Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – SUMMER 2013

Subject Code: 141701 **Date: 14-06-2013**

Subject Name: Control Theory

Time: 10.30 am - 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

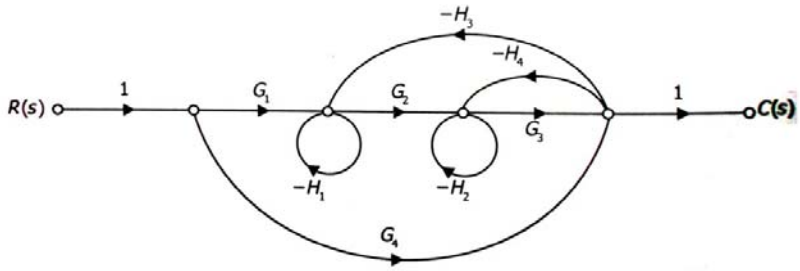
Q.1 **(a)** Define terms: **07**

1. State
2. State vector
3. Transfer function
4. Non touching loops
5. Sink node
6. Time response
7. Order of the system

(b) Explain force voltage analogy with suitable example. **07**

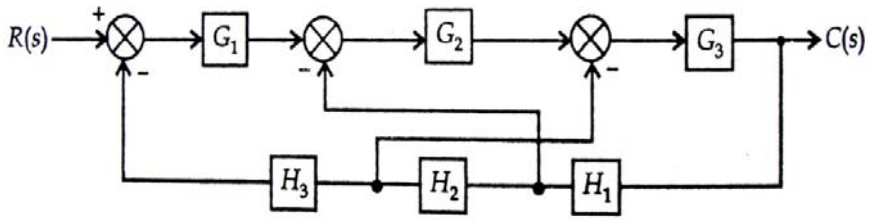
Q.2 **(a)** Derive transfer function for an armature controlled d.c.motor. **07**

(b) Determine the transfer function of the system with signal flow graph shown below: **07**



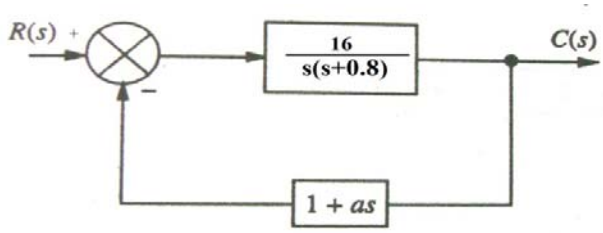
OR

(b) Determine close loop transfer function of the system shown below using block diagram reduction techniques. **07**



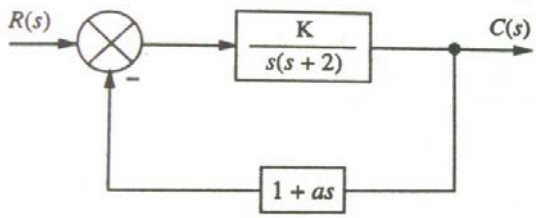
Q.3 **(a)** A second order control system is subjected to unit step input. Draw response curves for underdamped, overdamped and critically damped system. For under damped system define various performance indices. **07**

(b) Consider the system as shown in figure. Determine the value of '*a*' such that the damping ratio is 0.5. Also obtain the values of rise time and maximum overshoot M_p in its step response. **07**



OR

Q.3 **(a)** Determine the value of '*K*' and '*a*' such that the system has a damping ratio of 0.7 and an undamped natural frequency of 4 rad/sec for the system shown below. **07**



(b) Write note on steady state error and error constants. **07**

Q.4 **(a)** Using Routh's criterion check the stability of a system whose characteristic equation is given by **07**

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$

(b) Discuss Nyquist's stability criterion. **07**

OR

Q.4 **(a)** Using Routh array Determine the range of *K* for a unity feedback system whose open loop t.f. is given by **07**

$$G(s) = \frac{K}{s(s+1)(s+2)}$$

Q.4 **(b)** An open loop transfer function of a system is given by **07**

$$G(s)H(s) = \frac{K}{(s+1)(2s+1)}$$

Prepare Nyquist plot for it.

Q.5 The open loop transfer function of a feedback control system is given by **14**

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

Draw complete root locus plot as *K* varies from 0 to ∞. Also calculate the value of *K* for which the system becomes oscillatory.

OR

Q.5 Sketch Bode plot for the transfer function **14**

$$G(s) = \frac{200(s+2)}{s(s^2+10s+100)}$$

Determine there from gain margin and phase margin.

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