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EE-302

B. TECH.**THIRD SEMESTER EXAMINATION, 2003-2004
ELECTRICAL MEASUREMENT & MEASURING
INSTRUMENTS**

Time : 3 Hours

Total Marks : 100

Note : Answer **ALL** the Five questions.1. Answer any **FOUR** parts of the following :— (5×4=20)

(a) Explain the terms :

(i) Resolution (ii) Linearity

(iii) Hysteresis (iv) Drift

(v) Repeatability

(b) Describe the difference between deflection type and null type of instruments giving suitable examples. Discuss about their accuracy, sensitivity and suitability for dynamic measurements.

(c) Draw the possible methods of connections of the pressure coil of a wattmeter and compare the errors.

An electrodynamic wattmeter has a pressure coil of resistance 8,000 Ω and inductance of 63.6 mH, which is connected directly across the load carrying current of 8 A at voltage of 240 V, 50 Hz and power factor of 0.1 lagging. Estimate the percentage error in wattmeter reading.

- (d) A permanent magnet moving coil type full-wave bridge rectifier ammeter is used to measure current in a load connected across a supply of voltage

$$v = 5 \sin \theta + 0.6 \sin 3 \theta$$

Determine the reading of the ammeter, if its resistance is 30Ω . Assume dynamic resistance of each diode as 35Ω under forward biased condition.

- (e) Describe the three-ammeter method for measurement of power and power factor in a single-phase circuit. Derive the expressions for power and power factor.
- (f) What are the various types of errors encountered in electrical measurements? Discuss them in brief.
2. Answer any TWO parts of the following :— (10×2=20)

- (a) Differentiate between current transformer and potential transformer. How does a current transformer differ from an ordinary power transformer?

A current transformer has a single turn primary and a 200 turns secondary windings. The secondary winding supplies a current of 5A to a non-inductive burden of 1Ω resistance. The requisite flux is set up in the core by an mmf of 80 A. The frequency is 50 Hz and the net cross-section of the core is 1000 mm^2 .

Calculate the ratio and phase angle of the transformer. Also, find the flux density in the core. Neglect the effects of magnetic leakage, iron losses and I^2R losses.

- (b) Explain construction and working of the saturable core frequency-meter giving its merits and demerits.
- (c) Explain the following :—
- (i) Why is moving iron power factor meter less accurate than dynamometer type ?
 - (ii) What happens if the secondary of a current transformer is open circuited, while the primary carries the rated current ?
3. Answer any TWO parts of the following :— (10×2=20)
- (a) What do you understand by low, medium and high resistances ? What are the problems associated with the measurement of low resistances and how are they overcome in Kelvin's double bridge ? Derive an expression for the unknown resistance in case of Kelvin's double bridge.
- (b) In a four-arm bridge network, the arm AB consists of an imperfect condenser, BC and CD are non-reactive resistances of 1000Ω each and DA is a standard capacitor of $0.0115 \mu\text{F}$ capacitance in series with a resistance of 140Ω . If the bridge is balanced for frequency $\omega = 7500$ radians/sec., find the shunt-less resistance and capacitance of the imperfect condenser. Derive the equations used, if any.
- (c) Describe the substitution method of measurement of medium resistances. List the factors on which the accuracy of the method depends.

In a measurement of resistance by the substitution method, a standard resistance of

100 k Ω is used. The galvanometer has a resistance of 2,000 Ω and gives the following deflections :—

(i) with unknown resistance : 46 divisions.

(ii) with standard resistance : 40 divisions.

Find the value of unknown resistance.

4. Answer any TWO parts of the following :— (10 \times 2=20)

(a) Describe, with the help of a neat sketch, the working of a modern dc potentiometer and explain how it can be used for calibration of voltmeter.

(b) Explain the construction and principle of working of a co-ordinate a.c. potentiometer. Draw a diagram of scheme of connections and describe how the potentiometer is standardised.

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(i) In a measurement of resistance by potentiometer, the voltage drops across a resistor under test and across a 0.02 Ω standard resistor were found to be 0.735 V and 0.98 V respectively. Determine the value of resistance under test.

(ii) Calculate the inductance of a coil from the following measurements on an a.c. potentiometer :—

Voltage drop across 0.1 Ω standard resistor connected in series with the coil is 0.613 $\sqrt{12^{\circ}6}$ V, voltage across the test coil through a 100/1 volt-ratio box is 0.781 $\sqrt{50^{\circ}48}$ V, frequency is 50 Hz.

5. Answer any FOUR parts of the following :— (5×4=20)

- (a) Explain calibration of Ballistic galvanometer by means of a standard solenoid.
- (b) Explain the difference between $3\frac{1}{2}$ digit and 4 digit displays.
- (c) Explain the principle of frequency measurements using digital techniques. 0
- (d) A flux-meter is connected to a search coil of 100 turns and the mean area of the coil is $5 \times 10^{-4} \text{ m}^2$. The search coil is placed at the centre of a standard solenoid, 1 metre long, uniformly wound with 800 turns. When a current of 5 A is reversed, a deflection of 10 scale divisions is obtained with the flux-meter. Calculate the calibration constant of the instrument in wb-turns per division.))
- (e) With the help of block diagram, explain the working of a harmonic analyzer.
- (f) A $4\frac{1}{2}$ digit voltmeter is used for voltage measurements :
- (i) Find its resolution.
- (ii) How would 12.75 V be displayed on 10 V range ?
- (iii) How would 0.7525 V be displayed on 1 V range ?
- (iv) How would 0.7525 V be displayed on 10 V range ?

