GOVT CO-ED POLYTECHNIC

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LAB MANUAL

Branch : Electrical Engineering

Year & Semester : 2nd Year / 3rd Semester

2025362(024) – Electrical & Electronic Measurements (Lab)

INDEX

S.NO.	Experiment Name	Date	Signature	Grade

EXPERIMENT - 1

CALIBRATION AND TESTING OF SINGLE PHASE ENERGY METER

AIM:

To Calibrate and test the given Single phase energy meter by direct loading.

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APPARATUS:

S.NO	NAME	TYPE	RANGE	QUANTITY
1	Single phase Energy Meter	Induction	1500REV/KWH	1
2	Wattmeter	UPF	300V/5A	1
3	Voltmeter	MI	(0-300)V	1
4	Ammeter	MI	(0-5)A	1
5	Single Phase Variac	1-Ø	230V/ (0-270)V,10A	1
6	Rheostat	WW	110Ω/5A	1
7	Stop Watch	Digital	-	1
8	Connecting Wires	-	-	Required

CIRCUIT DIAGRAM:

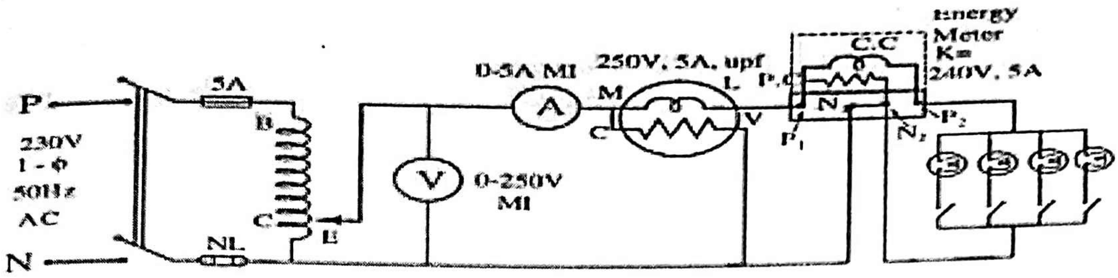

Fig – 1.1 Calibrations and Testing of Single Phase Energy Mete

THEORY:

Induction type of energy meters are universally used for measurement of energy in domestic and industrial a.c. circuits. Induction type of meters possesses lower friction and higher torque/weight ratio. Also they are inexpensive and accurate, and retain their accuracy over a wide range of loads and temperature conditions.

There are four main parts of the operating mechanism:

(i) Driving system

(ii) Moving system

(iii) Braking system and

(iv) Registering system.

Driving System: The driving system of the meter consists of two electro-magnets. The core of these electromagnets is made up of silicon steel laminations. The coil of one of the electromagnets is excited by the load current. This coil is called the 'current coil'. The coil of second electromagnet is connected across the supply and, therefore, carries a current proportional to the supply voltage. This coil is called the 'pressure coil'. Consequently the two electromagnets are known as series and shunt magnets respectively. Copper shading bands are provided on the central limb. The position of these banks is adjustable. The function of these bands is to bring the flux produced by the shunt magnet exactly in quadrature with the applied voltage. **Moving System**: This consists of an aluminium disc mounted on a light alloy shaft. This disc is positioned in the air gap between series and shunt magnets.

Braking System: A permanent magnet positioned near the edge of the aluminium disc forms the braking system. The aluminium disc moves in the field of this magnet and thus provides a braking torque. The position of the permanent magnet is adjustable, and therefore, braking torque can be adjusted by shifting the permanent magent to different radial positions as explained earlier.

Registering (counting) Mechanism: The function of a registering or counting mechanism is to record continuously a number which is proportional to the revolutions made by the moving system. In all induction instruments we have two fluxes produced by currents flowing in the windings of the instrument. These fluxes are alternating in nature and so they produce emfs in a metallic disc or a drum provided for the purpose. These emfs in turn circulate eddy currents in the metallic disc or the drum. The breaking torque is produced by the interaction of eddy current and the field of permanent magnet. This torque is directly proportional to the product of flux of the magnet, magnitude of eddy current and effective radius 'R' from axis of disc. The moving system attains a steady speed when the driving torque equals braking torque.

The term testing includes the checking of the actual registration of the meter as well as the adjustments done to bring the errors of the meter with in prescribed limits. AC energy meters should be tested for the following conditions:

1. At 5% of marked current with unity pf.

2.At 100% (or) 125% of marked current.

3.At one intermediate load with unity pf.

4.At marked current and 0.5 lagging pf.

PROCEDURE:

1. Connect the circuit as per the circuit diagram.

2. Keep the single phase variac at zero volt position.

3. Now switch on the power supply.

4. Gradually vary the variac to apply the rated voltage (230 volts).

5. For different values of load, note down the readings of the ammeter, voltmeter, wattmeter and time taken for 10 revolutions of the disc.

6. Gradually vary the variac to minimum or zero volt position.

7. Switch off the power supply.

8. Calculate observed reading, actual reading, %error, %correction.

9. Draw the graph between Load current (vs) % Error.

TABULAR COLUMN:

S.No.	Voltmeter (Volts)	Ammeter (Amps)	Wattmeter (Watts)	Time for 10 rev(sec)	Theoretical E1	Practical E2=W*t	% Error= (E1-E2)/E2 *100

Theoritical reading = E1

Practical reading = E2

MODEL CALCULATIONS:

Theoritical reading = No. of revolutions / (energy meter constant (k) Where, no. of revolutions = 10

Energy meter constant k=1500 rev/kwh

Practical reading = W *t

%Error = [(E1-E2)/E2] *100

%Correction = - % Error

RESULT:

PRE LAB VIVA QUESTIONS:

1. What is the working principle of energy meter?

2. What type of controlling torque is used in energy meter? 3. What is the purpose of using shading band in energy meter? 4. How does energy meter differ from a watt meter? 5. What is the purpose of brake magnet in energy meter? 6. How braking torque can be adjusted in energy meters? 7. Which type of meter is energy meter?

8. What is creeping? How to avoid error due to creeping? 9. Why aluminum disc is preferred over copper disc? 10. Why induction type energy meter are preferred?

POST LAB VIVA QUESTIONS:

1. What is your understanding of error in energy meter? 2. Can you say on which parameters the energy meter error depends? 3. What type of transformer is used in this circuit?

4. What type of energy meter is used?

EXPERIMENT - 2

CALIBRATION OF DYNAMO METER TYPE POWER FACTOR METER

AIM:

To calibrate dynamometer type power factor meter.

APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1	1-Phase Variac			
2	Power Factor Meter			
3	Ammeter			
4	Voltmeter			
5	Wattmeter			
6	Loads (1 - Ph)			
7	Connecting wires			

CIRCUIT DIAGRAM:

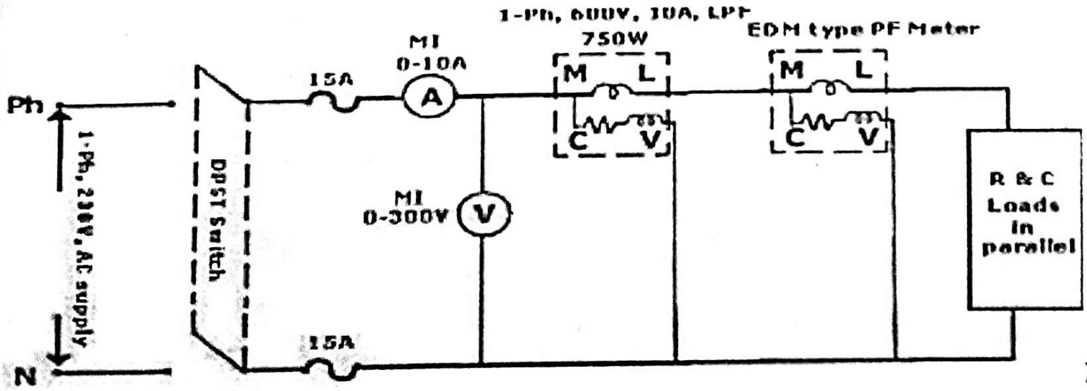

Fig – 2.1

Calibration of Dynamo Meter Type Power Factor Meter

PROCEDURE:

1. Keep the Auto transformer at Zero position

2. Make connections as per Circuit diagram shown below.

3. Switch on the 230 VAC, 50 Hz, Power supply.

4. Increase the input voltage gradually by rotating the auto transformer in clockwise direction 220V.

5. Adjust the load rheostat so that sufficient current flows in the circuit, Please note that the current should be less then 4A.

6. Note down the Voltmeter, Ammeter, Wattmeter and power factor meter readings for different voltage as per the tabular column.

7. Find out the percentage error by using equations.

TABULAR COLUMN:

S. No	Load		Voltmeter Reading (V)	Ammeter Reading (A)	Wattmeter Reading (W)	Power Factor Calculated (X) (CosØ= w/VI)	PF Meter Reading (Y)	% Error (X-Y) *100/Y
	R	L						
1								
2								
3								
4								
5.								

MODEL CALCULATIONS:

Cos Ø (X) = W / VI

% Error = $\frac{X-Y}{Y}$ x 100

RESULT:

PRE LAB VIVA QUESTIONS:

1. What is power factor?

2. Give expression for the PF.

3. What is principle of power factor meter?

4. What is the significance of power factor?

5. What are the different types of power factor meters?

6. Why is moving iron PF meters less accurate than dynamometer type?

7. How the power factor of a single phase circuit is measured?

8. Why is the controlling force not present in the power factor meter?

9. What type of meter is power factor meter?

10. What are the two different coils present in power factor meter?

POST LAB VIVA QUESTIONS:

1. What are the reasons for errors in power factor meters?

2. What are the different remedies to reduce errors in power factor meters?

EXPERIMENT - 3

MEASUREMENT OF RESISTANCE USING KELVIN'S DOUBLE BRIDGE

AIM:

To find the unknown Resistance using Kelvin's double bridge.

APPARATUS:

S. No	Equipment
1.	Educational trainer kit of Kelvin's double bridge
2.	Unknown Resistors
3.	Connecting wires
4.	Galvanometer
5.	D.C Supply

CIRCUIT DIAGRAM:

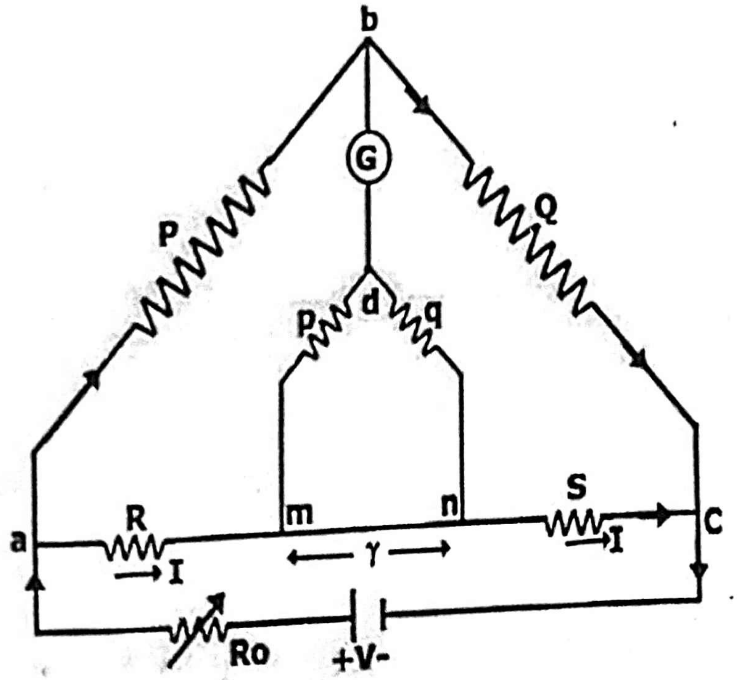

Fig – 3.1 Kelvin's Double Bridge

PROCEDURE:

1. By setting the coil of the galvanometer in free position, the position of pointer is set in the center of the scale by adjusting the zero turning knobs.

2. A galvanometer sensitivity control switches have to increase the galvanometer sensitivity gradually as null-point approaches.

3. The two terminal unknown resistances is measured by connecting +c, +p to one end of the resistance unknown and – c, - p to the other end.

4. After unknown resistance is connected choose the suitable range multipliers depending upon the magnitude of unknown resistance.

5. Get the null point of the galvanometer by depressing the key momentarily only and by depressing the key adjusting the main dial and slide wire.

6. After getting the null point in the galvanometer by placing sensitivity knob in the min position, the resistance is calculated by formula.

TABULAR COLUMN:

S. No.	X Main dial Reading	Y Slide dial Reading	Z Multiple range used	R =unknown resistance
1				
2				
3				

S. No.	Observed Value	Calculated Value	% Error
1			
2			

3			

MODEL CALCULATIONS:

R = (x+ y)z X = Main dial reading

Y = Slide dial reading

Z = multiplier range used for their resistance

$$\% \text{ Error} = \frac{\text{observed value} - \text{Calculated value}}{\text{Calculated value}} \times 100$$

RESULT:

PRE LAB VIVA QUESTIONS

1. What is the value of low resistance?

2. What is the value of high resistance?

3. What is the value of medium resistance?

4. What is the purpose of Kelvin's double bridge?

5. What type of bridge is used to find out the low values of resistance?

6. What type of bridge is used to find out the maximum values of resistance?

7. What is the advantage of Kelvin double bridge when compared Wheatstone bridge? 8. What is the purpose of using r0 in the circuit?

9. What are the precautions should be exercised for the safety of galvanometer. 10. How does a megger differ from ohm meter?

11. What is a megger?

POST LAB VIVA QUESTIONS

1. What happens if the current setting is in reverse direction?

2. Which method is accurate method for the measurement of resistance?

3. How to reduce error in the case Kelvin's double bridge?

EXPERIMENT - 4

CALIBRATION OF PMMC VOLTMETER AND AMMETER BY DC CROMPTON'S POTENTIOMETER

AIM:

To calibrate PMMC Voltmeter and Ammeter by DC Crompton's potentiometer.

APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1	DC Crompton's potentiometer Kit			
2	Standard Cell			
3	2 Channel RPS			
4	Voltmeter			
5	Ammeter			
6	Standard Resistance Box/DRB			
7	Voltage Ratio Box			
8	Galvanometer			
9	Patch Chords			

CIRCUIT DIAGRAM:

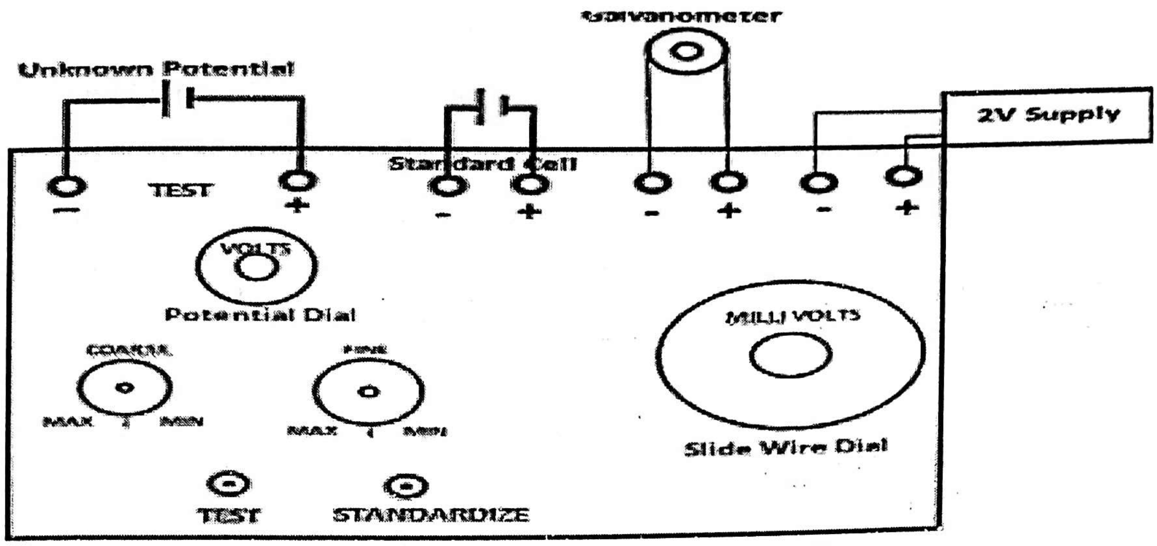

Fig – 4.1 Standardization

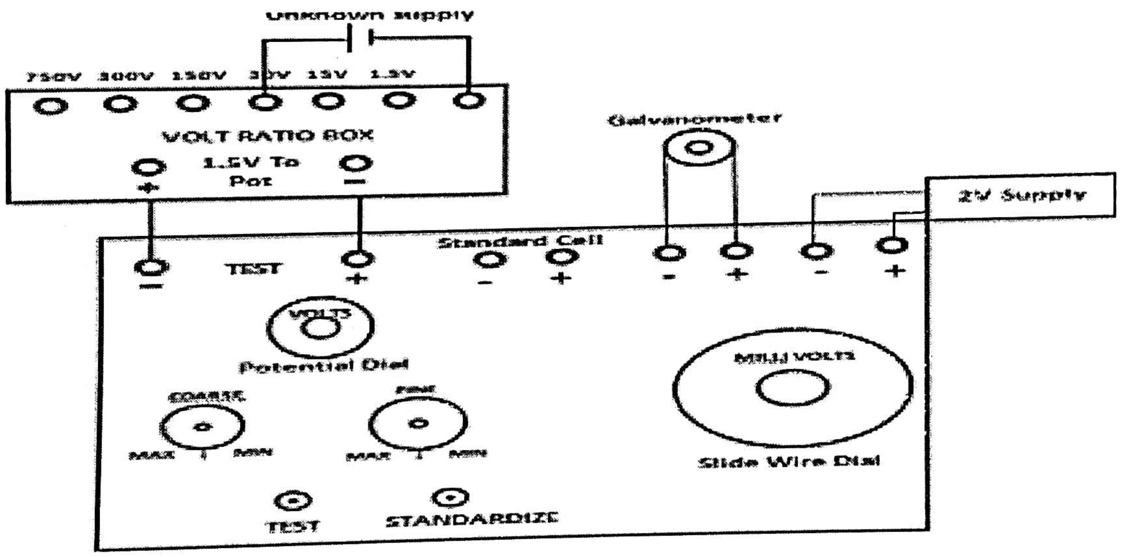

Fig – 4.2 Calibration of Voltmeter

PROCEDURE:

CALIBRATION OF AMMETER:

1. Connections are given as per the block diagram.

2. Adjust the potentiometer voltage dial to 1.0186V and switch on the supply.

3. Observe the deflection in the galvanometer by pressing the standardization knob on the meter kit.

4. If deflection is not zero, then adjust the fine and coarse knobs until there is no deflection in the galvanometer.

5. Now the potentiometer is standardized.

CALIBRATION OF VOLTMETER:

1. Connections are given as per the block diagram.

2. Apply test voltage. Reset the potentiometer dial reading closer to the applied test voltage. 3. Now by pressing the test button observe the deflection in the galvanometer.

4. Vary the dial reading until there is no deflection in the galvanometer.

5. Now note down the readings of Voltmeter, Potentiometer dial and calculate the error. 6. Repeat this procedure for different test voltages and find the error in the voltmeter.

CALIBRATION OF AMMETER:

1. Connections are given as per the block diagram.

2. Apply test voltage up to 30V. Reset the potentiometer dial reading closer to the applied test voltage.

3. Now by pressing the test button observe the deflection in thegalvanometer.

4. Vary the dial reading until there is no deflection in the galvanometer.

5. Now note down the readings of Ammeter, Potentiometer dial, Resistance and calculate the error.

6. Repeat this procedure for different values of Resistance and find the error in the Ammeter.

TABULAR COLUMN: VOLTMETER CALIBRATION:

S. No	**Voltage Reading (V_m)**	**Potentiometer Reading (V_P)**	**% Error**
1			
2			
3			
4			

AMMETER CALIBRATION:

S. No	Resistance (R)ohm	Ammeter Reading (I_m)A	Potentiometer Reading (V_P)V	Current in the circuit (I_c)mA	% Error
1					
2					
3					

MODEL CALCULATIONS: Voltmeter Calibration

% Error in Meter = $[(V_m - V_p)*100]/Vm$

Ammeter Calibration

Current in the circuit $I_c = [V_P/R]$

% Error in Meter = $[(I_m - I_c)*100]/Im$

RESULT

PRE LAB VIVA QUESTIONS

1. What is dc potentiometer?
2. What is ac potentiometer?
3. How DC potentiometer is made direct reading?
4. How the DC potentiometer is is standardized?
5. What is the difference between dc and ac potentiometer?
6. What is polar type potentiometer?
7. What is coordinate type potentiometer?
8. What is difference between polar and coordinate type potentiometer?
9. What is meant by standardization?
10. What is meant by calibration?

POST LAB VIVA QUESTIONS

1. What is the significance of voltage ratio box?

2. What precautions have to be followed in the case of standard cell?

3. How do you choose the standard resistance to be connected in the case of standardcell?

EXPERIMENT - 6

MEASUREMENT OF 3 - PHASE POWER BY USING SINGLE PHASE WATTMETER AND TWO CURRENT TRANSFORMERS

AIM:

To measure 3- phase power by using 1- phase wattmeter and two Current Transformers (CTs).

APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1	Wattmeter			
2	Current Transformers (CTs)			
3	Voltmeter			
4	Ammeter			
5	Resistive Load			
6	Connecting wires			

CIRCUIT DIAGRAM:

Fig - 1

PROCEDURE:

1. Connections are given as per the circuit diagram.
2. Supply is switched on.
3. Apply the different inductive loads
4. The meter readings are noted as per table given.

TABULAR COLUMN:

S. No	Load (A)	Wattmeter Reading (W_L)	Ammeter Reading (I_L)	Voltmeter Reading (V_L)	Active Power
1					
2					
3					
4					
5					

MODEL CALCULATION:

Active power = wattmeter reading*Multiplication Factor of Current Transformer* Multiplication Factor of wattmeter

Power measured by Wattmeter = $3\ V_p I_p \cos\phi$

RESULT:

PRE LAB VIVA QUESTIONS

1. What is electrodynamometer type wattmeter?
2. What is meant by balanced load?
3. What is meant by unbalanced load?
4. What is instrument transformer?
5. Why instrument transformers are used?
6. What is meant by term "burden "of an instrument transformer?
7. What is meant by testing of instrument transformers?
8. What are the different testing methods for a current transformer?

9. Why the secondary of a CT should not be kept open?

10. Where a current transformer is standardized?

POST LAB VIVA QUESTIONS

1. What is the difference between current and potential transformers?

2. How to reduce the losses that occur in the instrumentaltransformers?

3. What are the precautions to be followed while doing the experiment?

EXPERIMENT – 7

C.T. TESTING USING MUTUAL INDUCTOR – MEASUREMENT OF % RATIO ERROR AND PHASE ANGLE OF GIVEN C.T. BY NULL METHOD

AIM:

Conduct an experiment on CT testing using mutual inductor for measurement of % ratio error and phase angle by null method.

APPARATUS:

S. No	Name of Component	Range	Type	Quantity
1	Standard CT			
2	Wattmeter			
3	Ammeter			
4	Rheostat			
5	Load Burden			
6	Single phase Autotransformer			

CIRCUIT DIAGRAM:

Fig – 7.1Circuit diagram of Testing Using Mutual Inductor – Measurement of % Ratio

PROCEDURE:

1. Connect the circuit as shown in the Figure.

2. Primary of CT is connected across a low voltage supply at a non conducting Resistance R_p. 3. The secondary of CT complete the circuit through a variable non-inductive resistanceR_s. 4. The values of R_s & R_p are selected that the ratio of R_s to R_p is approximately equal to nominal ratio of CT.

5. The resistance R_p is adjusted so that full primary current flows while R_s is adjusted so that voltage drop across them are equal.

6. For obtaining Null deflection the magnitude & phase of both the voltage must be same.

TABULAR COLUMN:

S. No					
1					
2					
3					
4					
5					
6					

RESULT:

PRE LAB VIVA QUESTIONS

1. Difference between the CT and PT.

2. What is ratio error?

3. What is phase angle error?

POST LAB VIVA QUESTIONS

1. What is meant by mutual inductance?

2. What are types of testing of CT's?

3. What is meant by absolute method?