

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- VIth SEMESTER-EXAMINATION – MAY- 2012****Subject code: 162005****Date: 19/05/2012****Subject Name: Electromechanical Measurements & Instruments****Time: 10:30 am – 01:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** The specific gas constant of a certain gas is to be found assuming that the gas obeys the equation of state: **07**

$$PV = mRT.$$

Using following experimental results, calculate value of the gas constant and % overall uncertainty in it:

$$P = 300 \pm 5 \text{ Kpa} \quad m = 2 \pm 0.5 \% \text{ kg}$$

$$V = 0.6 \pm 0.01 \text{ m}^3 \quad T = 313 \pm 1 \text{ K}$$

- (b)** Prove that in a single-phase induction type energy meter, the total number of revolutions $= K \times (\text{energy})$. **07**

- Q.2 (a)** (i) Explain the following terms with neat sketch. **04**

(1) Overshoot (2) Fidelity

- (ii) Define: **03**

(1) Hysteresis (2) Threshold (3) Sensitivity

- (b)** Drive the expression for the time response of a first order system to a step input. **07**

OR

- (b)** Describe the construction and working of PMMC instrument with neat sketch. **07**

- Q.3 (a)** A dynamometer ammeter is fitted with two fixed coils having a total resistance of 3.0Ω and a total inductance of 0.12 H , and a moving coil of resistance 30Ω and an inductance of 0.003 H . Calculate the error in reading when the instrument is calibrated with d.c and used on a.c 50 Hz with moving coil shunted directly across the field coils. **07**

- (b)** (i) What are the advantages and disadvantages of MI instruments? **04**
(ii) Define passive and active transducers with example. **03**

OR

- Q.3 (a)** What is a strain gauge? and derive the equation $G_f = 1 + 2\nu$ **07**

- (b)** (i) Explain the characteristics of thermistors? **04**
(ii) Explain LVDT transducer with neat sketches **03**

- Q.4 (a)** A capacitive transducer circuit used for measurement of linear displacement. The transducer is a parallel plate air capacitor wherein the capacitance can be changed by changing the distance between the plates. This transducer is to be used for dynamic measurements. Suppose a flat frequency response with an amplitude ratio within 5% is required down to a frequency range of 20 Hz , what is the minimum allowable value of time constant? Calculate the phase shift at this frequency. The area of plates is 300 mm^2 and the distance between plates is 0.125 mm . calculate the value of series resistance R . What is the amplitude ratio at 5 Hz with above time constant? **07**

Calculate the high frequency voltage sensitivity of the transducer if the battery voltage is 100 V.

- (b) Formulate the governing equation for a first-order system-temperature measurement by a thermal measuring element (i.e. Mercury in glass thermometer). **07**

OR

- Q.4** (a) If P is the pull require to lift a load W by means of a pulley block, find a linear relation of the form $P = mW + c$ using the following data **07**

P (kg)	12	15	21	25
W (kg)	50	70	100	120

Also determine the pull required to lift weight of 75 and 150 kg respectively.

- (b) Explain with a neat diagram the construction and working of Eddy current dynamometer. **07**

- Q.5** (a) A shaft is to transmit power up to 44 kW at a constant speed of 25 rps and it is proposed that the torque be sensed by a pair of torque strain gauges bonded to a specially machine portions of the shaft. The gauges are to be connected push-pull in an equal-armed voltage sensitive bridge, the output of which is to be calibrated in power units. If the maximum strain value of the gauges is 0.0015, their resistance 120 Ω and gauge factor 2.1 calculate: **07**

(1) The diameter of steel shaft to which they should be bonded if its modulus of elasticity is $200 \times 10^9 \text{ N/m}^2$.

(2) The output voltage at full power if the excitation voltage of the bridge is 6 V.

(3) The sensitivity of the bridge is in V/kW.

- (b) Describe the construction and working of a "Dead Weight Tester". State the factors which affect the accuracy of dead weight testers. **07**

OR

- Q.5** (a) Give types of electrical filters and explain it. **07**

- (b) Derive the expression for bridge sensitivity in the case of a voltage sensitive Wheatstone bridge having equal arms. **07**
