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Question Paper Code : 31397

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

Fourth Semester

Electrical and Electronics Engineering

EE 2253/EE 44/EE 1253 A/10133 IC 401/080280033 — CONTROL SYSTEMS

(Common to Instrumentation and Control Engineering and Electronics and Instrumentation Engineering)

(Regulation 2008/2010)

(Common to PTEE 2253 – Control Systems for B.E. (Part-Time) Third Semester – Electronics and Instrumentation Engineering Regulation 2009)

Time : Three hours

Maximum : 100 marks

Note : Polar plot to be issued.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define transfer function of a system.
2. What are analogous systems?
3. Give the transfer function $G(s)$ of a PID controller.
4. For a unity feedback control system shown in Fig. Q. 4. Find the ratio of time constants of open loop response to closed loop response.

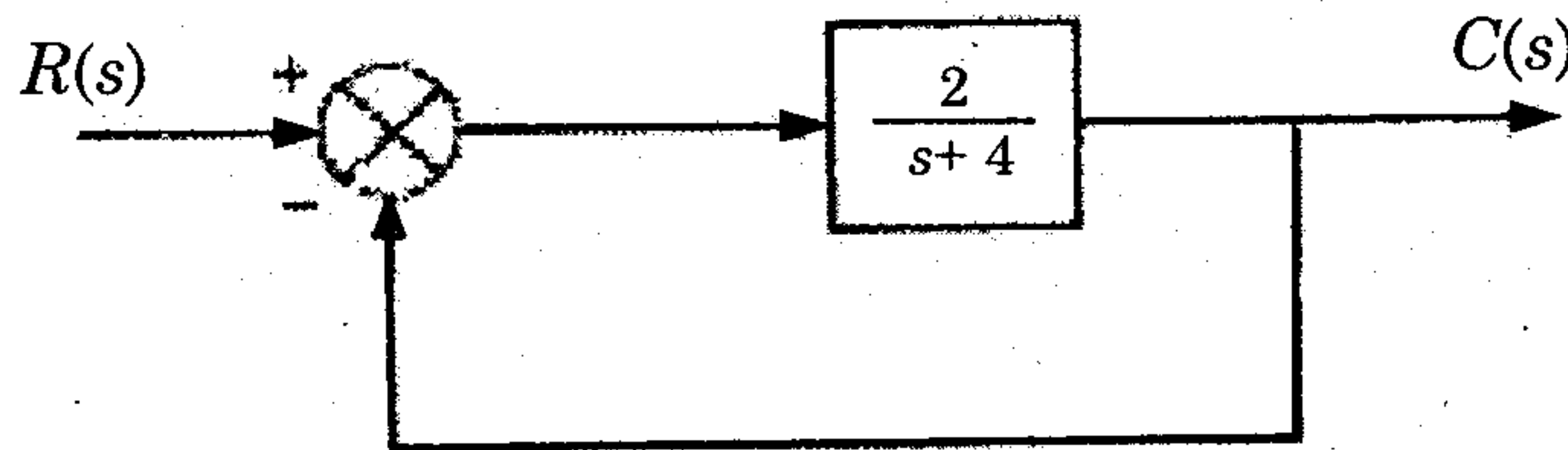


Fig. Q. 4

5. Define Phase crossover frequency.
6. What is the meaning of 6 dB/octave slope in a semi log sheet?
7. What is the condition for the system $G(s) = \frac{k(s+a)}{s(s+b)}$ to have a circle in its root locus?

8. State Nyquist stability criterion.
9. What are the primary advantages of the frequency domain design of control system?
10. Draw a bode plot of a typical lag compensator.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Obtain the mathematical model of an accelerometer. (8)
- (ii) Obtain the differential equation of a mechanical system as shown in Fig. Q. 11 (a). (8)

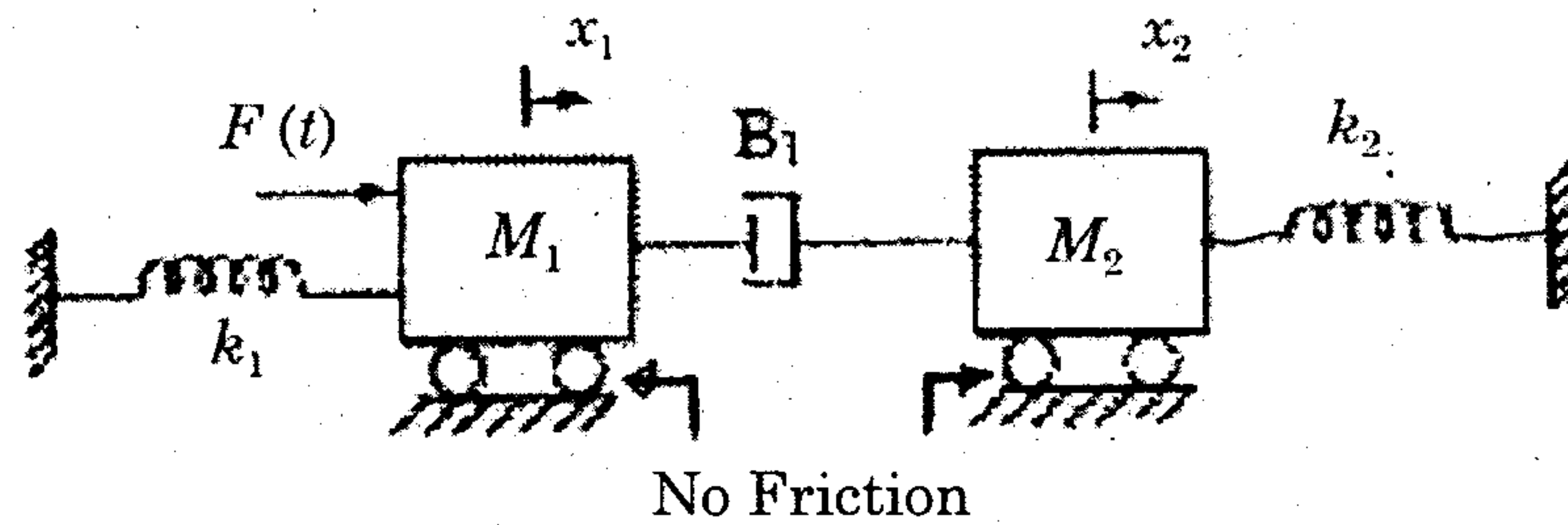


Fig. Q. 11 (a)

Or

- (b) (i) Obtain the mathematical model of an armature controlled DC motor. (8)
- (ii) Write the differential equation for the electric circuit shown in Fig. Q. 11 (b) hence find $\frac{E_0(s)}{E_1(s)}$. (8)

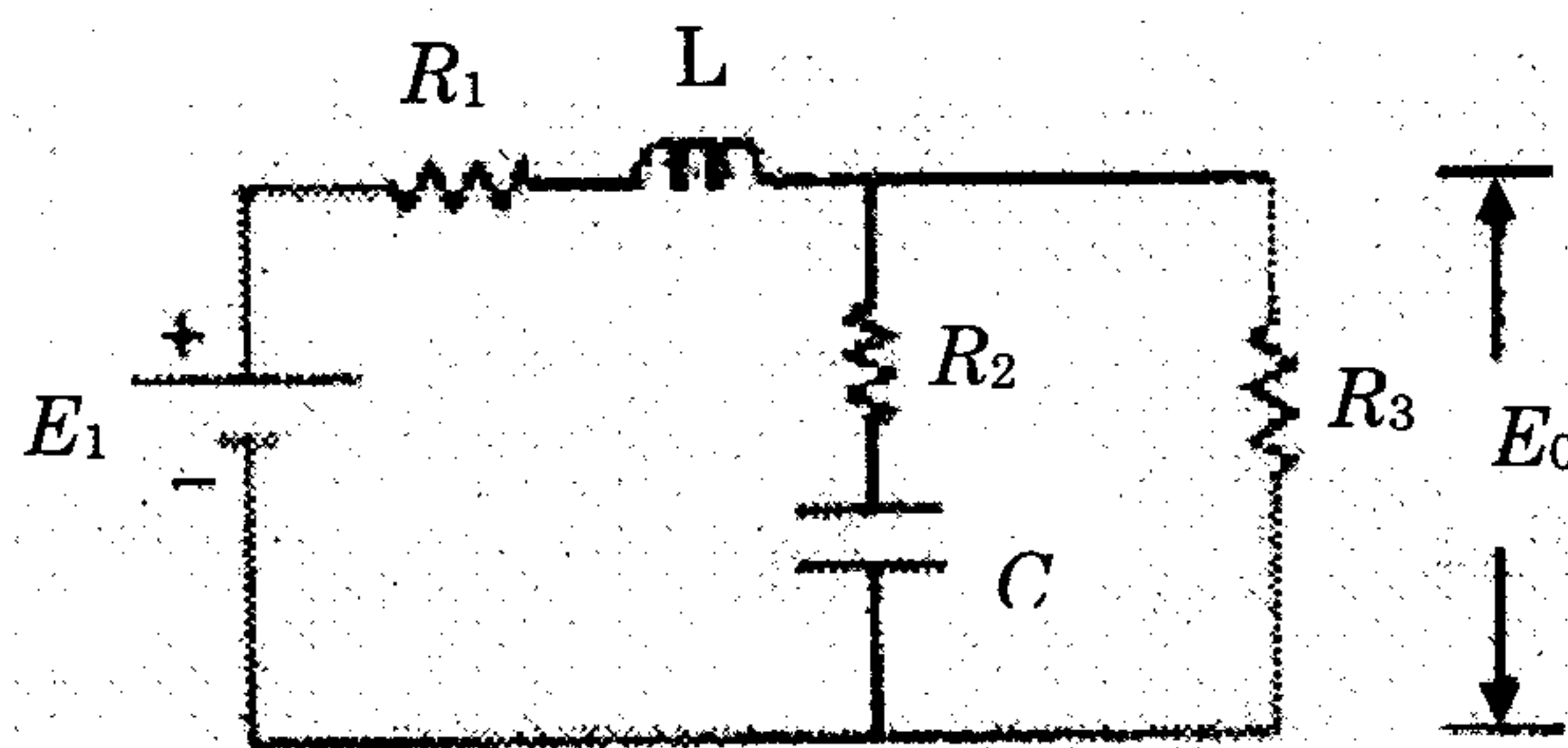


Fig. Q. 11 (b)

12. (a) Derive the time response of a typical under damped second order system for a unit step input. (16)

Or

- (b) (i) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{k}{s(Ts+1)}$ where k and T are positive constants. By what factor should the amplifier gain be reduced so that the peak overshoot of unit step response of the closed loop system is reduced from 75% to 25%? (8)
- (ii) For a closed loop system with $G(s) = \frac{1}{s+1}$ and $H(s) = 5$, calculate the generalized error coefficients and find error series. (8)
13. (a) (i) Obtain the relations for resonance peak magnitude (M_r) and resonant frequency (ω_r) in terms of damping factor (ζ). (8)
- (ii) Determine the closed-loop bandwidth, closed-loop peak magnitude, gain margin and phase margin for the following system
- $$G(s) = \frac{4}{s(s+1)}. \quad (8)$$
- Or
- (b) The open loop transfer function of an unity feedback system is given by $G(s) = \frac{10(s+3)}{s(s+2)(s^2+4s+100)}$. Draw the Bode plot and hence find the gain margin and phase margin.
14. (a) The open loop transfer function of a unity feedback system is given by $G(s)H(s) = \frac{5}{s(s+1)(s+2)}$. Draw the Nyquist plot and hence find out whether the system is stable or not.
- Or
- (b) Sketch the root locus for a unity feedback system with open loop transfer function $G(s) = \frac{k(s+0.5)}{s^2(s+4.5)}$.
15. (a) The open loop transfer function of the uncompensated system is $G(s) = \frac{5}{s(s+2)}$. Design a suitable compensator for the system so that the static velocity error constant K_v is 20/sec, the phase margin is atleast 55° and the gain margin is atleast 12 dB. (16)
- Or
- (b) Open loop transfer function of the uncompensated system is $G(s) = \frac{1}{s(s+1)(s+2)}$. Compensate the system by cascading suitable lag-lead compensator so that the compensated system has the static velocity error constant of 10/sec, the phase margin of 45° and gain margin of 10 dB or more. (16)