

# CBCGS SCHEME

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15EE61

**Sixth Semester B.E. Degree Examination, Aug./Sept.2020**

## Control Systems

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Define control systems. Explain with examples open loop and closed loop systems. List the merits and demerits of open loop and closed loop systems. (08 Marks)
- b. For the mechanical system shown in Fig.Q1(b), find the transfer function  $\frac{X_2(s)}{F(s)}$ .

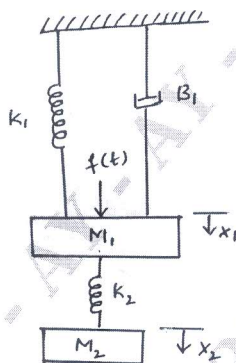


Fig.Q1(b)

(08 Marks)

OR

- 2 a. Find the transfer function, for the electromechanical system shown in Fig.Q2(a), i.e.  $\frac{X(s)}{E(s)}$ .

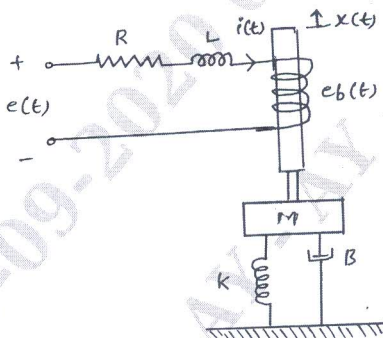


Fig.Q2(a)

(08 Marks)

- b. Show that two systems shown in Fig.Q2(b)(i) and (ii) are analogous systems by comparing their transfer functions.

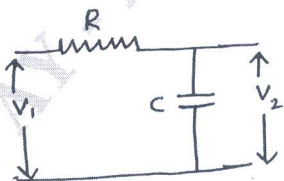


Fig.Q2(b)(i)

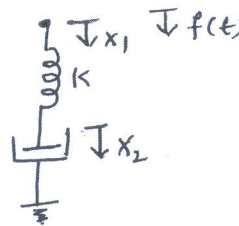


Fig.Q2(b)(ii)

(08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

**Module-2**

- 3 a. What is block diagram representation. For the negative feedback control system, starting from the fundamentals show that the closed loop transfer function  $M(s) = \frac{Ng.Dh}{(Dg.Dh + Ng.Nh)}$  where  $G(s) = \frac{Ng}{Dg}$ ;  $H(s) = \frac{Nh}{Dh}$ . (08 Marks)
- b. Find  $\frac{C(s)}{R(s)}$  for the system shown in Fig.Q3(b) using block diagram reduction rules.

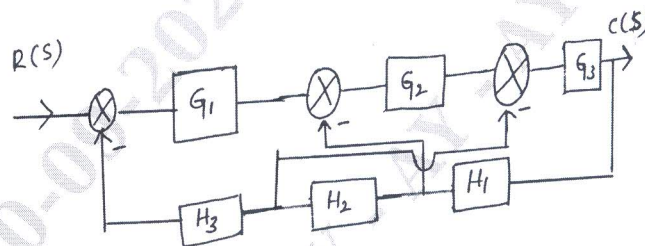


Fig.Q3(b)

(08 Marks)

**OR**

- 4 a. Using Maron's gain formula, find the gain of following system in Fig.Q4(a).

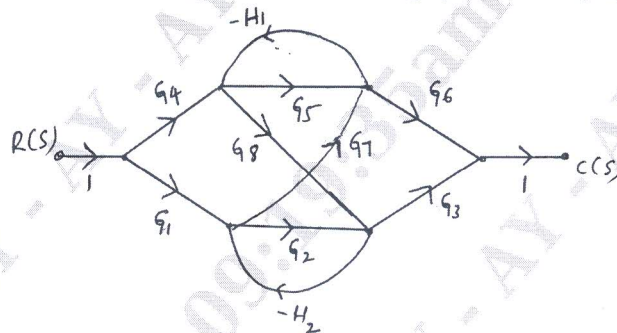


Fig.Q4(a)

(08 Marks)

- b. Draw the signal flow graph of electrical network in the Fig.Q4(b).

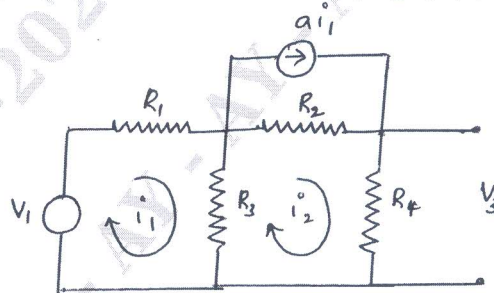


Fig.Q4(b)

(08 Marks)

**Module-3**

- 5 a. Draw the sketch of underdamped second order system, with unit step input, show the various specifications on it and define them. (08 Marks)
- b. An unity feedback system has  $G(s) = \frac{20(1+s)}{s^2(2+s)(4+s)}$ , calculate its steady state error coefficients and error when applied input  $r(t) = 40 + 2t + 5t^2$ . (08 Marks)

OR

- 6 a. A unity feedback system control system has  $G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$  using Routh's criterion, calculate the range of K for which the system is (i) stable (ii) has its closed loop, poles more negative than -1. (08 Marks)
- b. What are the two special cases of Routh's array? How there can be handled and also explain the concept of relative stability analysis? (08 Marks)

**Module-4**

- 7 a. What are the general steps to solve the problems on root locus? (06 Marks)
- b. Draw the approximate root locus diagram for a closed loop system, whose transfer function is given by  $G(s)H(s) = \frac{K}{s(s+5)(s+10)}$ . Comment on stability. (10 Marks)

OR

- 8 a. Sketch the bodeplot for transfer function  $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$ , determine the value K for the gain cross-over frequency 5 rad/sec. (10 Marks)
- b. Briefly explain (i) Gain margin G.M. (ii) Phase margin P.M and also what should be the values of gain margin GM and phase margin P.M. (06 Marks)

**Module-5**

- 9 a. State the mapping theorem, explain any two cases. (06 Marks)
- b. Sketch the Nyquist plot for the system with  $G(s)H(s) = \frac{1+0.5s}{s^2(1+0.1s)(1+0.02s)}$ , comment on stability. (10 Marks)

OR

- 10 a. Fig.Q10(a) shows PD controller used for the system, determine the value  $T_D$  so that the system will be critically damped. Calculate its settling time.

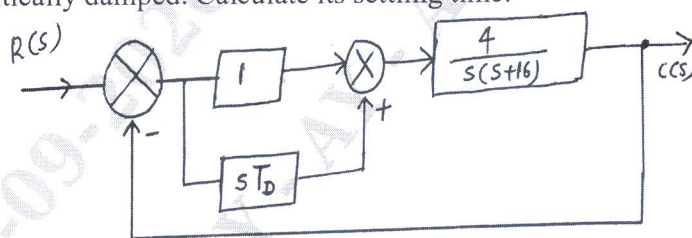


Fig.Q10(a)

- b. Explain the effect of PD and PI controllers on performance of second order system. (08 Marks)

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