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B.E. (Full-time) END SEMESTER DEGREE EXAMINATIONS, NOV / DEC 2011

ELECTRICAL & ELECTRONICS ENGINEERING,

Third Semester
(Regulation 2009)

EE 9203 MEASUREMENTS AND INSTRUMENTATION

Time : 3 hr | Answer ALL questions | Max. marks : 100.

PART – A (10 x 2 = 20)

1. In a single-phase a.c. circuit, the power consumed by the load is measured to be (600 ± 30) W. The load voltage is (100 ± 10) V. The load current is (10 ± 2) A. Evaluate the load power factor?
2. Show that σ^2 = (Mean of squares) – (Square of mean).
3. A (0-1)mA PMMC ammeter with coil resistance of 100 Ω, is to be extended as (0-5)A ammeter. Evaluate the shunt resistance required.
4. Distinguish between an a.c. and a d.c. tachometer.
5. How is creeping avoided in an induction type energy meter?
6. Just draw a diagram which explains the construction of a repulsion type Moving Iron Ammeter? Mark the important parts, so that the diagram is self-explanatory.
7. "Though that MI instrument can read both d.c. and a.c., it cannot be employed as a transfer instrument" – Why is it so?
8. A quartz piezo-electric crystal has a thickness of 2 mm and a voltage sensitivity of 0.054 V-m/N. Evaluate the pressure to which it should be subjected, in order to obtain an output voltage of 100 V?
9. A thermistor, with characteristics $R_T = a\ R_0 \exp(b/T)$, exhibits a resistance of 4000Ω at 0^o C and 1000Ω at 50^o C. Find the R_T at 25^o C?
10. 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?

PART – B (5 x 16 = 80)

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) i) Distinguish between 'primary standard for emf' and 'secondary standard for emf'?

(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 3.0 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)

OR

b) i) The total iron losses experimentally determined at various frequencies, with a constant flux density in the ferromagnetic material, are as follows:

Frequency, f Hz	1100	1400	1700	2000
Total Iron Losses, P mW	46	62	94	122

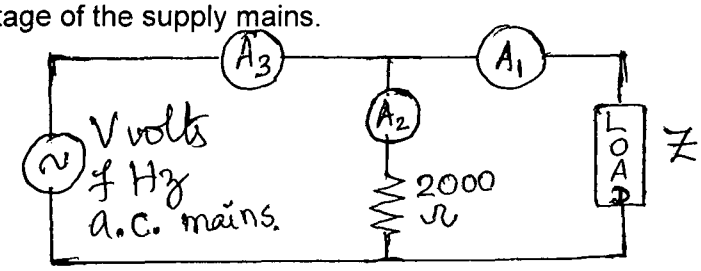
Evaluate the eddy-current losses occurring at a frequency of 1500 Hz, after fitting a suitable curve employing least square error.

ii) How is 'Lloyd-Fisher Magnetic Square method' employed for the iron loss measurement ?

iii) How does a 'power factor meter' operate? (6+5+5)

13. a) i)A 3-ϕ Y-connected balanced load is supplied by a 3-ϕ balanced voltage source. Ammeter connected in one of the lines reads 16 A. Wattmeter reads 1.6 kW, when the current coil is connected in the R phase and the voltage coil connected across R phase and Neutral of the load. When the voltage coil is connected across B and Y phases (without changing current coil connection), it reads 2.6 kW. Evaluate the voltage of the supply mains.

ii) In the circuit shown, the a.c. ammeters: A_1 reads 5 A, A_2 reads 2 A and A_3 reads 6 A. Evaluate the real power consumed by the load, shown as 'Z'. (10 + 6)



OR

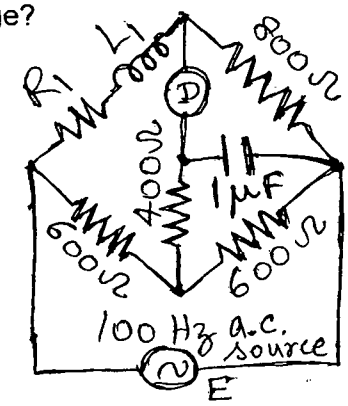
b) i) How is a current transformer different from a power transformer? A current transformer with 5 primary turns has a secondary burden consisting of a resistance of 0.16 Ω, and an inductive reactance of 0.12 Ω. When the primary current is 200 A, the magnetizing current is 1.5 A and the iron-loss current is 0.4A. Evaluate the number of secondary turns required to make the current ratio as 100:1. Derive any expressions used.

ii) Discuss briefly the constructional features of an induction type energy meter?

(8 + 8)

14. a) i) Derive the null balance conditions for a Maxwell's inductance capacitance bridge. When is a Hay's bridge preferable to this bridge?

ii) Convert the given Anderson's bridge into equivalent Maxwell's bridge. Assuming that the parameters given correspond to null balance conditions, and using the conditions for Maxwell's bridge that you have derived in the first part, evaluate R_1 and L_1. (8 + 8)



OR

b) i) Explain how Schering's bridge can be used for the measurement of the capacitance of a given capacitor?
ii) In a Wein's bridge, two capacitors of equal values of $C_1=C_2=0.47\mu F$ are employed. Under balance conditions, the mechanically coupled variable pot is $R_1=R_2=1234\ \Omega$. The other branch resistances are $2k\Omega$ and $1k\Omega$. Evaluate the frequency of the a.c. source used. Derive the formula used. (8 + 8)

15. a) i) A variable potential divider has a total resistance of 2 kΩ and is fed from 10 V dc supply. The output is connected to a load resistance of 5 kΩ. One more resistance of 10 kΩ is connected between the variable resistance knob and the input point, with a view of minimizing the loading error. Determine the loading errors for the wiper positions corresponding to K = xi/xt = 0.25 and 0.75?
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.
iii) How would you employ the concept of LVDT, which is a displacement transducer, for the measurement of acceleration of a moving vehicle? (6+6+4)

OR

b) i) Explain how the differential pressure can be measured with the help of pairs of unbonded strain gauges attached to the diaphragm. Show how will you connect the strain gauge coils to form a Wheatstone bridge, and also derive an expression for the voltage sensitivity obtained.
ii) Explain how liquid flow rate can be measured employing a rotameter or electromagnetic flow meter or a turbine flow meter. (10 + 6)