ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

LAB MANUAL

Year	**:**	**2017- 2018**
Subject Code	**:**	**AEE101**
Regulations	**:**	**R16**
Class	**:**	**B. Tech II Semester**
Branch	**:**	**CSE**

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Electrical and Electronics Engineering

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ELECTRICAL AND ELECTRONICS ENGINEERING

Program Outcomes	
PO1	**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design / Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life - Long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes	
PSO1	**Professional Skills:** The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.
PSO2	**Problem - Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.

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ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Exp. No.	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Verification of KVL and KCL.	P01,P02,P03,P012	PSO1,PSO2
2	Verification of Superposition theorem	P01,P02,P03,P012	PSO1,PSO2
3	Verification of Thevenin's theorems.	P01,P02,P03,P012	PSO1,PSO2
4	Verification of Norton's theorems.	P01,P02,P03,P012	PSO1,PSO2
5	Verification of Maximum power transfer theorem.	P01,P02,P03,P012	PSO1,PSO2
6	Verification of KVL and KCL using digital simulation.	P01,P02,P03,P012	PSO1,PSO2
7	Verification of Superposition theorem and Thevenin's theorem using digital simulation.	P01,P02,P03,P012	PSO1,PSO2
8	Verification of Norton's theorem and maximum power transfer theorem using digital simulation.	P01,P02,P03,P012	PSO1,PSO2
9	Volt Ampere characteristics of P-N junction diode	P01,P02,P03,P012	PSO1,PSO2
10	Zener diode V-I Characteristics	P01,P02,P03,P012	PSO1,PSO2
11	Application of diode as half wave rectifier and full wave rectifier	P01,P02,P03,P012	PSO1,PSO2
12	Verify the characteristics of common base transistor.	P01,P02,P03,P012	PSO1,PSO2
13	Verify the characteristics of common emitter transistor.	P01,P02,P03,P012	PSO1,PSO2

ELECTRICAL AND ELECTRONICS LABORATORY

OBJECTIVE:

This lab complements the electrical and electronics devices circuits' course. Students will gain practical experience with identification of all the basic electrical and electronic components. After going through this course the student gets a thorough knowledge on basic electrical circuits, With which he / she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

OUTCOMES:

Upon the completion of electrical and electronics practical course, the student will be able to:

1. **Understand** the circuit theorems and various electrical components.
2. **Design** the electrical circuit theorems by using digital simulation.
3. **Analyze** the characteristics of various electronics components.

EXPERIMENT - 1

VERIFICATION OF KVL AND KCL

AIM:

To verify Kirchhoff's voltage law (KVL) and Kirchhoff's current law (KCL) in a passive resistive network

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Ammeter			
2.	Voltmeter			
3.	R.P.S			
4.	Bread Board			
5.	Resistors			
6.	Connecting Wires			As required

CIRCUIT DIAGRAMS:

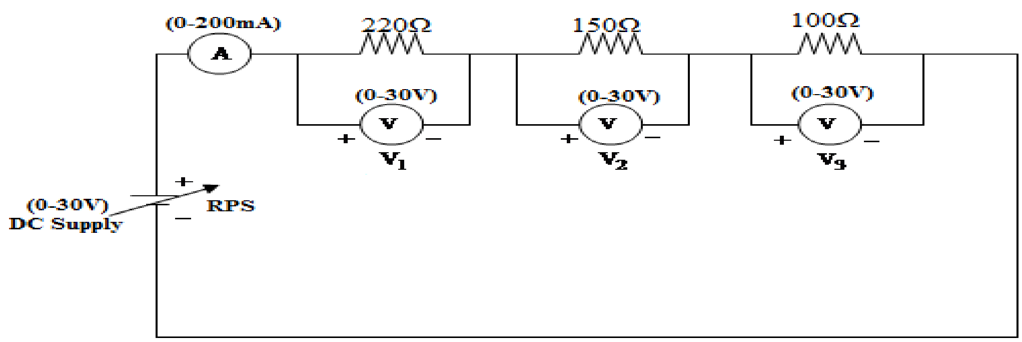


Figure – 1.3.1 Verification of KVL

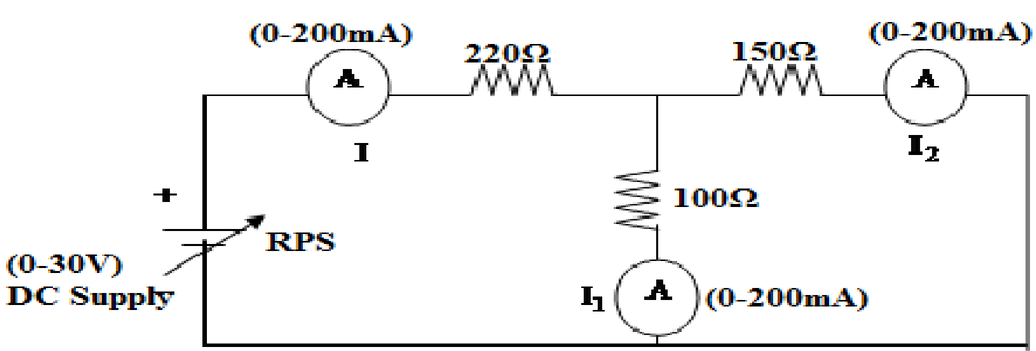


Figure – 1.3.2 Verification of KCL

PROCEDURE:

To Verify KVL

1. Connect the circuit diagram as shown in Fig. 1.3.1.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5V) and note the voltmeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of voltmeters.
6. Sum up the voltmeter readings (voltage drops) , that should be equal to applied voltage .
7. Thus KVL is verified practically.

To Verify KCL

1. Connect the circuit diagram as shown in Fig. 1.3.2.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5V) and note the Ammeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of Ammeters.
6. Sum up the Ammeter readings (I_1 and I_2), that should be equal to total current (I).
7. Thus KCL is Verified practically

OBSERVATIONS:

For KVL

Applied Voltage V (volts)	V_1 (volts)		V_2 (volts)		V_3 (volts)		$V_1+V_2+V_3$ (volts)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

For KCL

Applied Voltage V (volts)	I (A)		I_1 (A)		I_2 (A)		I_1+I_2(A)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected.

RESULT:

PRE LAB VIVA QUESTIONS:

1. Define current.
2. Define voltage.
3. Describe resistance?
4. State ohm's law.
5. What is KCL and KVL?

POST LAB VIVA QUESTIONS:

1. What do you mean by junction?
2. Derive current division rule.
3. What are the positive and negative signs in KVL?
4. Describe the colour coding of resistors.
5. What are the precautions to be taken while doing the experiment?
6. What is the range of ammeters and voltmeters you used in this experiment?

EXPERIMENT - 2

VERIFICATION OF SUPERPOSITION THEOREM

AIM:

To verify superposition theorem theoretically and practically

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Ammeter			
2.	Voltmeter			
3.	R.P.S			
4.	Bread Board			
5.	Resistors			
6.	Connecting Wires			As required

CIRCUIT DIAGRAM:

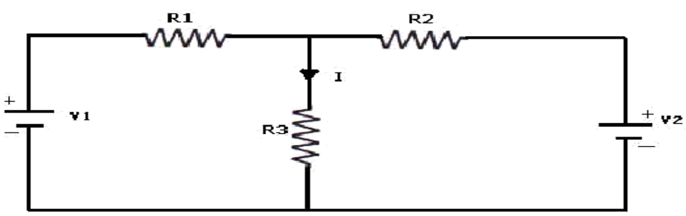


Fig- 2.3.1 Both Voltage Sources are acting (V_1&V_2)

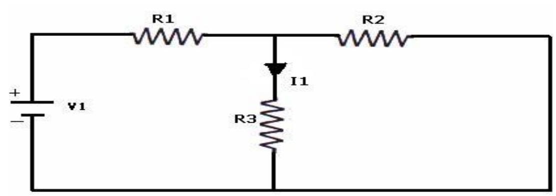


Fig - 2.3.2 Voltage Source V_1 is acting alone

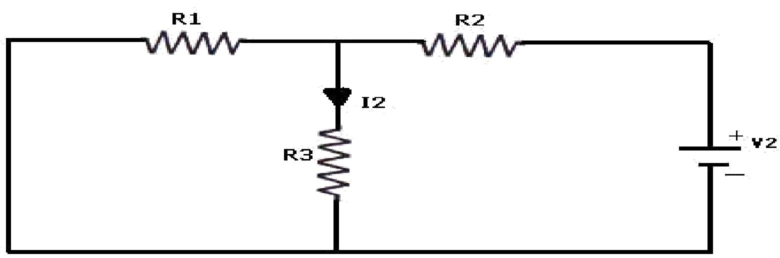


Fig - 2.3.3 Voltage Source V_2 is acting alone

PROCEDURE:

1. Connect the circuit as shown in fig. (2.3.1) and note down the current flowing through R_3 and let it be I.
2. Connect the circuit as shown in fig. (2.3.2) and note down the ammeter Reading, and let it be I_1.
3. Connect the circuit as shown in fig. (2.3.3) and note down the ammeter reading, and let it be I_2.
4. Verify for $I=I_1+I_2$.
5. Compare the practical & theoretical currents.

PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper colour coding of resistors
3. The terminal of the resistance should be properly connected.

RESULT:

PRE LAB VIVA QUESTIONS:

1. Define voltage.
2. Define current.
3. Ammeter is connected in series or parallel?
4. Voltmeter is connected in series or parallel?
5. Define mesh.
6. State ohm's law
7. State superposition theorem.

LAB ASSIGNMENT:

1. Explain KVL & KCL with required circuits

POST LAB VIVA QUESTIONS:

1. Discuss the current division rule.
2. Discuss the voltage division rule.
3. State KCL.
4. State KVL.
5. Explain the color coding of resistors.

EXPERIMENT - 3

VERIFICATION OF THEVENIN'S THEOREM

AIM:

To verify Thevenin's theorem

STATEMENT:

Any linear, bilateral network having a number of voltage, current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance, where the value of the voltage source is equal to the open circuit voltage and the resistance is the equivalent resistance measured between the open circuit terminals with all energy sources replaced by their internal resistances

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Ammeter			
2.	Voltmeter			
3.	R.P.S			
4.	Bread Board			
5.	Resistors			
6.	Connecting Wires			As required

CIRCUIT DIAGRAM:

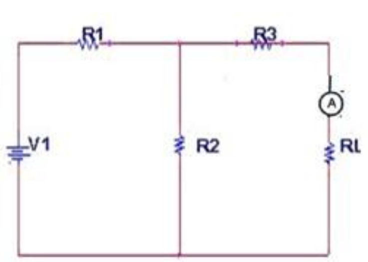


Fig-3.4.1 Measurement of I_L

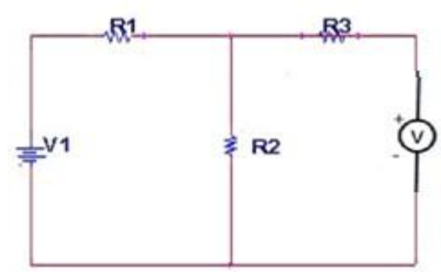


Fig – 3.4.2 Measurement of V_{TH}

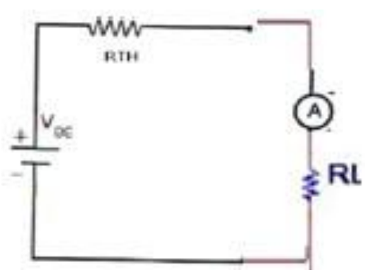


Fig – 3.4.3 Measurement of I_L ($I_L = V_{TH}$ or $V_{OC}/ R_{TH} + R_L$)

PROCEDURE:

1. Connect the circuit diagram as shown in fig. 3.4.1
2. Measure current in R_L
3. Connect the circuit as shown in fig. 3.4.2.
4. Measure open circuit voltage Voc by open circuiting terminals i.e. V_{TH}
5. Draw the Thevenin's equivalent circuit as shown in fig. 3.4.2
6. Measurement current in R_L

RESULT:

PRE LAB VIVA QUESTIONS:

1. What is load resistance?
2. How will you calculate thevenin's resistance R_{TH}?
3. How will you calculate thevenin's voltage V_{TH}?

LAB ASSIGNMENT:

1. Solve the theoretical value of thevenin's theorem for different circuits

POST LAB VIVA QUESTIONS

1. Explain series connection.
2. Explain parallel connection.
3. State Thevenin's theorem.

EXPERIMENT - 4

VERIFICATION OF NORTON'S THEOREM

AIM:
To verify Norton's theorem

STATEMENT:

Any linear, bilateral network with current sources, voltage sources and resistances can be replaced by an equivalent circuit consisting of a current source in parallel with a resistance. The value of the current source is the short circuit current between the short circuit terminals of the network and the resistance is the equivalent resistance measured between the terminals of the network with all the energy sources replaced by their internal resistances.

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Ammeter			
2.	Voltmeter			
3.	R.P.S			
4.	Bread Board			
5.	Resistors			
6.	Connecting Wires			As required

CIRCUIT DIAGRAM:

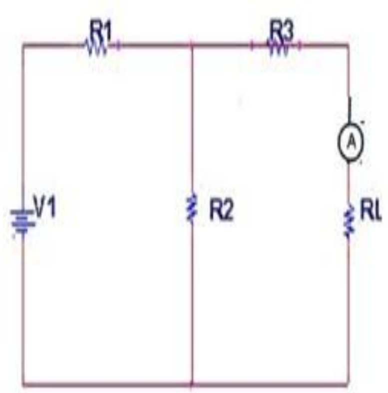


Fig – 4.3.1 Measurement of I_L

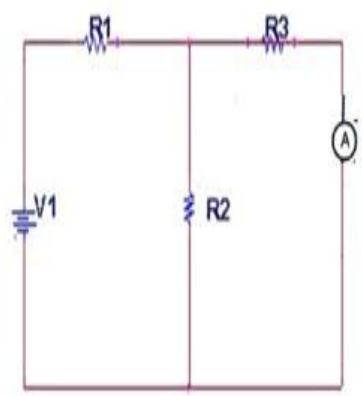


Fig – 4.3.2 Measurement of I_N

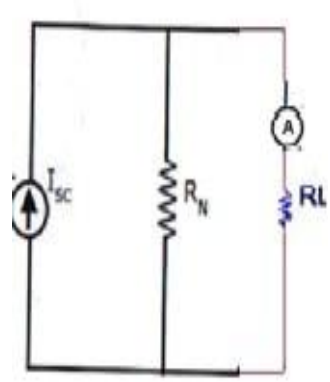


Fig – 4.3.3 Measurement of I_L

PROCEDURE:

1. Connect the circuit diagram as shown in fig. 4.3.1.
2. Measure current in R_L
3. Connect the circuit diagram as shown in fig. 4.3.2.
4. Measure the short circuit current I_{sc} (or) I_N by short circuiting the load resistance
5. Draw Norton's equivalent circuit by connecting I_N & R_N in parallel as shown in fig. 4.3.3,
6. Note down the load current I_L

TABULAR COLUMN:

Parameters	Theoretical Values	Practical Values
Voc		
Isc		
R_{TH}		
I_{RL}		

RESULT:

PRE LAB VIVA QUESTIONS:

1. What is load resistance?
2. How will you calculate Norton's resistance R_N?
3. How will you calculate Norton's current I_N?
4. What is Norton's current?

LAB ASSIGNMENT:

1. Solve the theoretical value of Norton's current for different circuits.

POST LAB VIVA QUESTION

1. State Norton's theorem.
2. Explain series connection.
3. Explain parallel connection.

EXPERIMENT – 5

MAXIMUM POWER TRANSFER THEOREM

AIM:

To verify maximum power transfer theorem

STATEMENT:

The maximum power transfer theorem states that maximum power is delivered from a source resistance to a load resistance when the load resistance is equal to source resistance. Rs = RL is the condition required for maximum power transfer.

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Ammeter			
2.	Voltmeter			
3.	R.P.S			
4.	Bread Board			
5.	Resistors			
6.	Connecting Wires			As required

CIRCUIT DIAGRAM:

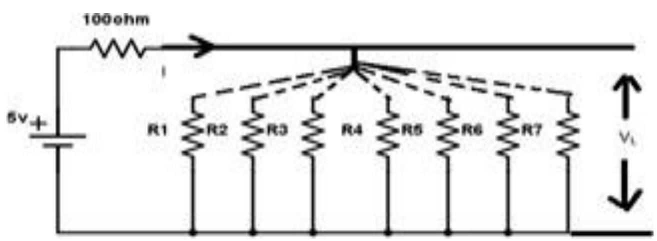


Fig – 5.4.1 Circuit Diagram

PROCEDURE:

1. Connect the circuit as shown in fig. 5.4.1.
2. Vary the load resistance in steps and note down voltage across the load and current flowing through the circuit.
3. Calculate power delivered to the load by using formula P=V*I.
4. Draw the graph between resistance and power (resistance on X- axis and power on Y-axis).
5. Verify the maximum power is delivered to the load when R_L = Rs for DC.

TABULAR COLUMN:

S. No	R_L	V_L	I_L	P=VI
1				
2				
3				
4				
5				

MODEL GRAPH:

Graph should be drawn in a logarithmic graph sheet

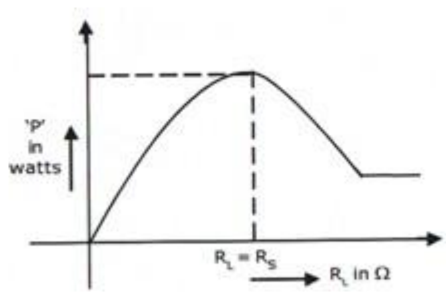


Fig – 5.7.1 Expected graph

RESULT:

PRE LAB VIVA QUESTIONS:

1. State maximum power transfer theorem.
2. Define voltage.
3. Define current.
4. What is the load resistance?
5. What is the source resistance?

LAB ASSIGNMENT:

1. Solve the theoretical value of maximum power for different circuits.
2. State and prove maximum power transfer theorem.
3. State and prove maximum power transfer theorem.

POST LAB VIVA QUESTIONS:

1. What are conditions for maximum power transfer theorem?

EXPERIMENT – 6

Verification of KVL and KCL using digital simulation

AIM:

To verify Kirchhoff's voltage law (KVL) and Kirchhoff's current law (KCL) using digital simulation.

APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	01

CIRCUIT DIAGRAMS:

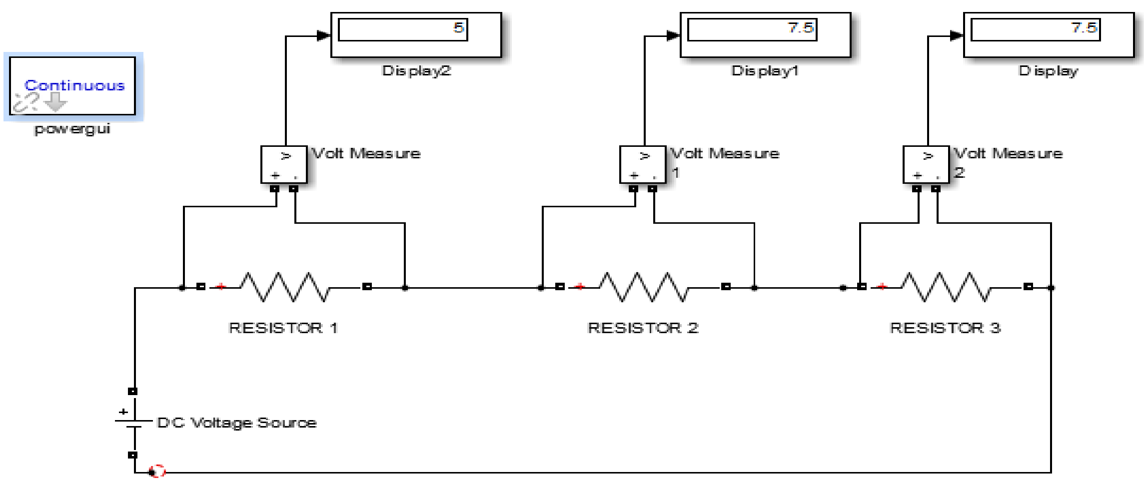


Figure – 6.3.1 Verification of KVL

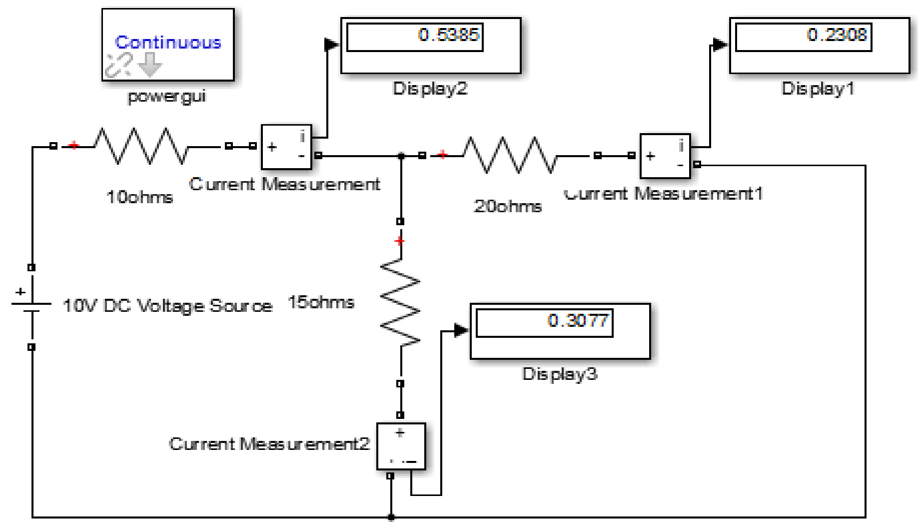


Figure – 6.3.2 Verification of KCL

PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MULTISIM/MATLAB Simulink.
2. Measure the voltages and currents in each resistor.
3. Verify the KVL and KCL.

OBSERVATIONS:

For KVL

Applied Voltage V (volts)	V_1 (volts)		V_2 (volts)		V_3 (volts)		$V_1+V_2+V_3$ (volts)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

For KCL

Applied Voltage V (volts)	I (A)		I_1 (A)		I_2 (A)		I_1+I_2(A)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

RESULT:

PRE LAB VIVA QUESTIONS:

1. Define current.
2. Define voltage.
3. What is resistance?
4. State ohm's law.
5. What is KCL and KVL?

POST LAB VIVA QUESTIONS:

1. Define junction.
2. State KCL.
3. State KVL.
4. Which precautions to be taken while doing the experiment?
5. Compare hard ware results with digital simulation result.

EXPERIMENT – 7

VERIFICATION OF SUPERPOSITION THEOREM AND THEVENIN'S THEOREM USING DIGITAL SIMULATION

AIM:

To verify Superposition theorem and Thevenin's theorem using digital simulation.

APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	01

CIRCUIT DIAGRAMS:

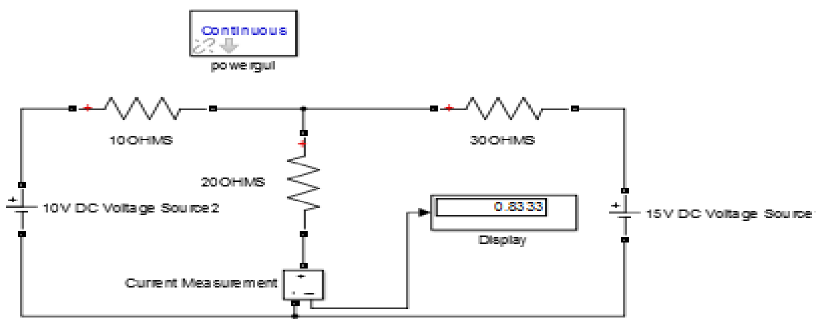


Figure – 7.3.1. Total response in 20 ohms

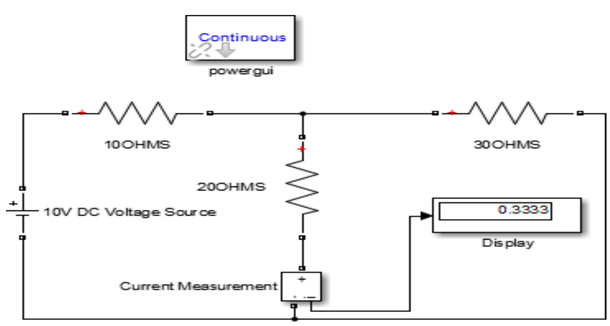


Figure – 7.3.2. Response in 20 ohms due to 10V

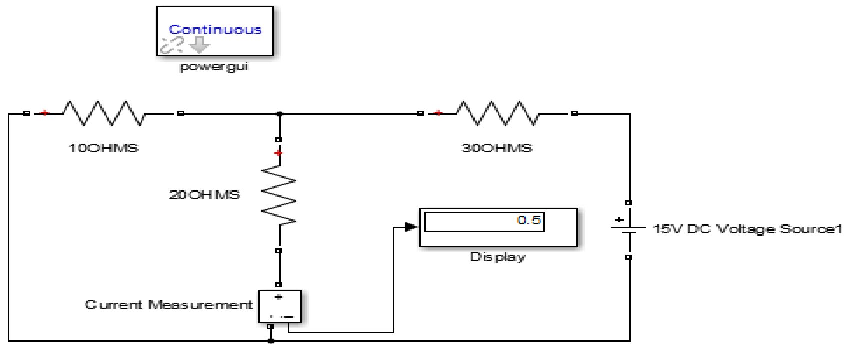


Figure – 7.3.3. Response in 20 ohms due to 15V

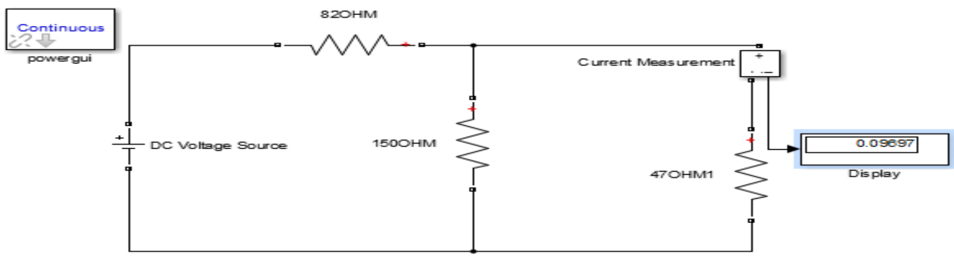


Figure – 7.3.4. Measurement of load current

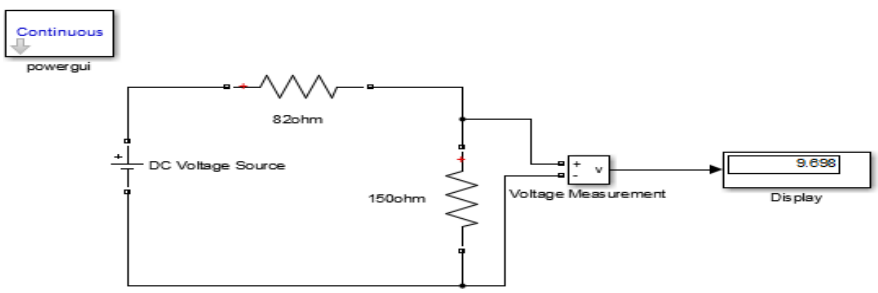


Figure – 7.3.5. Measurement of Thevenin's voltage

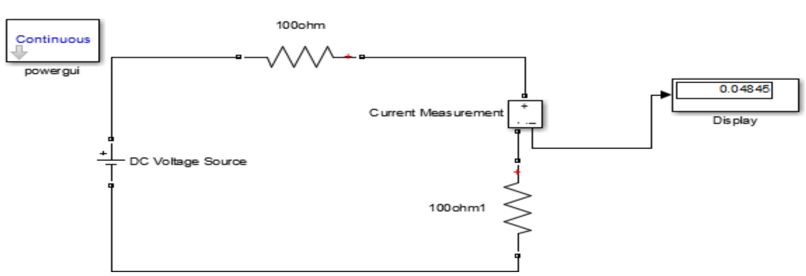


Figure – 7.3.6. Measurement of load current using Thevenin's theorem

PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MULTISIM/MATLAB Simulink.
2. Measure the voltages and currents in the resistor, to be calculated.
3. Verify the superposition and Thevenin's theorem.

RESULT:

PRE LAB VIVA QUESTIONS:

1. Define active elements.
2. Define passive elements.
3. Ammeter is connected in series or parallel?
4. Voltmeter is connected in series or parallel?
5. Define mesh.
6. What is ohms law?
7. State supposition theorem.
8. State thevenin's theorem.
9. Define circuit.

LAB ASSIGNMENT:

1. Explain KVL & KCL with required circuits.
2. Explain superposition theorem calculations with examples.

POST LAB VIVA QUESTIONS:

1. Discuss the current division rule.
2. Discuss the voltage division rule.
3. State supposition theorem.
4. State Thevenin's theorem.

EXPERIMENT – 8

VERIFICATION OF NORTON'S THEOREM AND MAXIMUM POWER TRANSFER THEOREM USING DIGITAL SIMULATION

AIM:

To verify Norton's theorem and Maximum Power Transfer theorem using digital simulation

APPARATUS:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	01

CIRCUIT DIAGRAMS:

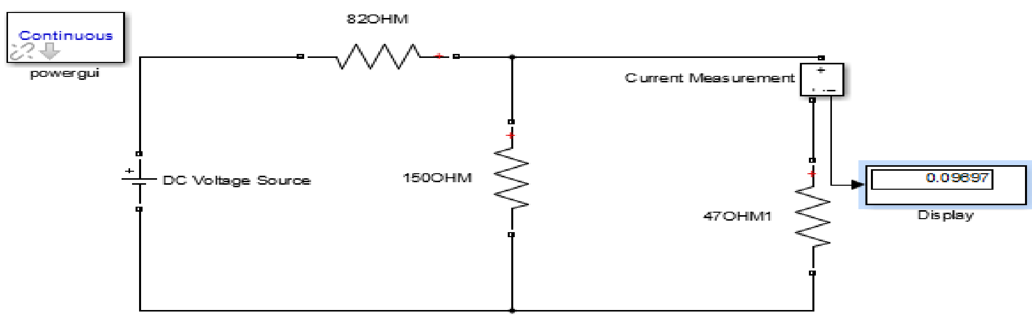


Figure – 8.3.1. Measurement of load current

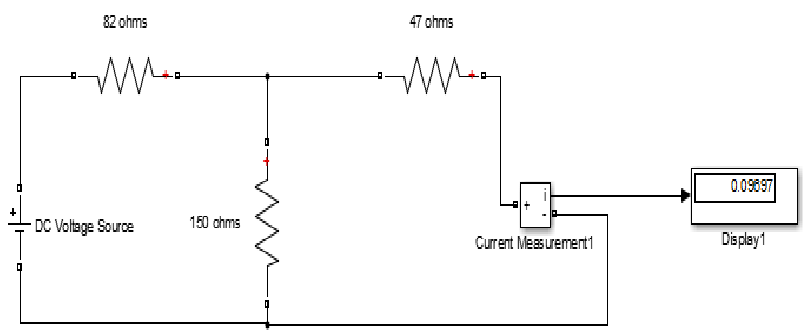


Figure – 8.3.2. Measurement of Norton's current

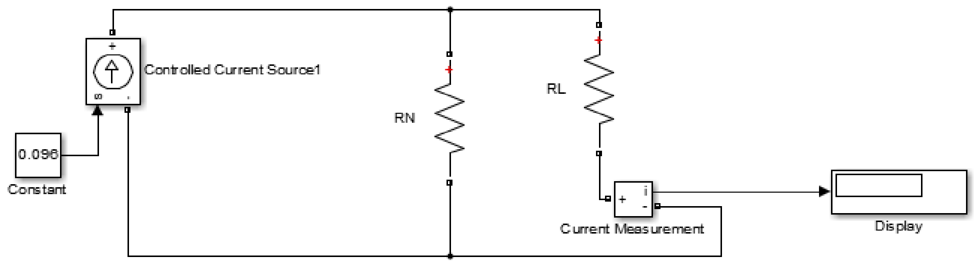


Figure – 8.3.3. Measurement of load current using Norton's theorem

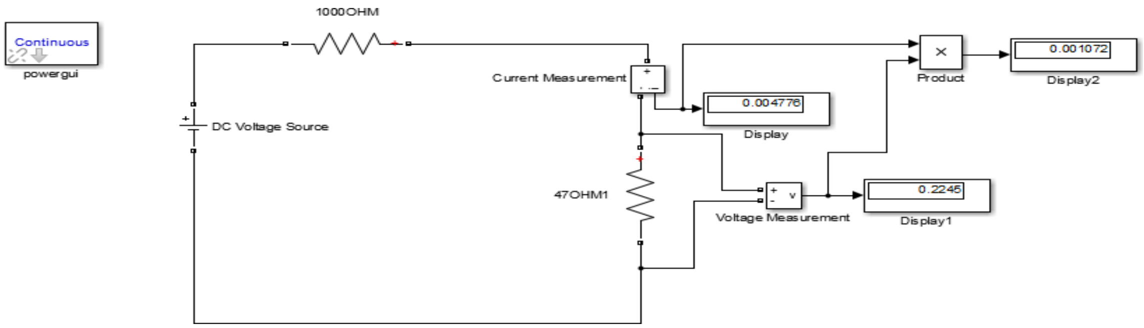


Figure – 8.3.4. Verification of Maximum Power Transfer theorem

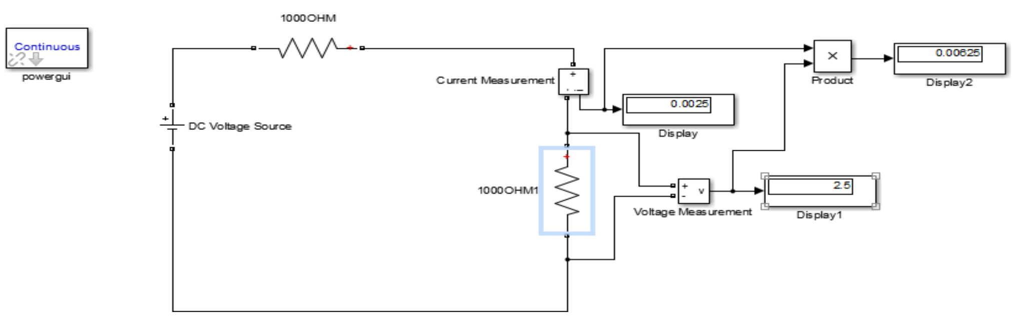


Figure – 8.3.5. Verification of Maximum Power Transfer theorem

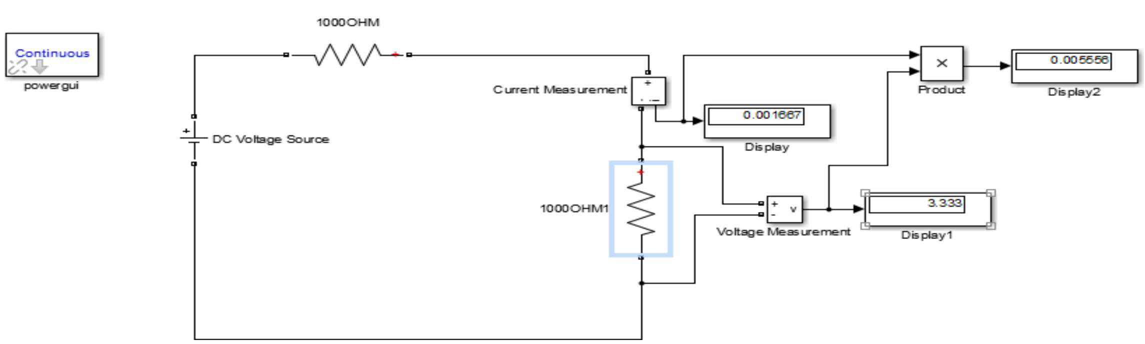


Figure – 8.3.6. Verification of Maximum Power Transfer theorem

PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MULTISIM/MATLAB Simulink.
2. Measure the voltages and currents in the resistor, to be calculated.
3. Verify the superposition and Thevenin's theorem.

RESULT:

PRE LAB VIVA QUESTIONS

1. Define power.
2. State the maximum power transfer theorem.
3. Ammeter is connected in series or parallel?
4. Voltmeter is connected in series or parallel?
5. Define mesh.
6. State ohm's law and write equations.
7. State Norton's theorem.

LAB ASSIGNMENT

1. Determine Norton's current with an example.

POST LAB VIVA QUESTIONS

1. Discuss the current division rule.
2. Discuss the voltage division rule.
3. State KCL.
4. State KVL.
5. Compare circuit and network.
6. Compare hardware result with digital simulation result.

EXPERIMENT – 9

VOLT AMPERE CHARACTERISTICS OF P-N JUNCTION DIODE

AIM:

To plot the V-I characteristics of a P-N junction diode in both forward and reverse directions, determine Cut in voltage (knee voltage), static and dynamic resistance in forward direction at forward current of 2mA & 8mA respectively and find static and dynamic resistance at 10V in reverse bias condition.

APPARATUS:

S.No	Device	Range/Rating	Quantity (in No.s)
1.	Semiconductor diode trainer Board Containing DC Power Supply. Diode (Silicon) Diode (Germanium) Carbon Film Resistor	 (0-15) V 1N 4007 OA79 1 KΩ, 1/2 W	 1 1 1 1
2.	DC Voltmeter DC Voltmeter	(0-1) V (0-20) V	1 1
3.	DC Ammeter DC Ammeter	(0-200) µA (0-20) mA	1 1
4.	Connecting wires	5A	10

CIRCUIT

DIAGRAMS:

Forward Bias

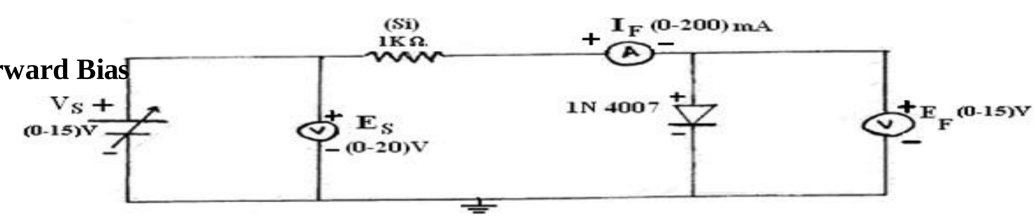


Figure – 9.3.1. Forward Bias Circuit

Reverse Bias

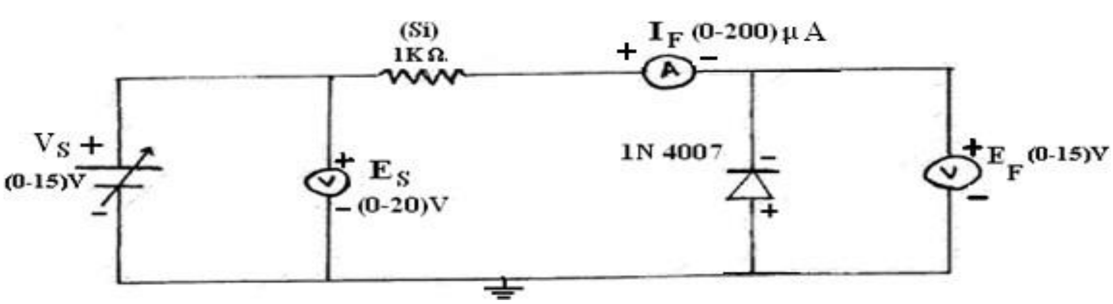


Figure – 9.3.2. Reverse Bias Circuit

EXPECTED GRAMS:

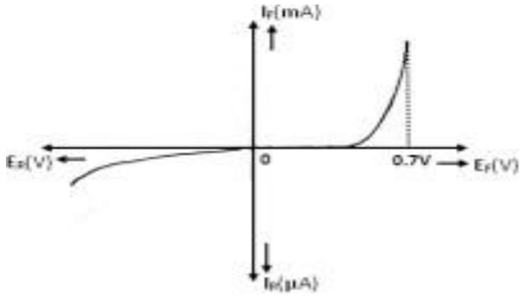


Figure – 9.4.1. Volt Ampere Characteristics of P-N Junction Diode

TABULAR COLUMN:

FORWARD BIAS

E_s (volts)	E_f (volts)	I_f (mA)
0.1		
0.2		
0.3		
0.4		
0.5		
0.6		
0.7		
0.8		
0.9		
1		
2		
4		
6		
8		
10		
12		
14		

REVERSE BIAS

E_s (volts)	E_r (volts)	I_r (μA)
0.1		
0.2		
0.3		
0.4		
0.5		
0.6		
0.7		
0.8		
0.9		
1		
2		
4		
6		
8		
10		
12		
14		

PRECAUTIONS:

1. Ensure that the polarities of the power supply and the meters as per the circuit diagram.
2. Keep the input voltage knob of the regulated power supply in minimum position both when switching ON or switching OFF the power supply.
3. No loose contacts at the junctions.
4. Ensure that the ratings of the meters are as per the circuit design for precision.

CALCULATIONS:

Forward Bias

Static Resistance at 8mA = E_f / I_f =

Static resistance at 2mA = E_f / I_f =

Dynamic resistance at 8mA = $\Delta E_f / \Delta I_f$ =

Dynamic resistance at 8mA = $\Delta E_f / \Delta I_f$ =

Reverse Bias

Static Resistance at (10V) = E_r / I_r =

Dynamic resistance at (10V) = $\Delta E_r / \Delta I_r$ =

RESULT:

PRE LAB QUESTIONS:

1. Define depletion region of a diode.
2. What is meant by transition and space charge capacitance of a diode?
3. Is the V-I relationship of a diode Linear or Exponential?
4. Draw the ideal characteristics of P-N junction diode.
5. What is the diode equation?

POST LAB QUESTIONS:

1. Define cut-in voltage of a diode and specify the values for Si and Ge diodes.
2. What are the applications of a p-n diode?
3. What is PIV?
4. Define break down voltage.
5. What is the effect of temperature on PN junction diodes?

EXPERIMENT NO: 10

ZENER DIODE CHARACTERISTICS AND VOLTAGE REGULATOR

AIM:

Plot the V-I characteristics of a Zener diode, find Zener breakdown voltage in reverse bias condition, find static and dynamic resistance in both forward and reverse bias conditions and perform Zener diode voltage regulator.

APPARATUS:

S.NO	DEVICES	RANGE /RATING	QUANTITY (in No.s)
1.	Zener diode trainer Board Containing a) DC Power Supply. b) Zener Diode c) Zener Diode d) Carbon Film Resistor	 (0-15) V 4.7 V 6.2 V 1 KΩ, 1/2 W	 1 1 1 1
2.	DC Voltmeter DC Voltmeter	(0-1) V (0-20) V	1 1
3.	a) DC Ammeter b) DC Ammeter	(0-200) µA (0-20) mA	1 1
4.	Connecting wires	5A	10

CIRCUIT DIAGRAMS:

Forward Bias

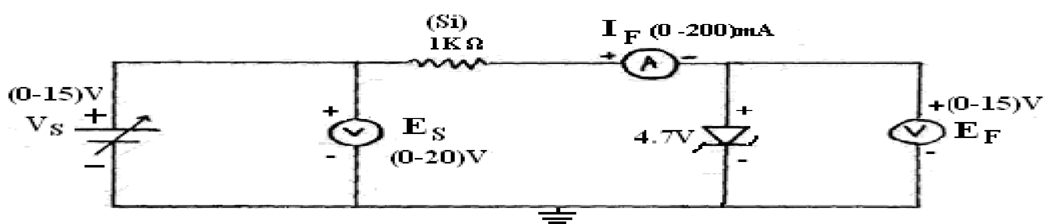


Figure – 10.4.1. Forward Bias Circuit

Reverse Bias

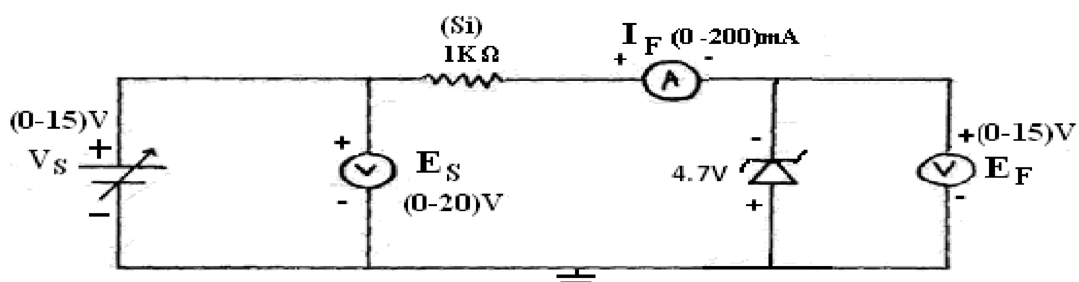


Figure – 10.4.2. Reverse Bias Circuit

Zener Diode as Voltage Regulator

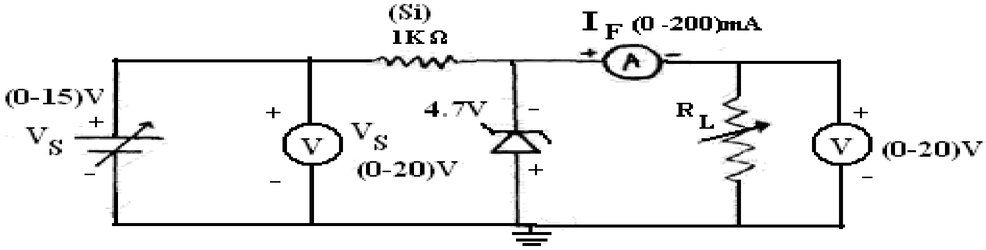


Figure – 10.4.3. Zener Diode as Voltage Regulator

PROCEDURE:

Forward Bias

1. Connect the circuit as shown in figure 10.4.1.
2. Vary the supply voltage E_s in steps and note down the corresponding values of E_f and I_f as shown in the tabular column.

Reverse Bias

1. Connect the circuit as shown in figure10.4.2.
2. Repeat the procedure as in forward bias and note down the corresponding Values of E_r and I_r as shown in the tabular column

EXPECTED GRAPH:

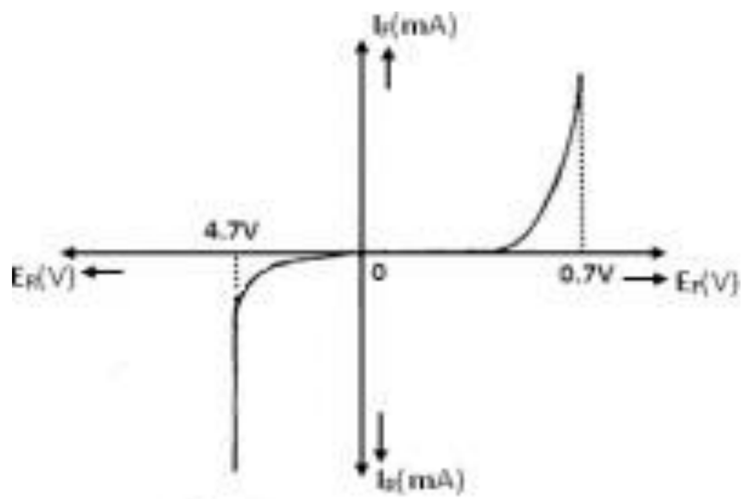


Figure – 10.4.3. Zener Diode as Voltage Regulator

TABULAR COLUMN:

Forward Bias

E_s (volts)	E_f (volts)	I_f (mA)
0.1		
0.2		
0.3		
0.4		
0.5		
0.6		
0.7		
0.8		
0.9		
1		
2		
4		
6		
8		
10		
12		
14		

Reverse Bias

E_s (volts)	E_r (volts)	I_r (mA)
0.1		
0.2		
0.3		
0.4		
0.5		
0.6		
0.7		
0.8		
0.9		
1		
2		
4		
6		
8		
10		
12		
14		

Zener Diode as Voltage Regulator:

V_{in}=15V, **V_{NL}=_____**

R_L(Ω)	V_{FL}(volts)	I_L (mA)	%Regulation
100			
200			
500			
1K			
2K			
5K			
10K			
20K			

R_L=15K

E_s (volts)	E_{FL} (volts)	I_L (mA)
1		
2		
4		
6		
8		
10		
12		
14		

PRECAUTIONS:

1. Ensure that the polarities of the power supply and the meters as per the circuit diagram.
2. Keep the input voltage knob of the regulated power supply in minimum position both when switching ON or switching OFF the power supply.
3. No loose contacts at the junctions.
4. Ensure that the ratings of the meters are as per the circuit design for precision.

CALCULATIONS:

Forward Static resistance at 6 mA= E_f / I_f

Forward Dynamic resistance at 6mA=$\Delta E_f / \Delta I_f$

Reverse Static resistance at 6 mA= E_f / I_f

Reverse Dynamic resistance at 6mA=$\Delta E_f / \Delta I$

RESULT:

1. V-I characteristics of Zener diode are plotted and verified in both forward and reverse directions.
2. Zener breakdown voltage for 4.7V zener diode = 4.7V.
3. (i) Forward Bias:
    a) Static resistance at 6 mA =
    b) Dynamic resistance at 6 mA=

    (ii) Reverse Bias:

    Static resistance at 6 mA=

    Dynamic resistance at 6 mA=

PRE LAB QUESTIONS:

1. What type of temperature Coefficient does the zener diode have?
2. If the impurity concentration is increased, how the depletion width effected?
3. How the breakdown voltage of a particular diode can be controlled?
4. What type of temperature coefficient does the Avalanche breakdown has?

LAB ASSIGNMENT:

1. To plot the V-I characteristics of a Zener diode (6.1V) in both forward and reverse directions by using multisim.

POST LAB QUESTIONS:

1. Explain briefly about avalanche and Zener breakdowns.
2. Draw the Zener equivalent circuit.
3. Differentiate between line regulation & load regulation.
4. In which region Zener diode can be used as a regulator?

EXPERIMENT – 11(A)

HALF WAVE RECTIFIERS WITH / WITHOUT FILTER

AIM:

Examine the input and output waveforms of a half wave rectifier without and with filters. Calculate the ripple factor with load resistance of 500Ω, 1 KΩ and 10 KΩ respectively. Calculate ripple factor with a filter capacitor of 100μF and the load of 1KΩ, 2KΩ and 10KΩ respectively.

APPARATUS:

S.No	Device	Range/Rating	Quantity in No.
1	Rectifier and Filter trainer Board Containing a) AC Supply. b) Silicon Diodes c) Capacitor	 (9-0-9) V 1N 4007 0.47μF	 1 7 1
2	a) DC Voltmeter b) AC Voltmeter	(0-20) V (0-20) V	1 1
3	DC Ammeter	(0-50) mA	1
4	Cathode Ray Oscilloscope	(0-20) MHz	1
5	Decade Resistance Box	10Ω-100KΩ	1
6	Connecting wires	5A	12

CIRCUIT DIAGRAMS:

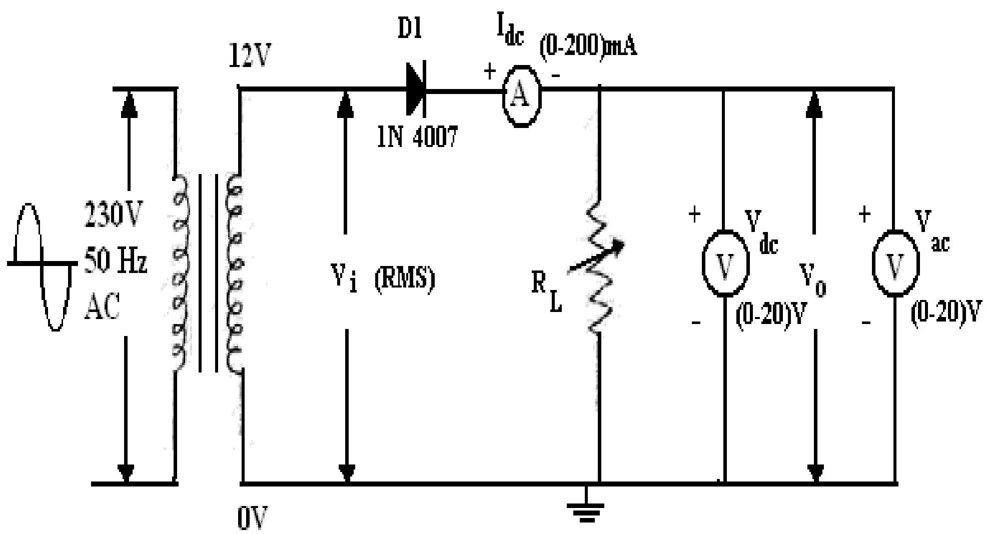


Figure – 11.4.1. Half Wave Rectifier without Filter

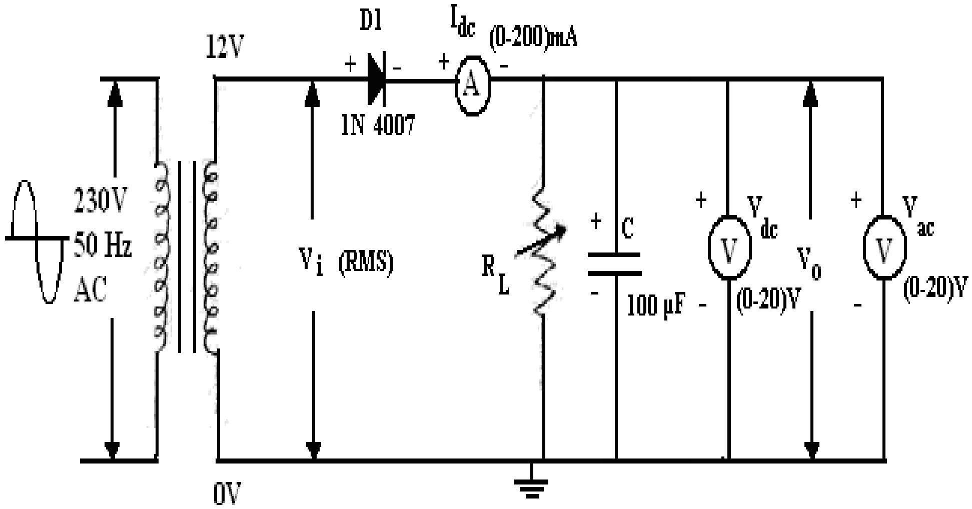


Figure – 11.4.2. Half Wave Rectifier with Filter

PROCEDURE:

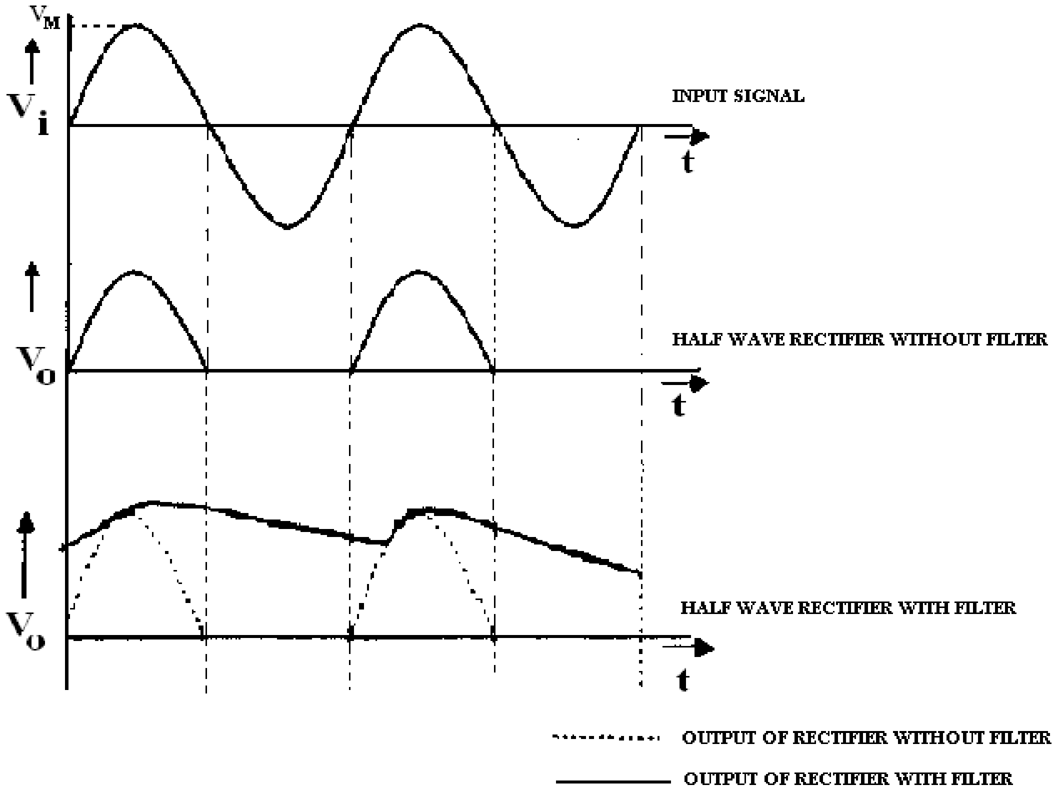
Half Wave Rectifier without filter

1. Connect the circuit as shown in figure 11.4.1.
2. Adjust the load resistance, R_L to 500Ω, and note down the readings of input and output voltages through oscilloscope.
3. Note the readings of dc current, dc voltage and ac voltage.
4. Now, change the resistance the load resistance, RL to 1 KΩ and repeat the procedure as above. Also repeat for 10 KΩ.
5. Readings are tabulated as per the tabular column.

Half Wave Rectifier with filter

1. Connect the circuit as shown in figure 11.4.2 and repeat the procedure as for half Wave rectifier without filter.

EXPECTED GRAPHS:



PRECAUTIONS:

1. No loose contacts at the junctions.
2. Meters of correct ranges must be used for precision

TABULAR COLUMNS:

Half Wave Rectifier without Filter

S.No	Load Resistance (R_L)	Input Voltage Peak (V_m)	Output Voltage Peak (V_o)	Average dc current (I_{dc})	Average Dc voltage (V_{dc})	RMS Voltage (V_{ac})	Ripple Factor $\gamma = \frac{V_{ac}}{V_{dc}}$
1.	500Ω						
2.	1KΩ						
3.	10KΩ						

Half Wave Rectifier with Filter C=10µF

S.No	Load Resistance (R_L)	Input Voltage Peak (V_m)	Output Voltage Peak (V_o)	Average dc current (I_{dc})	Average Dc voltage (V_{dc})	RMS Voltage (V_{ac})	Ripple Factor $\gamma=\frac{V_{ac}}{V_{dc}}$
1.	1KΩ						
2.	2KΩ						
3.	10KΩ						

PRE LAB QUESTIONS:

1. What is a rectifier?
2. How Diode acts as a rectifier?
3. What is the significance of PIV? What is the condition imposed on PIV?
4. Define regulation.
5. Define time constant.

LAB ASSIGNMENT:

1. Plot the wave forms of Half wave rectifier with R=5000 ohms, C = 680µF.

POST LAB QUESTIONS:

1. Draw the o/p wave form without filter.
2. Draw the o/p wave form with filter.
3. What is meant by ripple factor? For a good filter whether ripple factor should be high or low?
4. What happens to the o/p wave form if we increase the capacitor value?
5. What happens if we increase the capacitor value?

RESULT:

1. Input and Output waveforms of a half-wave with /without filter are observed and plotted.
2. For Half-wave rectifier without filter-

   γ, Ripple factor at 500Ω=

   1KΩ=

   10 KΩ=

3. For Half-wave rectifier with filter:-

   γ, Ripple factor at 1KΩ, 100μF =

   2KΩ, 100μF =

   10 KΩ, 100μF =

EXPERIMENT – 11(B)

FULLWAVE RECTIFIERS WITH/WITHOUT FILTER

AIM:

Examine the input and output waveforms of a full wave (center tapped) rectifier without and with filters.
Calculate the ripple factor with load resistance of 500Ω, 1 KΩ and 10 KΩ respectively.
Calculate ripple factor with a filter capacitor of 100μF and the load of 1KΩ, 2KΩ and 10KΩ respectively.

APPARATUS:

S.No	Device	Range /Rating	Quantity (in No.s)
1	Rectifier and Filter trainer Board Containing a) AC Supply. b) Silicon Diodes c) Capacitor	 (9-0-9) V 1N 4007 0.47μF	 1 7 1
2	a) DC Voltmeter b) AC Voltmeter	(0-20) V (0-20) V	1 1
3	DC Ammeter	(0-50) mA	1
4	Cathode Ray Oscilloscope	(0-20) MHz	1
5	Decade Resistance Box	10Ω-100KΩ	1
6	Electrolytic Capacitor	100μF	1
7	Connecting wires	5A	12

CIRCUIT DIAGRAMS:

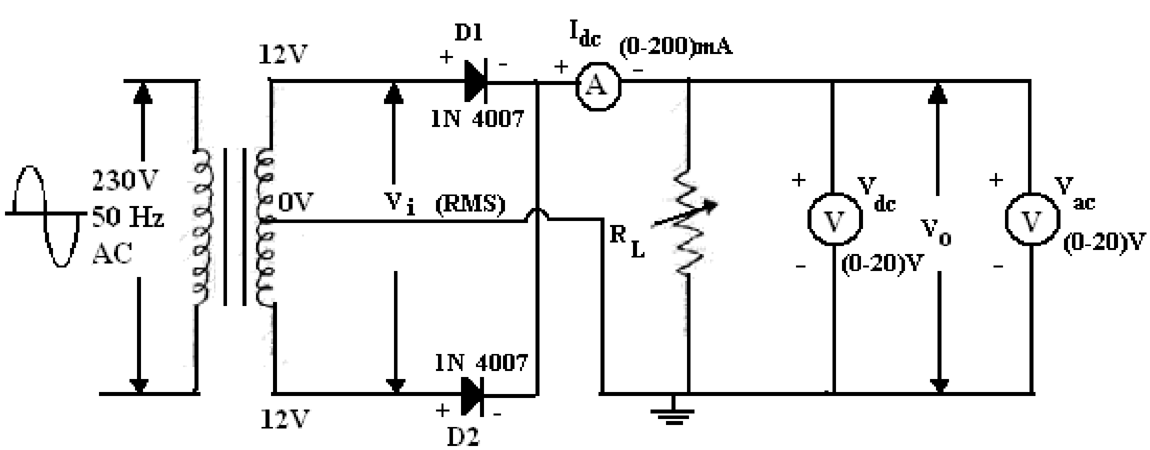


Figure – 11.15.1. Full Wave Rectifier (Center-tap) Without Filter

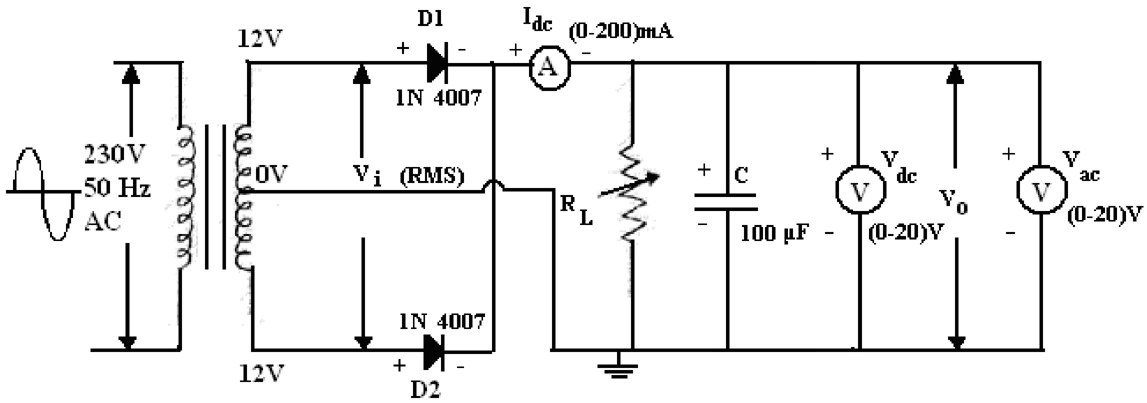


Figure – 11.15.2. Full Wave Rectifier (Center-tap) With Filter

PROCEDURE:

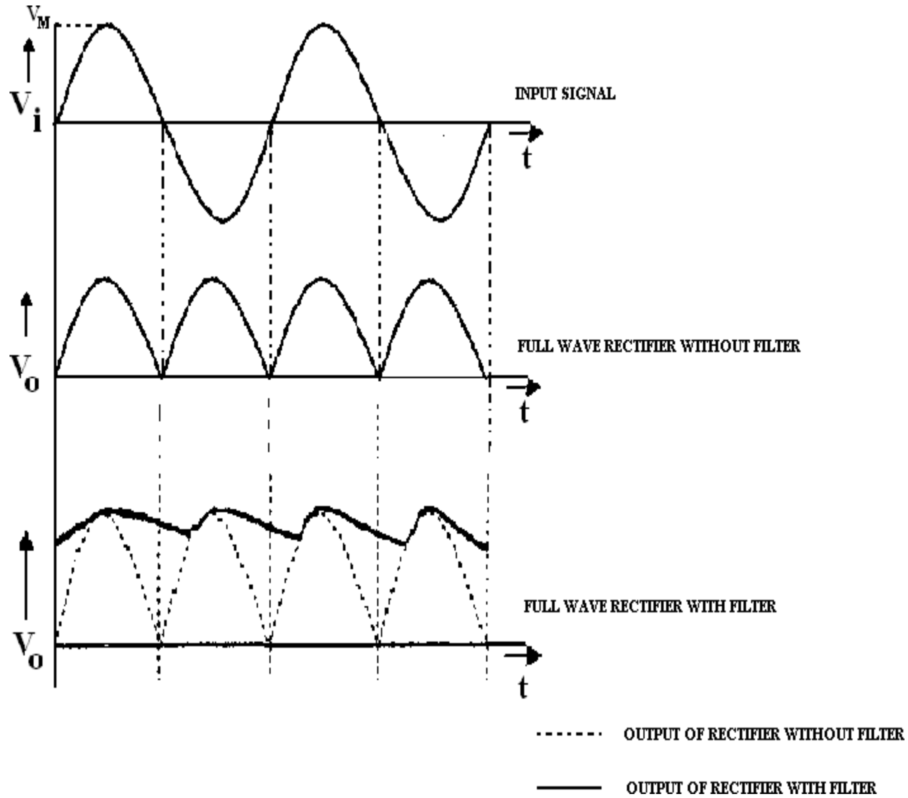
Full-wave Rectifier without filter

1. Connect the circuit as shown in the figure (a).
2. Adjust the load resistance R_L to 500Ωand connect a capacitor of 100µF value in parallel with the load and note the readings of input and output voltages through Oscilloscope.
3. Note the readings of DC current, DC voltage and AC voltage.
4. Now change the load resistance RL to 2000Ω and repeat the procedure as theabove.
5. Readings are tabulate as per the tabular column.

Full-wave Rectifier with filter

1. Connect the circuit as shown in the figure (b).
2. Adjust the load resistance R_L to 1KΩand connect a capacitor of 100µF values in parallel with the load and note the readings of input and output voltages through Oscilloscope.
3. Note the readings of DC current, DC voltage and AC voltage.
4. Now change the load resistance R_L to 2KΩ and repeat the procedure as the above. Also repeat for 10K, 100µF values
5. Readings are tabulate as per the tabular column.

EXPECTED GRAPHS:



PRECAUTIONS:

1. No loose contacts at the junctions.
2. Meters of correct range must be used for precision.

TABULAR COLUMNS:

Full wave Rectifier (Center-tap) Without Filter

S.No	Load Resistance (R_L)	Input Voltage Peak (V_m)	Output Voltage Peak (V_o)	Average dc current (I_{dc})	Average Dc voltage (V_{dc})	RMS Voltage (V_{ac})	Ripple Factor $\gamma = \frac{V_{ac}}{V_{dc}}$
1	500Ω						
2	1KΩ						
3	10KΩ						

Full wave Rectifier (Center-tap) With Filter   C = --- µF

S.No	Load Resistance (R_L)	Input Voltage Peak (V_m)	Output Voltage Peak (V_o)	Average dc current (I_{dc})	Average Dc voltage (V_{dc})	RMS Voltage (V_{ac})	Ripple Factor $\gamma = \frac{V_{ac}}{V_{dc}}$
1	500Ω						
2	1KΩ						
3	10K						

PRE LAB QUESTIONS:

1. What is a full wave rectifier?
2. How Diode acts as a rectifier?
3. What is the significance of PIV requirement of Diode in full-wave rectifier?
4. Compare capacitor filter with an inductor filter.
5. What is the theoretical maximum value of ripple factor for a full wave rectifier?

LAB ASSIGNMENT:

Plot the wave forms of full wave rectifier with R=500 ohms, C = 470µF.

POST LAB QUESTIONS:

1. Draw the o/p wave form without filter? Draw the O/P? What is wave form with Filter.
2. Define ripple factor. For a good filter whether ripple factor should be high or low? What happens to the ripple factor if we insert the filter?
3. Define regulation. Why regulation is poor in the case of inductor filter?
4. Define time constant.
5. What happens to the o/p wave form if we increase the capacitor value? What happens if we increase the capacitor value?

RESULT:

1. Input and Output waveforms of a full-wave (center tapped) and bridge rectifier with /without filters are observed and plotted.
2. For Full-wave rectifier(center tapped) without filter-
    i. γ, Ripple factor at 500Ω, 100µF =
        a. 2KΩ, 100µF =
3. For full-wave rectifier (Center tapped) with filter-
    i. γ, Ripple factor at 500Ω, 100µF =
        a. 2KΩ, 100µF =

EXPERIMENT – 12

TRANSISTOR CB CHARACTERISTICS

AIM:

Plot the input and output characteristics of a transistor connected in Common Base configuration.

Calculate the input resistance R_i at I_e= 12 mA, output resistance R_o at V_{CB}=8V and current gain at V_{CB}=6V.

APPARATUS:

S.No.	Device	Range /Rating	Quantity (in No.s)
1.	Transistor CB trainer Board Containing a) DC Power Supply. b) PNP Transistor c) Carbon Film Resistor	 (0-12) V CK100 470Ω, 1/2 W	 2 1 2
2.	a) DC Voltmeter b) DC Voltmeter	(0-1) V (0-20) V	1 1
3.	DC Ammeter	(0-50) mA	2
4.	Connecting wires	5A	12

CIRCUIT DIAGRAM:

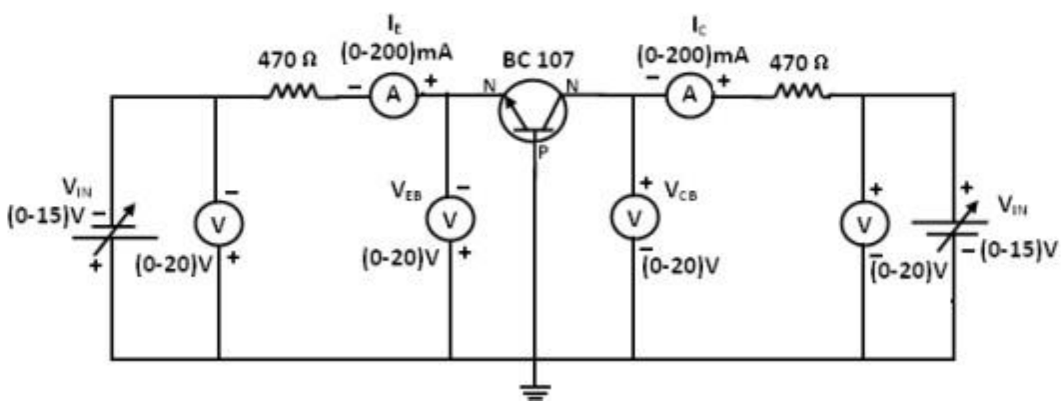


Figure – 12.3.1. Transistor CB Characteristics

PROCEDURE:

Input

Characteristics:

1. Connect the transistor as shown in figure12.3.1
2. Keep the V_{CB} constant at 4V and 8V.Vary the V_{EB} in steps and note corresponding I_E values as per tabular form.

Output Characteristics:

1. Keep the I_E constant at 4mA and 8mA.Vary the V_{CB} in steps and note Corresponding I_C values.
2. Readings are tabulated as shown in tabular column

EXPECTED GRAPHS:

Input Characteristics:

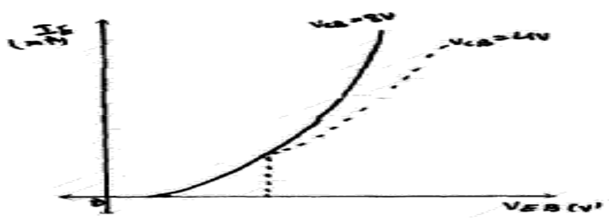


Figure – 12.5.1. Transistor CB Input Characteristics

Output characteristics:

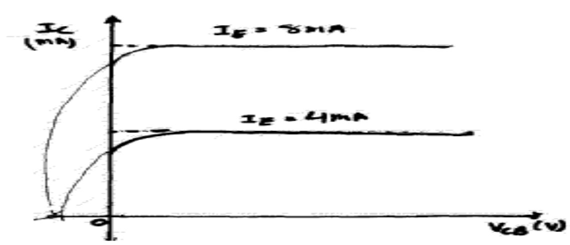


Figure – 12.3.1. Transistor CB output Characteristics

PRECAUTIONS:

1. Keep the knobs of supply voltages V_{EB} & V_{CB} at minimum positions when switching ON or switching OFF the power supply.
2. No loose contacts at the junctions.
3. Do not overload the meters above its rated ranges.

TABULAR COLUMN:

Input Characteristics

V_{CB} = -4V		V_{CB} = -8V	
V_{EB} (Volts)	I_E (mA)	V_{EB} (Volts)	I_E (mA)

Output Characteristics

I_E = 8mA		I_E = 4mA	
V_{CB} (Volts)	I_C (mA)	V_{CB}(Volts)	I_C(mA)

CALCULATIONS:

Input Resistance (I_E =12 mA) = $\Delta V_{EB}/\Delta I_E$ =
At V_{EB} = 4V
Input Resistance (I_E =12 mA) = $\Delta V_{EB}/\Delta I_E$ =
At V_{EB} = 8V
Output resistance (I_E =8mA) = $\Delta V_{CB}/\Delta I_C$ =
At V_{CB} = -8V.
Output resistance (I_E =4mA) = $\Delta V_{CB}/\Delta I_C$ =
At V_{CB} = -8V.
Current Amplification Factor 'α'= $\Delta I_C/\Delta I_E$ =

PRE LAB QUESTIONS:

1. What is the range of α for the transistor?
2. Draw the input and output characteristics of the transistor in CB configuration?
3. Identify various regions in output characteristics?
4. What is the relation between α and β?

LAB ASSIGNMENT:

Plot the I/O characteristics of CB configuration for Vcc = 12V, VEE = 6V, RE= 100K ohms, Rc = 1K ohms, α =0.98, Vbe = 0.7V.

POST LAB QUESTIONS:

1. Discuss the applications of CB configuration?
2. What are the input and output impedances of CB configuration?
3. Define α (alpha)?
4. What is EARLY effect?
5. Discuss the power gain of CB configuration

RESULT:

1. Input and output curves are plotted.
2. R_i Input Resistance:
   (i) V_{EB} = 4V and I_E =12 mA, R_i =
   (ii) V_{EB} = 8V and I_E =12 mA, R_i =
3. R_o Output Resistance:
   (i) V_{CB} = 8V and I_E = 8 mA, R_o =
   (ii) V_{CB} = 8V and I_E = 4 mA, R_o =
4. Current Amplification factor

   'α' =

   (at V_{CB} =6V)

EXPERIMENT NO: 13

TRANSISTOR CE CHARACTERISTICS

AIM:

Plot the input and output characteristics of a transistor connected in Common Emitter configuration. Calculate the input resistance R_i at I_B= 20 µA, output resistance R_o at V_{CE}=10V and current gain at V_{CE} =10V.

APPARATUS:

S. No	Devices	Range / Rating	Quantity (in No's)
1.	Transistor CE trainer Board Containing a) DC Power Supply. b) NPN Transistor c) Carbon Film Resistor	(0-12) V BC 107 470Ω, 1/2 W 100KΩ, 1/2 W	2 1 1 1
2.	a) DC Voltmeter b) DC Voltmeter	(0-1) V (0-20) V	1 1
3.	DC Ammeter	(0-50) mA (0-200) µA	1 1
4.	Connecting wires	5A	12

CIRCUIT DIAGRAM:

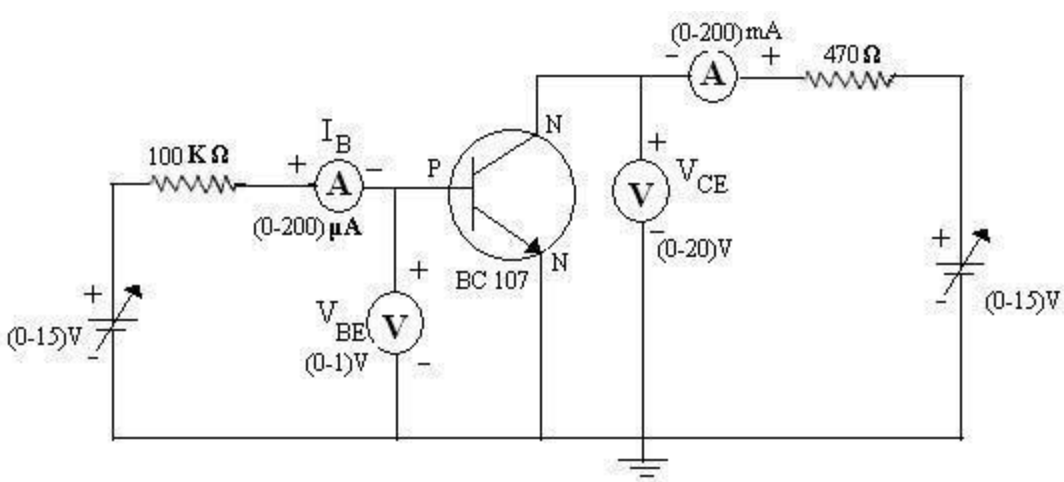


Figure – 13.3.1. Transistor CE Characteristics

PROCEDURE:

Input

Characteristics:

1. Connect the transistor as shown in figure 13.3.1
2. Keep the V_{CE} constant at 2V and 6V.
3. Vary the I_B in steps and note down the corresponding V_{EB} values as per tabular column.

Output Characteristics:

1. Keep the I_B constant at 20 μA and 40 μA.
2. Vary the V_{CE} in steps and note corresponding I_C values.
3. Readings are tabulated as shown in tabular column.

EXPECTED GRAPHS:

Input Characteristics:

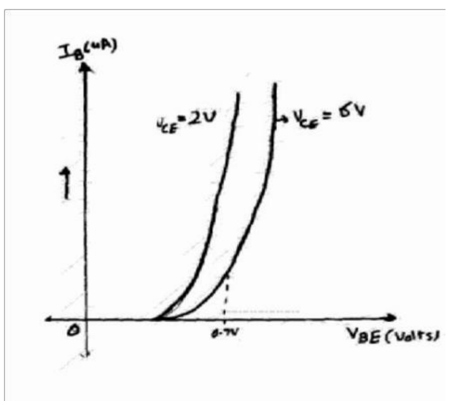


Figure – 13.5.1. Transistor CE Input characteristics

Output characteristics:

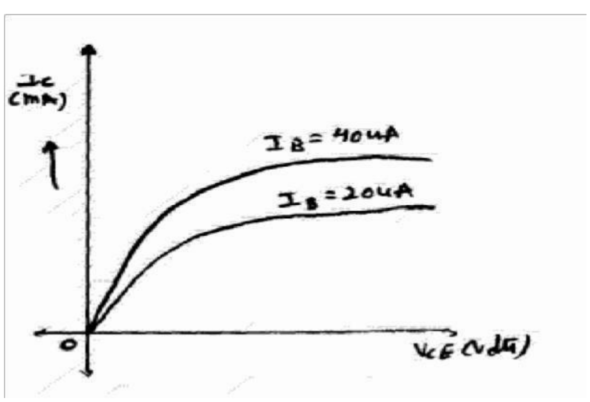


Figure – 13.5.2. Transistor CE Output Characteristics

PRECAUTIONS:

1. Keep the knobs of supply voltages V_{BE}& V_{CE} at minimum positions when switching ON or switching OFF the power supply.
2. No loose contacts at the junctions.
3. Do not overload the meters above its rated ranges.

TABULAR COLUMNS: Input

Characteristics:

V_{CB} = 2V			V_{CB} = 6V	
V_{BE} (Volts)	I_B (μA)		V_{BE} (Volts)	I_B (μA)
	0			0
	0.2			0.2
	0.4			0.4
	0.6			0.6
	0.8			0.8
	1			1
	2			2
	4			4
	6			6
	8			8
	10			10
	20			20
	30			30
	40			40
	50			50
	60			60

Output characteristics:

$I_B = 20\mu A$	
V_{CE} (Volts)	I_C (mA)
0	
0.5	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

$I_B = 40\mu A$	
V_{CE} (Volts)	I_C (mA)
0	
0.5	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

CALCULATIONS:

Input Resistance (I_B=20µA) = $\Delta V_{BE}/\Delta I_B$ = At V_{CE} = 2V

Input Resistance (I_B =20µA) = $\Delta V_{BE}/\Delta I_B$ = At V_{CE}= 6V

Output resistance (V_{CE}=10V) = $\Delta V_{CE}/\Delta I_C$= At I_B=20µA

Output resistance (V_{CE}=10V) = $\Delta V_{CE}/\Delta I_C$ = At I_B=20µA

Current Amplification Factor 'β'= $\Delta I_C/\Delta I_B$ =

RESULT:

1. Input and Output curves are plotted.

2. R_i, Input Resistance:
a. V_{CE} = 2V and I_B =20 µA, R_i =
b. V_{CE} = 6V and I_B =20 µA, R_i =

3. R_o, Output Resistance:
a. V_{CE}= 10V and I_B = 20µA, R_o =
b. V_{CE} = 10V and I_B = 40µA, R_o =

4. Current Amplification factor 'β' =
(at V_{CE} =10V)

PRE LAB QUESTIONS:

1. What is the range of 'β' for the transistor?
2. What are the input and output impedances of CE configuration?
3. Identify various regions in the output characteristics?
4. What is the relation between 'α*' and* 'β'?

POST LAB QUESTIONS:

1. Define current gain in CE configuration.
2. Why CE configuration is preferred for amplification?
3. What is the phase relation between input and output?
4. Draw diagram of CE configuration for PNP transistor.
5. What is the power gain of CE configuration?
6. What are the applications of CE configuration?