Register Number……

B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

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. If the output influences the value of input, then such systems are termed as

   A) open loop control system B) Automatic control system

   C) closed loop control system D) unstable system

2. In rotational mechanical system equivalent for mass (in translational system) is

   A) L B) J C) F D) 1/K

3. Using Routh- Hurwith's criterion which one of the following is possible

   A) Find relative stability of the system B) find stability with exact root location

   C) identify unstable systems only D) find absolute stability

4. A stable system is the one whose closed loop transfer function has

   A) poles only on right side of s-plane

   B) poles on right side of s-plane or on imaginary axis

   C) poles any where other than right side of s-plane

   D) poles only on left side of s-plane

5. ---------- input produces a finite steady state error for a type 2 system.

   A) impulse B) step C) ramp D) parabolic

6. The closed loop control system is more sensitive to variations in

   A) parameters in forward path B) parameters in feedback path

   C) disturbance in forward path D) load torques

7. The type of input given to the system to find the frequency response of the system is

   A) Impulse B) step C) ramp D) sinusoidal

8. The number of sign change entries in the first column of Routh's array denotes the

   A) number of open loop poles in the RHP

   B) number of roots of the characteristic polynomial in RHP

   C) number of zeros of the system in RHP

   D) number of open loop zeros in RHP.

9. The pole factor 1/ 1+jωT has a slope of

A) 20 dB/decade B) −20 dB/decade C) 40 dB/decade D) −40 dB/decade

10. For damping ratio $\varsigma = 0$, $\omega_r =$ is equal to

A) 0 B) $= \omega_n$ C) $\omega_n / \sqrt{1-\varsigma^2}$ D) $\omega_n \sqrt{1-\varsigma^2}$

PART B (10 x 2 = 20 Marks)

11. State the advantages of open loop control system over closed loop control system.

12. Draw the block diagram for a position control system consisting of Error amplifier, Armature controlled DC motor, gear train, load and a pair of synchros.

13. Find the value of **X** for the block diagrams shown in Fig. a and Fig.b to be equivalent.

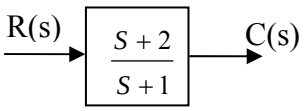


Fig.a

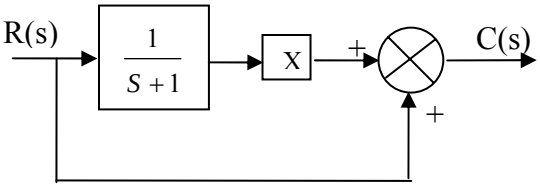


Fig.b

14. A closed loop control system has the forward path gain $G(s) = \frac{K}{s(s+6)}$ and feedback gain, $H(s) = 0.2$. If the system is to have a damping ratio of 0.7 determine the value of K.

15. What is Nyquist contour? State Nyquist stability criterion.

16. Obtain transfer function of a series RL and parallel C circuit.

17. What is compensation?

18. Define Transfer function.

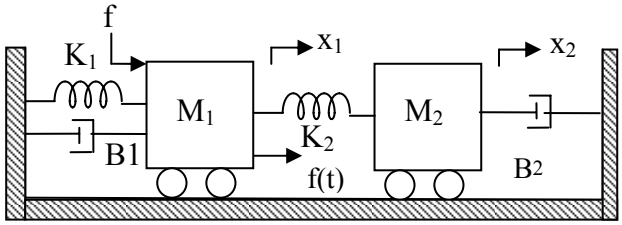
19. Define resonance peak and bandwidth.

20. What is polar plot?

PART C (5 x 14=70 Marks)

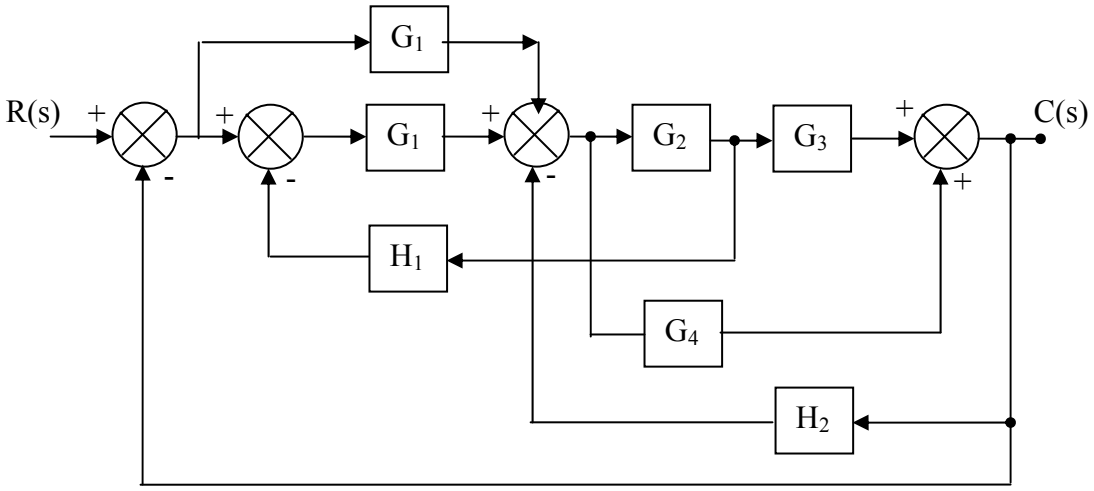
21. a) i) Derive the transfer function of AC servo motor.

ii) Find the differential equations representing the system.



(OR)

b) Determine the transfer function $\frac{C(s)}{R(s)}$ for the block diagram as shown in fig, by first drawing signal flow graph and then using the Mason's gain formula.



22. a) Obtain the unit step response of a second order system with under damped and critical damped condition.

(OR)

b) i) Derive the generalized error coefficient of a system.

ii) For a closed loop system with $G(s)=\frac{1}{s+5}$ and H(s) = 5, calculate the generalized error coefficients and find errors.

23. a) Draw the bode plot for a unity feed back system with $G(s)=\frac{K(s+0.3)}{(s+4)(s^2+30s+20)}$ where K=2000. Determine gain margin, phase margin, ω_{gc}, ω_{pc}. Comment on stability. Determine the value of K to obtain phase margin of 30º.

(OR)

b) Draw the complex Nyquist plot for a system with $G(s)H(s)=\frac{K}{s(s+1)(s+5)}$ and discuss stability.

24. a) For the system $G(s)=\frac{2(1-s)}{(s+2)(s+3)}$; H(s) =1. Sketch the nyquist plot for K = 2; and use the nyquist criterion to determine whether the closed loop system is stable for this gain. Find the range of K for the system to be stable.

(OR)

b) Sketch the root locus for a system with open loop transfer function $G(s)H(s)=\frac{K(s+1)}{s^2+4s+13}$.

25. a) Design a compensating network for $G(s) = \frac{K}{s(1+0.2s)(1+0.01s)}$, so that its phase margin is at least 40º and the steady state error will be in the final position will not exceed 2% of the final velocity.

(OR)

b) Design phase lag compensator so that the phase margin of the system having transfer function $G(s) = \frac{20}{s(s+4)}$ will at least be 60º.

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