B. Tech.

(SEM. VI) EXAMINATION, 2006-07

INSTRUMENTATION & PROCESS CONTROL

Time : 2 Hours] [Total Marks : 50

Note : Attempt all questions.

1. Attempt any four parts of the following : 3.5x4=14
   (a) Draw the block diagram of an instrument and explain the function of different functional elements.
   (b) What are the desirable and undesirable properties of an instrument? How these properties help in choosing the right instrument for a particular measurement?
   (c) Describe the working of a recording type instrument.
   (d) What is meant by calibration of an instrument? How is it performed?
   (e) Explain: a precise measurement may not necessarily be accurate and vice-versa.
   (f) What is meant by dynamic characteristics of an instrument? How is it obtained?
2 Attempt any four parts of the following: \(3 \times 4 = 12\)

(a) How are the pressure measuring instruments classified? Describe the principle, construction and operation of a ring balance.

(b) How are the temperature measuring instruments classified? What is the working principle of a bimetallic thermometer? How can a bimetallic strip be used as a compensating device for ambient temperature changes in case of pressure measurements with Bourdon tubes?

(c) Describe any method of liquid level measurement for measuring the level of a corrosive liquid.

(d) Describe the principle of operation of an orifice plate, and a venturitube as used in fluid flow measurements.

(e) Describe an ionization gauge. What are its disadvantages?

(f) Describe briefly any spectroscopic method for composition analysis.

3 Attempt any two parts of the following: \(6 \times 2 = 12\)

(a) Given a system with the transfer function

\[
\frac{Y(s)}{X(s)} = \frac{\tau_1 s + 1}{\tau_2 s + 2}
\]

(i) find \(Y(t)\) if \(X(t)\) is a unit-step function

(ii) if \(\tau_1/\tau_2 = 5\), determine the numerical values of minimum, maximum and ultimate values that may occur during the transient.

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(b) A step change of magnitude 4 is introduced into a system having the transfer function.

\[
\frac{Y(s)}{X(s)} = \frac{10}{s^2 + 1.6s + 4}
\]

_Determine:_

(i) percent overshoot
(ii) rise time
(iii) maximum value of \(Y(t)\)
(iv) ultimate value of \(Y(t)\)

(c) Write short notes on any two of the following:

(i) linearization of non-linear equations
(ii) transportation lag
(iii) interacting and non-interacting systems

4 Attempt any two parts of the following: \(6 \times 2 = 12\)

(a) What is feedback control? What are the typical elements of a feedback control loop? Develop the block diagram of a generalized feedback control system with one disturbance, incorporating in each block the appropriate transfer function and on each stream the appropriate variable.

(b) Compute the response of a PD controller to a linear change in error. Sketch the contributions of the proportional and derivative actions separately. On the basis of this example discuss the anticipatory nature of the derivative control term.
(c) The set point of the control system shown in the following figure 1 is given step change of 0.1 unit. Determine

(i) the maximum value of C and the time at which it occurs

(ii) the offset

(iii) the period of oscillation.

Fig. 1