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Third Semester B.E. Degree Examination, January/February 2006

Common to EC/TC/IT/BM/ML

Electrical and Electronics Measurements

Time: 3 hrs.)

(Max.Marks : 100)

Note: Answer any FIVE full questions.

1. (a) It is suspected that an error has been made in the derivation of the expression

$$I = \frac{\omega M C}{\sqrt{(\omega^2 M^2 + R_1 R_2)^2 + \omega^2 L_1 R_1^2}}$$

for the current in a circuit, in terms of voltage E, angular velocity ω , mutual inductance M, self inductance L_1 and resistances R_1 & R_2 . Ascertain if this is so and, if necessary, make a correction to ensure that the equation is dimensionally correct. (8 Marks)

- (b) Explain with the help of a neat sketch the theory and principle of operation of Kelvin Double bridge for the measurement of low resistance. (8 Marks)

- (c) A low resistance is measured by Kelvin Double bridge. At bridge balance following readings are obtained.

$$P = Q = p = q = 500\Omega$$

$$S = \text{Standard resistance} = 0.001\Omega$$

Calculate the value of the low resistance. (4 Marks)

2. (a) Draw a neat sketch to explain the theory and measurement of unknown inductance and resistance by Anderson Bridge. What is type of null detector used in this bridge? What are the sources of errors? (8+2=10 Marks)

- (b) Draw the phasor diagram at bridge balance. (4 Marks)

- (c) An Anderson bridge is arranged as follows :

Branch AB is an inductive resistor; branches BC and ED are variable non-reactive resistors; branches CD and EA are non-reactive resistors of 200Ω each; branch CE is a $1 - \mu F$ capacitor. The supply is connected between A and C while the detector is connected between B and E. Balance is obtained when the resistance of BC is 400Ω and that of DE is 500Ω .

Calculate the resistance and the inductance of the bridge. (6 Marks)

3. (a) Derive, by drawing neat phasor diagram, the expressions of ratio error and phase angle error of a current transformer. What is the material of the core of a current transformer? (8+2=10 Marks)

- (b) What happens if the secondary of a CT is open circuited while the primary is carrying normal load current? (4 Marks)

- (c) A 50 Hz CT has a bar primary and a 200 turn secondary. The latter supplies a non-inductive ammeter of
- 1Ω
- resistance with a normal current of 5A. The flux requires 80 AT

i) Calculate the maximum core-density for a core of 10 sq cm cross section.

ii) Calculate current ratio and phase angle.

Neglect winding resistance and reactance. (3+3=6 Marks)

4. (a) Explain, with the help of neat sketch, the theory and construction of a 1-phase induction type energy meter. (8 Marks)
- (b) What are sources of errors in this instrument and how are they eliminated? (4 Marks)
- (c) A 240V, 5A, 1-phase energy meter has a registration constant of 1200 revolutions per kWh. It is tested by means of a 240V, 5A wattmeter having 500 scale divisions which can be read to 0.1 division and a stop watch, which can be read to 0.01 second having negligible error. When tested at full load, the meter makes 40 revolutions in 99.8 seconds. If the human error in timing be taken as ± 0.05 second, estimate the limits within which the error of the meter may lie. The wattmeter is accurate to within 0.05% of its full scale reading. (8 Marks)
5. (a) Explain the principle of operation of low power factor wattmeter. (10 Marks)
- (b) Explain the principle of operation of any one type of phase sequence indicator. (10 Marks)
6. (a) Explain with the help of block diagram the function of integrating type digital voltmeter. (8 Marks)
- (b) Explain the principle of operation of electronic multimeter. (6 Marks)
- (c) A $5\frac{1}{2}$ digit DVM is used for voltage measurements.
- i) Determine its resolution.
- ii) How would 11.95 V be displayed on 10V range and 1V range? (6 Marks)
7. (a) Explain the principle of operating of LVDT in translating a linear motion into an electrical signal. (8 Marks)
- (b) What are the advantages and disadvantages of LVDT? (6 Marks)
- (c) The output of a LVDT is connected to a 5V voltmeter through an amplifier of amplification factor of 200. An output of 3 mV appears across the terminals of the LVDT when the core moves through a distance of 0.5mm. The millivoltmeter scale has 100 divisions and can be accurately read to 1/5 of a division.
- i) Calculate the sensitivity of the LVDT
- ii) Calculate the sensitivity of the whole set up
- iii) Calculate the resolution of the instrument. (6 Marks)
8. (a) Explain the working of IEEE 488 electrical interface towards testing of computer controlled instrumentation system. (10 Marks)
- (b) Explain the principle of operation of fibre optic power measurements. (10 Marks)

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