



RM-6461

B. E. - II (Sem. IV) (Computer) Examination
May / June - 2010
Control System Engineering

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दृष्टावेव निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. - 2 (Sem. 4) (Comp)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="Control System Engineering"/>	<input type="text"/>
Subject Code No. : <input type="text" value="6"/> <input type="text" value="4"/> <input type="text" value="6"/> <input type="text" value="1"/>	<input type="text" value="Student's Signature"/>
Section No. (1, 2,...): <input type="text" value="1&2"/>	

- (2) Attempt **all** questions.
- (3) Answer to the **two** sections must be written in **separate** answer book.
- (4) Figure to the right indicate full marks.
- (5) Assume necessary data wherever required.
- (6) Scientific calculator upto Casio-100D, 100MS series is permitted.

SECTION - I

- 1 (a) Attempt all :
 - (i) R-L-C network is an example of time invariant systems. (True/False) 1
 - (ii) Write two disadvantages of closed loop control system. 2
 - (iii) A unity feedback control system has a forward 1

path transfer function $= \frac{42.25}{s^2(s+6.5)}$. The unit step

response of the system will have its maximum value at a time = _____.

- (a) 0 sec
- (b) 0.56 sec
- (c) 5.6 sec
- (d) ∞

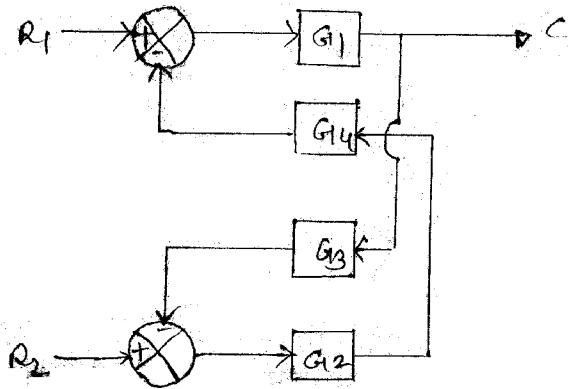
- (iv) What is the type and order of the transfer function 1

$$G(s) = \frac{(s+2)(2s+3)}{s^3(s+1)^2(s+3)} ?$$

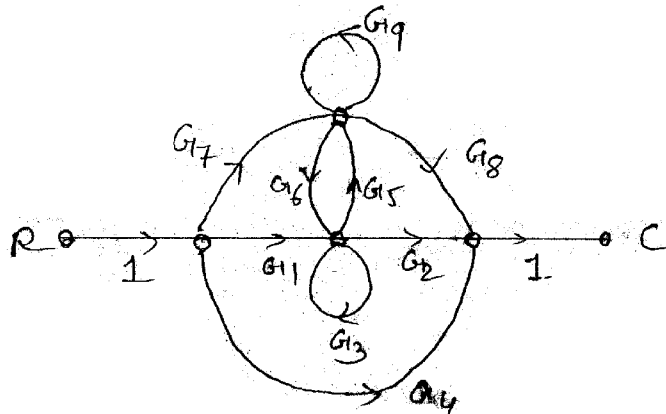
- (v) Match the analogous quantities in Torque-Voltage systems. 3

- (a) Torque (p) Inductance
 (b) Angular displacement (q) Charge
 (c) Moment of Inertia (r) Voltage

- (b) Obtain expression of output C_1 for the multiple input system as shown in below figure. 6



- (c) Find the transfer function C/R for the system shown in figure using Mason's gain formula. 6

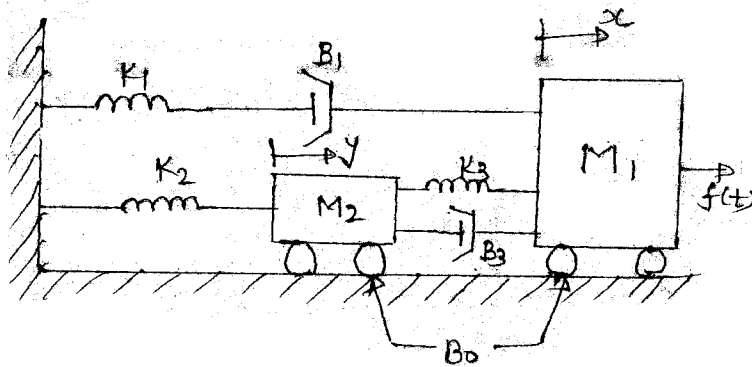


- 2 (a) Consider the system as shown in below figure :

- (i) Draw the free body diagram. 2

- (ii) Find the transfer function $\frac{X(s)}{F(s)}$ and $\frac{Y(s)}{F(s)}$. 4

- (iii) Obtain force-voltage analogy and draw electrical equivalent network using it. 2

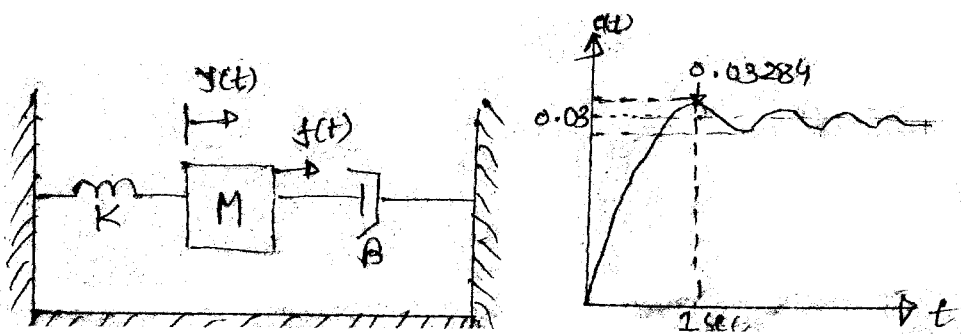


- (b) Derive the transient response for a second order system when subjected to unit step input for damping ratio $(\delta) > 1$. 7

OR

- 2 (a) A force of 9N is suddenly applied to a mechanical vibration system as shown in figure. The transient response under this condition gives peak magnitude of 0.03284 at peak time t_p equal to 1 sec. The final steady displacement is 0.03 m with zero steady state error. Find M, B and K for the mechanical system. 7

Also find $\frac{Y(s)}{F(s)}$.

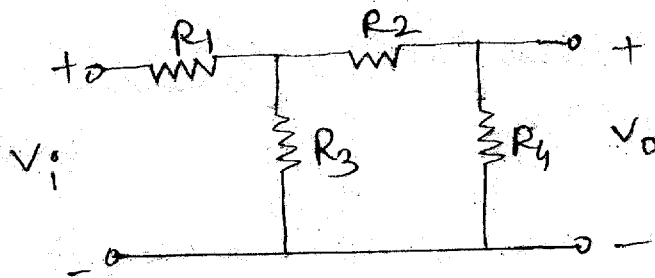


- (b) Define and derive the equation for following terms : 8
- Peak time (t_p)
 - Maximum overshoot (M_p)

3 Attempt any three :

15

- (i) Determine the transfer function for given electrical network.



- (ii) A unity feedback system has forward path transfer function $G(s) = \frac{81}{s(s+9)}$. Find the error-series of the system when the input is $r(t) = (1+2t+3t^2)u(t)$
- (iii) Explain Magnetic Amplifier.
- (iv) Derive the transfer function $\frac{\theta(s)}{E_a(s)}$ for Armature control D.C. Servo motor.
- (v) Explain synchro.

SECTION - II

4 (a) Fill in the blanks :

5

- (i) The frequency at which Nyquist diagram crosses the negative real axis is known as _____.
- (ii) A lag network for compensation normally consists of _____ elements.
- (iii) Root locus start at pole. At every pole value of K is _____.

- (iv) The slope of the magnitude curve of the Bode Plot of $G(j\omega)$ at the gain crossover usually given an indication of _____ stability. (relative/absolute)
- (v) In a linear system if output approaches infinity, the system is _____.
- (b) True/false questions : 5
- (i) Relative stability can be obtained from R H Criteria.
- (ii) In a lead Compensator, zero is nearer to origin.
- (iii) M and N circles are applicable to non unity feedback system.
- (iv) When one or more non repeated roots of the system are on imaginary axis then system is marginary stable.
- (v) If there are three zeros and two poles of $GH(S)$, then there will be three root loci.
- (c) Discuss the stability of the system whose 4
characteristic equation
- $$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$$
- (d) Determine the range of K for the system to be stable. 4
- $$S^4 + 5S^3 + 5S^2 + 4S + K = 0$$
- (e) Write down the limitation of Hurwitz's Criterion. 2
- 5 (a) A unity feedback system has open loop transfer 8
function

$$G(s) = \frac{10}{s(s+1)(s+2)}$$

Using Nyquist criterion check whether the system is stable for closed loop configuration.

- (b) Principle of argument in complex variable theory. 7

OR

- 5 (a) Using Nyquist criterion, determine the range of value K for which the unity feedback control system with open loop transfer function

$$G(s) = \frac{K}{s(s+2)(s+4)} \text{ is stable.}$$

- (b) Obtain the equation for Constant M and Constant N circles in G plane. 7

- 6 (a) Draw the bode diagram of the open loop transfer function given as 10

$$G(s) = \frac{10K}{s(s+1)(s+10)}$$

- (i) Determine gain margin, phase margin and the corresponding cross over frequencies with $K = 1$.
- (ii) Find value of K for gain margin = 40 db.
- (b) Derive the relationship between resonant peak (M_p) and damping ratio ρ .

OR

6 The open loop transfer function of unity feedback control

system is given by
$$G(s) = \frac{K(1+2s)}{s(s+1)(0.5s+1)(1+0.2s)}$$

Draw Bode plot in the magnitude and phase and hence determine

- (i) The gain margin, phase margin and the corresponding cross over frequencies with $K = 10$. 7
 - (ii) The value of K which gives phase margin of 20° . 4
 - (iii) The value of $K=5$, find gain margin and phase margin. 4
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