5 Attempt any **two** parts : 2×10=20

(a) Express the following open loop transfer function in closed loop form using unity feedback. Draw the signal flow graph :

$$\frac{C(S)}{R(S)}=\frac{3}{S^4+2S^3+3S+2}$$

(b) Design the lead compensator for a unity feedback control system with open loop transfer function

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

Such that velocity error constant $K_v = 10$ and phase margin of the system be at least 45^o.

(c) Discuss the working of the Lag-Lead Compensator. Sketch the Bode Plot of Lag-Lead compensator. Give the design steps of a lag compensator.

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2056 Roll No.

B.Tech

(SEM V) ODD SEMESTER THEORY EXAMINATION 2009-10

CONTROL SYSTEM

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt* ***all*** *questions.*

1 Attempt any **four** parts : 4×5=20

(a) Explain open loop and closed loop controls with the help of suitable examples.

(b) Discuss the effect of feedback on the following :

(i) Sensitivity

(ii) Stability

(iii) Error.

(c) Find the transfer function of the system shown in the **fig.1** using Mason's gain formula.

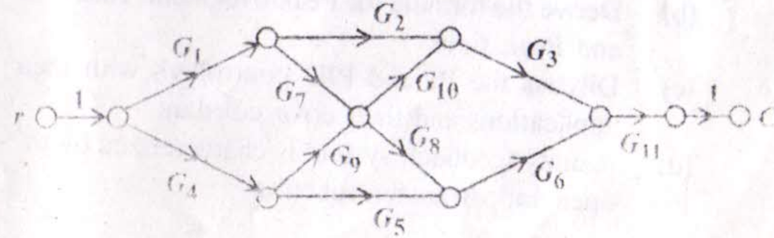

Fig. 1

(d) Explain block diagram reduction technique to determine transfer function of a complicated system.

(e) For the system represented by the following equations, find the transfer function X(s)/U(s) by signal flow graph technique :

$$X = X_1 + \beta_3 U$$
$$X_1' = -a_1 X_1 + X_2 \beta_2 U$$
$$X_2' = -a_2 X_1 + \beta_1 U$$

2 Attempt any **four** parts : 4×5=20

(a) For the system shown in the fig. 2 (i) determine ξ and ω_n without K_D (ii) K_D for $\xi = 0.60$ with controller.

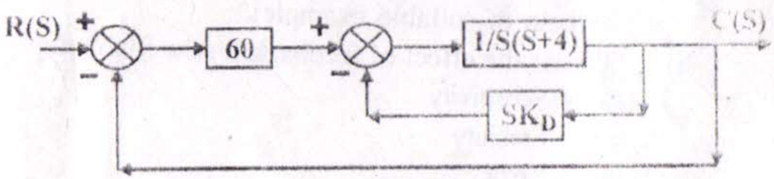

Fig. 2

(b) Derive the formula for Peak overshoot, Rise time and Peak time.

(c) Discuss the PI and PID controllers with their applications and their error constant.

(d) A unity feedback system is characterized by the open loop transfer function

$$G(S) = \frac{1}{S(0.5S+1)(0.2S+1)}$$

Determine the steady state errors for unit step and unit ramp input. Also determine the damping ratio and natural frequency of the dominant roots.

(e) For a general second order systems find the c (t), when input is unit step.

3 Attempt any **two** parts : 2×10=20

(a) (i) Determine the values of K>0 and a>0, so that system having

$$G(S) = \frac{K(S+1)}{S^3 + aS^2 + 2S + 1},$$

H(S)=1 oscillates at a frequency 2 rad/s.

(ii) Find the stability of the following polynomial by Hurwitz criterion

$$F(S) = S^5 + 2S^4 + 3S^3 + 6S^2 + 2S + 1$$

(b) Discuss the constructional feature and working principle of AC servomotor.

(c) Draw the root locus plot of :

$$1 + \frac{K(S+1.5)}{S(S+1)(S+5)(S+15)}$$

and also comment on its stability.

4 Attempt any **two** parts : 2×10=20

(a) Establish the correlation between time response and frequency response analysis and suitably explain with diagrams.

(b) Draw the bode plot of the given function

$$G(j\omega) = \frac{4(1+j\omega/2)}{j\omega\left(1 + \frac{j\omega}{10} - \left(\frac{\omega}{10}\right)^2\right)}$$

(c) Sketch the Nyquist plot for the following transfer function

$$G(S)H(S) = \frac{K}{S^2(1+\tau S)}$$

For $K > 0,\ \tau > 0$.