NEW SCHEME

IT35

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Third Semester B.E. Degree Examination, January/February 2004

Instrumentation Technology

Electrical & Electronic Measurements

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Discuss briefly on these : i) SI Units ii) Dimensional Equations & iii) Limitations of wheat-stone's Bridge method of measurement of medium resistances. (6 Marks)

   (b) Derive the dimensional equation for resistance-R, Inducatnce-L & Capacitance-C. Hence check for the dimensional correctness of the expression below, obtained for inductance from AC bridge measurements. Point out the error, if any, in the expression and suggest the required correction that makes the expression dimensionally valid.

   $$L = C(R_3/R_4)(R_2 + R_4 + R_2R_4)$$

   (8 Marks)

   (c) A Wheat-stone's bridge circuit arrangement is as follows : Ratio arms: 100 Ω and 10Ω, standard resistance 4Ω and the test resistance 50Ω. Calculate the unbalanced current in the galvanometer of internal resistance 20Ω, when the supply voltage is 10 Volts. Also find the value of unknown resistance corresponding to the null reading by galvanometers. (6 Marks)

2. (a) Derive the balance equation of Kelvin Double Bridge and hence obtain an expression for the unknown low resistance under measurement. (6 Marks)

   (b) Derive the balance equations of the Schering Bridge circuit configuration used for measurement of capacitances and hence arrive at the expression for loss angle of the test capacitor. Draw the phasor diagram at balance. (8 Marks)

   (c) An AC bridge circuit for measurement of effective inductance and capacitance of an iron cored coil is as follows: arm AB: the unknown impedance, arm BC: a pure resistance of 10Ω, arm CD: a loss free capacitance of $1\mu F$ and arm AD: a capacitance of $0.135\mu F$ in series with 842Ω resistance. Obtain the balance equations of the bridge and determine the unknown parameters in the arm AB. (6 Marks)

3. (a) Discuss briefly on the shunts and multipliers used for range extension of meters in electrical measurements. (6 Marks)

   (b) A moving coil meter takes 25 mA to produce full-scale deflection and the resistance of the meter is 10Ω. Design a suitable scheme so as to use the instrument as an ammeter, reading 0-20 Amps and as a voltmeter, reading 0-120 Volts. (6 Marks)

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(c) A Potential Transformer with a nominal ratio of 2000/100 V, Ratio Correction Factor of 0.995 and a phase angle of 22' is used with a current transformer of nominal ratio 100/5 A, Ratio Correction Factor of 1.005 and a phase angle error of 10', to measure the power (I_s $leads I_p$) to a single phase inductive load. The meters connected to these instrument transformers read correct readings of 102 Volts, 4 Amperes and 375 Watts. Determine the true values of voltage, current and power supplied to the load. (8 Marks)

4. (a) Write a note on the turns compensation used in instrument transformers. (5 Marks)

(b) With a neat diagram, explain the construction and working principle of a single-phase induction type energy meter. (8 Marks)

(c) For a 20 A, 230 V Energy meter, the number of revolutions per kWH is 480. If upon test at full load, the disc makes 40 revolutions in 66 seconds, determine the error in time taken by the meter disc as a percentage of metered valued. Is the meter running slow or fast? Comment. (7 Marks)

5. (a) Explain the advantages of electronic energy meters over the conventional disc type induction energy meters. (5 Marks)

(b) By stating the importance of each of the special features incorporated, explain how a Low Power Factor wattmeter is realized. (5 Marks)

(c) Explain the construction and working of : i) Phase Sequence Indicators ii) Electro dynamometers type Power Factor meters. (10 Marks)

6. (a) Discuss about the working principle of digital voltmeter employing the successive approximation technique. (8 Marks)

(b) Discuss on the different practical methods of connection the unknown components to the test terminals of a Q - meter. (6 Marks)

(c) Write the sketches for different types of force summing devices. (6 Marks)

7. (a) With a neat sketch, explain the un-bonded strain gage. (6 Marks)

(b) Briefly explain the working of LVDT used in displacement measurements. Why is a phase sensitive detector employed along with the LVDT? (8 Marks)

(c) Explain with block diagram, the essential functional operations of a digital data acquisition system. Compare the digital and analog forms of data acquisition systems. (6 Marks)

8. (a) Explain the interfacing of frequency counter with IEEE-488 BUS, with the help of a block diagram. (7 Marks)

(b) Write a brief note on the sources and detectors used for fibre optic measurements. (7 Marks)

(c) Discuss on the stabilized and calibrated light source that is used for fibre optic measurements. (6 Marks)

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