Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Sem-VI Examination May 2011

Subject code: 162005

Subject Name: Electromechanical Measurements & Instruments.

Date:23/05/2011 **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)** Explain the construction and working principle of (i) attraction type and (ii) repulsion type moving iron instrument with neat diagrams. Why these meters can be used for both a.c and d.c? **07**

(b) A moving coil ammeter has a fixed shunt of 0.05Ω with coil resistance of $R = 2000\Omega$ and potential difference of $800mV$ across it. Full scale deflection is obtained. (a) To what shunted current does this correspond? (b) Calculate the value of R to give full scale deflection when shunted current I is (i) 20 A. and (ii) 60 A.(c) With what value of R is 30 % deflection with I=120 A? **07**

Q.2 **(a)** Draw the circuit of a Kelvin's Double Bridge used for measurement of low resistance. Derive the equation for the balance. How thermoelectric emf effect can be eliminated? **07**

(b) (i) Differentiate between the terms "Accuracy" and "Precision" with suitable examples. **04**

(ii) What is brake fading, what are the precaution requires to avoid it. **03**

OR

(b) Explain with a block diagram Generalized Measuring System and its four functional elements. Show a block diagram of pressure measurement using a Bourdon tube pressure gauge. **07**

Q.3 **(a)** Explain the following transducers. **07**

(i) LVDT.

(ii) Thermocouple.

(b) A capacitance transducer uses two quartz diaphragms of area $500mm^2$ separated by a distance of $3mm$. A pressure of $7 \times 10^5 N/m^2$, when applied to the top diaphragms, causes a deflection of $0.45mm$. The capacitance is $350pF$ when no pressure is applied to diaphragms. Determine the value of capacitance after the application of pressure. **07**

OR

Q.3 **(a)** Define gauge factor of a strain gauge. Obtain its expression and explain the necessity of dummy strain gauge. **07**

(b) A strain gauge with a gauge factor of 2.3 is fastened to a metallic member subjected to a stress of $1500 Kg/cm^2$. The modulus of elasticity of the metal is $2.5\times10^6 Kg/cm^2$.Calculate the percentage change in resistance of the strain gauge. What is the value of Poisson's ratio? **07**

Q.4 **(a)** Classify Telemetry system also explain voltage telemetering system and draw block diagram of general telemetry system. **07**

(b) (i) Formulate the governing equation for a second-order system-spring mass system with damping. **04**

(ii) A first order instrument having a time constant of 0.25 seconds has been subjected to a sinusoidal input prescribed by relation, **03**

$$\theta_i = 0.25 \sin 20t$$

Develop an expression for the corresponding output.

OR

Q.4 **(a)** List the method of analog to digital conversion techniques. Explain anyone of them. **07**

(b) The discharge coefficient Cd of an obstruction flow meter can be found by collecting the water that flows through it during a time interval t when it is under a constant head h. The relation prescribing the discharge coefficient is **07**

$$Cd = \frac{4m}{t\ \rho\ \pi\ d^2\sqrt{2gh}}$$

Assuming the following data, find Cd with its uncertainty.

(i) m = 400 ± 0.25 kg
(ii) t = 600 ± 2 sec
(iii) h = 3.65 ± 0.003 m
(iv) g = 9.807 ± 0.1% m/sec^2
(v) d = 1.25×10^{-2} ± 0.0025×10^{-2} m
(vi) ρ =1000 ± 0.1% kg/m^3

Q.5 **(a)** What are "Systematic errors"? Explain briefly the following systematic errors: **07**

(i) Instrumental errors
(ii) Environmental errors

(b) Give the construction and working of a hot-filament ionization gauge. **07**

OR

Q.5 **(a)** Explain the principle, working and method of speed measurement using Stroboscope stating an illustration. **07**

(b) For measuring the torque transmitted by a shaft, four resistance strain gauges of *120* Ω each are used at *45°* to the shaft axis. These form the four arms of a dc Wheatstone bridge, with output resistance of *1000 Ω*. Find the output voltage of the bridge if the bridge supply voltage is 9 volts, Power transmitted is *3730* Watts, Speed of shaft *900* rpm, diameter of shaft 2 cm, modulus of rigidity of shaft material 8×10^{10} *N/m^2* and gauge factor 2.5. **07**

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