SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

AN AUTONOMOUS INSTITUTION

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23EET206 CONTROL SYSTEMS AND INSTRUMENTATION

QUESTION BANK

UNIT – II TIME RESPONSE ANALYSIS AND FREQUENCY RESPONSE ANALYSIS

PART – A

1. The damping ratio and the undamped natural frequency of a second order system are 0.5 and 5respectively. Calculate the resonant frequency.
2. Write the mathematical expressions for step input and impulse input.
3. Draw the time response of a second order under damped system when excited with unit step input.
4. How the system is classified depending on the value of damping ratio?
5. The closed loop transfer function of a second order system is given by $400/(s^2+2s+400)$. Determine thedamping ratio and natural frequency of oscillation.
6. Draw the unit-step response curve for the second order system and show the time domainspecifications.
7. What are the standard tests signals employed for time domain studies?
8. List out the time domain specification parameters.
9. What is time response?
10. What is transient and steady state response?
11. Name the test signals used in time response analysis
12. The closed-loop transfer function of second order system is $C(S)/R(S) = 10/ S^2 + 6S + 10$. What is thetype of damping?
13. Define rise time, delay time, peak time.
14. What is steady state error?
15. What are static error constants?
16. Define position, velocity error constants.
17. What are generalized error constants?
18. List the advantages of generalized error constants.
19. What is frequency response analysis?
20. Draw the polar plot of the function $G(S) = 1/S(S+T1)(1+ST2)$
21. What is polar plot?
22. Define gain cross over frequency.
23. Define Phase cross over frequency.
24. Define Phase Margin.
25. Define Gain Margin.
26. How do you calculate the gain margin from the polar plot?

27. How do you find the stability of the system by using polar plot?
28. What are the advantages of Bode plot?
29. List the Frequency domain specifications.
30. What is cut off frequency?
31. Compare bode plot and Nyquist plot analysis.
32. What is Bandwidth?
33. What is lag-lead compensation?
34. What is lag-lead compensator?
35. Draw electrical lag-lead compensator network.
36. Write transfer function of lag-lead compensator.
37. Compare series compensator and feedback compensator.
38. What is compensator? What are the different types of compensator?
39. What is resonant frequency?

PART – B & C

a. Draw the response of second order systems for critically damped case and when input is unit step signal.

b. The unity feedback system is characterized by an open loop transfer function G(s)=K/s(s+10). Determine the gain K, so that the system will have a damping ratio of 0.5. For this value of K, determine settling time, peak overshoot and time to peak overshoot for a unit step input.

c. The open loop transfer function of a unity feedback system is given by G(s) = K / S(ST + 1). Where K and T are positive constant. By what factor should the amplifier gain K be reduced, so that the peak overshoot of unit step response is reduced from 75% to 25%.

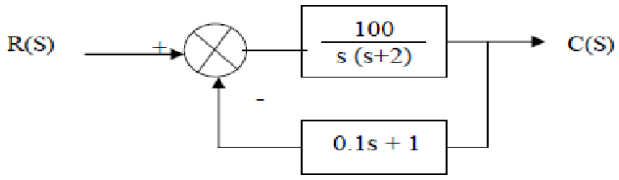
d. A unity f/b control system has open loop transfer function of G(S) =10/S(S+2). Determine its closed loop transfer function, damping ratio and natural frequency of oscillations. Also evaluate the rise time,peak overshoot, peak time and settling time for a step input of 12 units.

e. Derive the response of undamped second order systems for unit step input.

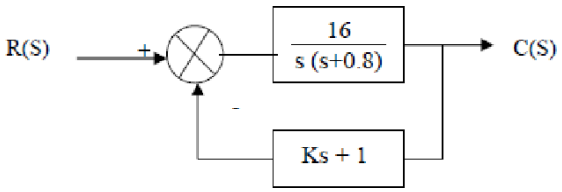
f. The response of a servomechanism is $c(t) = 1 + 0.2\, e^{-60t} - 1.2\, e^{-10t}$ when subject to a unit step input. Obtain an expression for closed loop transfer function. Determine the undamped natural frequency and damping ratio.

g. Derive the output response of a first order system for unit step input.

h. Derive the output response of the following system.



i. Derive the output response of the following system.



j.

k. Derive the response of critically damped second order systems for unit step input.

1. Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies $G(S) = 10/ S(1+0.4S) (1+0.1S)$
2. The open loop transfer function of a unity feedback system is $G(S) = 1/ S(1+S) (1+2S)$. Sketch the Polar plot and determine the Gain margin and Phase margin.
3. Sketch the Bode plot and hence find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. $G(S) = 0.75(1+0.2S)/ S(1+0.5S) (1+0.1S)$
4. Sketch the Bode plot and hence find Gain cross over frequency,Phase cross over frequency, Gain margin and Phase margin. $G(S) = 10(S+3)/ S(S+2) (S^2+4S+100)$
5. Sketch the polar plot for the following transfer function and find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. $G(S) = 10(S+2)(S+4)/ S (S^2 -3S+10)$
6. Construct the polar plot for the function $GH(S) =2(S+1)/ S^2$. Find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. (NOV/DEC 2010)
7. Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies $G(S) =K S^2 / (1+0.2S) (1+0.02S)$. Determine the value of K for a gain cross over frequency of 20 rad/sec.
8. Sketch the polar plot for the following transfer function and find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. $G(S) = 400/ S (S+2)(S+10)$
9. A unity feedback system has open loop transfer function $G(S) = 20/ S(S+2)(S+5)$.Using Nichol's chart determine the closed loop frequency response and estimate all the frequency domain specifications.
10. Sketch the Bode plot and hence find Gain cross over frequency,Phase cross over frequency, Gain margin and Phase margin. $G(S) = 10(1+0.1S)/ S(1+0.01S) (1+S)$.
11. What is compensation? Why it is needed for control system? Explain the types of compensation?
12. Realize the basic compensators using electrical network and obtain the transfer function.
13. Design a suitable lead compensator for a system with unity feedback and having open looptransfer function $G(S)= K/ S(S+1) (S+4)$ to meet the specifications. (i)Damping ratio=0.5 (ii)Undamped natural frequency ω_n =2 rad/sec.
14. A unity feed back system has an open loop transfer function $G(S)= K/ S(S+1)/(0.2S+1)$.Design a suitable phase lag compensators to achieve following specifications Kv= 8 and Phase margin 40 deg with usual notation.
15. Explain the procedure for lead compensation and lag compensation.
16. Explain the design procedure for lag – lead compensation.
17. Consider a type 1 unity feedback system with an open loop transfer function $G(S) =K/S (S+1) (S+4)$.The system is to becompensated to meet the following specifications Kv> 5sec and PM>43 deg. Design suitable lag compensators