

Total number of printed pages – 7

B. Tech
CPEE 5302

Sixth Semester Examination – 2008

CONTROL SYSTEM ENGINEERING

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory
and any five from the rest.*

*The figures in the right-hand margin
indicate marks.*

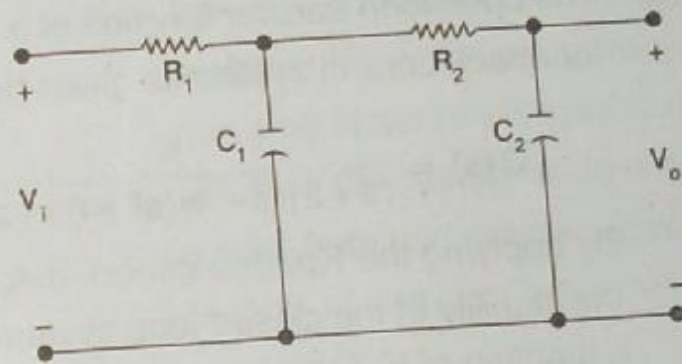
1. Answer the following questions : 2 × 10
- (a) What are the effects of negative feedback control on time constant and bandwidth of a system ?
- (b) What are the time response specifications ?

P.T.O.

- (c) Draw the Bode plot for a Proportional-Integral controller. What are the effects of integral control action ?
- (d) Explain the effects of adding a zero to a second order system.
- (e) What is a phase-lead compensator and why is it used ?
- (f) Explain gain margin and phase margin.
- (g) What is Nichol's chart ?
- (h) Distinguish between a minimum phase and a non-minimum phase system.
- (i) How does an AC tachometer work ?
- (j) Sketch the polar plots for :

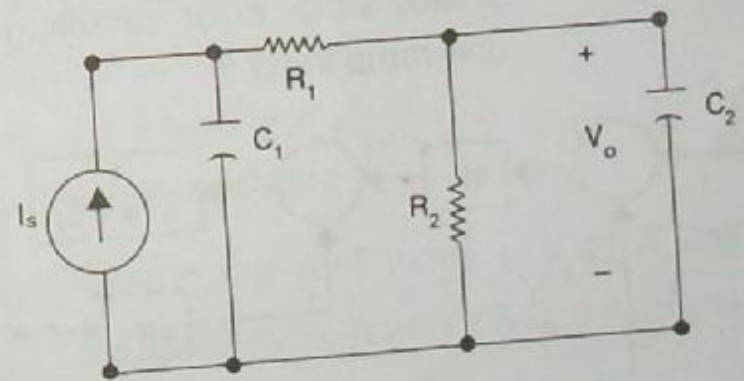
$$G(s)H(s) = \frac{1}{1+sT}$$

2. (a) Explain the construction and principle of operation of an amplidyne. 4
- (b) Obtain the transfer function, $\frac{V_o(s)}{V_i(s)}$ of the cascaded R-C circuit shown in Fig. 1. 6



(Figure 1)

3. (a) Discuss the construction, principle of operation, characteristics and modeling of a two phase servo motor. 5
- (b) Draw the signal flow graph for the circuit shown in Fig. 2 and determine $V_o(s)/I_s(s)$. 5



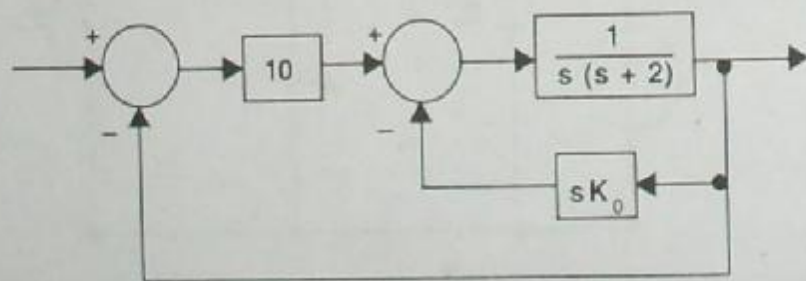
(Figure 2)

4. (a) The open-loop transfer function of a unity feedback control system is given by

$$G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$$

By applying the Routh criterion, discuss the stability of the closed-loop system as a function of K. Determine the values of K which will cause sustained oscillations in the closed loop system. What is the corresponding oscillation frequency? 5

- (b) (i) If the derivative feedback is absent ($K_0 = 0$) in the closed loop system shown in Fig. 3, determine the damping factor and natural frequency of the system. What is the steady-state error resulting from unit-ramp input? 2.5



(Figure 3)

- (ii) Determine the derivative feedback constant K_0 , which will increase the damping factor of the system to 0.6. What is the steady-state error resulting from unit-ramp input with this setting of the derivative feedback constant? 2.5

5. Draw the Bode diagram for :

$$G(s) = \frac{100(1+0.02s)}{(1+s)(1+0.1s)(1+0.01s)^2}$$

Determine the following from the Bode Diagram :

- the gain cross over frequency
- the phase cross over frequency
- the gain margin
- the phase margin

Is the system stable? 10

6. (a) Sketch the root locus plot of a unity feedback system with forward path gain,

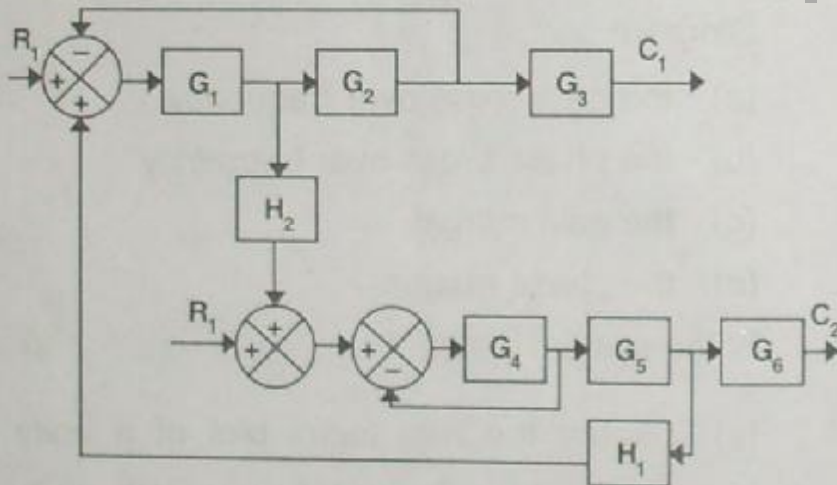
$$G(s) = \frac{K}{s(s+2)(s+4)} \quad 2$$

(b) Using Nyquist stability criterion determine the stability of system with : 5+3

(i) $G(s) H(s) = \frac{10(s+3)}{s(s-1)}$

(ii) $G(s) H(s) = \frac{(s+2)}{(s+1)(s-1)}$

7. (a) Using block diagram reduction technique in Fig. 4, determine C_1/R_1 and C_2/R_1 , assuming $R_2 = 0$. 5



(Figure 4)

(b) Explain the effects of the different controller gains of a PID controller on the system's performance from the basic equations of the PID controller. 5

8. (a) Explain the different generalised error coefficients. 5

(b) What is BIBO stability of a system? State the condition and derive it. 5