Reg. No. :

Question Paper Code : 42499

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018

Fourth Semester

Electrical and Electronics Engineering

EE2253 – CONTROL SYSTEMS

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

(Regulations 2008)

[Also Common to PTEE2253 – Control System for BE (Part – Time) Fourth Semester – EEE – Regulations 2009]

Time : Three Hours   Maximum : 100 Marks

Answer ALL questions

PART – A   (10×2=20 Marks)

1. What are the basic elements of feedback control system ?
2. State Mason's gain formula.
3. Draw the unit step input and the corresponding output signal for a first order system.
4. State the effect of PI controller on a system performance.
5. Draw the approximate polar plot for a Type 0 second order system.
6. Write the correlation between phase margin and damping factor.
7. How are the roots of the characteristic equation of a system related to stability ?
8. What is the "Principle of Argument" used in Nyquist stability criterion ?
9. What is the need for compensation in a control system ?
10. Sketch an electric lag-lead compensator network.

PART – B (5×16=80 Marks)

11. a) Write the differential equations governing the mechanical system shown in Fig.Q.11 (a). Draw the force-voltage and force-current electrical analogous circuits. (8+8)

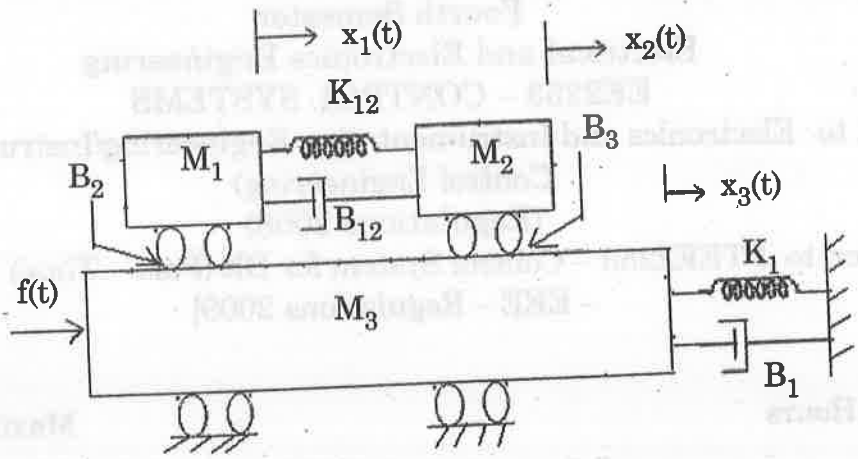

Fig. Q.11 (a)

(OR)

b) i) Derive the transfer function of a field controlled DC servomotor. (6)

ii) Explain the various block diagram reduction rules with examples. (10)

12. a) Derive the expression for the unit step response of a second order underdamped system. State the time domain specifications of the system. (12+4)

(OR)

b) i) Find the dynamic error coefficients of the unity feedback system whose forward path transfer function is $G(s) = \dfrac{100}{s(s+10)}$. Find the steady state error of the system for the input $r(t) = 1 + t + 4t^2$. (10)

ii) Explain the effect of derivative control action on the time response of a second order control system. (6)

13. a) Construct Bode plot for the system whose open loop transfer function is given below and examine the stability of the closed-loop system. (16)

$$G(s) = \frac{4}{s(1+0.5s)(1+0.08s)}$$

(OR)

b) i) Explain the correlation between time and frequency domain specifications. (10)

ii) Find the resonant frequency for a unity feedback control system whose open loop transfer function is given by $G(s) = \frac{50}{s(s+6)}$. (6)

14. a) i) Using Routh stability criterion, determine the stability of the system represented by the characteristic equation $s^4 + 8s^3 + 18s^2 + 16s + 5 = 0$. Comment on the location of roots of the characteristic equation. (6)

ii) Explain briefly the procedure for constructing Root locus of a system. (10)

(OR)

b) i) Describe the effect of addition of a pole to a stable system. (8)

ii) By use of the Nyquist stability criterion, determine whether the closed-loop system having the following open-loop transfer function is stable or not. If not, how many closed-loop poles lie in the right-half of s-plane. (8)

$$G(s)H(s) = \frac{s+2}{(s+1)(s-1)}$$

15. a) Derive the transfer function of a lag compensator network. Explain the design procedure for a lag compensator using Bode plots. (16)

(OR)

b) Design a lead compensator for a unity feedback system with an open loop transfer function $G(s) = \frac{K}{s(s+1)}$ for the specifications of $K_v = 10\ sec^{-1}$ and phase margin $\phi_m = 35°$. (16)
