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06ES43

Fourth Semester B.E. Degree Examination, June-July 2009
Control Systems

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer any FIVE full questions, choosing at least two questions from each.***
2. Missing data may be suitably assumed.

Part–A

1 a. Mention the merits and demerits of open loop and closed loop control systems and give an example for each. **(06 Marks)**

b. For the mechanical system shown in figure Q1 (b), obtain the force-voltage analogous network. **(08 Marks)**

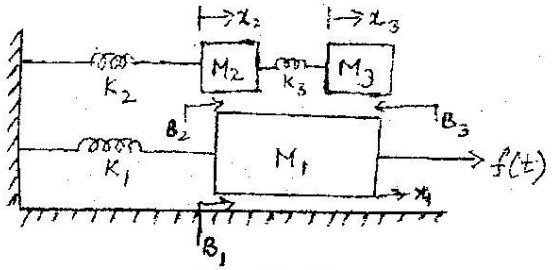

Fig. Q1 (b)

c. Obtain the transfer function of an armature controlled dc servomotor. **(06 Marks)**

2 a. Explain briefly the following terms:
i) Forward path. ii) Path gain. iii) Loop gain. iv) Canonical form. **(08 Marks)**

b. Obtain the C/R ratio for the block diagram shown using block-diagram reduction technique. **(05 Marks)**

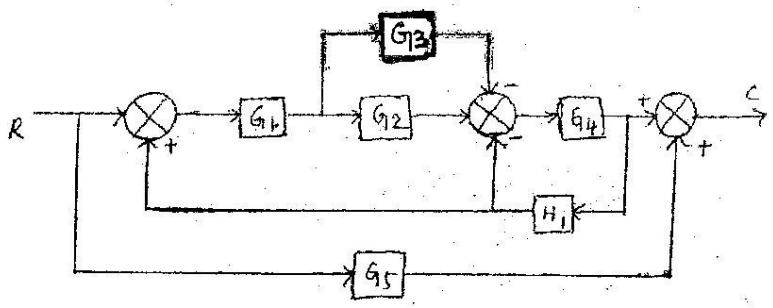

Fig. Q2 (b)

c. Find $\frac{C(s)}{R(s)}$ by Mason's gain formula (Fig. Q2 (c)). **(06 Marks)**

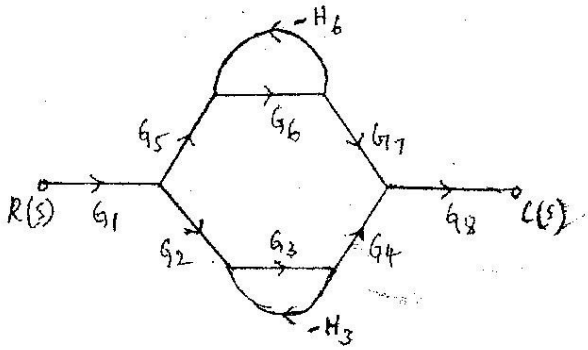

Fig. Q2 (c)

3 a. Derive an expression for the under damped response of a second order feed back contr system for step input. (06 Mark

b. Obtain expressions for rise-time and peak-time for a second-order feed back syste response for a step input (under-damped case). (06 Mark

c. A positional servomechanism is characterized by an open loop transfer functi $G(s)=\frac{k}{s(s+\alpha)}$, where k and α are positive constants, for a unity feedback. Find the valu of k and α for a damping coefficient value of 0.6 and damped frequency of 8 rad/sec. Al find the peak value of the response when the system is excited by a step of 2 volts. (08 Mark

4 a. Find K_P, K_V and K_a for the system whose open loop transfer function is given by, $G(s)H(s)=\frac{10(s+2)(s+3)}{s(s+1)(s+5)(s+4)}$.

Also find the steady-state error for an input $r(t)=3+t+t^2$. (08 Mark

b. Explain Routh-Hurwitz 's' criterion for determining the stability of a system and mention t limitations. (04 Mark

c. A unity feedback control system has:

$G(s)=\frac{k(s+13)}{s(s+3)(s+7)}$

Using the Routh's criterion, calculate the range of 'k' for which the system is

i) Stable

ii) Has its closed loop poles more negative than -1. (08 Mark

Part–B

5 a. Explain briefly the following terms with respect to root-locus technique:

i) Centroid.

ii) Asymptote.

iii) Break away point. (06 Mark

b. Sketch the root locus plot for a closed loop system having an open-loop transfer function: $G(s)H(s)=\frac{k(s+2)}{s(s+1)}$ for all values of k from 0 to ∞. Comment on the stability of the syste (08 Mark

c. Show that a part of the root-locus for the open loop transfer function: $G(s)H(s)=\frac{k(s+2)}{s(s+1)}$ is a circle. (06 Mark

6 a. The open loop transfer function of a negative feedback control system is:

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

Sketch the polar plot and hence find the following:

i) Phase cross-over frequency.

ii) Gain cross-over frequency.

iii) Gain-margin.

iv) Phase-margin. (10 Mark

b. Explain in detail the procedural steps of Nyquist stability criterion. (04 Mark

c. A feed back control system has loop transfer function: $GH(s)=\frac{1}{s(s+1)}$.

Sketch the Nyquist plot and comment on the stability of a system. (06 Mark

7 a. Derive expressions for resonant peak and resonant frequency for a second order system. **(06 Marks)**

b. Find the open-loop transfer function for a unity feed back second order control system for which resonant peak is 1.1 units and resonant frequency is 11.2 radians/sec. **(06 Marks)**

c. Sketch the Bode-plot for the transfer function: $G(s)=\frac{Ks^2}{(1+0.2s)(1+0.02s)}$

Determine the value of 'k' for the gain cross over frequency to be 5 rad/sec. **(08 Marks)**

8 a. Compare transfer function approach and state variable approach of analyzing control system. **(04 Marks)**

b. A feed back system is characterized by the closed loop transfer function:

$GH(s)=\frac{s^2+3s+3}{s^3+2s^2+3s+1}$.

Obtain its state model. **(08 Marks)**

c. State the properties of state transition matrix. Obtain the state transition matrix for:

$A=\begin{bmatrix}0 & -1\\ 2 & -3\end{bmatrix}$ **(08 Marks)**

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