Reg. No. :

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 — ($10 \times 2 = 20$ 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.

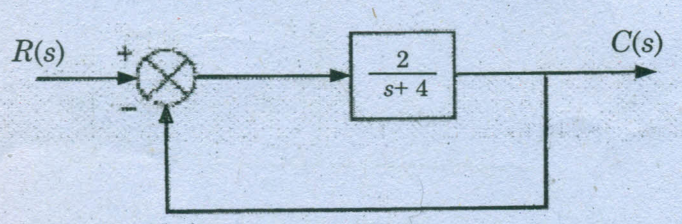

Fig. Q. 4

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 $G(s)=\dfrac{k(s+a)}{s(s+b)}$ 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)

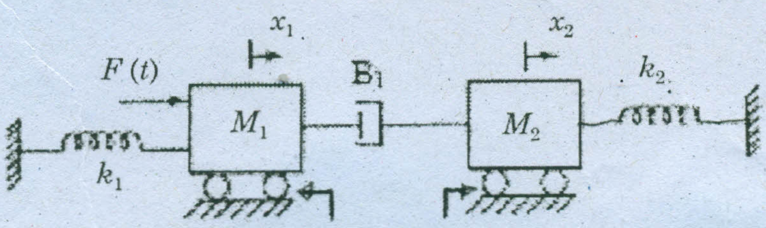

Fig. Q. 11 (a)

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)

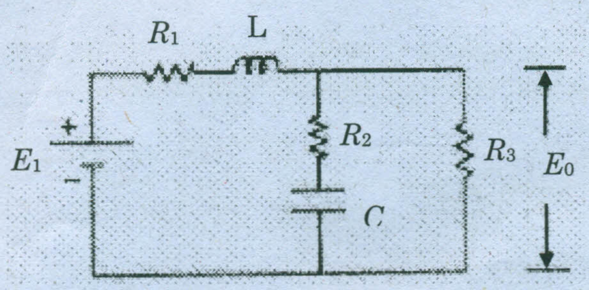

Fig. Q. 11 (b)

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