



SE-6809

B. E. III (Sem. V) (EL) Examination

April / May - 2011

Control System Engg.

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दशांशिक निशानीवाणी विगतो उत्तरवही पर अवश्य लभवी.
 Fillup strictly the details of signs on your answer book.

Seat No. :

Name of the Examination :

Name of the Subject :

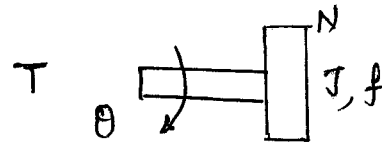
Subject Code No. : Section No. (1, 2,.....) :

Student's Signature

- (2) Attempt all six questions.
 (3) Figure to the extreme right indicate full marks.

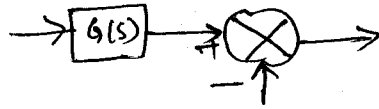
SECTION - I

- 1 (a) Answer the following : 10
 (1) For the rotational mechanical system shown in 2
Fig. below, write the dynamical equation of the system.

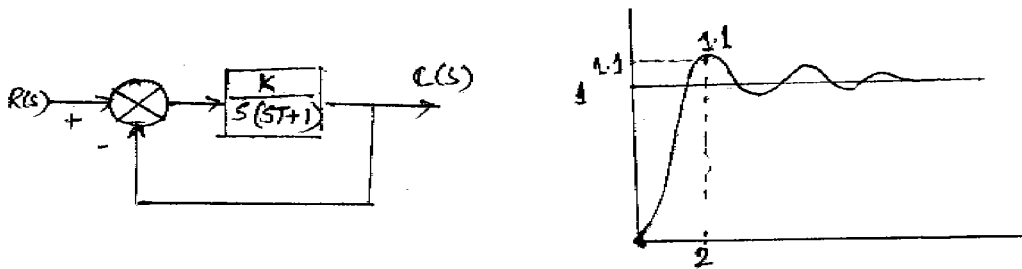


- (2) The order of the system is determined by ____ and 1
 the type of the system is determined by ____.
- (3) The response of a second order system to a step 2
 input is obtained as $c(t) = 1.66e^{-8t} \sin(6t + 37^\circ)$.
 The damping ratio is ____ and undamped natural
 frequency of oscillations is ____.
- (4) For a critically damped system, the damping ratio 1
 ζ is ____ and for an undamped system, ζ is ____.
- (5) If the damping in a system is increased, the peak 1
 overshoot will ____.

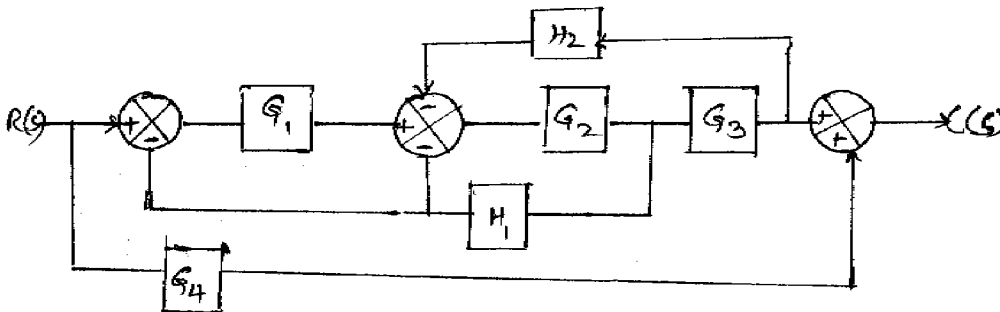
- (6) In the block diagram shown below, if the summing block is moved ahead of the gain block, the equivalent diagram will be 1



- (7) Define transfer function of a dynamical system. 2
 (b) For the system shown in Fig. below, when subjected to a unit step input, the output response is shown in the adjoining Fig. Determine the value of K and T from the response curve. 6



- (c) With suitable examples, explain open loop and closed loop systems. 4
- 2 (a) For the system shown in Fig. below, use block diagram reduction technique to obtain the overall transfer function $C(s)/R(s)$. 8



- (b) Derive transfer function $\theta(s)/V(s)$ of an armature controlled d.c. motor where θ is the angular position of the rotor and V is the d.c. input voltage. 7
- OR**
- 2 (a) With reference to a standard 2nd order system subject to 8
 a unit step input, define
 (i) Peak overshoot
 (ii) Peak time
 (iii) Settling time and derive the expressions for the same.

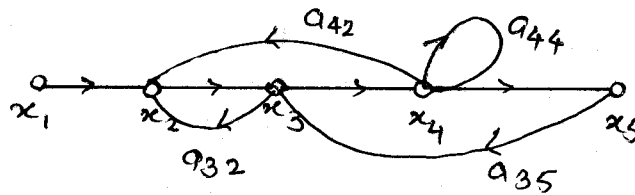
(b) A unity feedback system has $G(s) = \frac{20}{s(s+2)(s^2+2s+40)}$;

determine the error constants K_P , K_V and K_A and the associated errors. 5

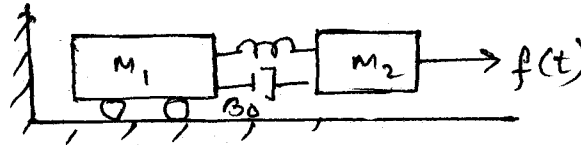
What is the disadvantage of static error constants over dynamic error coefficients. 2

3 Answer any **three** : 15

- (1) For the signal flow graph shown in Fig. below, use Mason's gain formula to obtain the overall transfer function $C(s)/R(s)$.



- (2) For a basic mechanical system shown below, obtain the force-voltage analogy for the same.



- (3) Discuss the effect of feedback on (i) system gain (ii) noise/disturbance rejection.
- (4) Show the various time responses of a standard 2nd order system subject to unit impulse input as the damping ratio is changed from zero to >1 .
- (5) Explain the construction and working of a stepper motor.

SECTION - II

4 (a) Fill in the blanks : 5

- (1) The first column of Routh table contains following integers 1
 2, -3, 4, 6 and 13. The system is _____.
- (2) In terms of Bode plot, the system is stable if gain margin and phase margin both are _____. 1
- (3) If the poles of control system lie on the imaginary axis of S plane, the system _____ stable. 1
- (4) To find stability from Bode plots requires _____ and 2 plots. 2

- (b) State whether following sentences are true or false : **5**
- (1) Gain margin is measure of relative stability of system.
 - (2) Polar plot is time domain criterion.
 - (3) In frequency domain analysis, both amplitude and phase vary with frequency.
 - (4) For the stable system all the roots must lie on left hand side of s-plane.
 - (5) Poles of closed loop transfer functions are equal to zeros of $1+G(s)H(s)$.
- (c) Define stability of system and explain what do you mean of absolute and relative stability. **4**
- (d) For characteristics equation $S^3 + 3KS^2 + (K + 2)S + 1 = 0$ find range of K for stability and frequency of oscillation. **6**
- 5** (a) For system $GH = \frac{10}{s(s+1)(s+10)}$, find GM, PM and stability of given transfer function using Bode plot. **10**
- (b) Explain gain margin and phase margin. **5**
- OR**
- 5** For system $GH = \frac{K}{s\left(1+\frac{s}{4}\right)\left(1+\frac{s}{40}\right)}$, determine the value of K for (1) GM=20db and (2) PM=30°. **15**
- 6** (a) For $GH(s) = \frac{1}{s+1}$, find stability using Nyquist plot. **6**
- (b) Define the constant M Loci and N loci in G plane and derive their expression. Write down steps of obtaining Nichol's chart. **9**
- OR**
- 6** (a) Write down correlation between frequency domain and time domain. **5**
- (b) For $GH(s) = \frac{20}{s(1+0.1s)(1+0.5s)}$ find stability using Nyquist plot. **10**
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