CONTROL SYSTEMS AND APPLICATIONS
(AEIE 4282)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) If the system has multiple poles on the jw axis, the system is
(a) stable (b) unstable
(c) marginally stable (d) conditional stable

(ii) The transfer function of a system is used to study its
(a) steady state behaviour only
(b)transient behaviour only
(c) transient & steady state behaviour only
(d) transient & partly steady state behaviour only

(iii) If the characteristic equation of a system is $(s^2+16) = 0$, the system is
(a) undamped (b) underdamped
(c) critically damped (d) overdamped

(iv) Integrators are
(a) stable (b) unstable
(c) marginally stable (d) conditional stable

(v) Signal flow graph is a
(a) topological representation of asset of differential equation
(b) Bode plot
(c) polar plot
(d) none of these

(vi) The unit step response of a system function is given by $y(t) = te^{-8t}$. The transfer function of the system is given by
(a) $\frac{1}{(s+8)^2}$ (b) $\frac{8}{(s+8)^2}$ (c) $\frac{1}{8(s+8)^2}$ (d) $\frac{1}{(s+8)}$

(vii) Derivative type controller normally influence which one of the following characteristics
(a) steady state behaviour only
(b) transient behaviour only
(c) transient & steady state behaviour only
(d) transient & partly steady state behaviour only

(viii) The transfer function of a system is given by $T(S) = \frac{5}{(s+3)(s+6)}$. The damping ratio will be
(a) 4.24 (b) 2.12 (c) 4 (d) 1.06

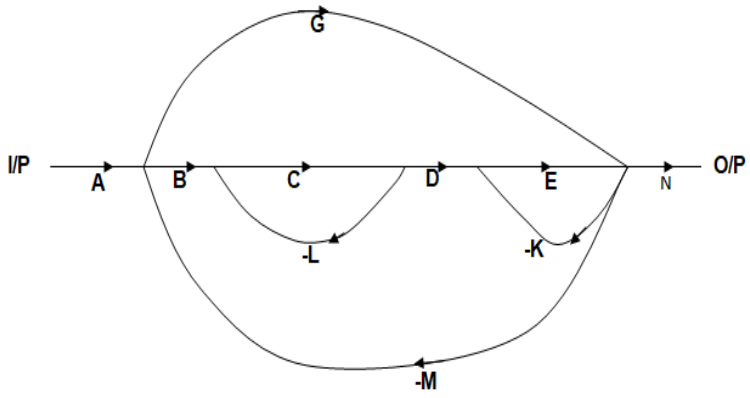
(ix) The open loop transfer function of a unity feedback control system is $(S) = \frac{50}{(1+0.1s)(1+2s)}$. The position error coefficient for a unit step input will be
(a) 0 (b) 50 (c) ∞ (d) 5

(x) Routh- Hurwitz criterion gives
1. absolute stability
2. the number of roots lying on right half of the s plane
3. gain margin and phase margin

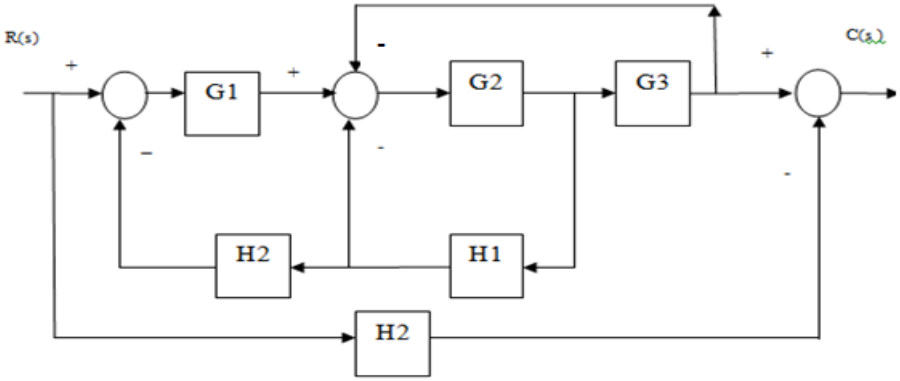
Which of the above statements are true?
(a) 1, 2, & 3 (b) 1 & 2 (c) 2 & 3 (d) 1 & 3

Group – B

2. (a) Find the overall transmittance of the system shown in figure below using MASON'S gain formula.



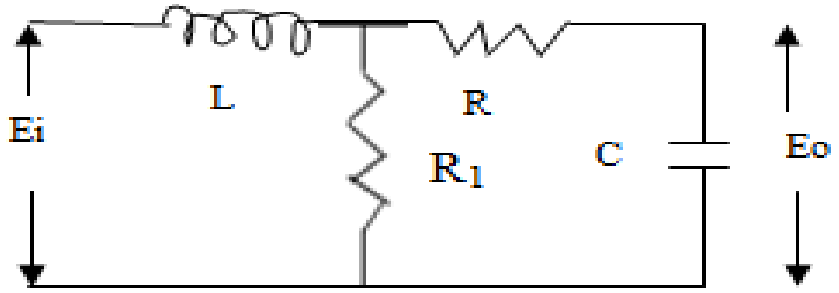
(b) Find the overall transfer function of a system having the following block diagram using block reduction technique.



6 + 6 = 12

3. (a) (i) Draw the block diagram of the electrical network system shown in figure below.

(ii) Find the transfer function of the system from the block diagram.



(b) What are the advantages of negative feedback?

(5 + 5) + 2 = 12

Group – C

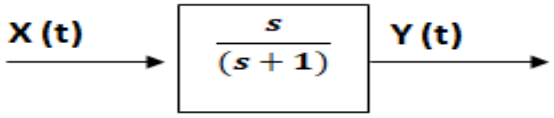
4. (a) Derive the expression for the unit step response of a second order unity gain negative feedback system having open loop transfer function $G(S) = \frac{W_n{}^2}{S(S+2\zeta W_n)}$, where ζ is the damping ratio and w_n is the natural frequency of oscillations.

(b) For the above system find the expression for peak time and maximum percentage peak overshoot.

7 + 5 = 12

5. (a) The forward path transfer function of a unity feedback system is $G(s)=k/s^n(s+a)$. The system has 10% overshoot and velocity error constant, $k_v=100$. What is the value of k?

(b) In the system shown in figure below, the input is x(t) = sin(t). What will be the steady state output of the system?



8 + 4 = 12

Group – D

6. (a) Consider the characteristics equation of a control system given by

$$s^6 + s^5 - 2s^4 - 3s^3 - 7s^2 - 4s - 4 = 0.$$

Show that the following three conditions are satisfied:

1. The system has three poles in the left half of the s plane.
2. The system has four poles symmetric about the origin.
3. The system has two poles on the jw axis.

(b) Determine the value of K such that the roots of the characteristics equation

$$s^3 + 10s^2 + 18s + K = 0$$

lie to the left of the **s** plane at s= -1.

(3 + 3 + 2) + 4 = 12

7. (a) Draw the root locus of the system given by $G(S) = \frac{K}{S(S+4)(S+5)}$.

(b) Investigate the following statements for the given system in (a).
(i) Gain margin for k= 1800 is -20 dB.
(ii) Gain k at breakaway point is 13.128.

8 + (2 + 2) = 12

Group – E

8. A unity feedback control system having open loop gain is given by $G(S) = \frac{25}{S(S+5)}$.

Calculate
(i) The natural frequency of oscillation, damped frequency of oscillations, damping factor, damping ratio of a unit step input.
(ii) If the damping ratio is to be made 0.75 by introduction of a derivative controller in the feedback path then determine the derivative rate feedback constant and compare the rise time, peak time, maximum overshoot without derivative control and with derivative control.

(4 + 8) = 12

9. (a) Briefly discuss on PID controller with the help of electronic circuit elements.

(b) Find the transfer function of a field controlled dc motor. Hence draw the block diagram to represent the system.

4 + (4 + 4) = 12

Department & Section	Submission Link
CHE/IT	https://classroom.google.com/c/MjgwMjY1NTk0ODcy/a/MzYwNDI3MTM0NTg3/details