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Question Paper Code : 52533

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fifth Semester

Aeronautical Engineering

AE 6505 — CONTROL ENGINEERING

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the conditions for a linear time invariant system to be stable?
2. Write the force balance equation of ideal spring and dashpot element.
3. Write the difference between open and closed 1oop systems.
4. Give the properties of signal flow graph.
5. What are static error constants?
6. Draw the time response of a first order system.
7. If the gain margin of the system is positive and phase margin is negative, comment upon the stability of the system.
8. Explain the necessary and sufficient conditions for stability.
9. List some of the problems associated with implementation of digital control.
10. What is a sampled data control system?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain the development of a flight control system. (6)

(ii) Explain the theory of simple hydraulic system with neat diagram.(7)

Or

(b) Determine the transfer function of $\frac{X_1(s)}{F(s)}$ and $\frac{X_2(s)}{F(s)}$ for the system shown in Figure 1 :

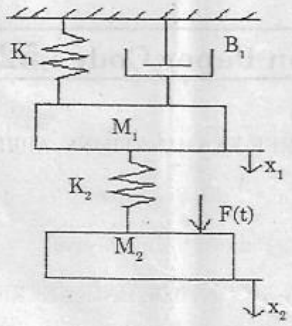

Figure 1

12. (a) Find the overall transfer function C/R for the control system shown in figure 2 using block diagram reduction technique.

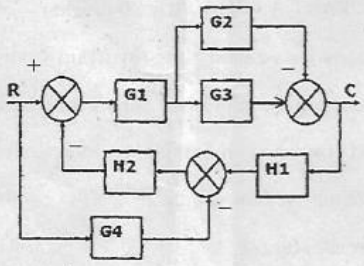

Figure 2

Or

(b) Find the overall transfer function C/R for the control system shown in figure 2 using Mason's gain formula.

13. (a) (i) Obtain the response of second order underdamped system with unit step input. (9)

(ii) Define :

(1) Rise time (2)

(2) Delay Time. (2)

Or

(b) For a unity feedback control system the open loop transfer function $G(S)=\frac{10(S+2)}{S^2(S+1)}$. Find the steady state error when the input is $R(S)$ where $R(S)=\frac{3}{S}-\frac{2}{S^2}+1/3S^3$.

14. (a) The open loop transfer function of an unity feedback system is given by:

$$G(s)=\frac{K}{s(s^2+6s+25)};\ H(s)=1$$

Sketch the root locus and determine the following

(i) Centroid, number and angles of symptotes (3)

(ii) Angle of departure of root loci from the poles (3)

(iii) Break-away point (3)

(iv) The value of K and the frequency at which the root locus crosses the imaginary axis and comment on the stability. (4)

Or

(b) Construct the Bode plot for a unity feedback system whose transfer function is given by :

$$G(s)=\frac{K}{S(1+0.2S)(1+S)};\ K=10$$

From the Bode plot, determine

(i) Gain and Phase Crossover frequency (5)

(ii) Gain and Phase margins (6)

(iii) Comment on the Stability of the closed loop control system. (2)

15. (a) (i) Determine the z-transform of a unit ramp function. (6)

(ii) Find the Z transform of $x[n]=-a^n u[-n-1]$. (7)

Or

(b) Explain the structure of digital PID controller and how it can be used for regulating a system.

PART C — (1 × 15 = 15 marks)

16. (a) Using Routh's stability criterion, assess the stability of the characteristic equation :

$$s^5 + 2s^4 + 24s^3 + 48s^2 - 25s - 50 = 0 .$$

Or

(b) Consider a system $G_c(s)\frac{k_v}{s(s+1)}$ and the specifications are e_{ss} for a velocity input should be less than 0.1 phase margin should greater than 40 degree. Design a phase lead compensator. (15)