

**III B.Tech II Semester Supplementary Examinations,
November/December 2005
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) Describe about the step response of second order system. [8+8]
- (b) A response test on a thermometer was thrust into temperature controlled bath of water maintained at 100°C and the time was observed as the indicated temperature reached preselected values giving the following readings.

Times(sec)	0.0	1.2	3.0	5.6	8.0	11.0	15.0	18.0
Temp(deg c)	20	40	60	80	90	95	98	99

Draw the response curve on a graph paper and show that it follows closely the form of a simple lag with a time constant of 4 secs.

2. (a) Explain the difference in principle of operation of a photo-emissive cell, a photo-conductive cell and a photo voltaic cell. Give the applications of each of these cells. [16]
- (b) Differentiate between null mode and deflection of operation of measurement systems with examples.
3. Explain the transducers used for following temperature measurements. [4+4+4+4]
 - (a) Temperature of an oven having range of 0 to 1000°C
 - (b) Temperature of molten steel of -50°C
 - (c) Liquid at a temperature of -50°C
 - (d) Furnace having temperature range 0 to 1700°C
4. (a) Draw a neat sketch of an ionization gauge; explain the working principle of the gauge. [10+6]
- (b) List merits and limitations of ionization gauges.
5. (a) Write the principle of operation of a bubbler purge and float leased level indicator. [16]
- (b) With neat sketch explain any one type of ultrasonic fluid level indicator.
6. (a) Explain how a vibrometer is calibrated to measure acceleration. [8+8]
- (b) How is measurement of vibrations on large structures done? Explain the method in detail.

7. (a) Draw any four types of strain gauge arrangement for measuring strain. [8+8]
(b) How resistive strain gauges are calibrated?
8. Explain the following with suitable examples and block diagrams: [16]
 - (a) Temperature control.
 - (b) speed control.

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1. (a) Measurement systems are classified frequently as first order or second order systems. Explain the meaning of terminology. [16]
(b) A thermometer has been suddenly plunged into a steaming water bath whose temperature remains steady at 100°C . It takes 10 seconds for the thermometer to reach the equilibrium condition which occurs at five time constants ($t = 5\tau$). Calculate the time constant and the time taken by the thermometer to indicate half of the temperature difference. The initial thermometer temperature can be considered to be zero.
2. (a) Give the classification of inductive transducers indicating their principle. [6+10]
(b) Describe in detail the construction and working of an inductive and a capacitive transducers to measure linear displacement.
3. (a) Explain thermocouple protection materials and for what range they are used. [12+4]
(b) Explain the construction and working of
 - i. Constant intensity optical pyrometer.
 - ii. Variable intensity optical pyrometer.
4. (a) Compare and contrast between pirani gauge and Thermocouple type conductivity gauge. [8+8]
(b) Define gauge pressure show three different constructions of elastic pressure sensing elements. Assuming that the stresses in a metallic diaphragm are linearly proportional to stress applied to the diaphragm
5. (a) Write the principle of operation of a bubbler purge and float leased level indicator. [16]
(b) With neat sketch explain any one type of ultrasonic fluid level indicator.
6. (a) What are the advantages of piezoelectric type accelerometer? [4+2+8]
(b) Why vibrations has to be measured. How vibrations are measured?
(c) What is a psychrometer? Explain the working of a psychrometer with neat sketch
7. (a) Draw any four types of strain gauge arrangement for measuring strain. [8+8]
(b) How resistive strain gauges are calibrated?

8. (a) The presence of disturbances is the main reason for using feedback control. Justify this statement. Discuss the commonly occurring disturbances in various control systems. [16]
- (b) What are feedforward-feedback control system? Give some examples.
- (c) Explain with the help of a block diagram any one feedforward-feedback control system.

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1. (a) Explain the following terms related to dynamic characteristics of an instrument [16]
 - i. Speed of response and measuring lag
 - ii. Fidelity and dynamic error
 - iii. Dead time and dead zone
 - iv. Step, ramp and linear input functions
- (b) Define the following terms as applied to the dynamic response of measurement systems subjected to sinusoidal input
 - i. Frequency and circular frequency
 - ii. Undamped natural frequency, damped natural frequency and resonant frequency
 - iii. Phase shift and time delay
2. Describe the method of measuring speed using [16]
 - (a) Capacitor type Impulse Tachometer
 - (b) Tachometers.
3. (a) Differentiate between the thermo couples connected in series and parallel. [16]
- (b) Distinguish between RTD and thermistors.
4. (a) Sketch the pirani-type thermal conductivity gauge, explain its operation. [16]
- (b) Explain limitations and merits of pirani gauge.
5. (a) With neat sketch describe the principle of operation, construction, advantages and limitations of rotameter. [16]
- (b) Explain the working of vane type flow meter.
6. (a) How seismic instruments are used for measuring acceleration. Explain in detail. [8+4]
- (b) What is the importance of humidity control in process industries?
7. (a) Classify strain gauges. [4+12]
- (b) Describe the method of surface preparation and bonding techniques while fixing strain gauge on a metallic member.

8. Describe a typical close-loop control system that can be used in order to control the following processes: [16]

- (a) the speed of a steam engine
- (b) the pressure in a furnace
- (c) the temperature of water being heated by steam and
- (d) the speed of an automobile vehicle.

Draw the block diagram of the arrangement and mention the use of feed back in the application.

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1. (a) State the advantages of electrical transducers over the other transducers. [16]
(b) Differentiate between analog and digital transducers. Give one example of each and discuss the working of one digital transducer.
2. (a) How the ionization transducer is used to measure displacement? Explain the same. [16]
(b) Discuss in detail about the concept of photoelectric transducer for measuring displacement.
3. (a) Explain the construction of platinum RTD. [8+8]
(b) With neat circuit diagram explain three wire and four wire RTD configuration.
4. (a) Describe the construction and working of c-type, spiral type and helical type Bourdon gauges with neat diagrams. [16]
(b) Describe the construction, working and theory of a diaphragm type strain gauge transducer using four strain gauges. Describe how they are connected in a wheatstone bridge and what is the output obtained. List their advantages and disadvantages.
5. (a) Certain meters are known as variable head meter. Explain clearly what is meant by the designation variable head. [16]
(b) Compare and contrast the use of venturimeter, flow nozzle and orifice meter as primary element for flow measurement.
6. (a) Explain the principle of a hydrometer. [16]
(b) What is a vibrometer? Explain any one of them.
7. (a) Explain the method of measuring force using strain gauges. [8+8]
(b) Why bridge circuit is necessary for a strain gauge? Explain how the bridge circuit is used with a strain gauge.
8. (a) Distinguish between open-loop and closed loop control systems with the help of a suitable diagram. [16]
(b) Illustrate your answer using block diagram schematics.
(c) Identify the system parameters and components in each case.
