Code No: 07A60204   **R07**   **Set No. 2**

III B.Tech II Semester Examinations,APRIL 2011
INSTRUMENTATION AND CONTROL SYSTEMS
Mechatronics

Time: 3 hours   Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) What do you mean by resistance strain gauges? Give a detailed discussion on the subject covering the basic principle, gauge and binding materials, instrumentation and application of the method.

   (b) Explain the different methods of temperature compensation employed for strain gauges. [8+8]

2. What is the working principle of Ultrasonic flow meter? State its advantages and disadvantages. [16]

3. Explain the working principle of a Ionization gauge with a neat sketch. State its advantages and disadvantages. [16]

4. Explain the following transducers briefly with neat diagrams

   (a) Linear variable differential transformer

   (b) Capacitive transducers. [16]

5. (a) Explain the principle of working of the following:
   i) Electrical generator dynamometer
   ii) Driving dynamometer

   (b) If a shaft of diameter 3 cm and length 1 m is transmitting torque of 700 N-m, find the angular deflection of the shaft assuming G = 8 x 10^{10} N/m^2. [8+8]

6. Derive the transfer function of a thermal system when the heat input rate is suddenly increased from its steady conditions . Discuss the assumptions made. [16]

7. A seismic motion transducer has a mass of 50 gm. Its undamped natural frequency is 10 Hz and damping ratio is 0.6. The relative motion of the seismic mass with respect to the frame of the transducer is converted to a voltage by a first order transducer which has a static voltage sensitivity of 2 V/mm and time constant of 0.01 s. Find the output voltage for an input motion of 0.5 mm at a frequency of 20 Hz. [16]

8. Explain the operation of ordinary traffic signals which control the automobile traffic at roadway intersections. Do they constitute an open-loop or closed-loop control system? Justify your answer. How can the traffic be controlled more effectively? [16]

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Code No: 07A60204 | **R07** | **Set No. 4**

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Time: 3 hours | Max Marks: 80

Answer any FIVE Questions
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1. What are the main static characteristics of measuring instruments? Explain them briefly. [16]

2. (a) Draw the bourdon pressure gauge neatly and name the parts. What are the advantages and disadvantages of bourdon pressure gauge.

   (b) What do you mean by low pressures. List out various indirect methods for measurement of low pressure. [8+8]

3. (a) Explain, with a sketch, the principle of working of a digital type angular speed measuring device.

   (b) List the advantages and limitations of stroboscope. [10+6]

4. Explain the construction and working of Ionization transducer. Mention its uses. [16]

5. (a) A delta type Rosette strain gauge arrangement is bonded on to an aluminium plate. The three measured strains are:

   $\varepsilon_1 = $ - 100 μm/m; $\varepsilon_2 = 150$ μm/m; $\varepsilon_3 = 250$ μm/m.
   Calculate the principal stresses and their locations.
   For aluminium, E = 8 x 10^{10} N/m^2, $\mu = 2.5$.

   (b) Distinguish between balanced bridge and unbalanced bridge, used for measuring the strain, and their applications. [8+8]

6. Discuss briefly with neat diagrams the following methods of liquid level Measurement:

   (a) Ultrasonic level measuring gauge

   (b) Capacitive type with Variable Dielectric constant [16]

7. A rope brake dynamometer, as shown in figure 1 is used to measure the output power of an engine running at 300 rpm. Find the torque and power measured, assuming: the diameter of brake drum = 1m, diameter of rope = 20 mm, weight W = 400 N, and spring balance reading = 50 N. [16]

8. For the system with block diagram as shown in figure 2, derive an expression for the closed loop transfer function. [16]
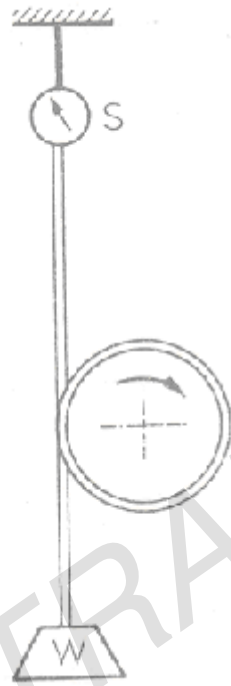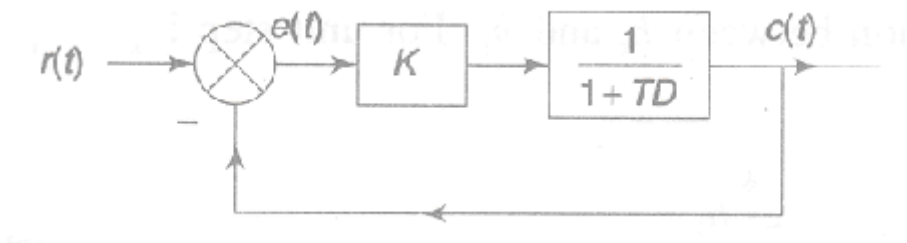
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Figure 1:

Figure 2:

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1. What is a rotameter? Describe its construction and working with a neat diagram. [16]

2. (a) Name the different types of mechanical tachometers. Sketch and explain the working of a centrifugal tachometer.

   (b) Explain clearly the principle of working of an eddy current drag cup tachometer. [8+8]

3. Derive the equations for time response of a first order system when subjected to

   (a) unit step input

   (b) unit ramp input.

   Draw the response curves in each case and make your own comments on them. [16]

4. Explain briefly the difference between :

   (a) Positive and negative feed back,

   (b) Servomechanism, process control and regulators. [8+8]

5. (a) What is gauge length? How does it influence the strain gauge performance?

   (b) A resistance strain gauge experiences 1% change in resistance when subjected to a uni-axial strain of 5000 μ-strain. What would be the sense and magnitude of error if a value of 1.9 is assumed for the gauge factor? [6+10]

6. What are the characteristics of capacitive transducers? State their advantages and disadvantages. [16]

7. (a) Describe the principles upon which different commercial humidity measurements are made? Which of these lend themselves best to

   i. remote reading;
   ii. to local reading;
   iii. to past response?

   (b) What is a psychrometer ? Where does it find application? How does it differ from a hygrometer? [10+6]

8. (a) Describe working principle of U-tube differential manometer with a neat sketch.

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(b) A differential manometer connected at the two points A and B in a pipe containing an oil of specific gravity of 0.9, shows a difference in mercury levels as 150 mm. Find the difference in pressures at the two points. [8+8]

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Code No: 07A60204 **R07** **Set No. 3**

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Time: 3 hours Max Marks: 80

Answer any FIVE Questions
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1. (a) Describe the principle of working of a piezoelectric load cell. What are the desirable characteristics of this load cell for force measurement?

   (b) What are the main features of a hydraulic load cell? Enumerate its applications. [8+8]

2. Explain the working principle, advantages and limitations of Magnetic flow meter with suitable diagram. [16]

3. (a) What are the requirements of materials for strain gauges?

   (b) Explain the construction and bonding technique for an electrical resistance strain gauge.

   (c) On what factors is the selection of grid material based and why? [4+6+6]

4. (a) "The description of a process control involves three acts identified as measurement, Evaluation, and control". Comment upon the validity of this statement.

   (b) Differentiate between open-loop and closed-loop control systems. [8+8]

5. (a) Explain the theory of Mcleod pressure gauge with a neat sketch.

   (b) For a Mcleod gauge, with a capillary of 1 mm diameter and effective bulb volume of 80 cm^3, find the reading as indicated by mercury column due to a pressure of 10 Pa. [8+8]

6. Explain the working of a total radiation pyrometer with a neat sketch. State its advantages and disadvantages. [16]

7. (a) Explain the principle of working of a seismic instrument used as a displacement measuring device.

   (b) A seismic vibrometer sensing displacement has undamped natural frequency of 10 Hz and damping ratio of 0.7. Determine the amplitude ratio and phase angle between the input and output, if the input is sinusoidal displacement of 1 kHz. [8+8]

8. In a response test on a thermometer, which was suddenly put in a water bath kept at 100^{0}C the following data was obtained.

Time t s	0	1	3	6	8	11	15	18
Temp^0 C	30	50	65	80	90	95	98	99

(a) Find the time constant of the thermometer.

(b) Find the steady state error if the thermometer is used to measure temperature of a liquid cooling at a constant rate of 1^0C every 6s. [8+8]

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