B. Power Engg. 3rd Year 1st Semester Supplementary Examination, 2017

Transducers and Measurement **Time 3 Hr.** **Full Marks: 100**

Answer any five questions

1. (a) Describe the working principle of the resistance thermometers. Name the materials used for RTDs along with their properties. 6+4
(b)What are thermistors? Discuss the resistance-temperature characteristics of thermistors and the method of measurement of temperature with the use of thermistors. 2+3+5

2. (a)Describe the methods measurement of pressure using different capacitive, piezoelectric transducers.
(b)Describe the working of a pH meter. 12+8

3. (a) Draw the equivalent circuit and phasor diagram of current transformer and derive the expression of phase angle error. 4
(b) A current transformer, of nominal ratio 1000/5 A, is operating with total secondary impedance of (0.3 + j0.4) Ω. At rated current, the components of the primary current associated with the core-magnetizing and core-loss effects are respectively, 5 A and 1.2 A, while the primary has 4 turns. Calculate the ratio error and phase angle error at rated primary current, if the secondary has 800 turns. 8
(b) The coil of a moving coil galvanometer is wound on a non-magnetic former whose height and width are both 2 cm and 1.5 cm respectively. It moves in a constant field of 0.12 Wb/m^2. The moment of inertia of its moving parts is 0.4×10^{-6} $kg\text{-}m^2$ and the control spring constant is 30×10^{-6} Nm/rad. Calculate (i) the number of turns that must be wound on the coil to produce the deflection of 120° with a current of 12 mA and (ii) the resistance of the coil to produce critical damping, all damping assumed to be electromagnetic. 8

4. (a)Describe the working of PMMC instruments. Derive the expression for steady state deflection. How the effect of temperature changes is adjusted using voltmeter-multipliers? 12
(b) The coil of a moving coil voltmeter is 40 mmX30 mm wide and has 100 turns wound on it. The control spring exerts a torque of 0.25X10-3 Nm when deflection is 50 divisions on the scale. If the flux density of the magnetic field is 1 wb/m2, estimate the resistance that must be put in series with the coil to give 1 volt per division. Resistance of the voltmeter is 10,000 ohm. 8

5. (a) Explain the working of repulsion type of MI instruments with the help of neat diagram. How the controlling and damping torques are produced in such instruments? 6
(b) The inductance of a MI ammeter is $8 + 4\theta - \frac{1}{2}\theta^2$ μH, where θ is the deflection in radian from zero position. The control spring torque is 15×10^{-6} Nm/rad. Calculate the scale position in radian for current 5 A and discuss the scale shape. 8
(c) Explain the working of electrodynamometer ammeter. 6

6. (a)How the unknown inductances are measured using Hay's bridge. What are the advantages of this bridge over the Maxwell's bridge? 6
(b) The four arms of a Maxwell's capacitance bridge at balance are: arm *a b*, an unknown inductance L_1, having an inherent resistance R_1; arm *b c*, a non inductive resistance of 1000 Ω; arm *c d*, a capacitor of 0.5 μF in parallel with a resistance of 1000 Ω; arm *d a*, a resistance of 1000 Ω.
(a) Derive the equations of balance for the bridge and determine the value of R_1 and L_1.
(b)Draw the phasor diagram of the bridge.
(c) Calculate the Q-factor.
(d)Write down the advantages and disadvantages of this bridge. 14

7. Write short notes on any two of the following: 2×10

a. Measurement of low resistance
b. Hall effect transducer
c. Force and torque equations of electrostatic voltmeters
d. Thermocouple