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Question Paper Code : 21360

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Fourth Semester

Electronics and Communication Engineering

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

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Graph sheet and Semi-log sheet are to be provided

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Name any two dynamic models used to represent control systems.

2. Write the Mason's gain formula of signal flow graph.

3. The closed loop transfer function of a second order system is given by $\frac{400}{s^2+2s+400}$. Determine the damping ratio and natural frequency of oscillation.

4. Give the steady state errors to a various standard inputs for type-2 system.

5. Draw the polar plot of an integral term transfer function.

6. Write the MATLAB statement to draw the Bode plot of the given system.

7. Write the necessary and sufficient condition for stability in Routh stability criterion.

8. Define Nyquist stability criterion.

9. What are the advantages of state space representation?

10. Define state and state variable.

PART B – (5 × 16 = 80 marks)

11. (a) (i) Consider the mechanical system shown in figure 11 (a) (i), write the differential equations describing the dynamics of the system and also draw the electrical analogy for the system. (8)

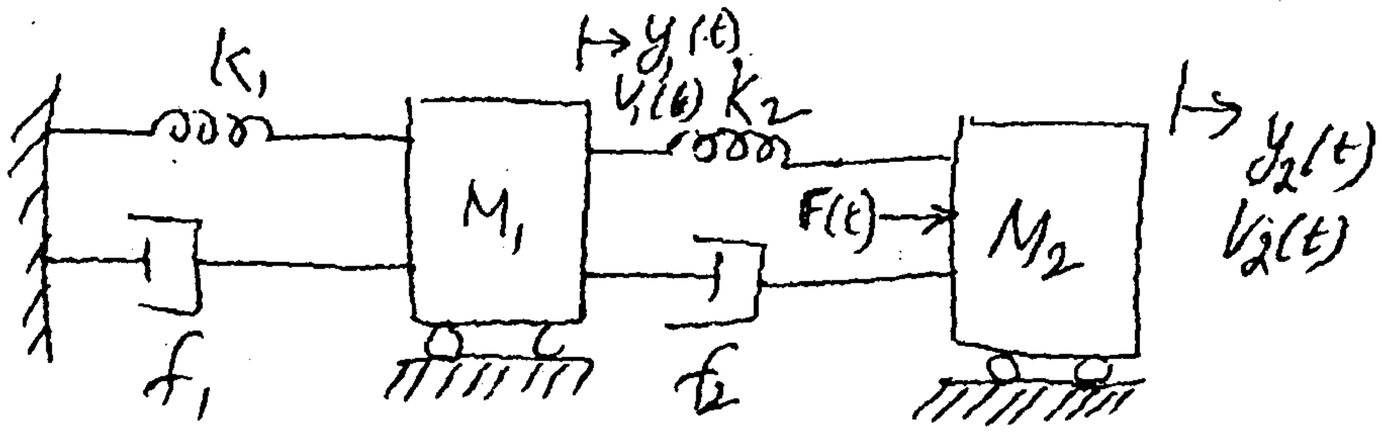

Figure 11 (a) (i)

(ii) The block diagram of a control system is shown in figure 11 (a) (ii). Determine the transfer function. (8)

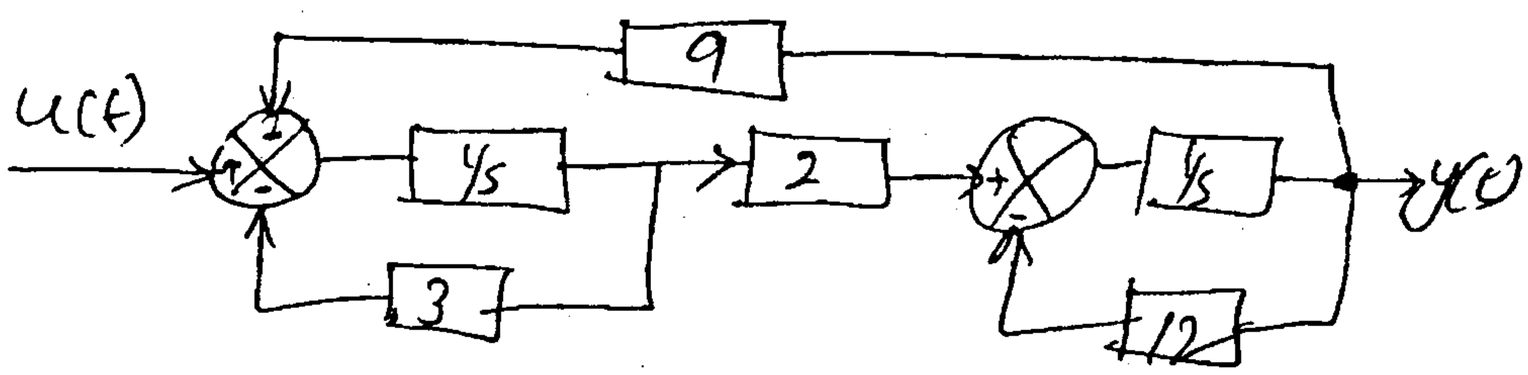

Figure 11 (a) (ii)

Or

(b) (i) Give the step by step procedure of determining transfer function using signal flow graph. (8)

(ii) Find the transfer function of the block diagram shown in figure 11 (b) (ii) using Masons gain formula. (8)

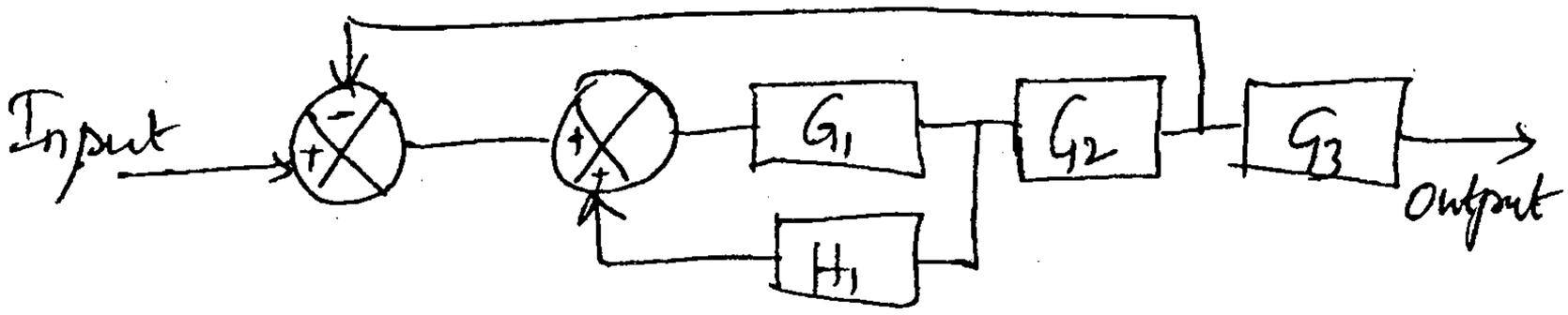

Figure 11 (b) (ii)

12. (a) Consider a second order model $\frac{Y(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\varsigma\omega_n s + \omega_n^2}$; $0 < \varsigma < 1$. Find the response $y(t)$ to a input of unit step function.

Or

(b) The unit impulse response of a unit feedback control system is given by $c(t) = -te^{-t} + 2e^{-t}$, $(t \geq 0)$ find the open loop transfer function.

13. (a) Consider a unity feedback open loop transfer function $G(s) = \frac{100}{s(1+0.1s)(1+0.2s)}$. Draw the Bode plot and find the phase and gain cross over frequencies, phase and gain margin and the stability of the system.

Or

(b) Explain in detail the design procedure of lead compensator using Bode plot.

14. (a) Consider the sixth order system with the characteristic equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. Use Routh-Hurwitz criterion to examine the stability of the system.

Or

(b) Sketch the root locus of the system having $G(s) = \frac{k(s+3)}{s(s+1)(s+2)(s+4)}$.

15. (a) A system is represented by the state equation $\dot{X} = AX + BU$; $Y = CX$ where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix}$ and $C = [100]$. Determine the transfer function of the system.

Or

(b) A system is characterised by the transfer function $\frac{Y(s)}{U(s)} = \frac{3}{s^3 + 5s^2 + 11s + 6}$. Identify the first state as the output. Determine whether or not the system is completely controllable and observable.