CBCS 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.

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.

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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 $\frac{X_2(s)}{F(s)}$.

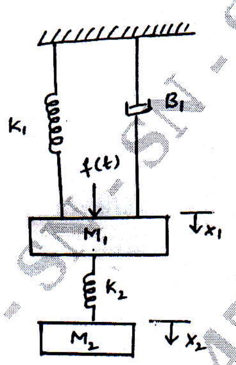

Fig.Q1(b) **(08 Marks)**

OR

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

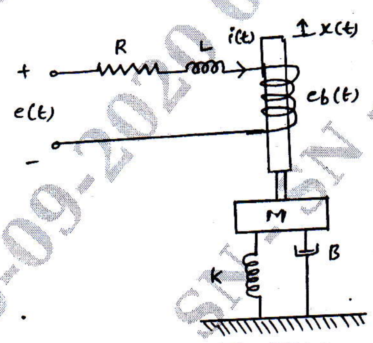

Fig.Q2(a) **(08 Marks)**

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

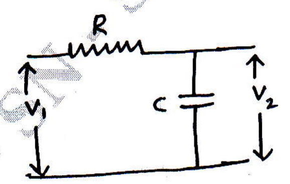

Fig.Q2(b)(i)

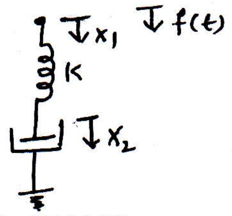

Fig.Q2(b)(ii) **(08 Marks)**

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.

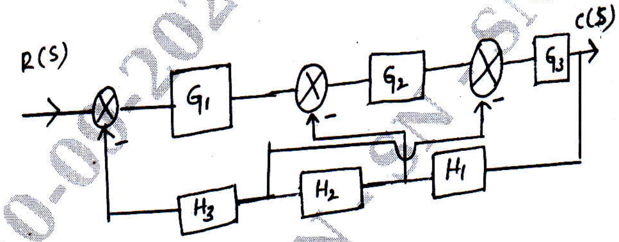

Fig.Q3(b) **(08 Marks)**

OR

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

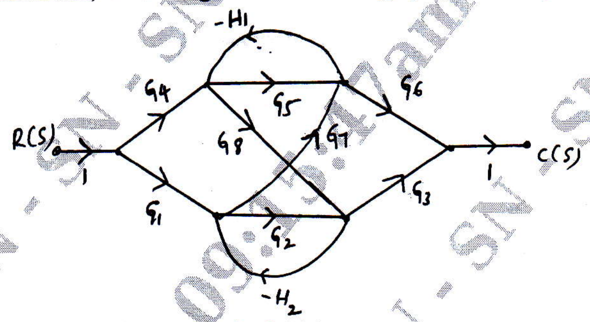

Fig.Q4(a) **(08 Marks)**

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

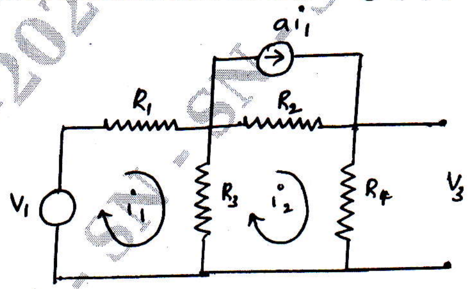

Fig.Q4(b) **(08 Marks)**

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)**

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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.

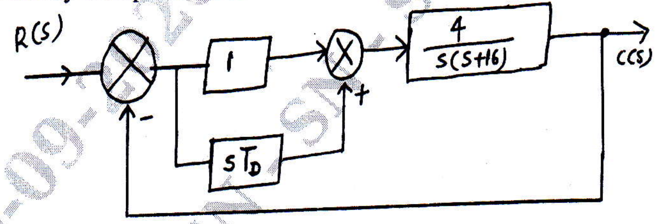

Fig.Q10(a) **(08 Marks)**

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

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