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Question Paper Code : X 20719

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Fifth Semester
Electrical and Electronics Engineering
IC 6501 – CONTROL SYSTEMS
(Common to Electronic and Instrumentation Engineering and Instrumentation and Control Engineering)
(Regulations 2013)
(Also Common to PTIC 6501 – Control Systems for B.E. Part time for Electrical and Electronics Engineering – Third Semester – Regulations 2014)

Time : Three Hours Maximum : 100 Marks

(Use to Graph Sheet, Semi log sheet Polar sheet is Permissible)

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. What are the basic elements in control systems ?

2. Define Synchros.

3. For the system described by $\frac{C(s)}{R(s)} = \frac{16}{s^2 + 8s + 16}$; find the nature of the time response.

4. Why is the derivative control not used in control systems ?

5. List out the different frequency domain specifications.

6. Give the need for lag/lag-lead compensation.

7. Draw the circuit of lead compensator and draw its pole zero diagram.

8. Define asymptotic stability.

9. Write the advantages of state space analysis.

10. State the concept of observability.

PART – B **(5×13=65 Marks)**

11. a) i) Explain open loop and closed loop control systems with examples. **(7)**

ii) Derive the transfer function of an armature controlled DC servomotor. **(6)**

(OR)

b) i) For the mechanical system shown in Fig. Q. 11(b)(i).

1) Draw the mechanical network diagram and hence write the differential equations describing the behaviour of the system. **(7)**

2) Draw the force-voltage and force-current analogous electrical circuits.

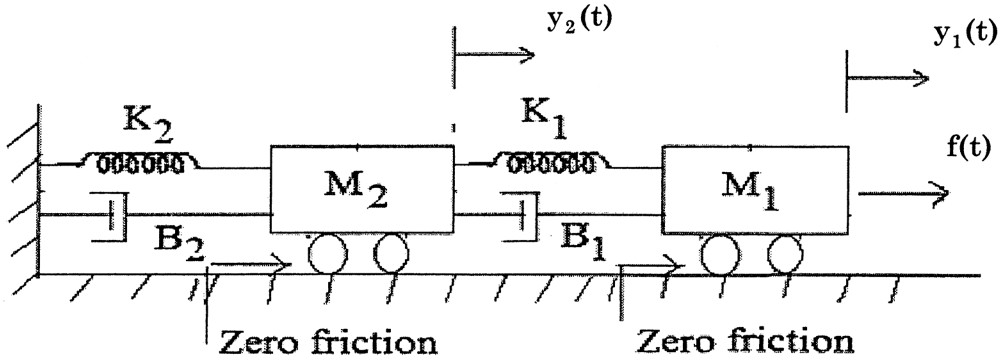

Fig. Q. 11(b) (i)

ii) For a non unity negative feedback control system whose open loop transfer function is G(s) and feedback path transfer function is H(s), obtain the control ratio using Mason's gain formula. **(6)**

12. a) Derive the expressions for second order system for under damped case and when the input is unit step.

(OR)

b) Find the static error coefficients for a system whose transfer function is, G(s). H(s) = 10/s (1 + s) (1 + 2s). And also find the steady state error for $r(t) = 1 + t + t_{2/2}$.

13. a) Plot the Bode diagram for the following transfer function and determine the phase and gain cross over frequencies.

$$G(S) = \frac{10}{S(1+0.4S)(1+0.1S)}$$

(OR)

b) The open loop transfer function of a unity feedback system is given by

$G(S) = \frac{1}{S(1+S)^2}$. Sketch the polar plot and determine the gain and phase margin.

14. a) The open loop transfer function of a unity feedback control system is $G(s) = \frac{k}{s(s+1)(s+2)}$. Design a suitable lag-lead compensator so as to meet the following specifications : static velocity error constant K_v = 10sec^{-1}, phase margin = 50 degree and gain margin ≥ 10 db. **(13)**

(OR)

b) Consider the unity feedback whose open loop transfer function is $G(s) = \frac{K}{[s(0.1s+1)(0.2s+1)]}$ system to be compensated to meet the following specifications : Static velocity error constant = 30 sec^{-1}, Phase margin ≥ 50 degree, Bandwidth (ω_b) = 12 rad/sec. **(13)**

15. a) Determine the canonical state model of the system whose transfer function is

$$T(s) = \frac{2(s+5)}{(s+2)(s+3)(s+4)}.$$ **(13)**

(OR)

b) Consider a linear system described by the following transfer function,

$\frac{Y(s)}{U(s)} = \frac{10}{s(s+1)(s+2)}$. Design a feedback controller with a state feedback so that the closed loop poles are placed at – 2, –1 ± j1. **(13)**

PART – C **(1×15=15 Marks)**

16. a) A unity feedback control system has an open loop transfer function, $G(s) = \frac{k}{s(s^2+4s+13)}$. Sketch the Root Locus. **(15)**

(OR)

b) Construct the Nyquist plot for a system whose open loop transfer function is given by $G(s)H(s) = \frac{K(1+s)^2}{s^3}$, find the range of K for stability. **(15)**