

ELECTRICAL TECHNOLOGY LABORATORY

LAB MANUAL

Academic Year : 2018 – 2019
Course Code : AEE114
Regulations : IARE - R16
Class : III Semester



Electrical and Electronics Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043



INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

Dundigal, Hyderabad - 500 043

Department of 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, apparatus, 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: An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.
PSO2	Problem-Solving Skills: An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.
PSO3	Successful Career and Entrepreneurship: An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.

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ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Exp. No.	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Time response of first order RC and RL networks	PO1, PO2, PO3	PSO2
2	Determination of impedance(Z) and admittance (Y) parameters of two port networks	PO1, PO2, PO3	PSO2
3	Determination of transmission and hybrid parameters.	PO1, PO2, PO3	PSO2
4	Plot the Open circuit characteristics of a DC shunt generator	PO1, PO3, PO4	PSO2
5	Determination of efficiency by conducting load test on DC shunt generator.	PO1, PO3, PO4	PSO2
6	Determination of efficiency of a DC shunts motor.	PO1, PO2, PO3	PSO2
7	Study the performance characteristics of DC shunt motor on load.	PO1, PO3, PO4	PSO2
8	Study the speed characteristics of a DC shunt motor	PO1, PO3, PO4	PSO2
9	OC & SC test on a Single phase Transformer	PO1, PO3, PO4	PSO2
10	Load test on single phase transformer.	PO1, PO3, PO4	PSO2
11	Transient response of RLC circuit.	PO1, PO2, PO3	PSO2
12	Simulation of low pass and high pass filters using digital simulation.	PO1, PO 2, PO3, PO5	PSO2
13	Magnetization characteristics of DC shunt generators using Sims cape power system	PO1, PO3, PO4, PO5	PSO2
14	Load test on DC shunt generator using Sims cape power system.	PO1, PO3, PO4, PO5	PSO2

ELECTRICAL TECHNOLOGY LAB

OBJECTIVE:

The objective of the Electrical Technology lab is to expose the students to the operation of electrical machines and networks and give them experimental skill. The purpose of lab experiment is to continue to build circuit construction skills using different circuit element and check the performance characteristics of machines. It also aims to introduce PSPICE, a circuit simulation software tool. It enables the students to gain sufficient knowledge on the programming and simulation of Electrical circuits and how to operate and find the efficiency of electrical machines.

OUTCOMES:

Upon the completion of Electrical Technology and simulation practical course, the student will be able to attain the following:

1. Familiarity with DC circuit analysis techniques, resistive circuits.
2. Analyze complicated circuits using different network functions.
3. Acquire skills of using PSPICE software for Electrical circuit studies.
4. Apply techniques for the analysis and simulation of linear electric circuits, and measurements of their properties.
5. Analyze the transient and AC steady state behavior of a circuit
6. Demonstrate the ability to work Lab Experimentation effectively to electrical circuit exercises / problems, circuit measurements, and computer work using PSPICE.

EXPERIMENT – 1

TIME RESPONSE OF FIRST ORDER RC AND RL NETWORKS

1.1 AIM:

To determine the time constant of series RL and RC circuits.

1.2 APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1	Resistor (D.R.B), Capacitor (D.C.B), Inductor (D.L.B)			
2	C.R.O.			
3	C.R.O.PROBES			
4	Signal Generator			
5	Bread Board			
6	Connecting wires			

1.3 CIRCUIT DIAGRAM:

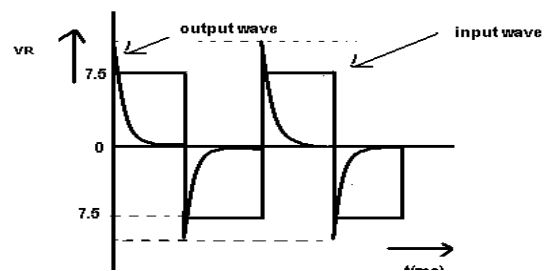
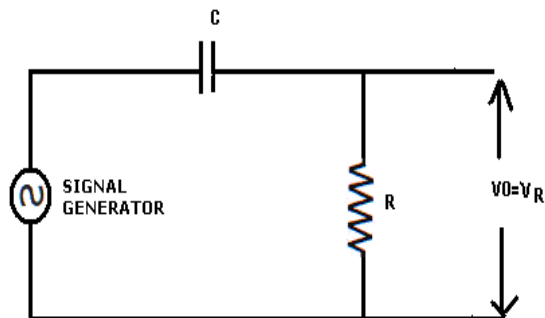


Fig – 1.1 RC Network Voltage across Resistor

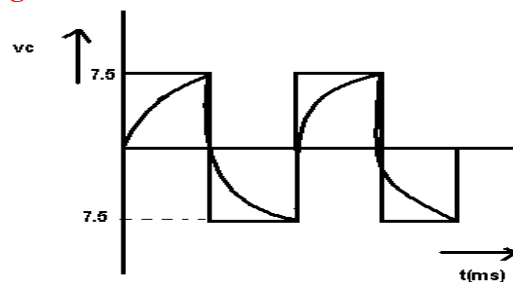
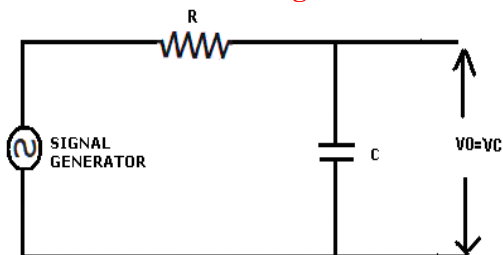


Fig – 1.2 RC Network Voltage across Capacitor

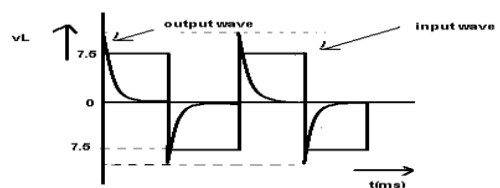
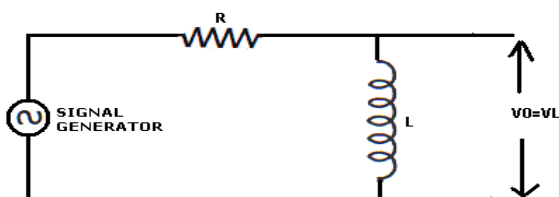


Fig – 1.3 RL Network Voltage across Inductor

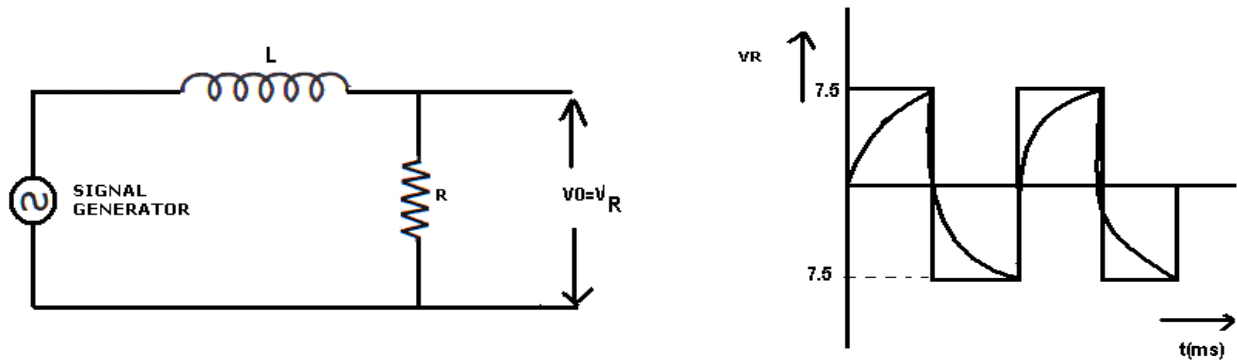


Fig – 1.4 RL Network Voltage across Resistor

1.4 PROCEDURE:

1.4.1 SERIES RC CIRCUIT:

1. Connect the circuit as shown in figure (1) with $R=1\text{kohm}$ and $C=0.1\mu\text{F}$.
2. Apply a voltage of 15vp-p from the signal generator at 800 Hz to the circuit.
3. Observe the output waveform i.e. V_R (voltage across the resistor) on the CRO and also input.
4. Connect the CKT as shown in figure (2), this time the capacitor is connected across the output terminals.
5. Observe the waveform of V_C (voltage across the capacitor) and note down the peak value of thin voltage, 0.632 times the peak value of thin voltage and note down the time corresponds to $0.632V_p$ (This value of time in the time constant value).
6. Calculate the theoretical time constant value by using $T=RC$ and compare with practical value.
7. Draw the input, V_R & V_C waveform on the graph sheet.

1.4.2 SERIES RL CIRCUIT:

1. Connect the circuit as shown in figure (3) with $R=1\text{kohm}$ and $L=50\text{mH}$
2. Apply a voltage of 15vp-p from the signal generator at 800 hz to the circuit.
3. Observe the output waveform i.e. V_L (voltage across the inductor) on the CRO and also input.
4. Connect the ckt as shown in figure (4), and observe the output waveform i.e. voltage across resistor V_R on the CRO and also the input waveform.
5. From the V_R waveform, note down the value of peak voltage 0.632 times the peak voltage and time corresponds to $0.632V_p$. This time is called the value of time constant.
6. Calculate the theoretical time constant value by using $T=L / R\text{sec}$ and compare with practical value.
7. Draw the input, V_R & V_L waveform on the graph sheet, Indicate time corresponds to $0.632V_r$.

1.5 EXPECTED GRAPH:

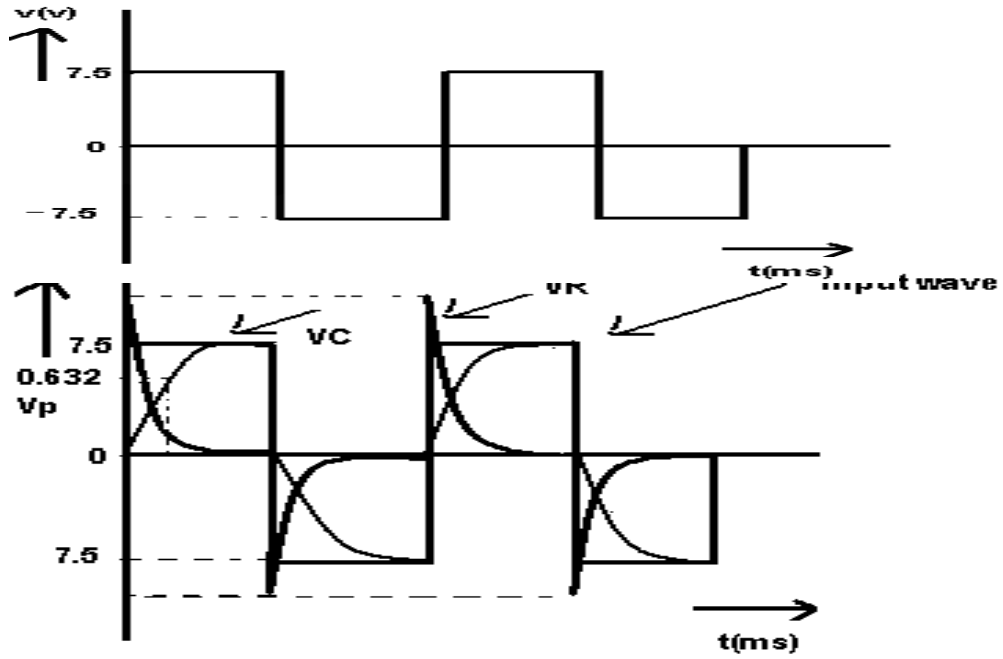


Fig – 1.5 Input & Output Voltage Wave

Expected Graph:

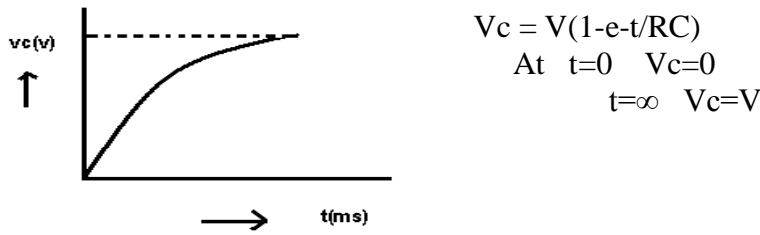


Fig – 1.6 Output Wave across capacitor



Fig – 1.7 Output Voltage Wave across Resistor

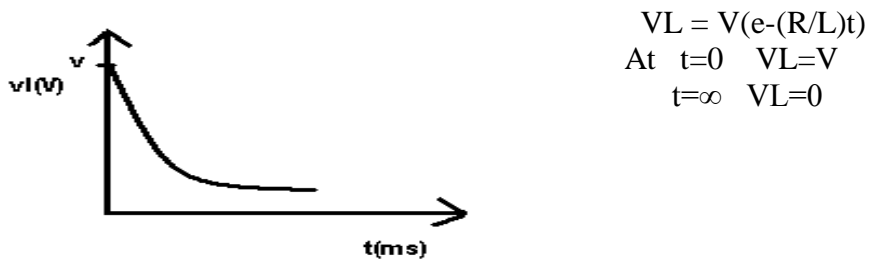
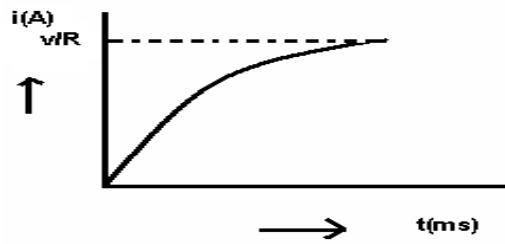


Fig – 1.8 Output Voltage Wave across inductor



$$i = \frac{V}{R}(1 - e^{-(R/L)t})$$

$$t=0 \quad i=0$$

$$t=\infty \quad i=V/R$$

Fig – 1.9 Current Wave Form

1.6 RESULT:

1.7 PRE LAB VIVA QUESTIONS:

1. Define transient.
2. What is time constant of series RL circuit?
3. What is time constant of series RC circuit?
4. Define time response.

1.8 POST LAB VIVA QUESTIONS:

1. What are the time domain specifications of a time response?
2. Define initial conditions of passive elements.
3. Inductor does not allow sudden change of current, why?
4. Capacitor does not allow sudden change of voltage, why?

EXPERIMENT – 2

Z & Y PARAMETERS

2.1 AIM:

To find the Z & Y parameters of a two port network.

2.2 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1.	Resistors			
2.	Ammeter			
3.	Voltmeter			
4.	R.P.S			
5.	Bread Board			
6.	Connecting wires			

2.3 CIRCUIT DIAGRAM:

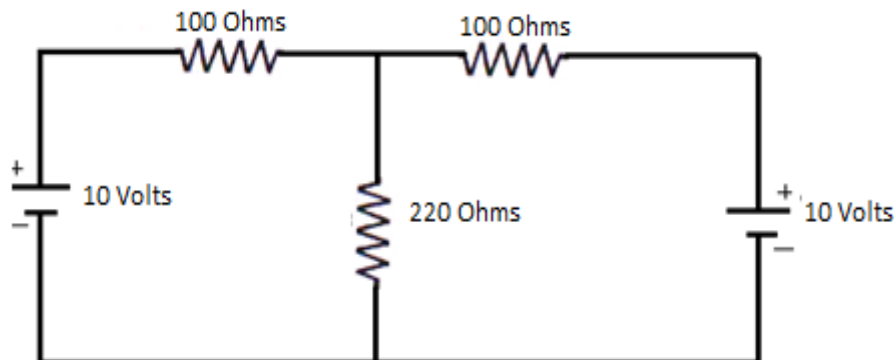


Fig – 2.1 Circuit Diagram

2.4 PROCEDURE:

Z – Parameters

1. Connect the circuit as shown in fig.
2. Open circuit port2 that is (i.e $I_2 = 0$) and measure I_1 and V_2 and calculate Z_{11} & Z_{21} using the formulas

$$Z_{11} = \frac{V_1}{I_1} | I_2 = 0$$

$$Z_{21} = \frac{V_2}{I_1} | I_2 = 0$$

3. To Measure Z_{12} and Z_{22} , open circuit port1 (i.e. $I_1=0$) and measure V_1 and I_2 and calculate Z_{12} & Z_{22} using the formulas

$$Z_{12} = \frac{V_1}{I_2} | I_1 = 0$$

$$Z_{22} = \frac{V_2}{I_2} | I_1 = 0$$

Y – Parameters

1. Connect the circuit as shown in fig.
2. Short circuit port 2 (i.e $V_2 = 0$) and measure V_1 , I_1 & I_2 and calculate Y_{11} & Y_{12} using the formulas

$$Y_{11} = \frac{I_1}{V_1} |_{V_2 = 0} \qquad Y_{21} = \frac{I_2}{V_1} |_{V_2 = 0}$$

3. To Measure Y_{12} and Y_{22} , short circuit port 1 (i.e. $V_1=0$) and measure V_2 , I_1 and I_2 and calculate Y_{12} & Y_{22} using the formulas

$$Y_{12} = \frac{I_1}{V_2} |_{V_1 = 0} \qquad Y_{22} = \frac{I_2}{V_2} |_{V_1 = 0}$$

2.5 TABULAR COLUMN:

When $I_2=0$

S.No	$V_1(V)$	$I_1(mA)$	$V_2(V)$
1			

When $I_1=0$

S.No	$V_1(V)$	$V_2(V)$	$I_2(mA)$
1			

When $V_2=0$

S.No	$V_1(V)$	$I_1(mA)$	$I_2(mA)$
1			

When $V_1= 0$

S.No	$I_1(mA)$	$I_2(mA)$	$V_2(V)$
1			

2.5 RESULT:

2.6 PRE LAB VIVA QUESTIONS:

1. What are Z parameters?
2. What are Y parameters?
3. What is the other name of Z parameter?
4. What is the other name of Y parameter?
5. What is the reciprocity and symmetry condition for Z parameters
6. What is the reciprocity and symmetry condition for Y parameters

2.7 LAB ASSIGNMENT:

1. Find out Z parameters for Π network and T network?
2. Find out Y parameters for Π network and T network?

2.8 POST LAB VIVA QUESTIONS:

1. Give the relation between Y and Z parameters.
2. What are the different parameters used to represent two port networks?
3. Represent Z parameter in terms of Y parameter.

EXPERIMENT – 3
TRANSMISSION AND HYBRID PARAMETERS

3.1 AIM:

To find the ABCD and H parameters of a two port network.

3.2 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1.	Resistors			
2.	Ammeter			
3.	Voltmeter			
4.	R.P.S			
5.	Bread Board			
6.	Connecting wires			

3.3 CIRCUIT DIAGRAM:

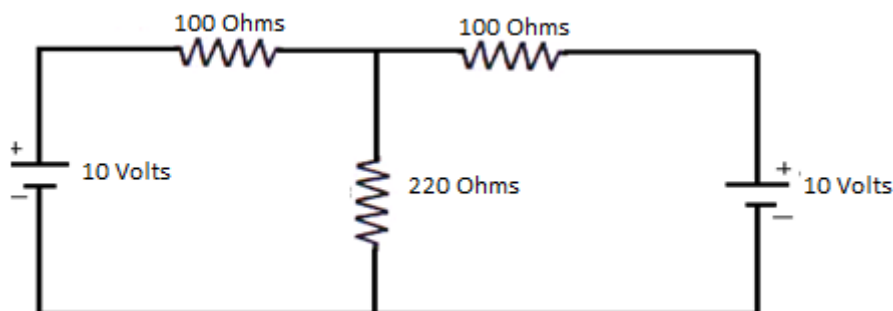


Figure – 3.1 Circuit Diagram

3.4 PROCEDURE

ABCD – Parameters

1. Connect the circuit as shown in fig.
2. Connect the circuit as shown in figure make $I_2=0$ and note down the values of V_1 , I_1 & V_2 .

$$A = V_1/V_2 \quad |I_2=0$$

$$C = I_1/V_2 \quad |I_2=0$$

3. Make $V_2=0$ and note down the values of V_1 , I_1 & I_2 .

$$B = -V_1/I_2 \quad |V_2=0$$

$$D = -I_1/I_2 \quad |V_2=0$$

4. Find the values of A, B, C, D and compare them with the theoretical values.

H – Parameters

1. Connect the circuit as shown in fig.
2. Connect the circuit as shown in figure make $V_2=0$ and note down the values of V_1 , I_2 & I_1

$$h_{11} = V_1/I_1 \quad |V_2=0$$

$$h_{21} = I_2/I_1 \quad |V_2=0$$

3. Make $I_1=0$ and note down the values of V_1 , V_2 & I_2 .

$$h_{12} = V_1/V_2 \quad |I_1=0$$

$$h_{22} = I_2/V_2 \quad |I_1=0$$

4. Find the values of h_{11} , h_{22} , h_{12} , h_{21} and compare them with the theoretical value

3.5 TABULAR COLUMN

When $I_2=0$

S.No	$V_1(V)$	$I_1(Ma)$	$V_2(V)$

When $I_1=0$

S.No	$V_1(V)$	$V_2(V)$	$I_2(Ma)$

When $V_2=0$

S.No	$V_1(V)$	$I_1(Ma)$	$I_2(Ma)$

3.6 RESULT:

3.7 PRE LAB VIVA QUESTIONS:

1. What are ABCD parameters?
2. What are H parameters?
3. What is the other name of ABCD parameter?
4. What is the other name of ABCD parameter?
5. What is the reciprocity and symmetry condition for ABCD parameters
6. What is the reciprocity and symmetry condition for H parameters

3.8 LAB ASSIGNMENT:

1. Find out ABCD parameters for Π network and T network?
2. Find out H parameters for Π network and T network?

3.9 POST LAB VIVA QUESTIONS:

1. Give the relation between ABCD and H parameters.
2. What are the different parameters used to represent two port networks?
3. Represent ABCD parameter in terms of H parameter.

EXPERIMENT – 4

OPEN CIRCUIT CHARACTERISTIC OF A D.C. SHUNT GENERATOR

4.1 AIM:

To determine experimentally the magnetization or open circuit characteristic of a DC Shunt generator and to determine the critical field resistance and critical speed. `

4.2 APPARATUS:

S. No	Item	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostat			
4	Tachometer			

4.3 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

Generator

Voltage	
Current	
Output	
Speed	

4.4 CIRCUIT DIAGRAM:

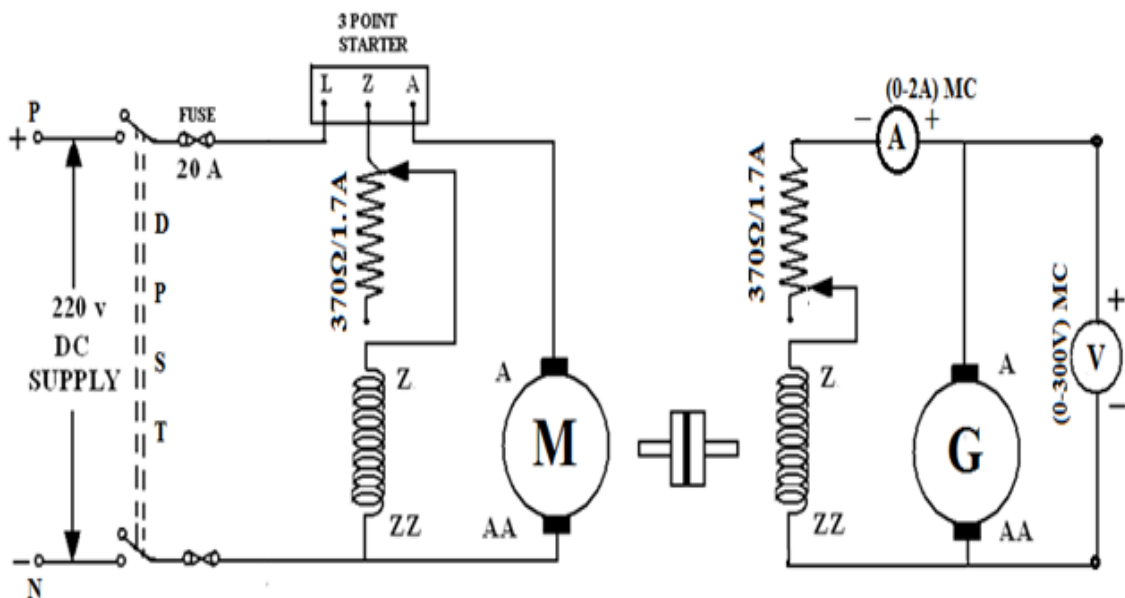


Fig – 4.1 Circuit Diagrams of Open Circuit Characteristics of DC Shunt Generator

4.5 PROCEDURE:

1. Choose the proper ranges of meters after noting the name plate details of the given machine and make the connections as per the circuit diagram.
2. Keep the motor field rheostat (R_{fm}) in the minimum position. The jockey [J] of the potential divider should be at the minimum voltage position [P] and start the MG set.
3. Observe the speed of the generator using a tachometer and adjust to the rated value by varying the motor field rheostat. Keep the same speed through out the experiment.
4. Note down the terminal voltage of the generator. This is the e.m.f. due to residual magnetism.
5. Increase the generator field current I_f (ammeter) by gradually moving the jockey J in the direction P to Q. for every value of I_f , field resistance of the generator note down the corresponding voltmeter reading. Increase the field current till induced e.m.f is about 120% of rated value.
6. Repeat the same procedure for decreasing values of the same field currents (I_{fg}) and finally note down the emf generated due to residual magnetism.
7. Draw the characteristics of generated emf (E_{fg}) versus field current for both increasing and decreasing values of field current. Draw the average O.C.C.
8. Draw a tangent to the initial portion of average O.C.C from the origin. The slope of this straight line gives the critical field resistance

4.6 TABULAR COLUMN:

S. No	ASCENDING		DESCENDING	
	Field current (amp)	Generated voltage (volts)	Field current (amp)	Generated voltage (volts)

4.7 MODEL GRAPH:

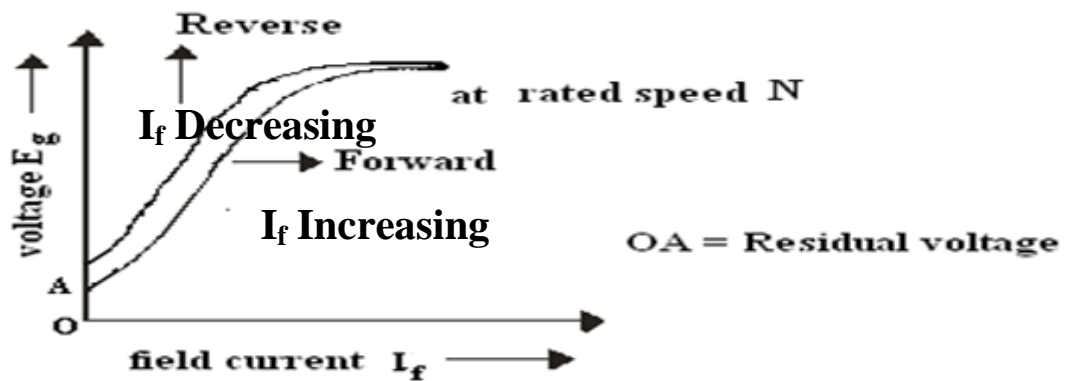


Fig – 4.2 Generated Voltage Vs Field Current

4.8 PRECAUTIONS:

1. The experiment should be done at constant speed.
2. The jockey should be moved only in one direction (i.e., from P to Q or Q to P). It should not be moved back and forth for obtaining a particular field current.
3. At zero field there would be some emf due to residual magnetism.
4. Avoid parallax errors and loose connections.

4.9 RESULT:

4.10 PRE LAB VIVA QUESTIONS:

1. Under what conditions does the DC shunt generator fail to self-excite?
2. OCC is also known as magnetization characteristic, why?
3. How do you check the continuity of field winding and armature winding?
4. How do you make out that the generator is DC generator without observing the name plate?
5. Does the OCC change with speed?

4.11 POST LAB VIVA QUESTIONS:

1. Define critical field resistance.
2. How do you get the maximum voltage to which the generator builds up from OCC?
3. What does the flat portion of OCC indicate?
4. Why OCC does not start from origin?
5. Why is $R_{sh} \gg R_a$ in dc shunt machine?
6. How do you create residual magnetism if it is wiped out?
7. Why does the OCC differ for decreasing and increasing values of field current?

EXPERIMENT – 5

LOAD TEST ON A DC SHUNT GENERATOR

5.1 AIM:

To conduct a load test on a DC shunt generator and to draw its external and internal load characteristics.

5.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

Generator

Voltage	
Current	
Output	
Speed	

5.3 CIRCUIT DIAGRAM:

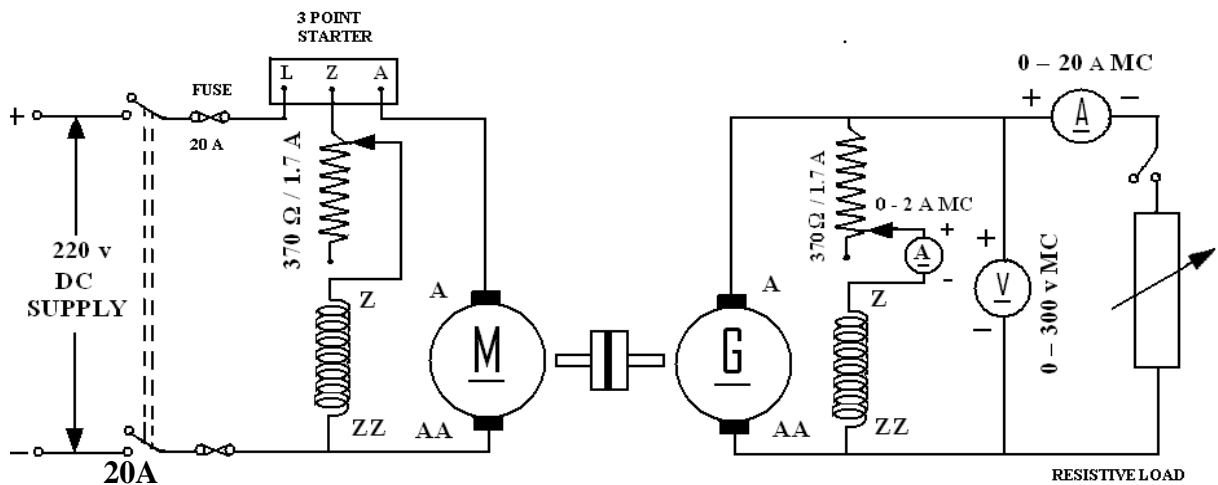


Fig - 5.1 DC Shunt motor - Shunt generator set

5.4 APPARATUS:

S.No.	Item	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostats			
4	Tachometer			

5.5 PROCEDURE:

1. Make the connections as shown in the circuit diagram. Keep the motor field rheostat in the minimum position and the generator field rheostat in the maximum position at starting.
2. Start the MG set and bring it to the rated speed of the generator by adjusting the motor field rheostat. Keep the speed constant at this value throughout the test as the emf generated depends on speed.
3. Adjust the terminal voltage to rated value by means of the generator field rheostat. Keep the rheostat in this position throughout the experiment as its variation changes the field circuit resistance and hence the generated emf.
4. Put on the load and note the values of the load current, I_L ; terminal voltage, V and field current, I_f at different values of the load until full load current is obtained. Calculate the armature current in each case: $I_a = I_L + I_f$.
5. Measure the armature resistance by volt ampere method. Note down the voltage drop V_a across the armature for different values of current I passing through it. Armature resistance in each case is calculated. $R_a = V_a / I$, $R_a (\text{Hot}) = 1.25 R_a$. Take the mean of the values which are close together as the resistance of the armature, R_a .
6. Calculate the generated e.m.f. E at each value of the load current. $E = V + I_a R_a$.
7. Draw external characteristic, V_T versus I_L and internal characteristic, E versus I_L .

5.6 TABULAR COLUMN:

S. No	$I_L(\text{Amp})$	$I_f(\text{Amp})$	$I_a(\text{Amp})$	$V_T(\text{Volt})$	$E(\text{Volt})$
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

5.7 MODEL GRAPH:

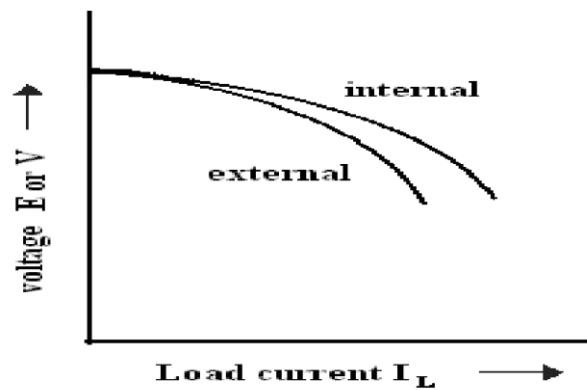


Fig - 5.2 Internal and external characteristics of DC Shunt generator

5.8 PRECAUTIONS:

1. Avoid parallax errors and loose connections
2. Take care while using the starter.
3. The speed should be adjusted to rated speed.
4. There should be no loose connections.

5.9 RESULT:

5.10 PRE LAB VIVA QUESTIONS:

1. Why is the generated emf not constant even though the field circuit resistance is kept unaltered?
2. Find out the voltage drop due to full load armature reaction?
3. State the conditions required to put the DC shunt generator on load.
4. How do you compensate for the armature reaction?
5. What happens if shunt field connections is reversed in the generator?
6. The E.M.F. induced in armature conductors of a DC shut generator is AC or DC?

5.11 POST LAB VIVA QUESTIONS:

1. Specify the applications of DC shunt Generators.
2. Differentiate between DC Shunt Motor and DC shunt Generator.
3. Which method is suitable for testing of high rating DC Generator?
4. Why the terminal voltage decreases when load is increased on the generator?

EXPERIMENT – 6

NO LOAD TEST OF A DC SHUNT MOTOR (SWINBURNE’S TEST)

6.1 AIM:

Determination the efficiency and constant losses of a D.C. Shunt Motor by Swinburne’s method.

6.2 APPARATUS:

S. No	Item	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostat			
4	Tachometer			

6.3 NAME PLATE DETAILS:

Motor

Voltage		Output	
Current		Speed	

6.4 CIRCUIT DIAGRAM:

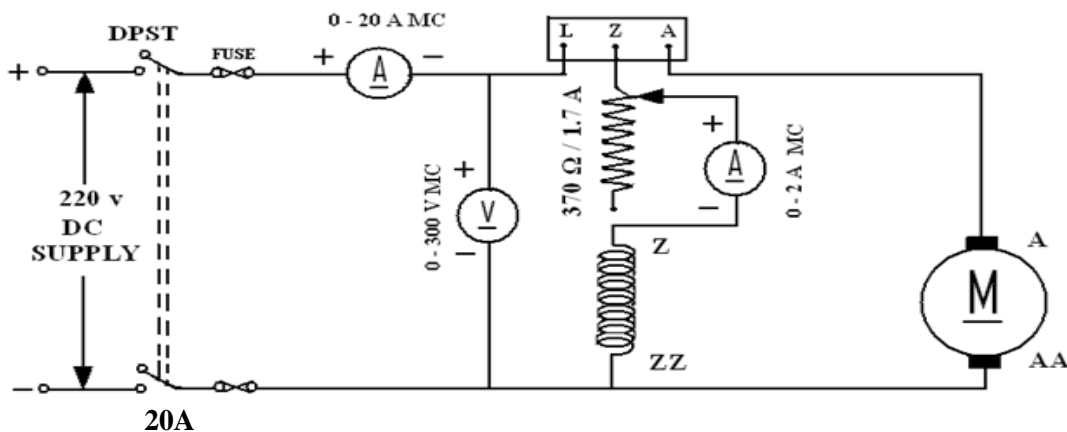


Fig - 6.1 Circuit Diagram of Swinburne’s Test

6.5 PROCEDURE:

1. Choose the proper ranges of meters after noting the name plate details of the given machine and make the connections as per the circuit diagram.
2. Keep the motor field rheostat (R_{fm}) in the minimum position, Start the motor by closing the switch and operating the starter slowly.
3. Run the motor at rated speed by adjusting the motor field rheostat.
4. Note down the voltage, no load current and field current.

6.6 TABULAR COLUMN:

S. No.	V	I_{L0}	I_f

6.7 MODEL GRAPH:

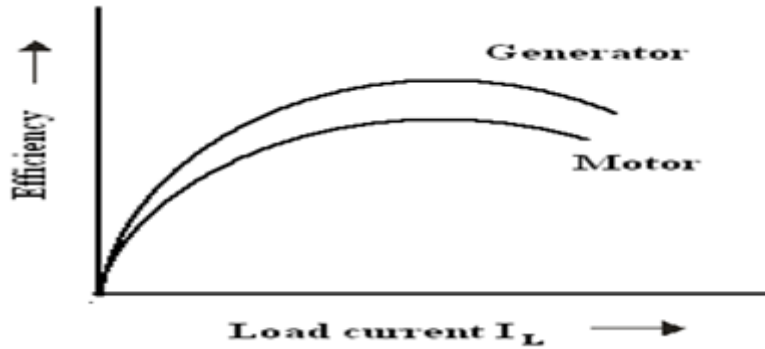


Fig – 6.2 Efficiency curve for Generator and Motor

6.8 CALCULATIONS FOR SWINBURNE’S TEST:

From the no load test results,

Supply voltage = V_L Volts.

No load line current = I_{L0} Amperes.

Field current = I_f Amperes.

Therefore No load Armature Current = $I_{a0} = I_L - I_f$ Amperes.

Resistance cold = R_m

Effective resistance $R_e = 1.25 \times R_m$ ohms.

No load copper losses are $= I_{a0}^2 R_e$

No load power input = $V_L I_L$

Constant losses = (No load power input - No load copper losses). ----- (1)

6.8.1 Efficiency as motor:

Efficiency = output/input = (input – total losses)/ input.

Where total losses = constant losses + variable losses.

Constant losses are known value from the equation (1)

Variable loss = $I_a^2 R_e$, where $I_a = I_L - I_f$

Input = $V_L I_L$. V_L is rated voltage of the machine

Assume line currents (I_L) as 2, 4, 6, ----20A and find corresponding efficiency

6.8.2 Efficiency as generator:

Efficiency = output/input = output / (output + total losses).

Where losses = constant losses + variable losses

Constant losses are same for both motor and Generator

$$\text{Armature Current} = I_a = I_L + I_F$$

$$\text{Variable loss} = I_a^2 R_e$$

$$\text{Output power} = V_L I_L. \quad V_L \text{ is rated voltage of the machine}$$

Assume load currents (I_L) as 2, 4, 6,----20A and find corresponding efficiencies

6.9 TABULAR COLUMN:

As a Motor: Rated voltage $V_L =$ Rated speed $N =$

S. No.	I_L	$V_L I_L$ INPUT Power	Constant losses $W_{const.}$	Copper losses $W_{cu} = I_a^2 R_e$	Total losses = $(W_{cons.} + W_{cu})$	Output power = (input power – losses)	η

As a Generator: Rated voltage $V_L =$ Rated speed $N =$

S. No	I_L	$V_L I_L$ Out power	Constant losses $W_{const.}$	Copper losses W_{cu} $= I_a^2 R_e$	Total loss = $(W_{cons.} + W_{cu})$	Input power = (output power + losses)	η

6.10 PRECAUTIONS:-

1. The experiment should be done at constant speed.
2. The jockey should be moved only in one direction (i.e., from P to Q or Q to P). It should not be moved back and forth for obtaining a particular field current.
3. At zero field there would be some emf due to residual magnetism
4. Avoid parallax errors and loose connections

6.13 RESULT:

6.14 PRE LAB VIVA QUESTIONS:

1. Will the values deduced from the Swinburne's method exactly coincide with the values realized by direct loading on the machine? Why?
2. Why are the constant losses calculated by this method less than the actual losses?
3. Can we conduct Swinburne's test on dc series motor?
4. What are the drawbacks of Swinburne's test?

6.15 POST LAB VIVA QUESTION:

1. Why Swinburne's is used to find efficiency of high rating motors?
2. How you can say that the wattmeter reading in the experiment is constant losses?
3. Why constant losses are constant irrespective of load?
4. Advantage of this test.

EXPERIMENT – 7

BRAKE TEST ON A DC SHUNTMOTOR

7.1 AIM:

To obtain the performance characteristics of a DC shunt motor by conducting brake test.

7.2 APPARATUS:

S. No.	Item	Type	Range	Quantity
1	Ammeter			
2	Ammeter			
3	Voltmeter			
4	Rheostats			

7.3 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

7.4 CIRCUIT DIAGRAM:

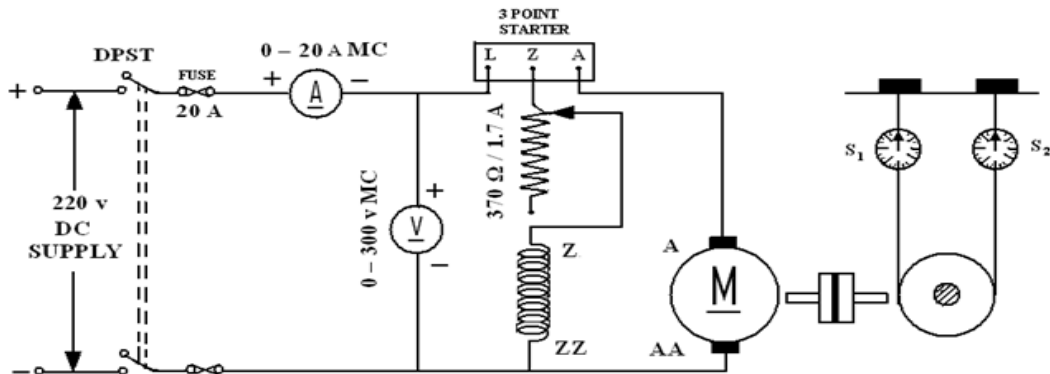


Fig – 7.1 D.C. Shunt Motor with Brake drum arrangement

7.5 PROCEDURE:

1. Make the connections as shown in the circuit diagram.
2. Keeping the field rheostat (R_f) at the minimum position, switch on the supply and start the motor.
3. Adjust the speed of the motor on no load to its rated value by means of the field rheostat. do not disturb the position of the rheostat throughout the test.
4. Put on the load by tightening the screws of the spring balances. Note down the spring tensions, the speed, the voltage and the currents at different loads until full load current obtained.

7.6 CALCULATIONS:

1. Measure the circumference of the brake drum and calculate its radius (r), in meters.
2. Calculate the torque, $T = Wrg$ (N.m). Where $W = W_1 - W_2 =$ spring balance reading (the difference between the spring tensions) and 'g' is acceleration due to gravity i.e.9.81. Calculate the power output of the motor given by $P_0 = 2\pi INT/60$
3. Calculate the input power, $P_1 = V_L(I_L)$ (I_L is the line current = $I_a + I_f$).
4. Calculate the percentage efficiency, $\eta = P_0/P_1 \times 100$
5. Draw the following graphs:

7.7 TABULAR COLUMN:

S.NO	I_L (A)	V_L (V)	W_1 kg	W_2 kg	W (kg) = $W_1 - W_2$	N (RPM)	$T = Wrg$ (N.m)	$P_0 = 2\pi INT/60$	$P_1 = V_L I_L$	$\eta = P_0/P_1 \times 100$
1										
2										
3										
4										
5										
6										

7.8 MODEL GRAPH:

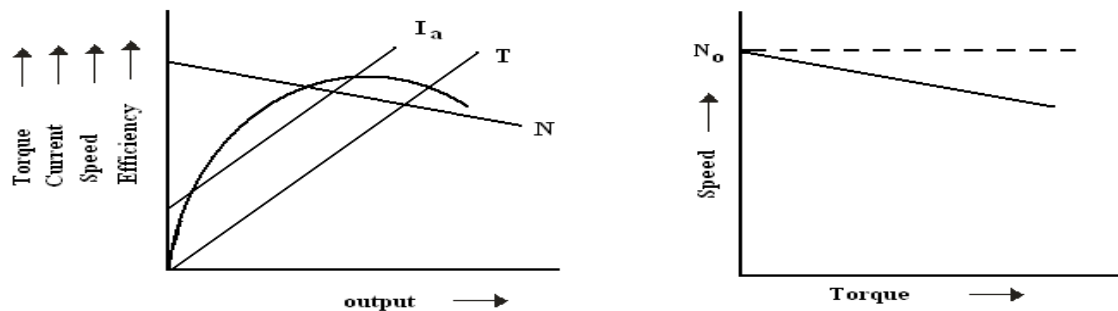


Fig – 7.2 Performance curves

- a) Output Vs η , T, I_a and N in one graph.
- b) Speed Vs Torque.

7.9 PRECAUTIONS:

1. The experiment should be done at constant speed.
2. The jockey should be moved only in one direction (i.e., from P to Q or Q to P). It should not be moved back and forth for obtaining a particular field current.
3. At zero field there would be some emf due to residual magnetism
4. Avoid parallax errors and loose connections

7.10 RESULT:

7.11 PRE LAB VIVA QUESTIONS:

1. Why did you use a 3-point starter for starting a D.C shunt motor?
2. What is the efficiency range of a D.C motor?
3. Where can you use the D.C shunt motor?
4. What is the starting torque?

7.12 POST LAB VIVA QUESTIONS:

1. If starter is not available, how can you start a D.C motor?
2. Why is it considered as a constant speed motor?
3. Why brake test is used to find the efficiency of DC motor?
4. Why the starting torque is low in dc shunt motor?

EXPERIMENT – 8

SPEED CONTROL OF A DC SHUNT MOTOR

8.1 AIM:

To vary the speed of the given D. C. shunt motor by armature control and field control methods and to pre-determine the efficiency of a D.C. shunt motor by Swinburne's method.

8.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

8.3 CIRCUIT DIAGRAMS:

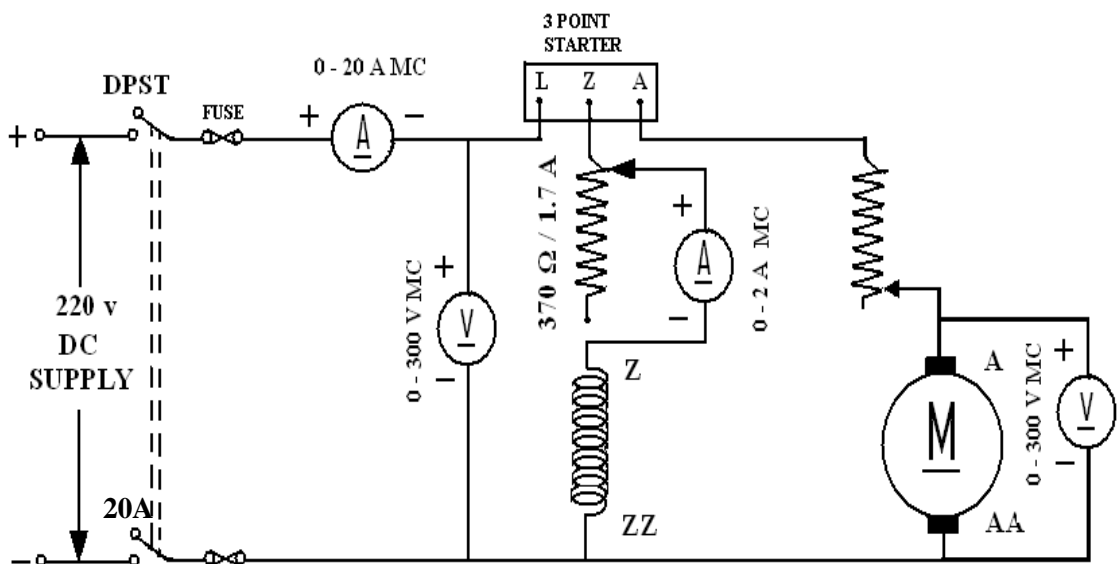


Fig – 8.1 DC Shunt Motor

8.4 APPARATUS:

S.No.	Item	Type	Range	Quantity
1	Ammeter	M.C		
2	Voltmeter	M.C		
3	Rheostat	Wire wound		
4	Tachometer	Digital		

8.5 PROCEDURE OF SPEED CONTROL:

Part - A

Armature Control Method: (below rated speeds)

1. Choose the proper ranges of meters after noting the name plate details of the given machine and make the connections as per the circuit diagram.
2. Keep the motor field rheostat (R_f) in the minimum position and the armature rheostat (R_{as}) in the maximum position, start the MG set.
3. Give supply and accelerate the motor using 3-point starter.
4. Decrease the armature rheostat value and note down speed and induced emf in motor winding.
5. Tabulate these readings and plot the graph E_b Vs N .

Part - B

Field Control Method: (above rated speeds)

1. Maintain the armature rheostat in maximum position and vary the field current (I_f) by varying the field rheostat. Note down the speeds (N) at different values of field current. Take care that the speed doesn't exceed 2000 rpm. Note down the armature voltage also.
2. Tabulate these readings and plot the N Vs I_f describes the field control of motor speed on no load.

8.6 TABULAR COLUMN:

ARMATURE CONTROL METHOD

S. No.	E_b (Volt)	Speed (rpm)
1		
2		
3		
4		
5		
6		

FIELD CONTROL METHOD

S. No.	I_f (Amp)	Speed (rpm)
1		
2		
3		
4		
5		
6		

8.7 MODEL GRAPH:

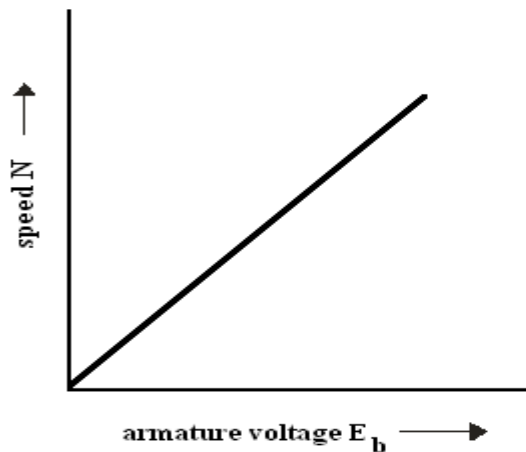


Fig – 8.2 Armature Control

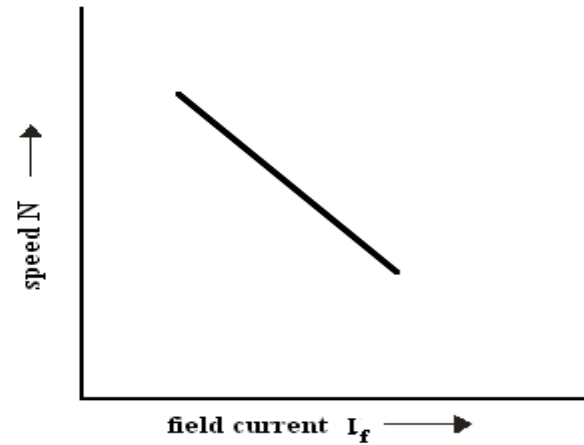


Fig 8.3 Field Control

8.8 PRECAUTIONS:

1. Avoid parallax errors and loose connection.
2. Take care while using the starter.
3. Keep the armature and field rheostats at proper positions.
4. The speed should be adjusted to rated speed.
5. There should be no loose connections.

8.9 RESULT:

8.10 PRE LAB VIVA QUESTIONS:

- 1 Explain why the graph of armature speed control of motor is linear?
- 2 Comment on the efficiency calculated by this method.
- 3 Why do you need a starter in a dc motor?
- 4 What is meant by rated speed?
- 5 Can we start the dc shunt motor and series motor without load?
- 6 What is meant by speed regulation?
- 7 Can we operate a dc motor an ac supply?
- 8 What are the other methods of controlling the speed of dc shunt motor?

8.11 POST LAB VIVA QUESTIONS:

1. How do you change the direction of rotation of a D.C. motor?
2. What is the disadvantage of using armature control of speed on load?
3. What are the limitations of shunt field control?
4. Can we conduct continuity test on ac supply?
5. While running if the field winding gets disconnected, what will happen?
6. What is the shape of the curve of field control of method motor speed? Explain why is it so?

EXPERIMENT – 9

OPEN CIRCUIT & SHORT CIRCUIT TEST ON A SINGLE PHASE TRANSFORMER

9.1 AIM:

To perform open circuit and short circuit test on a single phase transformer and to determine the efficiency, regulation and equivalent circuit of the transformer.

9.2 APPARATUS:

S. No	Equipment	Type	Range	Quantity
1	Voltmeter			
2	Ammeter			
3	Wattmeter			
4	Wattmeter			
5	Connecting Wires			

9.3 TRANSFORMER SPECIFICATIONS:

Transformer Rating :(in KVA) _____

Winding Details:

LV (in Volts): _____

LV side current: _____

HV (in Volts): _____

HV side Current: _____

Type (Shell/Core): _____

9.4 AUTO TRANSFORMER SPECIFICATIONS:

Input Voltage (in Volts): _____

Output Voltage (in Volts): _____

Frequency (in Hz): _____

Current rating (in Amp): _____

9.5 CIRCUIT DIAGRAM:

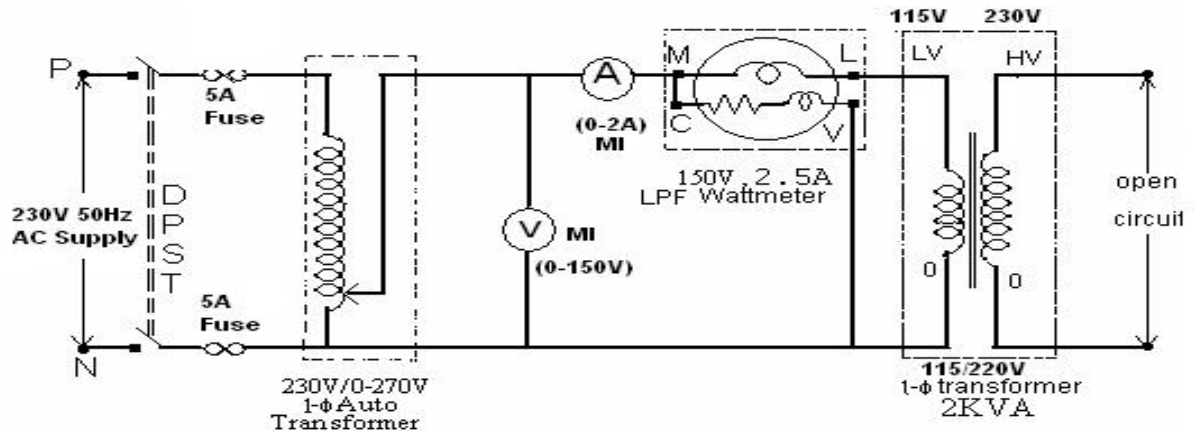


Fig – 9.1 Open Circuit Test

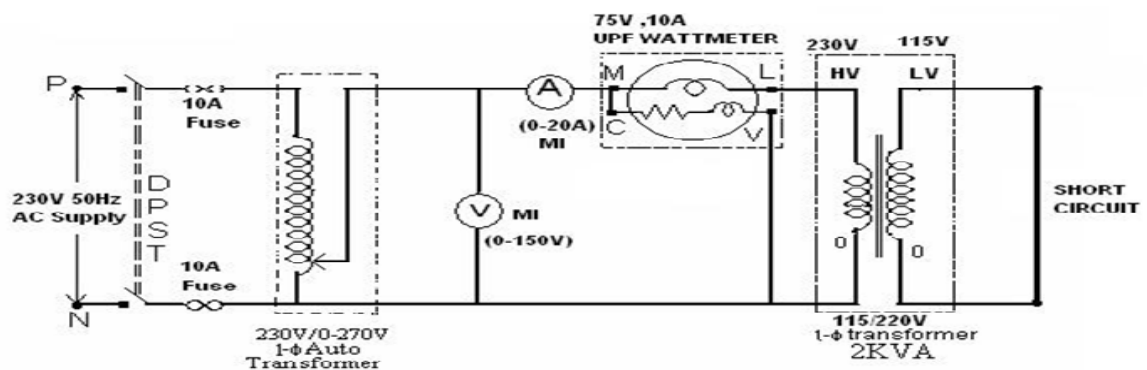


Fig – 9.2 Short Circuit Test

9.6 PROCEDURE:

9.6.1 Open circuit test:

1. Connections are made as per the circuit diagram
2. Ensure that variac is set to zero output voltage position before starting the experiment
3. Switch ON the supply. Now apply the rated voltage to the Primary winding by using Variac
4. The readings of the Voltmeter, ammeter and wattmeter are noted down in Tabular form
5. Then Variac is set to zero output position and switch OFF the supply
6. Calculate R_0 and X_0 from the readings

9.6.2 Short Circuit Test:

1. Connections are made as per the circuit diagram
2. Ensure that variac is set to zero output voltage position before starting the experiment
3. Switch ON the supply. Now apply the rated Current to the Primary winding by using Variac
4. The readings of the Voltmeter, ammeter and wattmeter are noted down in Tabular form
5. Then Variac is set to zero output position and switch OFF the supply
6. Calculate R_{01} and X_{01} from the readings.

9.7 OBSERVATIONS:

For OC test:-

S No.	Voltmeter reading(V _o)	Ammeter reading (I _o)	Wattmeter reading W _o	R _o	X _o	Cos φ _o

For SC test

S. No	Voltmeter reading (V _{sc})	Ammeter reading (I _{sc})	Wattmeter reading W _{sc}	R _{o1}	Z _{o1}	X _{o1}

9.8 MODEL CALCULATIONS:

From OC test:

Iron losses, P_I = P_o watts.

$$\text{No load P.f., } \cos \phi_o = \frac{P_o}{VI_o}$$

Magnetizing current, I_m = I_o Sinφ_o

Loss component of no load current, I_w = I_o Cosφ_o

$$\text{Magnetizing reactance, } X_o = \frac{V}{I_m}$$

$$\text{Equivalent resistance of iron losses, } R_o = \frac{V}{I_w}$$

From SC test:

Full load copper losses P_{Cu} = P_{sc} Watts.

$$\text{Power factor on short circuit, } \cos \phi_{sc} = \frac{P_{sc}}{V_{sc} I_{sc}}$$

$$\text{Short circuit impedance } Z_{o1} = \frac{V_{sc}}{I_{sc}} \Omega.$$

Referred to primary.

$$\text{HT equivalent resistance, } R_{o1} = \frac{P_{sc}}{I_{sc}^2}.$$

$$\text{HT equivalent reactance, } X_{o1} = \sqrt{Z_{o1}^2 - R_{o1}^2}$$

EFFICIENCY: At x times full load and power factor cosφ, output, P_o = x S cos φ kW where S is the KVA rating of the transformer.

$$\text{INPUT} = \text{OUTPUT} + \text{IRON LOSS} + X^2 P_{Cu}$$

$$\text{Percent efficiency, } \eta = \text{OUTPUT} / \text{INPUT} \times 100$$

1. Calculate the efficiency of the transformer at U. P. F. and 0.8 pf and 0.6 pf for $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1 and $1\frac{1}{4}$ full load and draw the characteristics.
2. Calculate the maximum efficiency and the load corresponding to maximum efficiency and compare the result obtained from graph.

REGULATION: Regulation is percent drop in voltage from no load to full load at any power factor due to voltage drops in resistance and leakage reactance of the transformer.

1. Calculate the percent resistance $V_R = I_1 R_1 / V_1 \times 100$ and percent reactance, $V_x = I_1 X_1 / V_1 \times 100$.
2. Calculate the percent regulation, $= V_r \cos \phi + V_x \sin \phi$ at different power factors viz: UPF, 0.8 pf lag & lead 0.6 pf lag & lead and draw the regulation curve.

S.No	p.f.	% reg	
		Lag	Lead

CosΦ = 0.8					
S.No	Load	Wcu (W)	O/P (W)	I/P (W)	□ (%)

9.9 GRAPHS: Plots drawn between

- (i) % efficiency Vs output
- (ii) % Regulation Vs Power factor

CosΦ = 1.0					
S.No	Load	Wcu (W)	O/P (W)	I/P (W)	Percent (%)

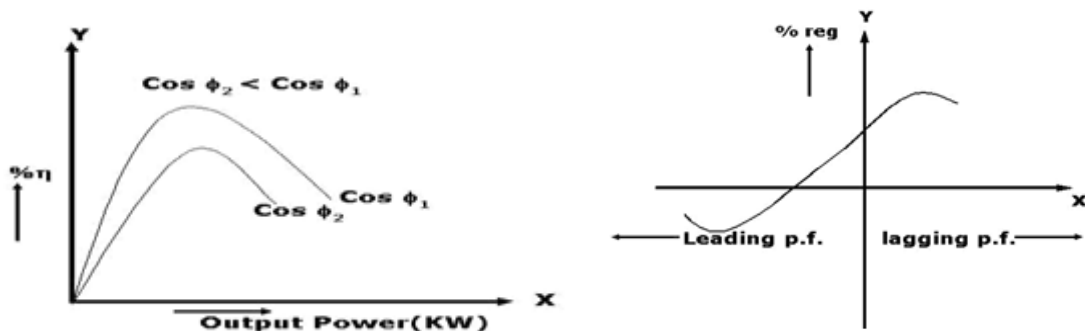


Fig – 9.3 Efficiency and Regulation curves

9.10 PRECAUTIONS:

1. Connections must be made tight
2. Before making or breaking the circuit, supply must be switched off

9.11 RESULT:

9.12 PRE LAB VIVA QUESTIONS:

1. What is the purpose of conducting open and short circuit test?
2. What is Auto transformer?
3. Why the copper losses negligible in OC test?
4. What do you mean by hysteresis loss, Eddy current loss and Copper Loss?
5. Which winding (LV or HV) should be kept open while conducting OC test?

9.13 POST LAB VIVA QUESTIONS:

1. Why short circuit test is performed on transformer?
2. Can we reduce iron losses?
3. Why OC test is done on LV side and SC test is done on HV side?
4. Where the maximum efficiency occur in a transformer?
5. Why transformer efficiency is higher than rotating machines?

EXPERIMENT – 10

LOAD TEST ON A SINGLE PHASE TRANSFORMER

10.1 AIM:

To conduct load test on single phase transformer and to find efficiency and percentage regulation.

10.2 APPARATUS:

S.No.	AIM	Range	Type	Quantity
1	Ammeter			
2	Voltmeter			
3	Wattmeter			
4	Auto Transformer			
5	Resistive Load			
6	Connecting Wires			

10.3 CIRCUIT DIAGRAM:

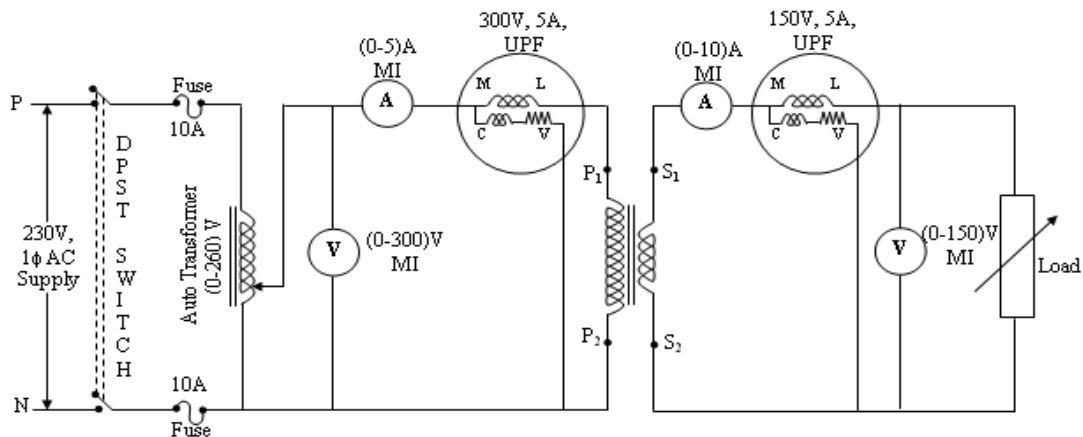


Fig -10.1 Load Test on a Single Phase Transformer

10.4 PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking the no load condition, minimum position of auto transformer and DPST switch is closed.
3. Ammeter, Voltmeter and Wattmeter readings on both primary side and secondary side are noted.
4. The load is increased and for each load, Voltmeter, Ammeter and Wattmeter readings on both primary and secondary sides are noted.
5. Again no load condition is obtained and DPST switch is opened.

10.5 TABULAR COLUMN:

S.No	Load	Primary			Secondary			Input Power W ₁ x MF	Output Power W ₂ x MF	Efficiency η %	% Regulation
		V ₁ (Volts)	I ₁ (Amps)	W ₁ (Watts)	V ₂ (Volts)	I ₂ (Amps)	W ₂ (Watts)				

10.6 FORMULAE:

Output Power = W₂ x Multiplication factor

Input Power = W₁ x Multiplication factor

$$\text{Efficiency } \eta \% = \frac{\text{Output Power}}{\text{Input Power}} \times 100\%$$

$$\text{Regulation R \%} = \frac{V_{NL} - V_{FL} (\text{Secondary})}{V_{NL}} \times 100\%$$

10.7 MODEL GRAPHS:

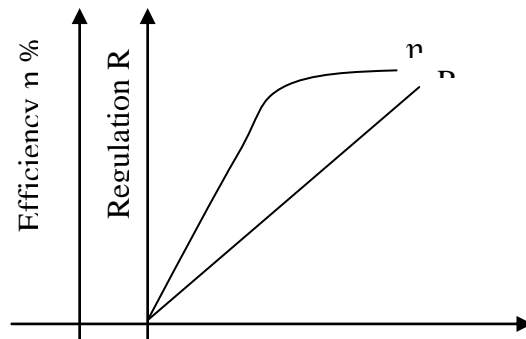


Fig – 10.2 Output Power (Watts)

10.8 PRECAUTIONS:

1. Auto Transformer should be in minimum position.
2. The AC supply is given and removed from the transformer under no load condition.

10.9 RESULT:

10.10 PRE LAB VIVA QUESTIONS

1. What is the purpose of conducting load test?
2. What is Auto transformer?
3. Why the copper losses negligible in OC test?
4. What do you mean by hysteresis loss, Eddy current loss and Copper Loss?
5. Is load test is a direct test or indirect test?

10.11 POST LAB VIVA QUESTIONS

1. Why we use UPF Wattmeter for load test?
2. Can we reduce iron losses?
3. What are performance characteristics of a transformer?
4. Where the maximum efficiency occur in a transformer?
5. Why transformer efficiency is higher than rotating machines?

EXPERIMENT – 11

SIMULATION OF TRANSIENT RESPONSE OF RLC CIRCUITS USING MATLAB

11.1 AIM:

To study the current and voltage in the series and parallel RLC circuit.

11.2 APPARATUS:

S. No	Software Used	Desktop Quantity
1	MATLAB	01

11.3 CIRCUIT DIAGRAMS:

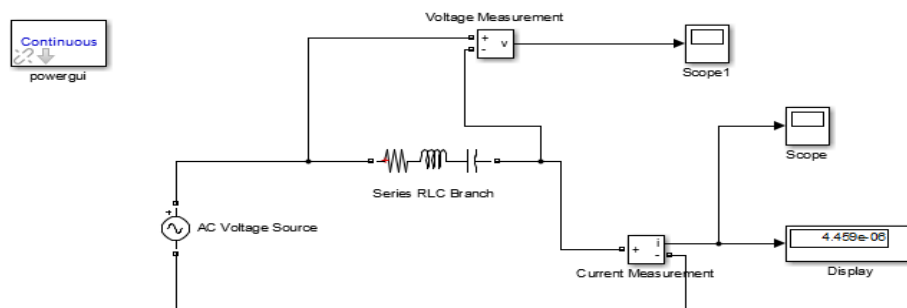


Fig – 11.1 Series RLC circuit

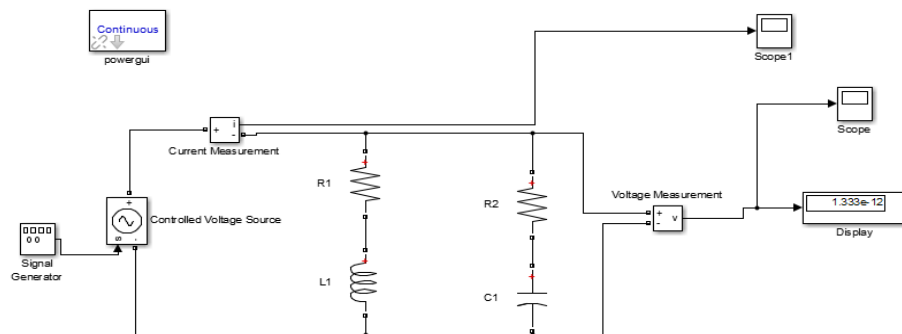


Fig – 11.2 Parallel RLC circuit

11.4 PROCEDURE:

- 1 Make the connections as shown in the figures 8.1 and 8.2 by using MATLAB Simulink.
- 2 Check the voltages and currents wave forms in each circuit.

11.5 RESULT:

11.6 PRE-LAB VIVA QUESTIONS:

1. Define transient response.
2. Define steady state response.
3. If $X_L > X_C$ then the circuit is -----.
4. If $X_L < X_C$ then the circuit is -----.

11.7 POST LAB VIVA QUESTIONS:

1. If $X_L > X_C$ then the nature of response in series circuit is -----.
2. If $X_L < X_C$ then the nature of response in parallel circuit is -----.
3. Application of series RLC circuits
4. Applications of parallel RLC circuits

EXPERIMENT – 12

DESIGN OF LOWPASS AND HIGHPASS FILTER USING DIGITAL SIMULATION

12.1 AIM:

To verify the characteristics of Low pass and High pass filter.

12.2 APPARATUS:

S. No	Software Used	Desktop Quantity
1	MATLAB	01

12.3 CIRCUIT DIAGRAM:

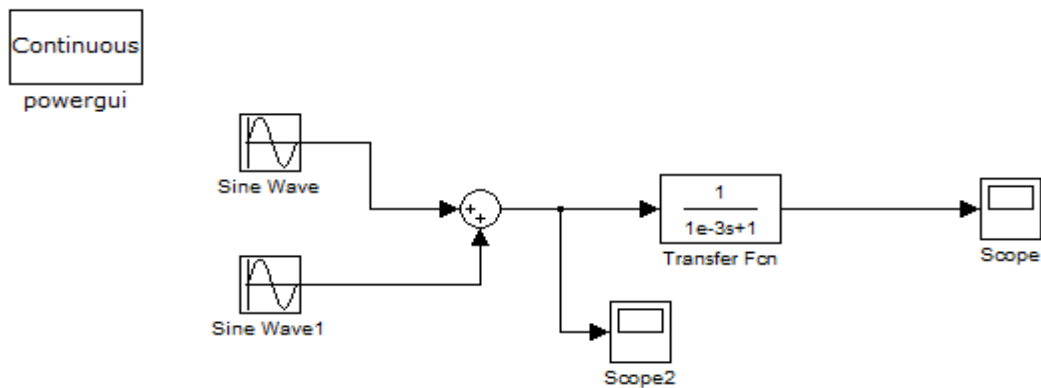


Fig - 12.1 Circuit diagram for analysis of low pass filter

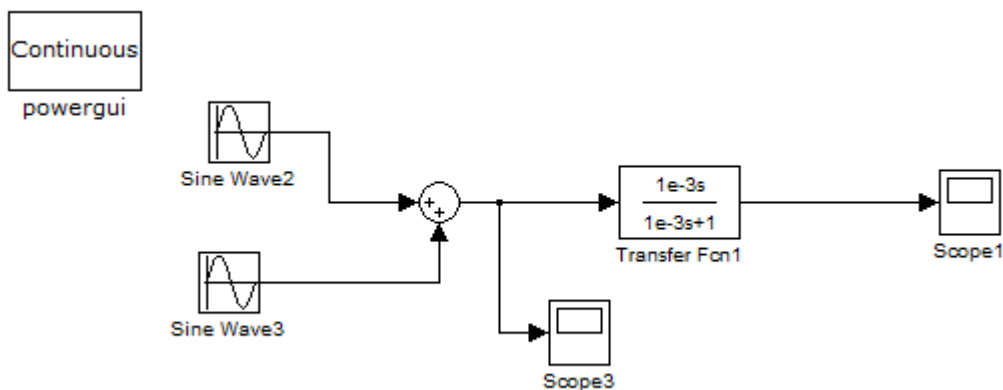


Fig - 12.2 Circuit diagram for analysis of high pass filter

12.4 PROCEDURE:

1. Make the connections as shown in the figures 9.1 and 9.2 by using MATLAB Simulink.
2. Change the parameters of transfer function block.
3. Check the waveform in scope.
4. In low pass filter circuit, you will observe it allows only low frequency sine wave and for high pass filter circuit it allows only high pass frequency sine wave.

12.5 OUTPUT WAVEFORMS:

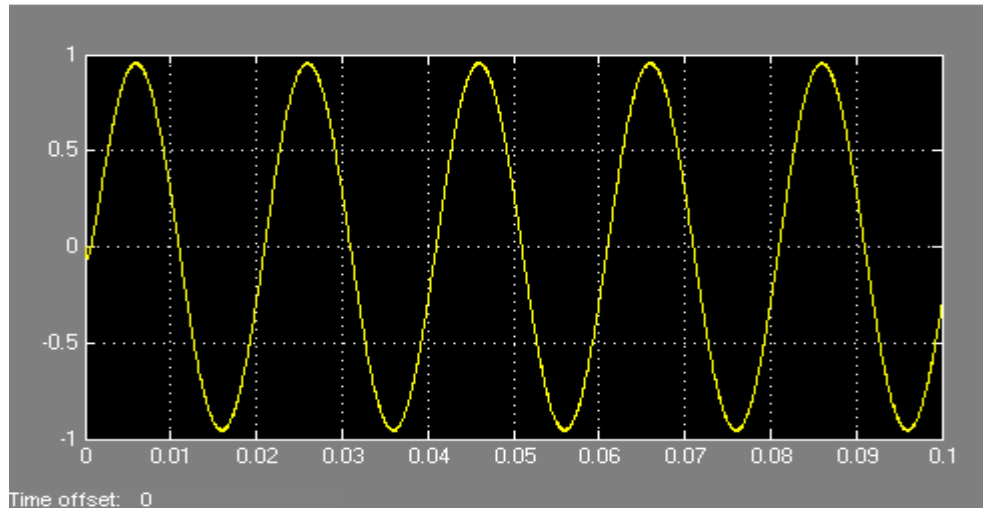


Fig - 12.3 Output waveform for analysis of low pass filter

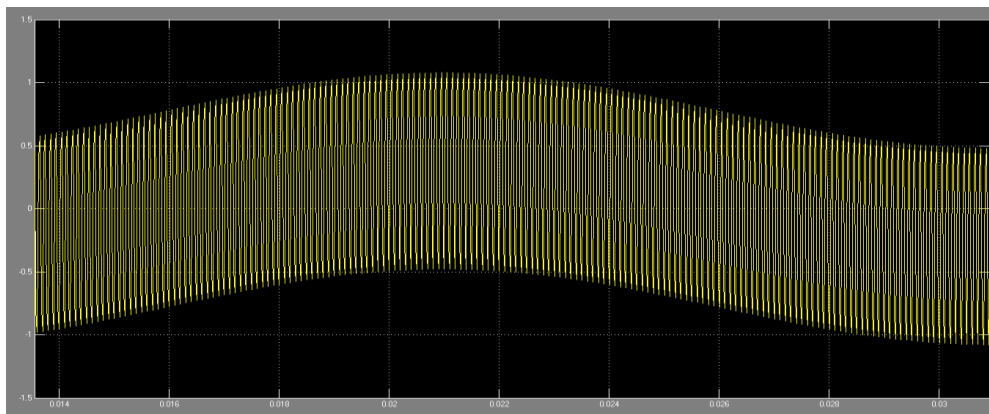


Fig - 12.4 Output waveform for analysis of high pass filter

12.6 RESULT:

12.7 PRE-LAB VIVA QUESTIONS:

1. What is high pass filter?
2. What is low pass filter?
3. What is expression for cut of frequency for line pass or high pass filter?
4. What is frequency response curve?

12.8 POSTLAB VIVA QUESTIONS:

1. When does cut of frequency occur?
2. What does high pass filter generally comprise of?
3. The region between pass band and stop band is called?
4. The rate of change of amplitude with frequency in a filter is?

EXPERIMENT – 13

OPEN CIRCUIT CHARACTERISTIC OF A DC SHUNT GENERATOR

13.1 AIM:

To simulate D.C Shunt generator using simscape power systems and plot the magnetization or open circuit characteristic to determine critical field resistance and critical speed.

13.2 APPARATUS:

S. No	Software	Desktop
1	Simscape power systems	1

13.3 CIRCUIT DIAGRAM:

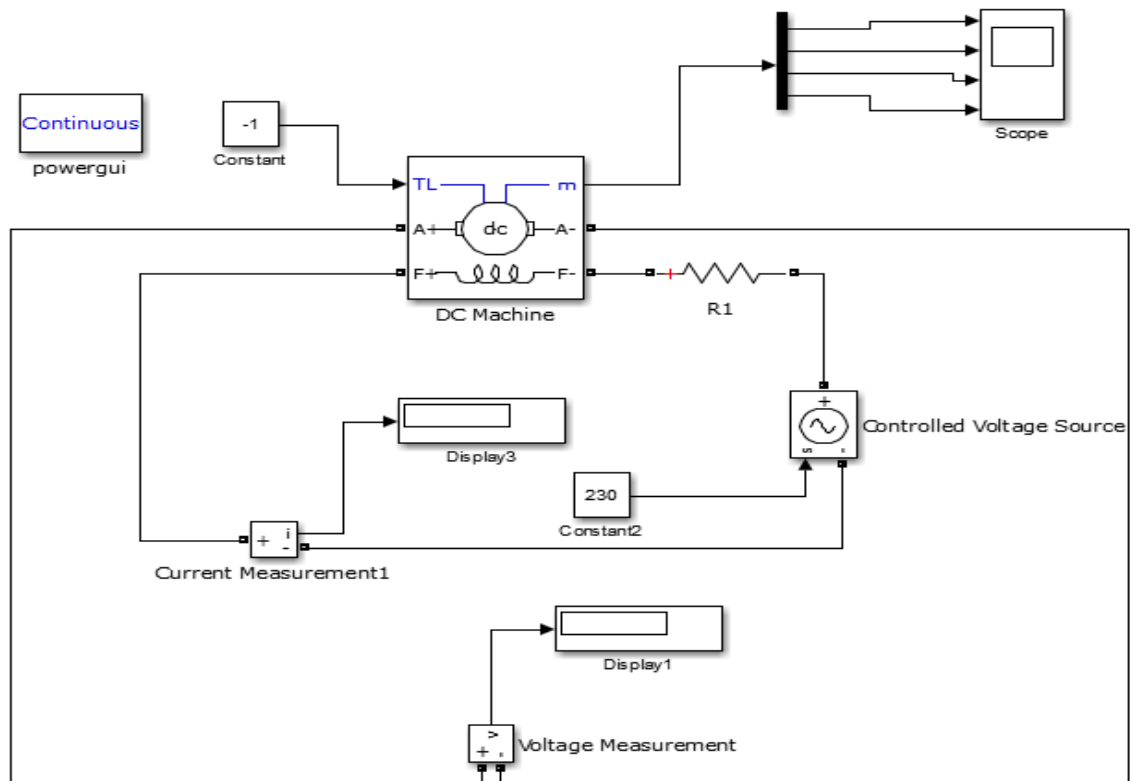


Fig - 13.1 Circuit diagram of open circuit characteristics of DC shunt generator

13.4 PROCEDURE:

1. Connect the circuit as per the figure 13.1 and using simscape power systems and simulate.
2. Note down the readings of ammeter and voltmeter by changing the values of R1
3. Draw the OCC curve plot between I_f and E_g
4. Calculate critical resistance from occ curve.

13.5 TABULAR COLUMN:

S. No	ASCENDING		DESCENDING	
	Field current (amp)	Generated voltage (volts)	Field current (amp)	Generated voltage (volts)

13.6 MODEL GRAPH:

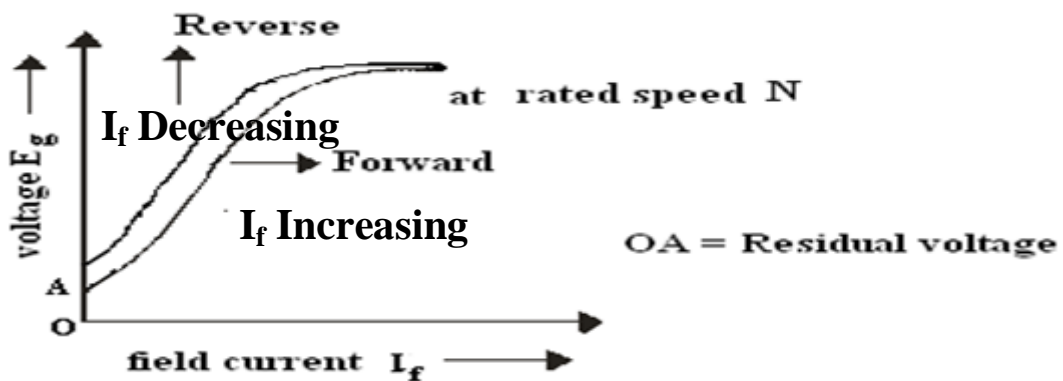


Fig – 13.2 Generated voltage Vs Field current

13.7 RESULT:

13.8 PRE LAB VIVA QUESTIONS:

1. Under what conditions does the DC shunt generator fail to self-excite?
2. OCC is also known as magnetization characteristic, why?
3. How do you check the continuity of field winding and armature winding?
4. How do you make out that the generator is DC generator without observing the name plate?
5. Does the OCC change with speed?

13.9 POST LAB VIVA QUESTIONS:

1. Define critical field resistance.
2. How do you get the maximum voltage to which the generator builds up from OCC?
3. What does the flat portion of OCC indicate?
4. Why OCC does not start from origin?
5. Why is $R_{sh} \gg R_a$ in dc shunt machine?
6. How do you create residual magnetism if it is wiped out?
7. Why does the OCC differ for decreasing and increasing values of field current

EXPERIMENT – 14

LOAD TEST ON DC SHUNT GENERATOR USING SIMSCAPE POWER SYSTEMS

14.1 AIM:

To simulate DC shunt generator using simscape power systems and plot the external characteristics.

14.2 APPARATUS:

S. No	Software	Desktop
1	Simscape power systems	1

14.3 CIRCUIT DIAGRAM:

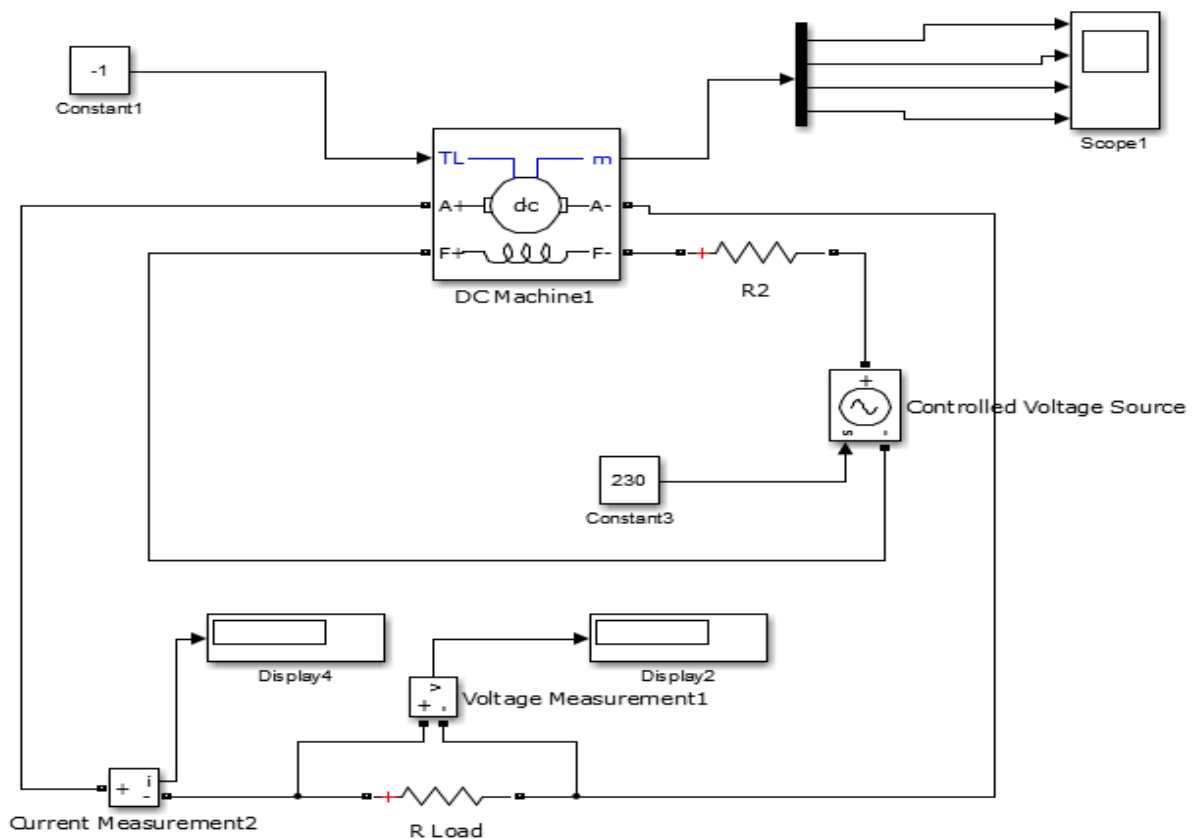


Fig - 14.1 Circuit diagram of load test on DC shunt generator

14.4 PROCEDURE:

1. Connect the circuit as per the figure 14.1 using simscape power systems and simulate
2. Note down the readings of am meter and voltmeter by varying R load in steps.
3. Draw the external characteristics between load current and load voltage.

14.5 TABULAR COLUMN:

S.No	I_L (Amp)	V_L (Volt)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

14.6 MODEL GRAPH:

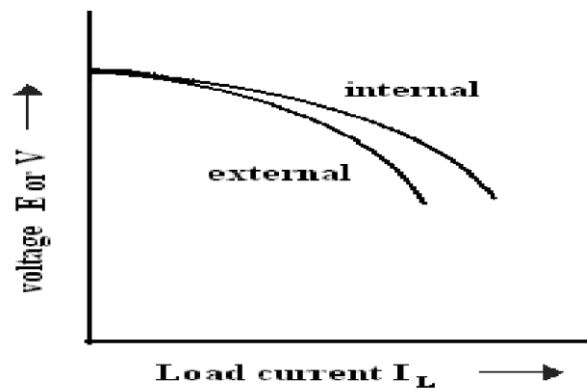


Fig – 14.2 Generated Voltage Vs Field Current

14.7 RESULT:

14.8 PRE LAB VIVA QUESTIONS:

1. Why is the generated emf not constant even though the field circuit resistance is kept unaltered
2. Find out the voltage drop due to full load armature reaction?
3. State the conditions required to put the DC shunt generator on load.
4. How do you compensate for the armature reaction?
5. What happens if shunt field connections is reversed in the generator?
6. The e.m.f. induced in armature conductors of a DC shut generator is AC or DC?

14.9 POST LAB VIVA QUESTIONS:

1. Specify the applications of DC shunt Generators.
2. Differentiate between DC Shunt Motor and DC shunt Generator.
3. Which method is suitable for testing of high rating DC Generator?
4. Why the terminal voltage decreases when load is increased on the generator?