B.E. DEGREE EXAMINATIONS: APRIL / MAY 2010

Fourth Semester

MECHATRONICS ENGINEERING

U07MH404: Control Systems

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

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

1. The electrical equivalent of displacement of mechanical translational system in force-voltage analogy is_____.

    A. Voltage　　　　B. Current　　　　C. Charge　　　　D. Resistance

2. The electrical equivalent of moment of inertia J of mechanical rotational system in torque – current analogy is _____.

    A. Current　　　　B. Voltage　　　　C. Flux　　　　D. Capacitance

3. For a critically damped system, the damping ration is _____.

    A. Zero　　　　B. less than 1　　　　C. Greater than 1　　　　D. Equal to 1

4. The expression for natural frequency of oscillation of second order electrical system is_____

    A. $\sqrt{LC}$　　　　B. $\sqrt{(K/M)}$　　　　C. $\sqrt{(K/J)}$　　　　D. $1/\sqrt{(LC)}$

5. The slope of the log magnitude curve near the cut off frequency is called the _____.

    A. Resonant frequency　　　　B. Bandwidth　　　　C. Cut off rate　　　　D. Gain margin

6. Gain margin is defined as the reciprocal of the magnitude of open loop transfer function at_____.

    A. Cut off rate　　　　　　　　B. Gain cross over frequency

    C.Phase cross over frequency　　　　　　D.Resonant Frequency

7. The necessary condition for stability is that all the coefficients of the characteristic polynomial be_____.

    A. Non zero　　　　B. Zero　　　　C. Positive　　　　D. Negative

8. The path taken by a root of characteristic equation when open loop gain K is varied from zero to infinity is called _____.

    A. Polar plot　　　　B. Root locus　　　　C. Nyquist plot　　　　D. Nichol's plot

9. The addition of a _____ to the open loop transfer function has the effect of pulling the root locus to the left.

    A. Zero　　　　B. Pole　　　　C. Order　　　　D. Pole – zero

10. The frequency corresponding to maximum phase lead, ω_m is _____.

   A. $T/\sqrt{\alpha}$ B. $1/T\sqrt{\alpha}$ C. $T\sqrt{\alpha}$ D. $\sqrt{\alpha}/T$

PART B (10 x 2 = 10 Marks)

11. State the principle of homogeneity.

12. What are the basic elements used for modeling mechanical rotational system?

13. Define damping ratio.

14. Determine the damped frequency of oscillation of a second order system having a damping ratio of 0.6 and natural frequency of oscillation of 10 rad/sec.

15. Mention the frequency domain specifications of a system.

16. What is a Nichol's plot?

17. State routh stability criterion.

18. What are asymptotes?

19. Define compensation.

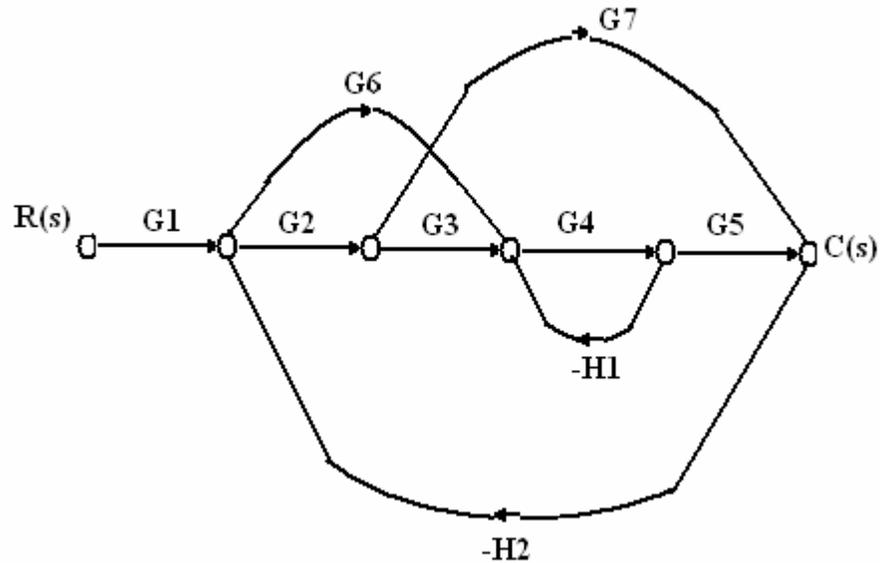20. When lag – lead compensation is employed?

PART C (5 x 14 = 70 Marks)

21. (a) (i) Define block diagram.   (2)

   (ii) Determine the closed-loop transfer function of the system shown below using block diagram reduction techniques.   (12)
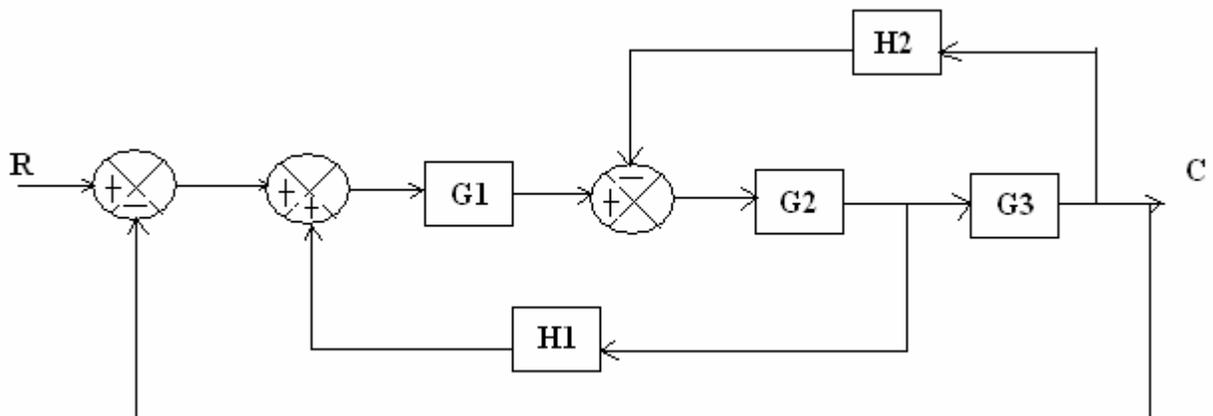
(OR)

(b) (i) State Mason's Gain formula. (2)

(ii) Obtain the closed-loop transfer function C(s) / R(s) of the system shown below. (12)

22. (a) Define steady state error. Determine its value for a closed loop system of different type

number fed with various input signals.

(OR)

(b) Determine the values of K and k of the closed-loop system shown below so that the

maximum overshoot in unit step response is 25% and the peak time is 2 seconds.

Assume that $J = 1$ Kg-m^2
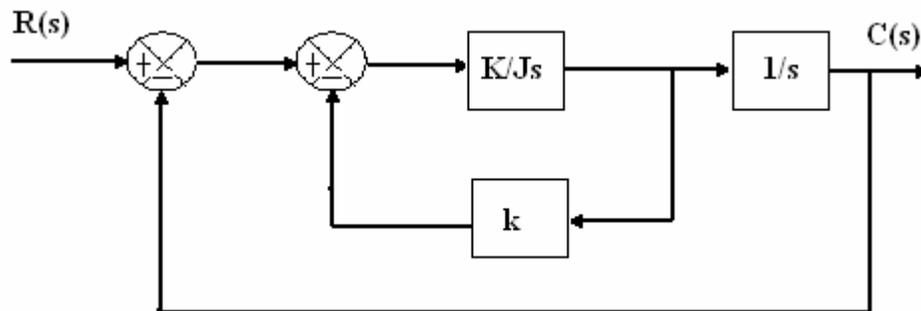
23. (a) Draw bode plot and obtain gain cross over frequency for the following transfer function

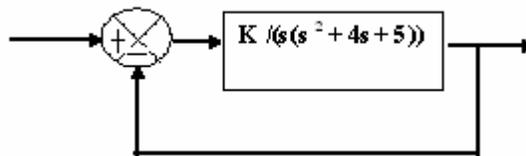G(s) = 20 / (s (1 + 3s) (1 + 4s)).

(OR)

(b) The open loop transfer function of a unity feedback system is given by

$G(s) = 20 / (s^2 (1 + s) (1 + 2s))$. Sketch the polar plot and determine the gain margin and phase margin.

24. (a) Show that the Routh's stability criterion and Hurwitz stability criterion are equivalent.

(OR)

(b) Sketch the root loci of the system shown below.

25. (a) Discuss the steps to be followed to design a lag and a lead compensator based on root locus approach.

(OR)

(b) Discuss the steps to be followed to design a lag - lead compensator based on bode plot approach.

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