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Question Paper Code : 31360

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fourth Semester

Electronics and Communication Engineering

EC 2255/EC 46/ EE 1256 A/ 080290023/10144 EC 406 — CONTROL SYSTEMS

(Regulation 2008/2010)

(Bode plot, Graph sheet, Semi – log, Nichol's chart are permitted)

Time : Three hours

Maximum : 100 marks

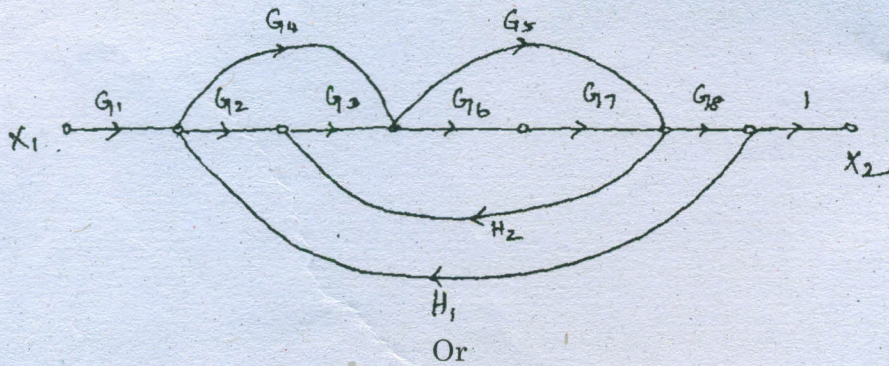
Answer ALL questions.

PART A — (10 × 2 = 20 marks)

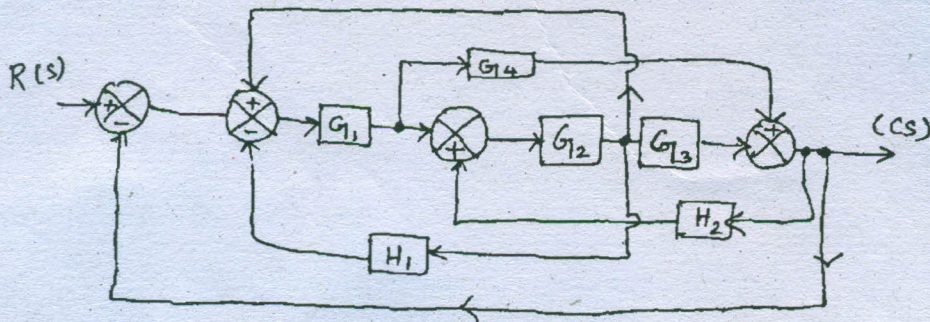
1. Define Transfer function.
2. Define resistance and capacitance of liquid level system.
3. What are the units of K_p , K_v and K_a ?
4. What is the effect of PI controller on the system performance?
5. Define phase margin.
6. State Nyquist stability criterion for a closed loop system when the open loop system is stable.
7. What are constant M and N circles?
8. State the property of a lead compensator.
9. Define state equation.
10. Give the concept of controllability.

PART B — (5 × 16 = 80 marks)

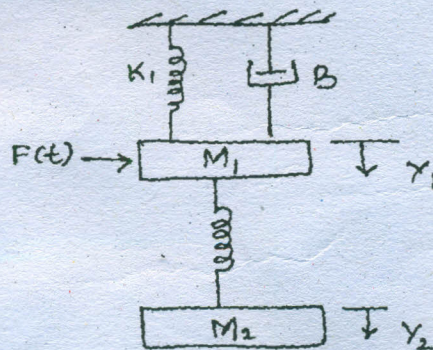
11. (a) State Mason's Gain formula using Mason's Gain formula to find $\frac{X_2}{X_1}$.



- (b) Use Mason's Gain formula to obtain $C(S)/ R(S)$ of the system shown below.



12. (a) Determine the transfer function $\frac{y_2(s)}{F(s)}$ of the system shown in figure.



Or

- (b) A unity feed back system is characterized by the open loop transfer function $G(s) = \frac{1}{s(0.5s+1)(0.2s+1)}$. Determine the steady state errors for Unit – step, Unit – ramp and Unit – acceleration unit. Also determine the damping ratio and natural frequency of the dominant roots.

13. (a) For the following transfer function draw bode plot and obtain gain cross – over frequency.

$$G(s) = \frac{20}{s(1+3s)(1+4s)}$$

Or

- (b) Discuss in detail about lead and lag networks.

14. (a) Sketch the root locus for $GH(s) = \frac{k(s+2)(s+3)}{(s+1)(s-1)}$.

Or

- (b) The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{k}{(s+2)(s+4)(s^2+6s+25)}$. By applying the Routh criterion, discuss the stability of the closed loop system as a function of K.

15. (a) For the given state variable representation of a second order system given below find the state response for a unit step input and $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \end{bmatrix} [u]$ $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ by using the discrete – time approximation.

Or

- (b) Consider the system with the state equation.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u.$$

Check the controllability of the system.