B.E. (CST) Part-III 5th Semester Examination, 2007

Automatic Control System

(EE-511)

Time : 3 hours **Full Marks : 100**

Use separate answerscript for each half.

Answer SIX questions, taking THREE from each half.

Two marks are reserved for neatness in each half.

FIRST HALF

1. a) What do you mean by stability of a linear control system? State and explain Routh stability criterion in this context.

   b) Consider the closed-loop system shown in Fig-1. Determine the range of K for stability. [Assume K > 0].

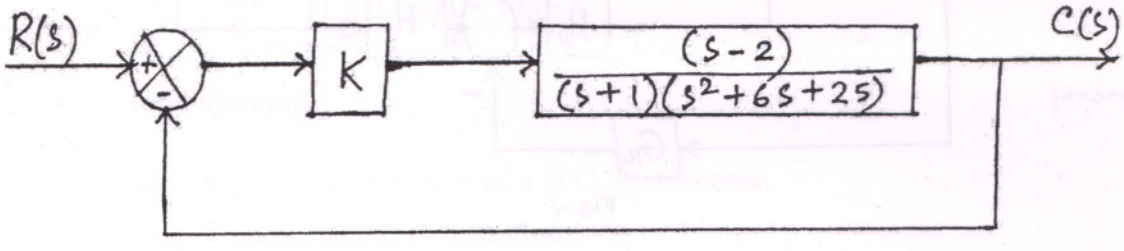

Fig. 1 (Closed Loop System)

   c) The input voltage $e_i(t)$ is connected with a series LCR network. The output $e_0(t)$ is to be measured across capacitor C. Find out the transfer function of the above system. **[3+8+5]**

2. Consider a feedback control system, whose characteristic equation is given below

$$1 + \frac{k(s^2 + 1)}{s(s + 2)} = 0$$

   Draw the root locus plot for the range of k as $0 < k < \infty$. **[16]**

3. a) The block diagram of a feedback control system is shown in the Fig.-2. The output Y(s) is

$$Y(s) = M(s)\,R(s) + Mw(s)\,W(s)$$

   Find the transfer functions M(s) and Mw(s)

5. Write short notes (any two) : [8+8]

   a) Transfer function of a standard thermal system

   b) Application of rules applied for Root locus plot

   c) Classification of control system and relevant examples.

SECOND HALF

6. a) For a standard second order system deduce the expression of peak overshoot to a unit step input.

   b) Draw the block-diagram of an A.C. position control system.

   c) State the salient constructional features and find the transfer function of an A.C. servomotor. [6+5+5]

7. a) Define static error constants. What is "type" of a system?

   b) Determine the step error constant for

$$G(s) = \frac{1000}{(1 + 0.1s)(1 + 10s)}$$

   c) Compare PI & PD controllers drawing block diagrams of the respective closed loop systems. [4+6+6]

8. a) Find the transfer function of a D.C. servomotor.

   b) State Nyquist Stability Criterion.

   c) Using Nyquist Stability Criterion, find closed loop stability of a unity feedback system with $G(s) = \frac{1}{s(s-1)}$. [4+4+8]

9. a) Draw the Bode Plots of :

$$G(s) = \frac{300}{s(s + 10)(s + 40)}$$

   b) Find the Gain Margin and Phase Margin from the plots in 9(a).

   c) What is the use of a Synchro? [8+4+4]

10. a) Design a PID controller based on Zeigler-Nichols tuning for :

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

   b) Define rise time and bandwidth of a system.

   c) What is a linear system? When is a system time invariant? [8+4+4]

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