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Question Paper Code : 80114

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

Third/Fourth Semester

Electronics and Communication Engineering

EC 8391 – CONTROL SYSTEMS ENGINEERING

(Common to Medical Electronics, Electronics and Telecommunication Engineering)

(Regulation 2017)

Time : Three hours   Maximum : 100 marks

May be permitted : Bode Plot-Semi-Log graph sheet and polar chart.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give two disadvantages of closed loop control over open loop control.

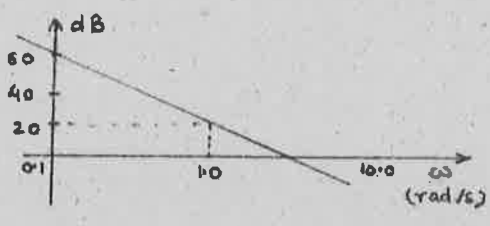
2. Obtain the gain $\frac{Y}{X}$ for the signal flow graph shown below :

3. What do you mean by order and type of a system?

4. Define a unit impulse function.

5. What do you mean by a nonminimum phase system?

6. Obtain the transfer function of the system whose Bode magnitude plot is as given below :



7. What is the main objective of root locus analysis technique.

8. Write the transfer function of a PID controller?

9. An LTI system given by the following state variable description :

$$X = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; \; Y = [1 \quad 0] X .$$

Determine whether the system is controllable or not.

10. The z-transfer function of an open loop system is given by $G(z) = \frac{2(z-1.5)}{(z-0.5)(z+0.5)}$. Is the open loop system stable? Justify.

PART B — (5 × 13 = 65 marks)

11. (a) Obtain the transfer function for the coupled circuit as shown Fig. 1 :

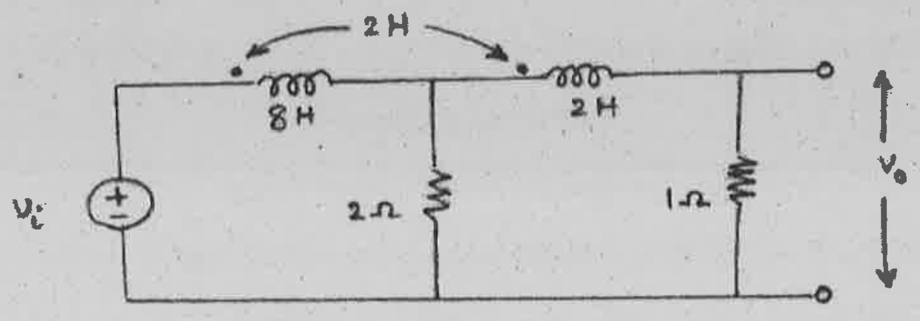


Fig. 1

Or

(b) Write the differential equations governing the motion of the mechanical system as shown in Fig. 2. Also obtain its analogous electrical circuit using either force-voltage or force-current analogy. (8 + 5)

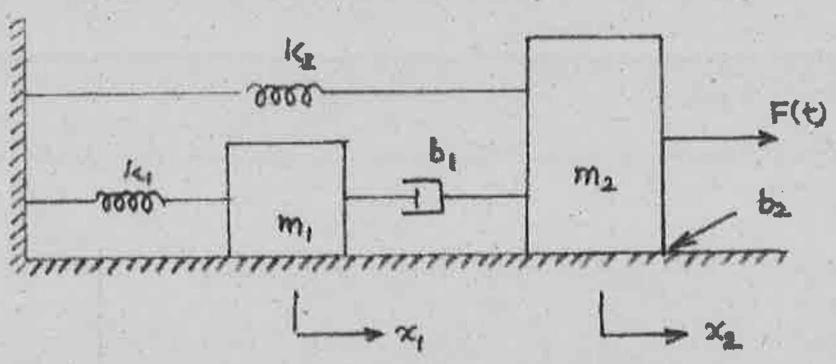


Fig. 2

12. (a) Derive the expression of the step response of a standard second order underdamped system. Use standard notations.

Or

(b) A unity feedback system with a PD controller as shown in Fig. 3. Determine the values of K_P and K_D so that the steady state error to a unit ramp input is 0.001 and damping ratio is 0.5.

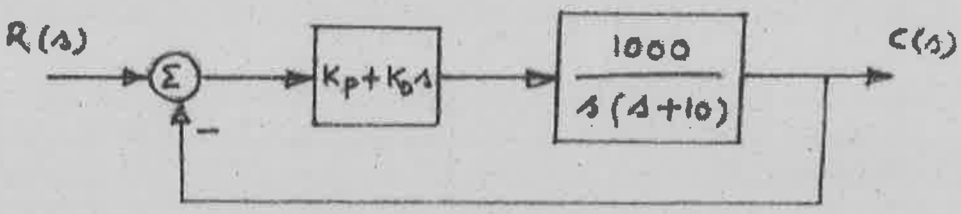


Fig. 3

13. (a) The open loop transfer function of a unity feedback system is given by, $G(s) = \frac{64(s+2)}{s(s+0.5)+(s^2+10s+64)}$. Sketch the Bode plot and compute the gain and phase margins of the closed loop system. Also comment on the stability of the closed loop system.

Or

(b) The open loop transfer function of a unity feedback system is given by, $G(s) = \frac{50}{s(s+1)+(s+5)(s+10)}$. Sketch the polar plot, calculate the gain and phase margins of the closed loop system and comment on the stability of the closed loop system.

14. (a) The open loop transfer function of a unity feedback system is given by, $G(s) = \frac{K}{s(s+1)+(s+5)}$ where $K > 0$. Apply Nyquist stability criterion to determine a range of K over which the closed loop system will be stable.

Or

(b) Draw the root locus diagram for the loop transfer function $G(s)H(s) = \frac{K(s+6)}{s(s+4)}$ and calculate K for which the closed loop system will be critically damped.

15. (a) (i) Obtain a state space model for an LTI system whose transfer function is given by $G(s) = \frac{-2s+1}{s^3+5s^2+3s+1}$. (6)

(ii) Obtain the transfer function of LTI system $\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$; $Y = [1 \quad 0] X$ and also check the stability of the system. (7)

Or

(b) Solve the state equation for the system as given in Q.9 (in PART-A) to obtain the time response $x(t)$ for a unit step input. Assume zero initial conditions.

PART C — (1 × 15 = 15 marks)

16. (a) Convert the signal flow graph shown in Fig. 4 to block diagram representation and thereafter obtain the overall transfer function of the system by block diagram reduction technique :

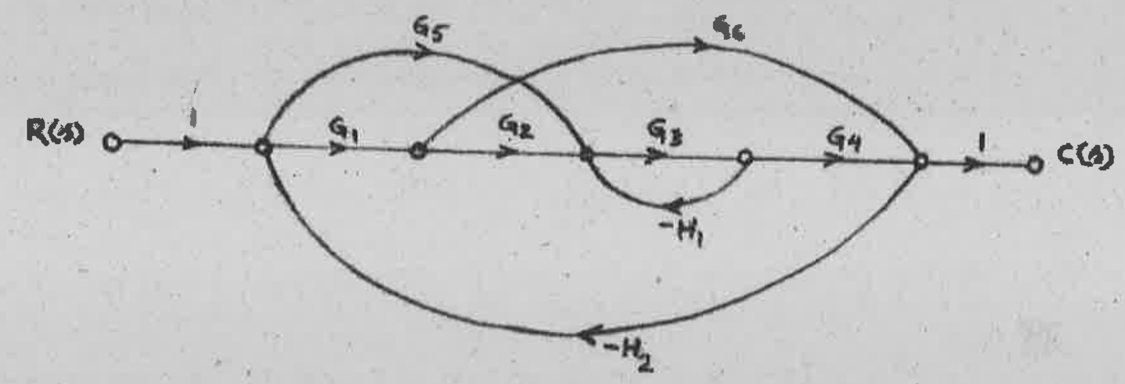


Fig. 4

Or

(b) Obtain a state space model for an armature controlled d.c. motor. Neglect load torque, assume armature inductance to be zero and consider angular position of the motor shaft as the output. Use standard notations.