5E5043

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5E5043

B. Tech. V Sem. (Main/Back) Exam., Nov.-Dec.-2016
Electrical Engineering
5EE3A Control Systems

Time: 3 Hours **Maximum Marks: 80**

Min. Passing Marks: 26

Instructions to Candidates:

*Attempt any **five questions**, selecting **one question** from **each unit**. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

UNIT – I

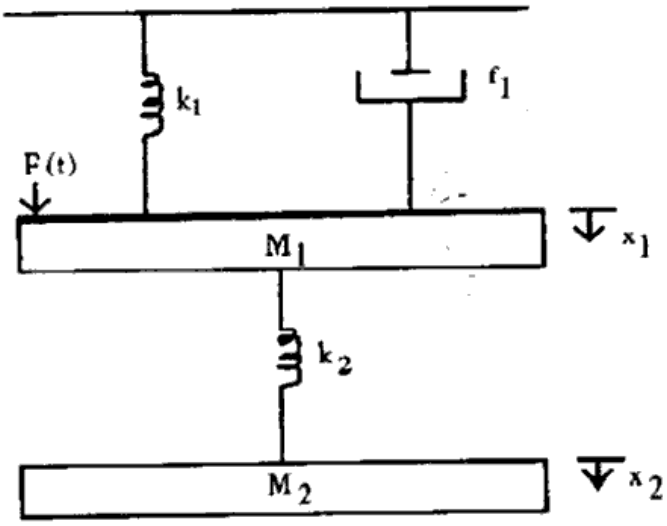
Q.1 (a) Determine the pole zero location of the following transfer function. [6]

(i) $s_1(t) = e^{-at}$; a decaying exponential

(ii) $s_2(t) = \cos wt$

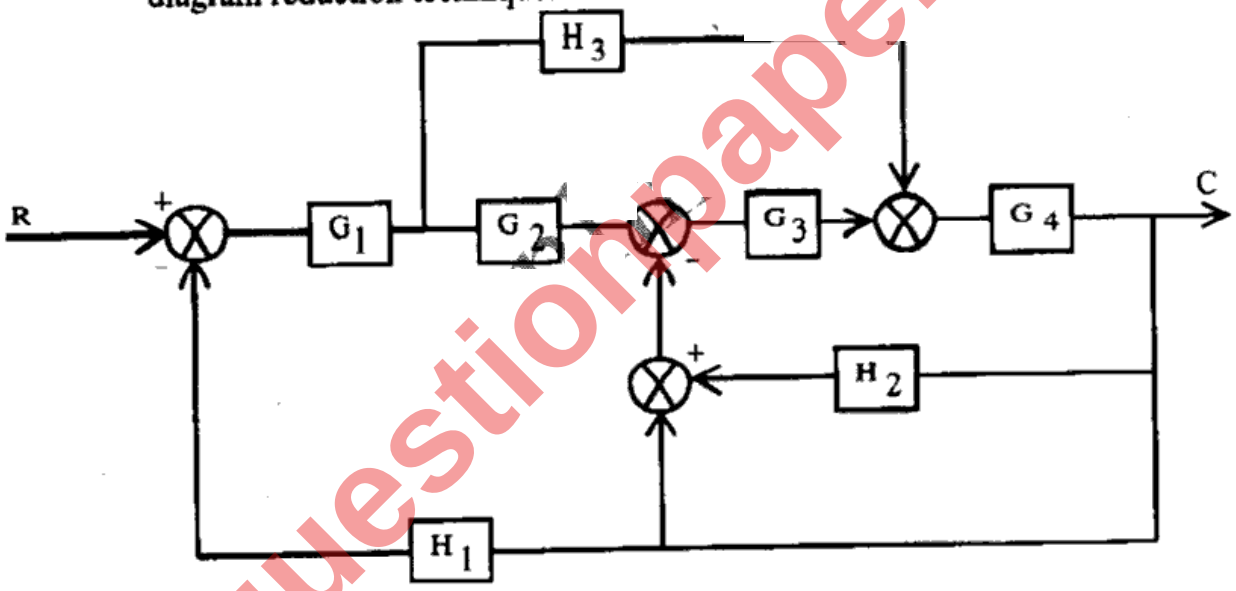
(iii) $s_3(t) = e^{-at} \cos wt$

(b) Determine system equation of the system shown in figure below. Also draw force – current analogy. [10]

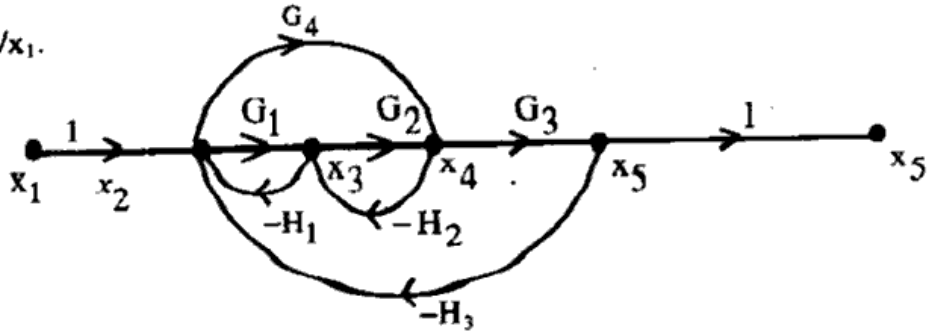


OR

Q.1 (a) Obtain the transfer function of the block diagram shown below using block – diagram reduction technique. [10]



(b) Apply the gain formula to the signal flow graph show in figure to find transfer function x_5/x_1. [6]



UNIT – II

Q.2 (a) Explain the effect of adding pole and zeros to transfer function. [6]

(b) A second order control system is represented by a transfer function given below. [10]

$$\frac{Q_o(s)}{T(s)} = \frac{1}{Js^2 + Fs + K}$$

Where Q_0 (s) is proportional output and T is the input torque.

A step input 10 N-m is applied to the system and test results are given below:-

(i) Peak overshoot Mp = 6%

(ii) Peak time tp = 1sec.

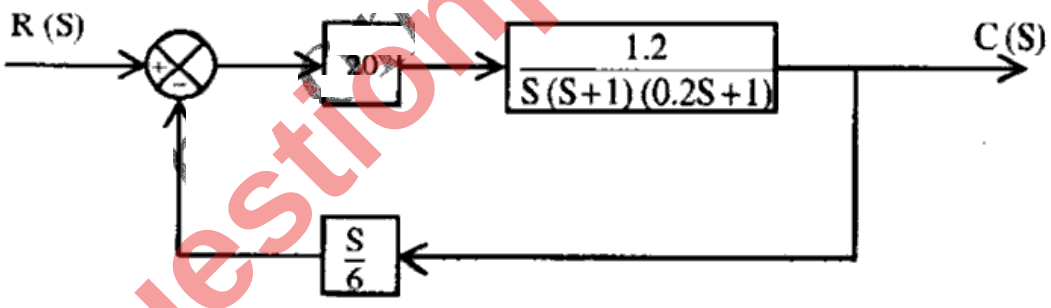
(iii) The steady state output of the system is 0.5 radian.

OR

Q.2 (a) Determine the step, ramp and parabolic error constant of the following unity feedback control system. The open loop transfer function is given by - [6]

$$G(s) = \frac{50}{S(s^2 + 5s + 50)}$$

(b) The block diagram of simple servo system is shown below. Find - [10]



(i) The characteristics equation of the system.

(ii) Undamped frequency of oscillation.

(iii) Damped frequency of oscillation.

(iv) Damping ratio.

(v) Maximum overshoot.

UNIT – III

Q.3 (a) Explain the construction and working of stepper motor. [8]

(b) Using the Routh Criterion check whether the system represented by the following characteristic equation is stable or not. [8]

$s^4 + 2s^3 + 6s^2 + 8s + 8 = 0$

OR

Q.3 (a) Sketch the root locus with K as a variable parameter of a unity feedback system whose open loop transfer function is - [10]

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

(b) Determine the range of valve of K for the system to be stable - [6]

$s^4 + 4s^3 + 13s^2 + 36s + K = 0$

UNIT – IV

Q.4 (a) Draw the Nyquist plot for a system having [10]

$$G(s)\,H(s) = \frac{s+4}{(s+1)(s-1)}$$

Use Nyquist criterion to determine the system stability.

Q.4 (b) Explain co–relation between time and frequency response. [6]

OR

Q.4 Draw the bode plot for the transfer function - [16]

$$G(s) = \frac{50}{s(1+0.25s)(1+0.1s)}$$

From the plot determine gain margin and phase margin.

UNIT – V

Q.5 (a) Derive the formula for steady state error (e_{ss}) of P. I. Control [8]

(b) Write down the merits and demerits of Phase-Lag-Lead Compensation. [8]

OR

Q.5 Compensate the system with the Open Loop Transfer Function - [16]

$$G_f(s) = \frac{k}{s(s+1)(s+5)}$$

to meet following specification:-

(a) Damping ratio (ε) = 0.3

(b) Settling time (t_s) = 12 sec.

(c) Velocity error constant $k_v \geq 8\ sec^{-1}$
