the current through a R_2 resistor and compare this value to those you obtained from your experiment
2. Find the current thought R_2 in Circuit – 12 using any circuit reduction technique and verify this value to those you obtained from the superposition theorem.
3. Find the current through the R_4 resistor using the superposition theorem for the Circuit – 13.



Circuit – 13

8. Exercises on Reciprocity Theorem

1. Understand the reciprocity theorem by analyzing Circuit – 14 with interconnected components using fundamental circuit laws where V = 10 V, R_1 = 100 Ω, R_2 = 220 Ω, R_3 = 1k Ω, R_4 = 150 Ω and R_5 = 82 Ω.



Circuit – 14

Try

1. Use Simulink to simulate Circuit–14 for determining the current through R_5 and R_1 by interchanging the voltage source in series with the R_5 resistor and compare this value to those you obtained from your experiment
2. Find the current thought R_3 using Thevenin's theorem.

9. Swinburne's test and speed control of dc shunt motor

1. Design the suitable test under no load conditions to measure no load losses in Dc shunt machines and speed control of DC shunt motor.

Try

1. Calculate the output power and efficiency when motor takes 10A on full load and 5A on half Load.
2. Measure the no load machine losses by using indirect method of testing.
3. Perform the speed control by varying the armature circuit resistance and field circuit resistance of DC shunt motor.

10 magnetization characteristics of dc shunt generator

1. Develop the circuit for analyzing the magnetization characteristics of DC shunt generator.

Try

1. From the Open circuit characteristics calculate the critical resistance of field winding.
2. Using magnetization characteristics calculate the critical speed of DC shunt generator at 100 Ω
3. Determine the performance of DC generator using the magnetization curve.
4. Calculate the critical value of shunt field resistance at 1500 rpm

11 Exercises on PN junction diode characteristics

Study the characteristics of PN junction diode as shown in Figure. 1

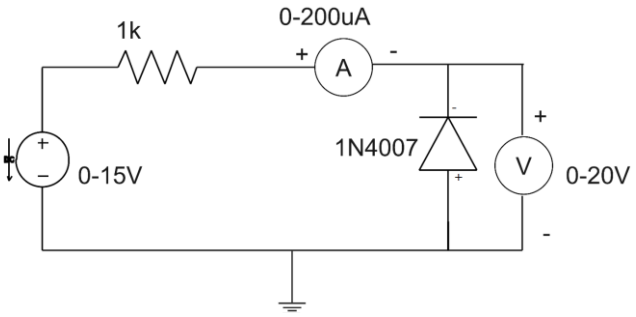


Figure. 1 diode as forward bias

Try

1. Plot the V-I Characteristics of germanium diode and find the cut in voltage.
2. Design diode acts as switch and plot the switching times of diode.

12 Zener diode characteristics and voltage regulator

Study the characteristics of Zener diode as shown in Figure. 2

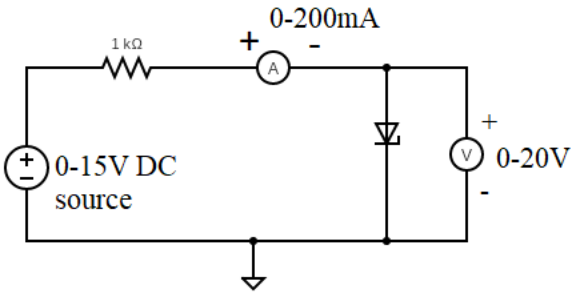


Figure. 2 Circuit diagram for Zener diode as forward bias

Try

1. Design a Zener voltage regulator circuit to drive a load of 6V, 100 mW from an unregulated
2. input supply of V_{min} = 8V, Vmax = 12V using a 6V Zener diode. .
3. Design square wave generator using Zener diode
4. Design for a Zener Transistor series voltage regulator circuit to drive a load of 6V, 1w,
5. from a supply of 10V with a ±3V ripple voltage

13 Half wave rectifier with/without filter

1. Design a half-wave rectifier circuit and analyze its output as shown in Figure. 3
2. Analyze the rectifier output using a capacitor in shunt as a filter as shown in Figure. 3

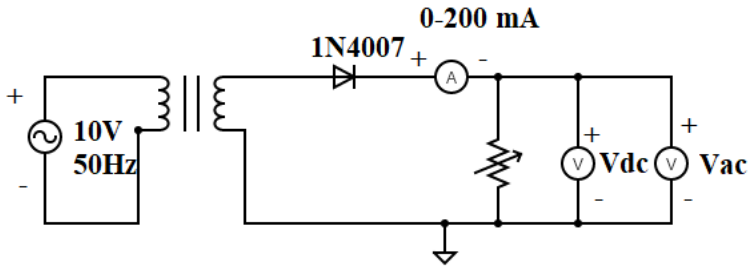


Figure. 3 Circuit Diagram for Half Wave Rectifier without Filter

Try

1. Design half wave rectifier with an applied input AC power is 100 watts, and it is to deliver an output power is 40 watts.
2. Design half wave rectifier with an AC supply of 230 V is applied through a transformer of turn ratio 10 : 1. Observe the output DC voltage, peak inverse voltage and identify dc output voltage if transformer turns ratio changed to 20:1.

14 Full wave rectifier with/without filter

1. Design a Full-wave rectifier circuit and analyse its output as shown in Figure. 4
2. Analyse the rectifier output using a capacitor in shunt as a filter as shown in Figure. 4

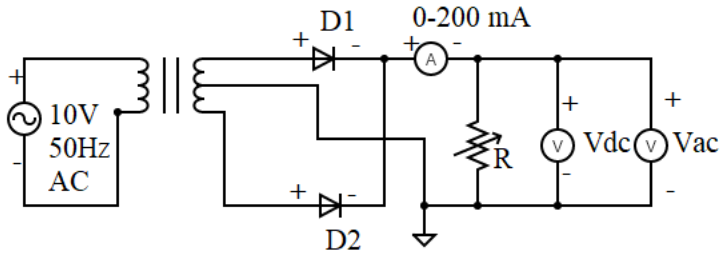


Figure 4: Circuit Diagram for Full Wave Rectifier without Filter

Try

1. Design a full wave rectifier with step down transformer and center tapped transformer. Justify the operation.
2. Design Full wave rectifier with capacitive filter using 10uF and 1uF. Observe the ripple

V. TEXT BOOKS:

1. A Chakrabarti, *CircuitTheory*, Dhanpat Rai Publications, 2004.

VI. REFERENCE BOOKS:

1. J P J Millman, C C Halkias, Satyabrata Jit, *Millman's Electronic Devices and Circuits*, Tata McGraw Hill, 2nd Edition, 1998.
2. RL Boylestad, Louis Nashelsky, *Electronic Devices and Circuits*, PEI/PHI, 9th Edition, 2006.

VII. ELECTRONICS RESOURCES:

1. https://www.nptel.ac.in/Courses/117106108
2. https://www.gnindia.dronacharya.info/EEEDept/labmanuals.html
3. https://www.textofvideo.nptel.iitm.ac.in
4. https://www.textofvideo.nptel.iitm.ac.in/

VIII. MATERIALS ONLINE

1. Course template
2. Lab manual