

Daffodil Institute of Technology

Diploma-in-Electrical Technology

6th semester

Responsible Teacher: Hasan Murad Munna (Jr. Instructor of Electrical Technology)

66751	Electrical & Electronic Measurement-I	T P C
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OBJECTIVES

Upon completion of this contents students will be able to achieve and acquire knowledge, skill and attitude in the area of Electrical and Electronic measurement-1 with special emphasis on;

- ☒ Accuracy, precision, sensitivity and error in electrical measuring instruments.
- ☒ Concept of operation of different types of electrical measuring instruments.
- ☒ Selection of correct type of meters for particular measurement.
- ☒ Measurement of power of single phase and three phase system.
- ☒ Concept of operation of energy meter.

SHORT DESCRIPTION

Fundamentals of measurements; Indicating instruments; Digital instruments; Current & voltage measuring instruments; Measurement of electrical power; Energy meters.

DETAIL DESCRIPTION

Theory:

1. Recognize the basic concept of measurements.
 - 1.1 Define measurements of electrical quantities.
 - 1.2 Discuss significance of measurements.
 - 1.3 Describe the terms accuracy, precision, sensitivity and resolution or discrimination.

- 1.4 Distinguish between accuracy and precision.
- 1.5 Demonstrate errors in measurements.
- 1.6 State true value, loading effect. static error or absolute error, relative error, static correction, limiting error and percentage limiting error.
- 1.7 Describe the loading effects due to shunt connected instruments.
- 1.8 Explain the loading effects due to series connected instruments.
- 1.9 Solve problems related to errors in measurement.
2. Interpret the classification of measuring instrument.
 - 2.1 Describe measuring instrument.
 - 2.2 Name different types of measuring instruments.
 - 2.3 Demonstrate absolute and secondary instruments.
 - 2.4 List secondary instruments according to their mode of operation and functions.
 - 2.5 Explain indicating, recording and integrating instruments.
 - 2.6 Describe the various effects of current or voltage utilized in measuring instrument upon which their operation depends.
3. Understand the principle of operation of indicating instruments.
 - 3.1 List different types of torque applied in indicating instrument which act upon their moving system.
 - 3.2 Describe deflecting torque and controlling torque.
 - 3.3 Explain spring control and gravity control system.
 - 3.4 Distinguish between spring control and gravity control system.
 - 3.5 Explain damping torque.
 - 3.6 State different types of damping systems.
 - 3.7 Compare air friction damping, fluid friction damping and eddy current damping
 - 3.8 Solve problems related to spring control and gravity control system.
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 4. Perceive the constructional features of measuring instruments.
 - 4.1 Name the essential parts of measuring instruments.
 - 4.2 Describe the parts of the instrument such as supporting, moving system, balancing, permanent magnets, pointer, scale, zero-adjuster, cases, etc.

- 4.3 Discuss the torque weight ratio.
- 4.4 Explain the principle of operation of ammeter and voltmeter.
- 4.5 Distinguish between the working principle of ammeter and voltmeter.
- 4.6 List the various types of ammeter and voltmeter.
- 5. Interpret the principle of operation of moving iron instruments.
 - 5.1 Describe the construction and working principle of moving iron attraction type instruments.
 - 5.2 Derive the torque equation of moving iron attraction type instruments.
 - 5.3 Describe the construction and working principle of repulsion type moving iron instrument.
 - 5.4 Derive the torque equation of repulsion type moving iron instrument.
 - 5.5 List the advantages and disadvantages of moving iron instruments.
 - 5.6 Discuss errors in moving iron instruments.
 - 5.7 Solve problems related to of moving iron instruments.
- 6. Conceive the principle of operation of moving coil instruments.
 - 6.1 Describe the construction and working principle of permanent magnet moving coil instruments.
 - 6.2 Derive the torque equation of the moving coil instrument.
 - 6.3 Mention the advantages and disadvantages of permanent magnet moving coil instruments.
 - 6.4 Describe the construction and working principle of dynamometer type moving coil instruments.
 - 6.5 Indicate the arrangement of coils of dynamometer type instruments for measurements of current and voltage.
 - 6.6 Discuss the errors of moving coil instruments.
 - 6.7 Solve problems related to torque equation of moving coil instruments.
- 7. Understand the principle of operation of electrostatic voltmeter.
 - 7.1 Describe the construction and working principle of a quadrant type voltmeter.
 - 7.2 Describe the construction and working principle of attracted disc type voltmeter.
 - 7.3 Mention the advantages of electrostatic voltmeter.
 - 7.4 List the limitations of electrostatic voltmeter.
 - 7.5 Mention the uses of electrostatic voltmeter.
- 8. Recognize the operation of dynamometer type wattmeter.
 - 8.1 Describe the construction and principle of operation of dynamometer type wattmeter.

- 8.2 List the advantages of dynamometer type wattmeter.
- 8.3 Specify the disadvantages of dynamometer type wattmeter.
- 8.4 Compare induction type wattmeter with dynamometer wattmeter.
- 9. Conceive the operation of induction type wattmeter.
 - 9.1 Describe the construction of induction type wattmeter.
 - 9.2 Describe the principle of operation of induction type wattmeter.
 - 9.3 List the advantages of induction type wattmeter.
 - 9.4 List the disadvantages of induction type wattmeter
- 10. Interpret the concept of measurement of single phase power.
 - 10.1 Derive the equation, $P = EI \cos\phi$.
 - 10.2 Demonstrate the circuit diagram connecting wattmeter in a single phase circuit.
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- 10.3 Explain the errors involved in connecting wattmeter in a single phase circuit.
- 10.4 Mention the function of compensating coil in wattmeter connection.
- 10.5 Solve problems on error calculation in single phase power measurement.
- 11. Apply the principle of power measurement in three phase circuit.
 - 11.1 List the method for the measurement of power in three phase circuit.
 - 11.2 Describe the method for measurement of three phase power by two wattmeter.
 - 11.3 Derive the equation for power and power factor in two wattmeter method.
 - 11.4 Describe the method of three phase power measurement by one watt meter.
 - 11.5 Describe the method of 1- ϕ reactive power measurement by single phase VAR meter.
 - 11.6 Describe the method of 3- ϕ reactive power measurement.
 - 11.7 Solve problems for the calculation of power and power factor.
- 12. Recognize the operation of energy meter.
 - 12.1 Describe the principle of operation of energy meter.
 - 12.2 List the different types of energy meter.
 - 12.3 Explain the working principle of motor meter.
 - 12.4 Describe the construction and working principle of mercury motor meter.
 - 12.5 Explain mercury meter modified as watt hour meter.

- 12.6 Explain the friction compensation in mercury motor meter.
- 12.7 Describe the construction and working principle of induction motor meter.
- 12.8 Explain errors in induction motor meter.
- 12.9 Describe working principle of poly phase induction type energy meter.
- 12.10 Sketch the connection diagram of poly phase induction type energy meter.
- 13. Perceive the concept of testing of energy meter.
- 13.1 Explain the necessity of testing of energy meter.
- 13.2 List the apparatus required for testing of energy meter.
- 13.3 State the methods of testing of energy meter.
- 13.4 Explain the short period testing using a standard wattmeter.
- 13.5 Solve problems related to energy meter testing.
- 14. Conceive the concept of digital instrument and digital display.
- 14.1 Explain the principle of operation of digital instruments.
- 14.2 Describe the advantages of digital instruments.
- 14.3 Compare digital instruments with the Analog instruments.
- 14.4 Mention the different types of digital display system.
- 14.5 Describe seven segment display and 3×5 dot matrix display.
- 14.6 Demonstrate the construction of liquid crystal display.
- 14.7 Express the operation of gas discharge plasma display.
- 14.8 Explain resolution in digital meter and sensitivity of digital meters.
- 15. Interpret the concept of digital voltmeter and digital energy meter.
- 15.1 Explain the operation of transistor voltmeter (TVM).
- 15.2 Describe the operation of ramp type digital voltmeter (RDVM).
- 15.3 Enumerate the operation of successive approximation digital voltmeter.
- 15.4 Describe the principle of operation of digital single phase energy meter
- 15.5 Describe the block diagram of a digital single phase energy meter
- 15.6 Explain the principle of operation of digital three phase energy meter
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- 15.7 Describe the block diagram of a digital three phase energy meter.

15.8 Explain the basic information about prepaid metering system.

PRACTICAL:

1. Find various types of measuring instruments.

1.1 Select at least eight different measuring instruments.

1.2 Identify the types of given instruments for measuring electrical quantities.

1.3 Observe the ranges of instruments.

2. Study the operation of indicating, integrating, recording and digital instruments.

2.1 Choose one indicating, one integrating, one recording and one digital instrument.

2.2 Select the tools and materials required.

2.3 Connect each instrument to the supply system with proper load, if necessary.

2.4 Observe the operation of moving system of each instrument.

3. Observe the parts of different types of measuring instruments.

3.1 Select two types of measuring instruments.

3.2 Disassemble the magnet, moving iron parts, controlling and damping parts, pointer, scale and case.

3.3 Analyze the balancing system of the moving parts.

3.4 Assemble the parts as original.

4. Select the correct type of ammeter and voltmeter.

4.1 Collect some ammeters and voltmeters.

4.2 Collect required numbers of tools to open ammeters and voltmeter.

4.3 Disassemble the parts of the instrument.

4.4 Identify the controlling and damping system.

4.5 Identify the parts of the meter.

4.6 Identify the types of meter.

4.7 Reassemble the meters

5. Study the wattmeter.

5.1 Select proper tools and wattmeter.

5.2 Disassemble the different parts of the wattmeter.

5.3 Identify the different parts of the wattmeter.

5.4 Identify the types of wattmeter.

5.5 Reassemble the wattmeter.

6. Measure the single phase power by ammeter, voltmeter and wattmeter.

6.1 Sketch the circuit diagram for measuring single phase power by ammeter, voltmeter and wattmeter.

6.2 List and collect tools, equipment and materials required.

6.3 Prepare the circuit according to the circuit diagram using necessary equipment.

6.4 Check the circuit before energizing.

6.5 Record the meter readings.

6.6 Calculate the power and power factor from the data obtained.

6.7 Determine error from calculation.

6.8 Draw vector diagram from the data obtained.

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7. Measure the three phase power by two wattmeter method.

7.1 Draw the circuit diagram for measuring power by two wattmeter of a three phase system.

7.2 List and collect tools, equipment and materials for the experiment.

7.3 Prepare the circuit according to the circuit diagram using required equipment.

7.4 Check the circuit before energizing.

7.5 Record the reading from the meters.

7.6 Calculate the power and power factor.

7.7 Determine error from calculation.

7.8 Draw vector diagram using relevant data as obtained.

8. Measure the three phase power by one wattmeter method.

8.1 Sketch the circuit diagram for measuring power by one wattmeter of a three phase system.

8.2 List and collect tools, equipment and materials for the experiment.

8.3 Prepare the circuit according to the circuit diagram using proper equipment.

8.4 Check the circuit before energizing it.

8.5 Record the reading from the meter.

8.6 Calculate the power.

8.7 Draw vector diagram using relevant data as obtained.

9. Study the different parts of an energy meter.

9.1 Select one energy meter and tools required.

9.2 Disassemble the different parts of the energy meter.

9.3 Identify the parts of the meter.

9.4 Identify the type of the energy meter.

9.5 Reassemble the meter.

10. Measure the energy of a single phase circuit by energy meter.

10.1 Sketch the circuit diagram for measuring energy in a single phase circuit by energy meter.

10.2 Select tools, equipment, materials and a load.

10.3 Connect the equipment as per the circuit diagram.

10.4 Record reading from the meter.

11. Measure the energy of a three phase circuit by a three phase energy meter.

11.1 Sketch the circuit diagram.

11.2 Select and collect tools, equipment, materials and a three phase load.

11.3 Connect the equipment according to the circuit diagram.

11.4 Record reading from the meter.

12. Test an energy meter for finding its error.

12.1 Draw the circuit diagram for testing an energy meter.

12.2 Select an energy meter and one wattmeter.

12.3 Select and collect tools, equipment and materials for the experiment.

12.4 Prepare the circuit according to the circuit diagram.

12.5 Record reading from the meter.

12.6 Calculate the error from the reading.

13. Measure the energy of a single phase circuit by single phase digital energy meter.

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13.1 Sketch the circuit diagram.

13.2 Connect the equipment as per the circuit diagram.

13.3 Record the reading from the meter.

14. Measure the energy of a three phase circuit by single phase digital energy meter.

14.1 Sketch the circuit diagram.

14.2 Connect the equipment as per the circuit diagram.

14.3 Record the reading from the meter.

REFERENCE BOOKS

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3. Measurement & Measuring Instruments - Goldings
4. A course in Electrical and Electronic measurements and instrumentation - A. K. Sawhney.
5. A Text Book of Electrical Technology - B.L. Theraja
6. Electric Instrumentation - H. S. Kals