D 30964 (Pages : 4) Name.....

Reg. No.....

FIFTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION OCTOBER 2012

EE 09 503—LINEAR CONTROL SYSTEMS

(2009 Scheme)

Time : Three Hours Maximum : 70 Marks

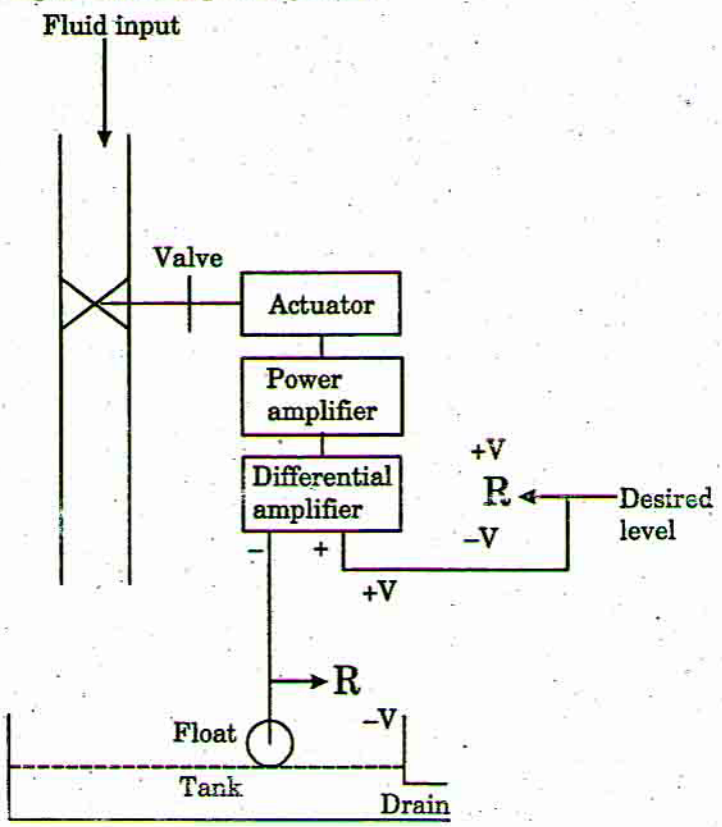
Part A

1. State the merits and demerits of open loop system over closed loop system.
2. Define loop and forward path in signal flow graph.
3. With a neat illustration, point out the transient and steady state part of the time response.
4. State the use of M–N circles.
5. Which type of controller is used to eliminate offset error ? Write its equation.

(5 × 2 = 10 marks)

Part B

1. A system is represented by the differential equation : $M\frac{d^2x}{dt^2} + Bx = U(t)$, draw the corresponding mechanical diagram.
2. Draw the block diagram for the given system :



Turn over

3. A unity feedback system has open loop poles at $s=-2\pm j2, s=-1$ and $s=0$; and a zero at $s=-3$. Find the angles made by root locus asymptotes with the real axis and the point of intersection.

4. Consider characteristic equation $q(s)=s^5+s^4+4s^3+24s^2+3s+63=0$. Investigate stability by Jury's test.

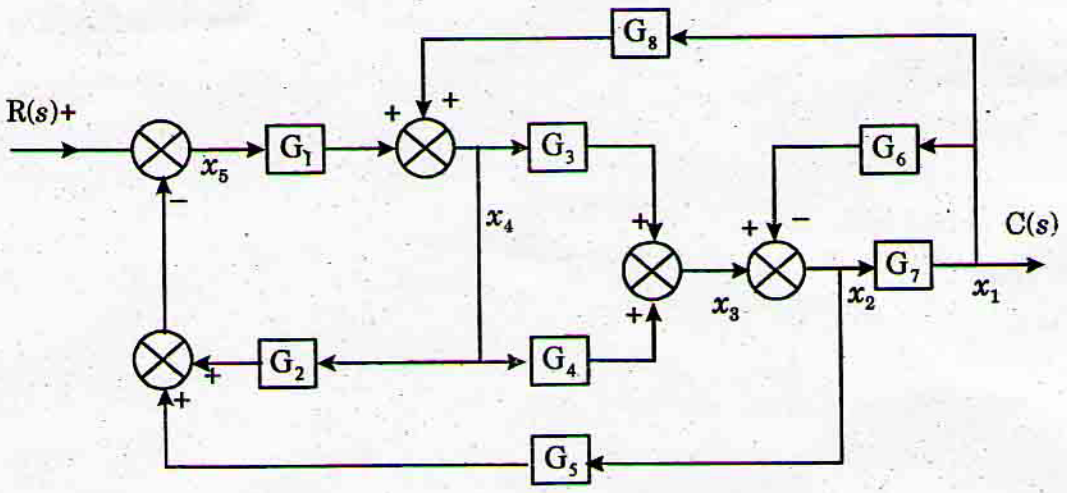
5. Derive the correlation between Maximum overshoot and resonant peak.

6. Write short notes on interacting and Non-interacting controllers.

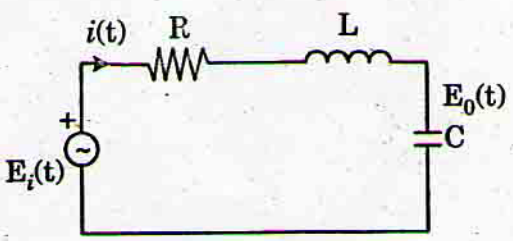
(4 × 5 = 20 marks)

Part C

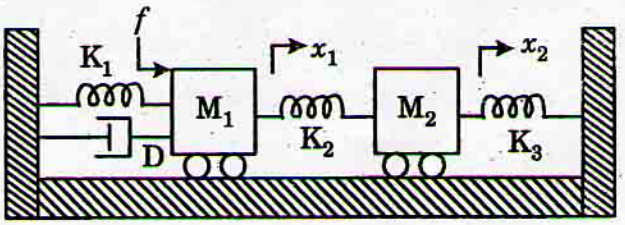
1. (a) Draw signal flow graph and obtain the overall transfer function.



(b) Determine the transfer function for the given circuit.



2. (a) Obtain the transfer function x_2 / f for the given mech. system.



(b) Derive the transfer function of armature controlled DC motor.

3. (a) In a first order circuit consisting of R and L elements, current achieves 63.2 of final value in 2 ms. If value of L is 0.5 H, find the value of current under steady state condition when the voltage applied is 100 V DC.

(b) The forward path Transfer Function of a unity feedback system is given by $G(s) = \frac{4}{s(s+3)}$.

Determine the time response expression for under damped, damped and over damped cases, for the system applied with unit step input.

4. Draw the root locus for the given loop transfer function, $G(s) = \frac{K}{s(s+2)(s+4)}$ when K is changed from $0 \rightarrow \infty$.

5. Sketch the Bode plot of a feedback system characterized by the open loop transfer function $G(s) = \frac{K}{s(1+0.1s)(1+s)}$. Find the value of gain K, so that the phase margin is 60°.

6. For the feedback system with open loop transfer function. $G(s)H(s) = \frac{12s}{s(1+4s)(1+5s)}$. Draw the Nyquist plot.

7. (a) Design a PI controller for a ufb plant with $G(s)H(s)=\frac{5}{(s+1)(s+2)}$ so that damping ratio is 0.5 and natural frequency of oscillation will be 2 rad/sec.

   (b) State the reasons why PID controller is most preferred in industry ?

8. Design a lag-lead compensator for a ufb system with $G(s)=\frac{K}{s(s+1)(s+3)}$ so that the system has (a) static velocity error constant as 10 sec^{-1} ; (b) phase margin at least 25° ; and (c) gain margin of 10 dB or more.

(4 × 10 = 40 marks)