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

III B.Tech II Semester Examinations,December 2010
INSTRUMENTATION AND CONTROL SYSTEMS
Mechatronics

Time: 3 hours   Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. (a) How are the flow measurements classified?

   (b) Discuss the construction of rotameter with a neat sketch. [8+8]

2. (a) Define vibration. Explain how it is characterized, and list some of its harmful effects.

   (b) Describe the operation of any transducer that can be used to measure the acceleration level of vibration. [8+8]

3. (a) With a sketch, explain the working of fluid friction dynamometers.

   (b) Explain, with a neat sketch, how an Eddy current dynamometer works. [8+8]

4. What are the Differential manometers? Mention various types of them. Explain any one in detail with a neat sketch. [16]

5. (a) Discuss the

   i. null and
   ii. deflection mode of a Wheatstone bridge circuit as used for the measurement of resistance and small changes of resistance occurring in the temperature and strain measuring systems.

   (b) List the main advantages of semi-conductor strain gauges. [12+4]

6. (a) What is transfer function? Derive the transfer function of an open-loop control system.

   (b) Explain the speed control system with a neat sketch. [8+8]

7. A copper - constantan thermocouple was found to have linear calibration between 0 and 400^0C with emf at maximum temperature (reference junction temperature 0^0C) equal to 20.68 mV.

   (a) Determine the correction which must be made to the indicated emf if the cold junction temperature is 25^0C.

   (b) If the indicated emf is 8.92 mv in the thermocouple circuit , determine the temperature of the hot junction. [8+8]

8. (a) Derive an expression for time response of first order system to step input.

   (b) A thermometer having a time constant of 5s is quickly inserted in a bath of temperature 80^0C , what would be the indication after 2.5 sec? [8+8]

⋆ ⋆ ⋆ ⋆

1

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

III B.Tech II Semester Examinations,December 2010
INSTRUMENTATION AND CONTROL SYSTEMS
Mechatronics

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Derive, from first principles, the relationship for gauge factor of a strain gauge.

   (b) Describe, with a neat sketch, the two - gage bridge system for strain gages.
   [8+8]

2. What are the applications of LVDT? Define its sensitivity and the resolution. [16]

3. Describe the construction and working of the following manometers with neat diagrams

   (a) Piezomter and

   (b) U-tube manometer [8+8]

4. Explain construction, working and applications of magnetic flow meter with suitable diagram. [16]

5. (a) Describe the construction and operation of a Rope brake type of absorption dynamometer. Explain a suitable arrangement of cooling the pulley of the dynamometer.

   (b) Define the term brake tare as applied to Prony brake dynamometer. How do you proceed to determine the brake tare? [10+6]

6. Summarize the essential features of open-loop and closed-loop control systems. Illustrate your answer by referring to a particular example of each type of system, and sketch its relevant block diagram. Point out the disadvantages of open- loop control system. [16]

7. (a) A seismic instrument used as a displacement measuring device has a natural frequency of 10 Hz and damping ratio of 0.6. A resistance potentiometer of static sensitivity 2 V/mm and time constant 0.01 s is used to convert the relative motion of the mass into voltage. Find the output voltage for a sinusoidal input motion of amplitude 0.5 mm and frequency of 30 Hz.

   (b) Explain, with a sketch, the principle of working of a resistance potentiometer used as a secondary transducer in a seismic instrument. [8+8]

8. Derive the expression for magnitude and phase of a first order system when subjected to a sinusoidal input signal. Draw the magnitude and phase versus frequency plots. [16]

⋆ ⋆ ⋆ ⋆

Code No: 07A60204 $\boxed{\textbf{R07}}$ $\boxed{\textbf{Set No. 1}}$

III B.Tech II Semester Examinations,December 2010
INSTRUMENTATION AND CONTROL SYSTEMS
Mechatronics

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. (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]

2. Compare mechanical and electrical transducers. Explain theory and construction of any one mechanical transducer. [16]

3. (a) "The feedback controller solves the control problem by trial-and-error procedure" How? Explain.

   (b) Explain the following terms as related to control systems:
   Measuring lag; Time constant; Dead time [8+8]

4. Explain construction, working and applications of ultrasonic flow meter with suitable diagram. [16]

5. (a) What is meant by a first order system? Derive its transform operator and give example of the system.

   (b) A thermometer initially at a temperature of 20^0C is suddenly plunged into a liquid bath maintained at 150^0C. After a time interval of 3 seconds , thermometer indicated a temperature of 95^0C. Determine the time constant for the thermometer. [8+8]

6. (a) Define strain. List some practical situations where strain measurement becomes essential. Can measurement of strain be applied in specialized transducers to measure certain mechanical quantities? If so, name those relevant mechanical quantities.

   (b) What is temperature compensation and how it is achieved when using bonded strain gauges for the measurement of axial thrust, bending loads and torque.
   [8+8]

7. Describe the following vacuum gauges briefly with neat sketches:

   (a) Thermocouple gauge.

   (b) Pirani gauge. [16]

8. (a) With suitable sketches, distinguish between the principles of working of axially loaded elastic member and cantilever type elastic member.

3

(b) A load cell deflects 0.05 mm due to a machine tool slide whose mass is 200 Kg. Find the highest frequency of force that may be measured with a 5% accuracy.   [8+8]

$\star\star\star\star\star$

4

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

III B.Tech II Semester Examinations,December 2010
INSTRUMENTATION AND CONTROL SYSTEMS
Mechatronics

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
⋆⋆⋆⋆⋆

1. (a) Explain the term 'strain'. Discuss the various methods for measuring strain. Differentiate between point by point and whole field techniques.

   (b) Explain the principle of operation of electrical resistance strain gauges.[10+6]

2. (a) List the different principles on which force measurements are made.

   (b) What is a proving ring? How is it used to measure force? Describe with a sketch. [8+8]

3. Discuss the construction, working principle, uses, advantages and disadvantages of optical pyrometers. [16]

4. (a) Draw a neat sketch of McLeod gauge. State its advantages and disadvantages.

   (b) State advantages and disadvantages of a thermocouple vacuum gauge [8+8]

5. Distinguish between Capacitance type level gauge & Ultrasonic liquid level Gauge. [16]

6. (a) A centrifugal tachometer having range of 25 - 300, 250 - 3000, and 2500 - 30000 rpm is to be used to measure the speed of a shaft which is believed to be in the vicinity of 3000 rpm. What range setting should be tried first and why?

   (b) Explain the difference between a speed counter, tachoscope and tachometer. [10+6]

7. Describe the difference between deflection and null type of instruments giving suitable examples. Discuss their accuracy, sensitivity and suitability for dynamic measurements. [16]

8. Propose a control system to fill a container with water after it is emptied through a stop cock at the bottom. The system must automatically shut off the water when the container is filled. Draw the block diagram of the proposed system. Which component or components comprise the plant, the controller, and the feed back? [16]

⋆⋆⋆⋆⋆