Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER–IV • EXAMINATION – SUMMER 2013

Subject Code: X41102   **Date: 06-06-2013**
Subject Name: Control Theory
Time: 10.30 am - 01.00 pm   **Total Marks: 70**
Instructions:
    1. Attempt all questions.
    2. Make suitable assumptions wherever necessary.
    3. Figures to the right indicate full marks.

Q.1 **(a)** Define control system & explain with example open loop & close loop control system.   **07**

      (b) Describe the transient & steady state response. Also derive the expression for the rise time, maximum overshoot & peak time for 2nd order control system subjected to unit step.   **07**

Q.2 **(a)** Draw the Force to Voltage analogous circuit for the system with necessary equilibrium equations. (See Fig. 1)   **07**

      (b) Define the term Transfer Function. Also determine the transfer function C/R for the system represented by the block diagram reduction techniques. (See Fig. 2)   **07**

OR

      (b) Define Forward Path, Loop Transmittance & Self Loop. Also Determine the Transfer Function for the system by using Manson's Gain Formula. (See Fig. 2)   **07**

Q.3 **(a)** Define the term sensitivity & discuss the effect of feedback on time constant of a control system.   **07**

      (b) The open loop transfer function of a control system is given by   **07**
         $G(s)H(s) = 2(s^2+3s+20)/[s(s+2)(s^2+4s+10)]$
         Determine the static error coefficient & steady state error for the input given as:
         1) 5 2) 4t 3) $4t^2/2$.

OR

Q.3 **(a)** Explain the derivative control system & derive the expression for the steady state error for the same.   **07**

      (b) Determine the sensitivity of the overall transfer function for the system (See Fig. 3) at w= 1 rad/sec w. r. t.   **07**
         1) Forward path transfer function
         2) Feedback path transfer function

Q.4 **(a)** Sketch the root locus for the open loop transfer function of a unity feedback control system given by, $G(s)=K/[s(s+1)(s+3)]$ & determine the value of K for $\zeta = 0.5$ & for marginal stability.   **07**

      (b) List the limitations of Routh's criterion. For given system, $s^4 + 22s^3 + 10s^2 + s + K = 0$, find K_{mar} & w at K_{mar}.   **07**

OR

Q.4 **(a)** The open loop transfer function of a unity feedback control system is given by $G(s)=(s+0.25)/[s^2(s+1)(s+0.5)]$ determine the closed loop stability by applying Nyquist criterion. **07**

(b) Explain the correlation between transient response & frequency response. **07**

Q.5 **(a)** Draw the Bode Plot for the system $G(s) H(s) = 30/[s(1 + 0.5s)(1+0.08s)]$. Determine the GM, PM & comment on stability **07**

(b) Explain in brief observability. **07**

OR

Q.5 **(a)** Define state & state variable. Explain the fact that for any system the set of state variables are non unique. **07**

(b) Explain the principal of argument. **07**

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