Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH (CT)/SEM-7/CHE (CT)-701/2010-11

2010-11
INSTRUMENTATION & PROCESS CONTROL

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words
*as far as practicable.*

GROUP – A
(Multiple Choice Type Questions)

1.   Choose the correct alternatives of the following :

$10 \times 1 = 10$

   i)   Each instrument must have what number of elements ?

   a)   Two

   b)   Three

   c)   Four.

   ii)   Which is not a transducer ?

   a)   Pressure gauge   b)   Magnetic pick-up

   c)   Strain gauge   d)   Photovoltaic cell.

   iii)   The typical input to photovoltaic cell is

   a)   Force

   b)   Light

   c)   Temperature.

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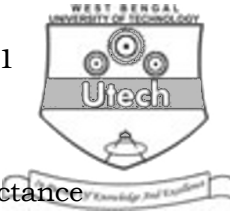
iv) Typical output of an LVDT is

    a)   Resistance   b)   Inductance

    c)   Voltage   d)   None of these.

v) The speed of response of an instrument is affected by

    a)   static error   b)   lag

    c)   dead zone   d)   all of these.

vi) Transfer function is defined only for

    a)   non-linear system

    b)   linear time-invariant system

    c)   linear time-varying system.

vii) Overall transfer function of a system is $\dfrac{4}{2\,s^2 + 4s + 9}$

    The system is

    a)   critically damped

    b)   underdamped

    c)   overdamped.

viii) Which type of control action is not used independently ?

    a)   P

    b)   I

    c)   D.

ix) The characteristic equation of a system is $s^2 + 4 = 0$. The system is

    a)   stable

    b)   unstable

    c)   marginally stable.

x) With derivative control the damping factor

    a)   increases

    b)   decreases

    c)   remains unchanged.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

$3 \times 5 = 15$

2. Explain the working principle of a vacuum gauge.

3. What do you mean by static and dynamic characteristics of an instrument ?

4. A thermometer having a time constant of 10 sec is at a steady state temperature of 50°F. At time $t = 0$, the thermometer is placed in a temperature bath maintained at 80°F. Find the time needed for the thermometer to read 76°F.

5. Discuss the effects of integral control action on the closed loop response of a process.

6. The charcteristic equation of a feedback control system is $s^3 + 2s^2 + (2 + K_c) s + \dfrac{K_c}{\tau_I} = 0$. Find the condition that must be satisfied by K_c and τ_I so that the system is stable.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. Explain the operation of a Bourdon Gauge with the help of a neat sketch. Identify the sources of errors that normally occur in such elastic deformation type gauge and suggest some ways to eliminate these errors.
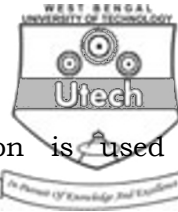
8. a) Explain how Wien's law of radiation is used in measuring temperature above 1000°C.

   b) Describe the working principles of resistance thermometer and thermocouple.

9. a) Apply block diagram reduction method to obtain C/R of a given system.

   b) Obtain the SFG and hence find C/R of the same system.
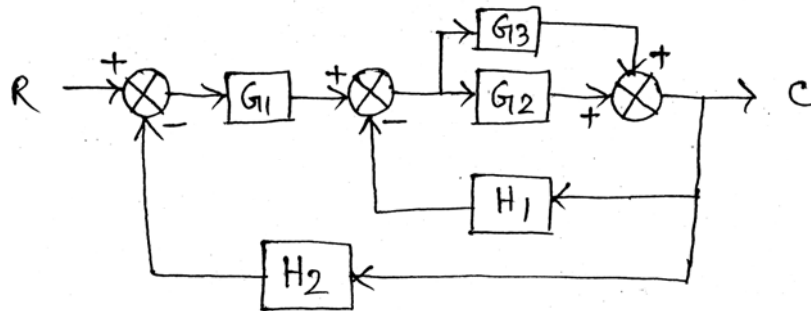
10. A unity feedback system has $G(s) = \dfrac{20}{(s+1)(s+5)}$

   Determine the characteristic equation, w_n, ξ, w_d, t_p, M_p, t_s, time period of oscillation and the number of cycles completed before reaching the steady state.

11. Draw the Bode diagram of a system with loop gain $= \dfrac{1}{s\left(1 + \dfrac{s}{10}\right)(1 + s)}$ Also state whether the system is stable or not.

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