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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, OCT / NOV 2013

ELECTRICAL & ELECTRONICS ENGINEERING

Third Semester / Regulation 2008

EE 9203 Measurements and Instrumentation

(Common with EE 331& EE 283 of Reg 2002 / 2004)

Time : 3 Hours Answer ALL Questions Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. What is the primary standard for emf?
2. Distinguish between accuracy and precision?
3. What is 'creeping' in an induction disc type energy meter? How is it avoided?
4. A piezo-electric crystal has a voltage sensitivity of 0.12 Vm/N. Its thickness is 2 mm. Evaluate the voltage that it would develop, when a pressure of 2 MN/m^2 is applied?
5. What are the two types of Moving Iron Instruments? Distinguish between them.
6. What is the type of damping employed in PMMC meters?
7. Draw the circuit diagram of a megohm bridge?
8. What is a transducer? Give two examples for resistive transducers.
9. How does an electromagnetic flow meter operate?
10. Name the a.c. bridge that you would use for measurement of Inductance considering each of the following: low Q, medium Q and high Q coils?

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) Explain how liquid level can be measured employing resistive or capacitive transducer arrangement. (10 + 6).

12. a) What is an 'LVDT'? How would you employ the concept of LVDT, which is a displacement transducer, for the measurement of acceleration of a moving vehicle?.

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) A class of 72 students consists of 24 girl students and remaining boys. The average height of the overall class is 153 cm and the standard deviation is 10.0 cm. The average height of the girls, is 143 cm and the corresponding standard deviation is 2.0 cm. Evaluate the average height of the boys and the standard deviation corresponding to the heights of the boys.
iii) Using Voltmeter-Ammeter method, the resistance of a resistor is measured. The current through the resistor is varied and the following sets of readings are

recorded: (3.09V,1.49A) , (2.91V,1.52A) , (2.07V,0.98A) , (1.95,1.04A) , (0.93V,0.62A) and (0.89V,0.65A) . Some of the readings were taken with voltmeter connected closer to the load, and remaining readings were taken with ammeter being connected closer to the load. Find the best estimate for the resistance. (6 + 5 + 5)

13. a) i) What is a 'thermo-couple'? List the materials popularly used as thermocouples and also indicate the temperature ranges for which each pair 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) A single strain gauge having resistance of 120 Ω is mounted on a steel cantilever beam at a distance of 0.15 m from the free-end. An unknown force F applied at the free-end produces a deflection of 12.7 mm of the free-end. The change in the gauge resistance is found to be 0.152 Ω. The beam is 0.25 m long with a width of 20 mm and a depth of 3 mm. The Young's modulus for steel is 200 GN/m^2. Calculate the gauge factor. (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= 1200 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 an Anderson bridge, the arm AB consists of an unknown impedance with inductance L and resistance R, a known variable resistance in arm BC, fixed resistance of 900 Ω each in arms CD and DA, a known variable resistance in arm DE, and a capacitor with fixed value of 0.47 μF in arm CE. The a.c. supply of 100Hz is connected across A and C, a detector is connected between B and E. If balance is obtained with a resistance of 400Ω in the arm DE and a resistance of 800Ω in the arm BC, 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°C. It exhibits a resistance of 600Ω at a temp. of 60°C. Also, it exhibits a resistance of 570Ω at a temp. of 45°C. Find its resistance at a temp. of 50°C, employing quadratic approximation approach method around the mean temperature of 45°C?

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) With constructional diagram, discuss the working principle of an induction disc type 1-Φ energy meter?

ii) The inductance of a moving iron instrument is given by $L = (10 + 4\theta - \theta^2)$ μH, where θ - is the deflection from zero position. Given that 4A current causes a deflection of 90°, evaluate the deflecting angle for a current of 2A. Assume that spring control is employed. Also derive the expression for the deflection torque.

(8 + 8)