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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APR / MAY 2014

ELECTRICAL & ELECTRONICS ENGINEERING
Fourth Semester
EE 8404 Electrical Measurements and Instrumentation
(Regulation 2012)

Time : 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. What is special about the saturated Weston cell?
2. Distinguish between accuracy and precision?
3. What is 'creeping' in an induction disc type energy meter? How is it avoided?
4. "Neither control spring nor gravity control is employed in a power factor meter" – Still, how does it operate?
5. What are the two types of Moving Iron Instruments? Distinguish between them.
6. What is the type of damping employed in PMMC meters? Why is this method of damping not employed in electrodynamometer type instruments?
7. Draw the circuit diagram of a megohm bridge?
8. What is a transducer? Give two examples for resistive transducers.
9. What is 'burden' of a current transformer?
10. Just draw the construction diagram of a Weston frequency meter?

Part – B (5 x 16 = 80 marks)

11. i) Along with a neat sketch of constructional diagram and derivation for deflection torque developed, explain either PMMC type or electrodynamometer type d.c. ammeter.
ii) Given two concentric cylindrical metal plates (inner cylinder having an outer radius of 'r' and the outer cylinder having an inner radius of 'R'), suggest a scheme for level measurement of a non-conducting liquid employing the concept of capacitive transducer. Ignoring edge effects, show that the change in capacitance is proportional to the change in liquid level. (8 + 8).

12. a) i) What is an 'LVDT'? Discuss how an LVDT can be used for displacement measurement?.
ii) Explain how a rotary shaft encoder can be used for measurement of angular position. (10 + 6)

OR

b) i) Draw a block diagram showing the functional elements of an instrumentation system and illustrate the significance of each element by considering 'Bourdon tube' as example.
ii)Show that σ^2 = (Mean of Squares) – (Square of mean). Use it to solve : The average mark of a class of 70 students is 73.45. The standard deviation is 6.54. One of the students, who has scored 87 marks discontinues studies. Find the new standard deviation for the remaining class of 69 students. Remember that σ is to be calculated by considering deviations from the new average.
iii) The iron loss test is conducted on a 1-Φ transformer by maintaining the peak flux density constant and keeping same form factor. The total iron

losses at different frequencies are : 15W @ 20 Hz, 38W @ 40Hz and 66W @ 60Hz. Evaluate the hysteresis and eddy current losses separately at 50Hz. (5 + 6 + 5)

13. a) i) What is an 'RTD'? List the materials popularly used in RTDs and also indicate the temperature ranges for which each of them is used?
ii) Obtain expressions for the slope and y-axis intercept of the best fitting straight line, based on the concept of Least Mean Square technique. How would you use this concept for fitting expression of the form: $R_T / R_0 = a \exp(b/T)$, which is the characteristics of a thermister? R_T - is the resistance at a temperature of T^O K; and, R_0 – is the resistance at a temperature of 0^O C or 273^O K. Evaluate a and b, using curve fitting concepts, with the following data:

Temperature T^OK	273	313	323	373
Resistance ratio R_T / R_0	1.0	0.264	0.20	0.061

(6 + 10)

OR

b) i) What is a strain gauge? What are its types? Discuss how unbonded metal strain gauge can be employed for the measurement of force.
ii) An electrically deflected CRT has a final anode voltage of 1800 V and parallel deflecting plates 1.5 cm long and 5 mm apart. If the screen is 50 cm from the centre of deflecting plates, find the deflection sensitivity of the tube. (10+6)

14. a) i) Derive an expression for the bridge sensitivity of the Wheatstone bridge?
ii) In a Wien's bridge, two capacitors of equal values of C1=C2=0.47μF are employed. Under balance conditions, the mechanically coupled variable pot is R1=R2= 1234 Ω. The other branch resistances are 2kΩ and 1kΩ. Evaluate the frequency of the a.c. source used. Derive the formula used. (8 + 8)

OR

b) i) For a Kelvin's double bridge, obtain expressions for the bridge balance conditions?
ii) In a Hay's bridge, the arm AB consists of an unknown impedance with inductance L and resistance R, a non-inductive resistance of 1200 Ω in arm BC, fixed resistance of 900 Ω in series with a standard capacitor of 0.4 μF in arm CD, a known variable resistance in arm DA. The a.c. supply of 100Hz is connected across A and C, a detector is connected between B and D. If balance is obtained with a resistance of 18000 Ω in the arm DA, calculate the value of unknown R and L. Derive the conditions for balance and draw the phasor diagram under balanced conditions. Also list the advantages of this bridge, when compared to the other inductance measurement bridges? (8 + 8)

15. a) i) An RTD exhibits a resistance of 550Ω at a temp. of 30^OC. It exhibits a resistance of 598 Ω at temp. of 60^OC. Also, it exhibits a resistance of 567 Ω at a temp. of 45^OC. Find its resistance at a temp. of 50^OC, employing quadratic approximation approach method around the mean temperature of 45^OC?
ii) Explain how Schering's bridge can be used for the measurement of the capacitance of a given capacitor? Also provide the phasor diagram, showing important circuit variables under balanced conditions.. (6 + 10)

OR

b) i) The inductance of a moving iron instrument is given by $L = (8 + 5\theta - \theta^2)$ μH, where θ - is the deflection from zero position. Given that 4A current causes a deflection of 90^O, evaluate the deflecting angle for a current of 3A. Assume that spring control is employed. Also derive the expression for the deflection torque?
ii) With constructional diagram, discuss the working principle of an induction disc type 1-Φ energy meter?. (8 + 8)