Reg. No. :

Question Paper Code : 90201

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fourth Semester

Electrical and Electronics Engineering

EE8403 – MEASUREMENTS AND INSTRUMENTATION

(Regulations 2017)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. What are the functional elements of an Instrument ? Illustrate with a suitable example.
2. Distinguish between 'accuracy' and 'precision'.
3. What is 'creeping' in an induction disc type energy meter ? How is it avoided ?
4. What are the components of 'Iron loss' ?
5. How does 'loading effect' cause error in a D.C. potentiometer based measurement ?
6. How are the measuring instruments protected from electrostatic and electromagnetic interference ?
7. Distinguish between LED and LCD displays.
8. List the parts of a Cathode Ray Tube (CRT).
9. What is 'piezoelectric effect' ? How is this concept used as a transducer ?
10. List the elements of a data acquisition system.

PART – B **(5×13=65 Marks)**

11. a) Along with a diagram showing constructional features and derivation for the deflection torque developed, explain the working principle of a Permanent Magnet Moving Coil type ammeter. What is the type of damping used in this meter ? Given a (0 – 0.1) A d.c. ammeter, how would you obtain a multi-range d.c. voltmeter for ranges : (0 – 10) V, (0 – 30) V and (0 – 600) V ?

(OR)

b) Distinguish between 'attraction type' and 'repulsion type' moving iron meters. For an attraction type moving iron meter, derive an expression for the deflection torque. The inductance of a moving iron instrument is given by $L(\theta) = (8 + 5\theta - \theta^2)$ μH, where θ is the deflection from zero position in radians. Given that a current of 4A causes a deflection of 90°, evaluate the deflection angle for a current of 3A. Assume that spring control is employed.

12. a) Along with constructional diagram and derivation for the torque developed, discuss the working principle of an induction disc type single-phase energy meter. Also explain how braking torque is obtained in it.

(OR)

b) In the construction of an electrodynamometer type Wattmeter, how is the scale made uniform over a large range ? Derive an expression for the correction factor due to the pressure coil inductance. How does this expression get modified considering phase angle errors of the current transformer and the potential transformer used ? You may assume lagging power factor case. The indication on a 110V, 5A wattmeter used in conjuction with potential and current transformers of nominal ratios of 100/1 and 20/1 respectively is 360W. If the resistance and inductance of the pressure coil are 300Ω and 20 mH and the ratio and phase angle errors of the potential and current transformers at the operating conditions are : + 0.75%, – 0 .6° and – 0.25%, + 1.25°. What is the true value of the power being measured ? The load phase angle is 60° lagging and the frequency is 50 Hz.

13. a) i) For a Kelvin's double bridge, obtain expressions for the bridge balance conditions.

ii) Along with relevant phasor diagram under balance conditions and derivation of expression for balance conditions, explain how Maxwell's bridge is useful for measurement of an unknown inductance ? **(6+7)**

(OR)

b) i) Write a detailed note on 'transformer ratio bridges'.

ii) In a schering bridge, the fixed resistor of 1000 Ω and fixed capacitor of 50 pF form opposite arms : bc and ad. The arm ab consists of the capacitor whose capacitance is required to be measured along with its dissipation factor. The arm cd consists of a variable resistor in series with a variable capacitance. The balance is obtained when variable resistance is 4200 Ω and variable capacitance is 0.00196 μF. Evaluate the capacitance connected in arm ab and its dissipation factor. Derive the expressions used. **(6+7)**

14. a) i) Along with a neat sketch of the block diagram, describe the working of X – Y plotter.

ii) Along with a functional block diagram, explain the operation of a Cathode Ray Oscilloscope. **(6+7)**

(OR)

b) i) Explain the theory of 'Seven Segment display'. You may consider common anode type for your explanations.

ii) What is a 'data logger' ? What are its components ? What are the functions of a data logger ? **(6+7)**

15. a) i) Explain how differential pressure can be measured using capacitive type transducer.

ii) Describe briefly 'Data Acquisition System'. With generalized block diagram, explain its functions. **(6+7)**

(OR)

b) i) Give two examples for resistive transducers. Also explain in detail, any one of these two.

ii) Discuss in detail, any one inductive type transducer. **(6+7)**

PART – C **(1×15=15 Marks)**

16. a) In an Anderson bridge for the measurement of inductance, the arm AB consists of unknown impedance with inductance L in series with resistance R, a known variable resistance in arm BC, fixed resistance of 600 Ω each in arms CD and DA, a known variable resistance in arm DE and a capacitor with fixed capacitance of 1 microfarad in the arm CE. The a.c. supply of 100 Hz is connected across A and C and the detector is connected between B and E. If the balance is obtained with a resistance of 800 Ω in the arm BC and a resistance of 400 Ω in the arm DE, evaluate R and L by converting the bridge into Maxwell's L.C. bridge by performing star-delta transformation of the three resistors across CD, DA and DE.

(OR)

b) Given two concentric cylindrical metal plates (inner cylinder having an outer radius of 'r' and outer cylinder having an inner radius of 'R'). Suggest a scheme for level measurement of a non-conducting liquid employing the concept of a capacitive transducer. Assume the relative permittivity of the liquid to be ϵ_r and that of the air above to be unity. Ignoring edge effects, show that the change in capacitance is proportional to the change in liquid level.