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B. TECH

THIRD SEMESTER EXAMINATION, 2002-2003

ELECTRICAL MEASUREMENTS & MEASURING INSTRUMENTS

: 3 Hours   Total Marks : 100

: (1) Attempt **ALL** questions.

(2) Parts of a question must be attempted together.

Attempt any FOUR of the following :—

(a)   Differentiate clearly between :   (5)

   (i)   Direct and Indirect methods of measurement.

   (ii) Primary and Secondary standards.

   (iii) Systematic and Random error in measurements.

(b)   Show the constructional features of both types of Moving Iron instruments.

   Derive the torque equation for any one type.   (5)

(c)   Calculate the necessary values of resistors to be provided using Aryton's multiranging method so that a d.c. m-Ammeter having a basic movement with $R_m = 40\,\Omega$ and full-scale current of 1 mA can be used for measuring currents in the range of 10 mA, 50 mA.   (5)

(d)   Derive the equation for average power over a cycle. Prove that it can be measured by a electrodynamometer type of wattmeter.   (5)

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(e) Draw connection diagram and vector diagram for power measurement in a 3ϕ load using 2-wattmeter method.

A 3ϕ 400 volt load has p.f. of 0·6 lagging. The two wattmeters read a total input of 20 kW. Find the reading of each watt-meter. (5)

(f) How is the torque produced in a single phase induction type energymeter? An energymeter with constant of 100 makes 365 revolutions when connected to a load carrying 40A at 230 volts and 0·5 p.f. (lagging) for an hour. Find the error in measurement. (5)

2. Attempt any FOUR of the following :—

(a) Derive the relation for transformation ratio in a Current Transformer (C.T.).
What are the characteristics of C.T.? (5)

(b) A C.T. with turn ratio of 1:201 is rated as 1000/5 A, 25 VA. The core loss and the magnetising components of primary are 3 A and 7A under rated conditions. Find the ratio and phase errors for full burden at 0·8 p.f. leading.
Secondary winding resistance and leakage may be neglected. (5)

(c) Derive the expression for ratio error in Potential Transformers (P.T.). How are P.T.s tested? Describe. (5)

(d) With the help of neat labelled diagram, explain the principle of operation of single phase electrodynamometer type of power-factor meters. (5)

(e) Explain the arrangement and operation of saturable core type of frequency meter. **(5)**

(f) What is the principle of operation and application of :

(i) Synchoscope,

(ii) Phase sequence indicator ? **(5)**

). Attempt any TWO of the following :—

(a) What is the principle of using loss of charge technique for measurement of high resistance ? Derive necessary relation.

A length of cable was tested for insulation resistance using loss of charge method. A capacitance formed by sheath of cable of 300 pF is found to have a drop in voltage from 300 V to 100 V in 120 seconds. Calculate the insulation resistance of the cable. **(10)**

(b) (i) In a Wheatstone bridge, for the measurement of resistance, derive the relation for sensitivity of bridge, with detecting galvanometer in operation. **(5)**

(ii) For a bridge, as above, the ratio arms are each 100 Ω and bridge is balanced with standard arm adjusted to 230 Ω. If each of the ratio arms have an accuracy of $\pm 0.02\%$ and standard has $\pm 0.01\%$ accuracy guaranteed, what are the limiting values of unknown resistance ? **(5)**

(c) For Anderson's bridge, derive the relation for unknown impedance.

What are the advantages and limitations of this bridge ? **(10)**

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4. Attempt any TWO of the following :—

    (a) (i) What is the procedure of standardisation of d.c. potentiometers ? (5)

    (ii) How can it be used for calibration of ammeters and voltmeters? (5)

    (b) (i) Explain the arrangement, standardisation and operation of a.c. coordinate type of potentiometer. (6)

    (ii) How can these be used for calibration of voltmeters ?

    (c) Write technical notes on any TWO of the following :— (5+5)

    (i) Principle and application of self-balancing potentiometers.

    (ii) Calibration of Wattmeters by potentiometer.

    (iii) Direct reading potentiometers

5. Attempt any TWO of the following :—

    (a) Derive the relation, for measurement of flux by fluxmeter, from first principle.

    How is it modified for measurement of large flux ? Explain. (10)

    (b) Detail the following two methods of obtaining B-H curve of given ring specimen :

    (i) using Ballistic galvanometer,

    (ii) using C.R.O. (5+5)

    (c) (i) Explain clearly the difference between operating principles of integrating type and successive approximation type of digital voltmeters. (5)

(i) An analog voltage of 10 volts is to be measured digitally. Find the minimum number of bits and actual resolution to have an accuracy better than 0.01% and conversion time for a clock frequency of 10 kHz assuming successive approx type of DVM.

(5)