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B.E. DEGREE EXAMINATIONS: APRIL/MAY 2012

Sixth Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

ECE117: Control Systems Engineering

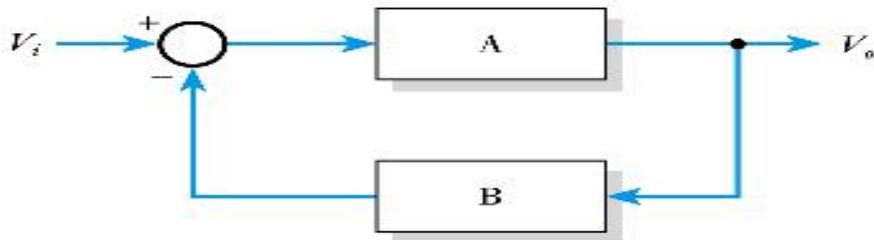*(Graph sheet, Polar chart and Semi log sheet will be provided)*

Time: Three Hours   **Maximum Marks: 100**

Answer All Questions:-

PART A (10 x 1 = 10 Marks)

1. What is the voltage gain of the following arrangement?

   (a) (1+AB)/A   (b) A/ (1+AB)   (c) B/(1+AB)   (d) (1+AB)/B

2. Electrical time-constant of an armature-controlled dc servomotor is

   (a) Equal to mechanical time-constant   (b) smaller than mechanical time-constant

   (c) Larger than mechanical time-constant   (d) not related to mechanical time-constant

3. For a type one system, the steady – state error due to step input is equal to

   (a) infinite   (b) zero   (c) 0.25   (d) 0.5

4. Peak overshoot of step-input response of an under damped second-order system is
   explicitly indicative of

   (a) Settling time   (b) rise time   (c) natural frequency   (d) damping ratio

5. The constant M-circles corresponding to the magnitude(M) of the closed loop transfer
   function of a linear system of values of M greater than one lie in the G-plane and to the

   (a) Right of the M=1 line   (b) left of the M=1 line

   (c) upper side of the M=+j1 line   (d) lower side of the M= -j1 line

6. If the Nyquist plot of the loop transfer function G(s) H(s) of a closed-loop system
   encloses the (-1, j0) point in the G(s) H(s) plane, the gain margin of the system is

   (a) zero   (b) greater than zero   (c) less than zero   (d) infinity

7. The phase angle of the system G(s)= $\dfrac{(S+5)}{(S^2+4S+9)}$ varies between

   (a) 0º and 90º   (b) 0º and -90º   (c) 0º and -180º   (d) 90º and -180º

8. A property of phase lead compensation is that the

(a) Overshoot is increased

(b) bandwidth of closed loop system is reduced

(c) rise time of closed loop system is reduced

(d) gain margin is reduced

9. The transfer function $G(s) = \dfrac{(1+0.5S)}{(1+S)}$ represents a

(a) Lag network   (b) lead network (c) lag-lead controller   (d) proportional controller

10. The break- away points of the root locus occur at

(a) Imaginary axis   (b) positive real axis   (c) negative real axis   (d) all the above

PART B (10 x 2= 20 Marks)

11. State any four applications of control system in industry.

12. Compare open loop control system and closed loop control system.

13. Draw the time response of first order system for step input.

14. Define steady state error.

15. Define phase margin and gain cross over frequency.

16. Sketch the polar plot of type1-order2 system.

17. State Nyquist stability criterion.

18. List out frequency domain specifications.

19. Draw the pole-zero diagram of lead network.

20. What is compensator?

PART C (5 x 14= 70 Marks)

21. a) (i) Derive the transfer function of armature controlled DC servo motor.   (7)

(ii) Write the differential equations governing the Mechanical system shown in fig.
Draw the force – voltage analogous circuit.   (7)
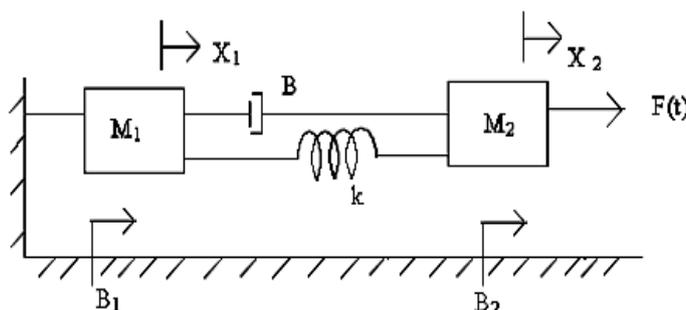
(OR)

b) Find the closed transfer function C(S)/R(S) of the system represented by the block diagram of fig using Mason's gain formula.
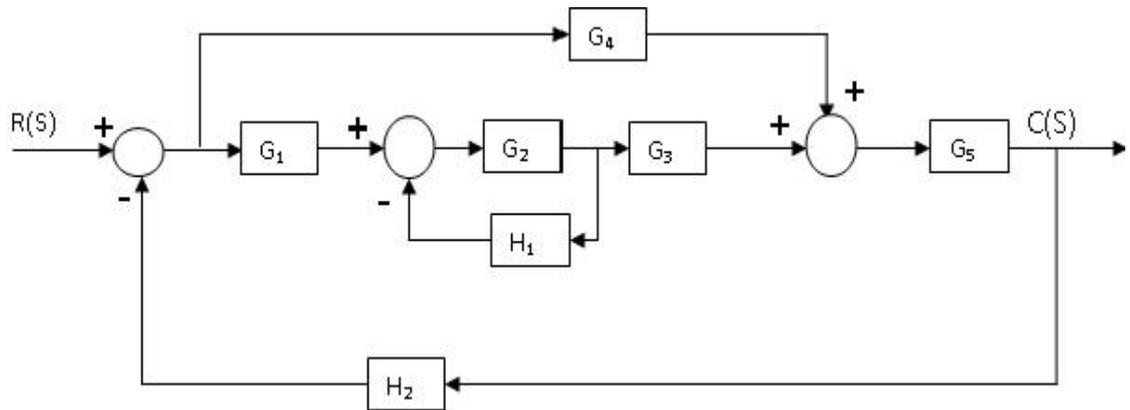
22. a) Derive an expression for time response of second order under damped system when subjected to unit step input.

(OR)

b) (i) A unity feedback system has an open loop transfer function $G(S) = \dfrac{20}{S^2 + 5S + 5)}$.

Determine Rise time, Peak overshoot, time to peak overshoot and settling time. (7)

(ii) A unity feedback system is represented by $G(S) = \dfrac{K}{S(S+2)(1+0.5S)}$ .Find the value of K for the steady state error e_{ss} =0.4 when the system is subjected to r (t) =3t. (7)

23. a) Sketch the bode plot for the following transfer function $G(S)\,H(S) = \dfrac{40}{S(S+2)(S+5)}$.

Find the gain margin and phase margin.

(OR)

b) (i) Explain the correlation between frequency domain and time domain specifications. (7)

(ii) Prove that the magnitude of closed loop transfer function is a circle. (7)

24. a) (i) Examine the stability of the system represented by the characteristic equation $S^5+2S^4+4S^3+8S^2+3S+1=0$ using Routh stability criterion. (7)

(ii) Sketch the Nyquist plot for the open loop transfer function given by

$G(S)\,H(S) = \dfrac{1}{(S+2)}$. (7)

(OR)

b) Sketch the root locus for the following open loop transfer function and is given by

$$G(S)H(S) = \frac{K}{S(S+2)(S+3)}$$

25. a) (i) Derive the transfer function of lag network. (7)

   (ii) Explain the design procedure for lag compensation (7)

(OR)

b) A type-1 unity feedback system with an open loop transfer function G(S) = K/ S(S+1). It is desired to have the velocity error constant K_v=10 and phase margin of the system be atleast45. Design a suitable lead compensator.

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