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328556 (28)

BE (5th Semester)

Examination, Nov.-Dec., 2014

Branch : Et & T

AUTOMATIC CONTROL SYSTEM (NEW)

Time Allowed : Three Hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : (i) Part (a) of each question is compulsory & carry 2 marks.

(ii) Attempt any two from part (b), (c) & (d) each carry 7 marks.

Q. 1. (a) Differentiate between open loop & close loop control system. 2

(b) Find the transfer function of the system shown in figure-1. 7

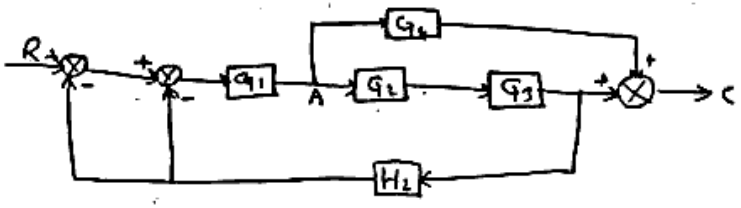


Figure-1

(c) Obtain the output of the system whose signal flow graph is shown in figure-2. 7

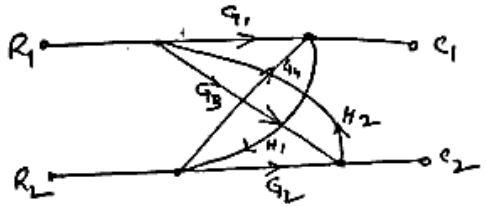


Figure-2

(d) Obtain the transfer function $\frac{C(s)}{R(s)}$ from the signal flow graph shown in figure-3. 7

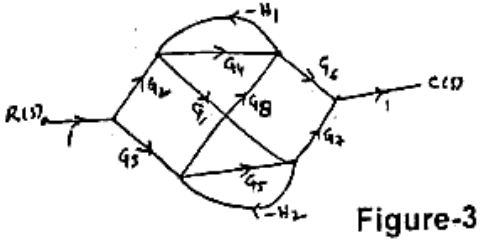


Figure-3

Q. 2. (a) Define steady state response & steady state error. 2

(b) The open loop transfer function of a unity feed back system is given by : 7

$$G(s) = \frac{k}{s(\tau s + 1)}; k > 0, \tau > 0$$

By what factor should the gain be reduced so that the peak overshoot of unit step function response of the system is reduced from 75% to 25%.

(c) Derive the expression for peak time & rise time for second order system when input is unit step. 7

(d) The characteristic equation of feed back control system is : 7

$$s^4 + 20s^3 + 15s^2 + 2s + K = 0$$

(i) Determine the range of K for the system to be stable.

(ii) Can the system be marginally stable ? If so, find the required value of K & frequency of sustained oscillations.

Q. 3. (a) What is polar plots ? Define gain margin & phase margin from polar plots. 2

(b) Write short notes on : 7

(i) Gain margin

(ii) Phase margin

(iii) Gain cross over frequency

(iv) Phase cross over frequency

(c) For the transfer function

$$G(s)\,H(s) = \frac{k}{s(s+6)(s^2+4s+13)}$$

Sketch the root locus & determine :

(i) The break away point

(ii) Stability conditions

(iii) The angle of departure from complex poles 7

(d) Construct bode plot for the system whose open-loop transfer function is given below & determine : 7

(i) The gain margin

(ii) The phase margin

(iii) Closed loop stability

$$G(s)\,H(s) = \frac{4}{s(1+0.5s)(1+0.08s)}$$

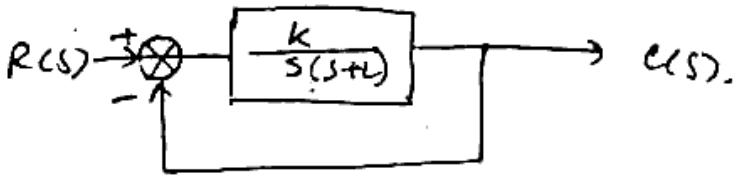
Q. 4. (a) What is feed back compensation ? 2.

(b) Describe the lead compensator. Also derive its transfer function & attenuation factor. 7

(c) The open loop transfer function of a unity feed back control system is given by : 7

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

The system is to have 50% maximum overshoot & peak time 1.0 sec. Determine the value of K & tachometer feed back constant K_t.



(d) Explain the Nyquist stability criterion with suitable examples, also explain the advantages of Nyquist method. 7

Q. 5. (a) Define controllability & observability. 2

(b) Define the following terms w.r.t. state space approach : 7

(i) State

(ii) State variables

(iii) State vector

(iv) State space

(v) State space equation

(c) The transfer function of a system is given by : 7

$$\frac{Y(s)}{U(s)} = \frac{s^2 + 3s + 2}{s^3 + 9s^2 + 26s + 24}$$

Determine the state model. Use direct decomposition method.

(d) Check controllability & observability of a system having following coefficient matrix : 7

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -11 & 6 \end{bmatrix} B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \& \ C^T = \begin{bmatrix} 10 \\ 5 \\ 1 \end{bmatrix}$$