Reg. No. : ____________

Question Paper Code : 23500

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fourth Semester

Electrical and Electronics Engineering

EE 2253 — CONTROL SYSTEMS

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

(Regulations 2008)

(Also Common to PTEE 2253 – Control Systems for B.E. (Part-Time) Third Semester – EEE – Regulations 2009)

Time : Three hours | Maximum : 100 marks

(Graph sheet, semi log sheet and polar sheet may be permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Compare closed and open loop system.

2. State the basic elements for modeling in translational and rotational systems.

3. Find the acceleration error coefficient for $G(s) = [K(1+s)(1+2s)]/[s^2(s^2+4s+20)]$.

4. State the effect of PI and PD controller on system performance.

5. Draw the polar plot of $G(s) = 1/(1+sT)$.

6. Define phase and gain margin.

7. State Routh's Hurwitz criterion.

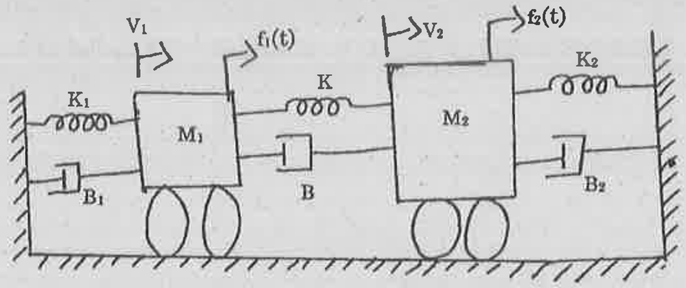
8. What is the effect of pole on the system response?

9. What are the primary advantages of the frequency domain design of control system?

10. Draw a bode plot of a typical lag compensator.

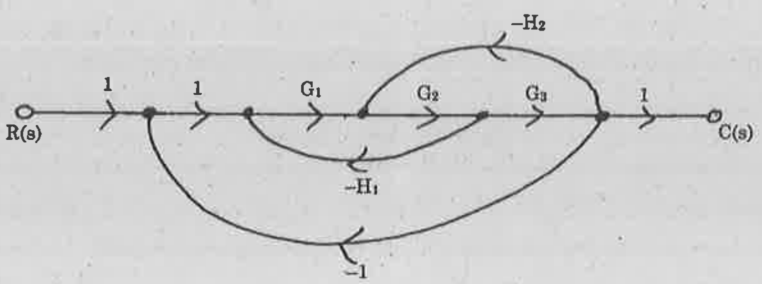
PART B — ($5 \times 16 = 80$ marks)

11. (a) Write the differential equations governing the system and draw the force current and force voltage analogous circuit.



Or

(b) Obtain the transfer function using Mason's Gain formula for the system given.



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 $G(s) = \dfrac{k}{s(Ts+1)}$ 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 $G(s) = \dfrac{1}{s+1}$ and $H(s) = 5$, calculate the generalized error coefficients and find error series. (8)

13. (a) Sketch the bode plot for the following transfer function and determine the value of K for the gain cross over frequency of 5 rad/sec $G(s) = Ks^2 / [(1+0.2s)(1+0.02s)]$. (16)

Or

(b) Sketch the polar plot for the following transfer function and determine the gain and phase margin. $G(s) = 1/[s(1+s)(1+2s)]$. (16)

14. (a) (i) Explain the concept of stability based on the location of poles. (4)

(ii) Sketch the Nyquist plot and comment on closed loop stability system whose open loop transfer function is $G(s) = \frac{10}{s^2(s+2)}$. (12)

Or

(b) (i) Test the stability for the system with characteristic equation $s^3 + 5s^2 + 6s + 30 = 0$ using Routh's Hurwitz. (4)

(ii) Draw the root locus for a unity feedback system having open loop transfer function $G(s) = \frac{K}{s(s^2 + 8s + 36)}$. (12)

15. (a) (i) Explain the different types of compensation techniques. (6)

(ii) A unity feedback system has the open loop transfer function $G(s) = \frac{K}{s(s+2)}$. Design a lead compensator for the system to achieve the following specifications. Velocity error constant $K_v \geq 12\,\text{sec}^{-1}$ and phase margin $\Phi_{pm} \geq 45°$. (10)

Or

(b) (i) Explain the performance characteristics of Lead, Lag, Lag-Lead compensators. (6)

(ii) A unity feedback system has the open loop transfer function $G(s) = \frac{K}{s(1+2s)}$. Design a lag compensator so that the phase margin is 40° and the steady state error for ramp input is less than or equal to 0.2. (10)