CBCS SCHEME

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18EE61

Sixth Semester B.E. Degree Examination, Feb./Mar. 2022
Control Systems

Time: 3 hrs. Max. Marks: 100

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.

Module-1

1 a. Distinguish between open-loop and closed-loop control systems with example. **(06 Marks)**

b. Derive the transfer function for the mechanical system shown in Fig Q1(b).

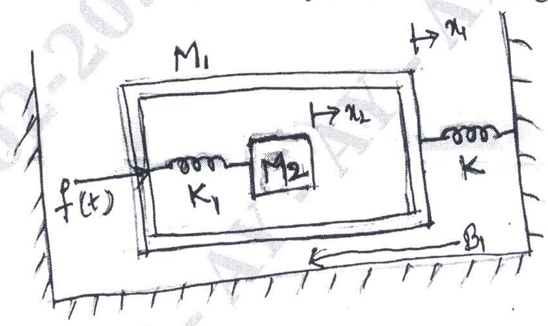

Fig Q1(b) **(06 Marks)**

c. Obtain the transfer function of armature controlled dc motor. **(08 Marks)**

OR

2 a. Draw the mechanical network. Write differential equations and also draw the analogous electrical circuit of the system, shown in Fig Q2(a), with equilibrium equations.

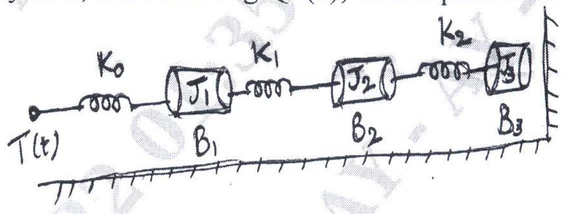

Fig Q2(a) **(10 Marks)**

b. Obtain the equivalent spring constant for the system shown in Fig Q2(b)

Fig Q2(b) **(10 Marks)**

Module-2

3 a. Reduce the block diagram and obtain the TF for Fig Q3(a).

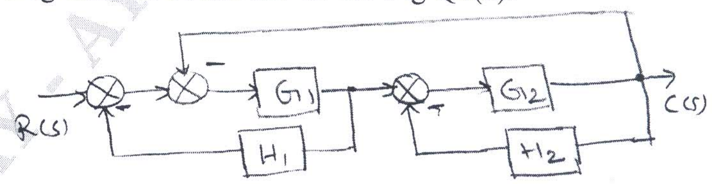

Fig Q3(a) **(10 Marks)**

b. Draw the corresponding signal flow graph of given block diagram showing Fig Q(3(b)

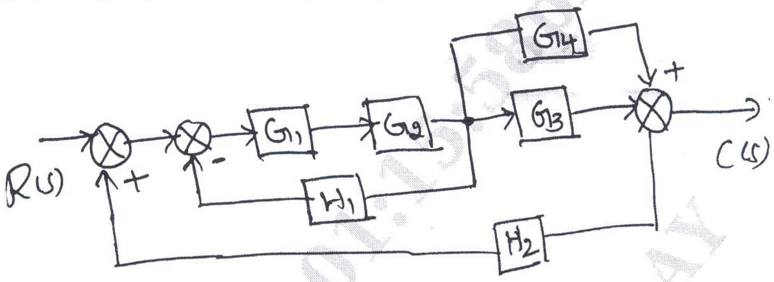

Fig Q(3(b) **(05 Marks)**

c. Illustrate how to perform the following in connection with block diagram reduction techniques.
   i) Moving a summing point ahead of a block
   ii) Moving a take off point behind a block **(05 Marks)**

OR

4 a. Find C(s)/R(s) for the signal flow graph shown in Fig Q4(a).

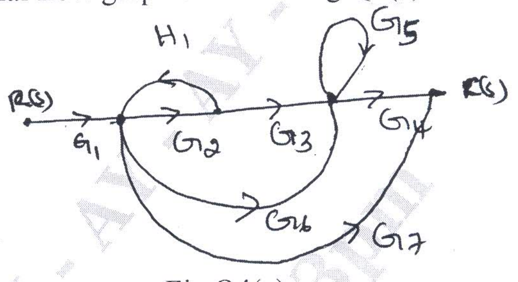

Fig Q4(a) **(10 Marks)**

b. Draw the SFG and find TF for Fig Q4(b).

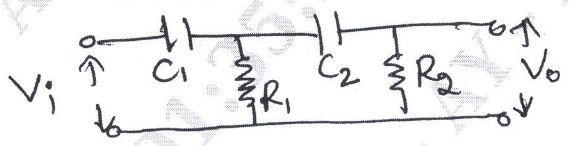

Fig Q4(b) **(10 Marks)**

Module-3

5 a. Discuss the various standard inputs used in the control system analysis. **(06 Marks)**

b. For a unity feedback control system with $G(s) = \dfrac{10(s+2)}{s^2(s+1)}$ find static error co-efficient. **(04 Marks)**

c. Draw the sketch of an underdamped second order system response with unit step input. Show the various specifications on it and define them. **(10 Marks)**

OR

6 a. Check the stability of the given characteristic equation using Routh's method.
$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ **(06 Marks)**

b. A unity feedback system has $G(s) = \dfrac{K(s+13)}{s(s+3)(s+7)}$. 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. **(06 Marks)**

c. A given system oscillates with frequency 2rad/sec. Find value of K_{mar} and P.

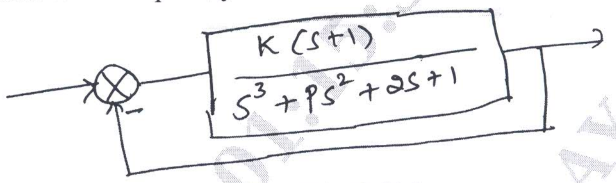

Fig Q6(c) **(08 Marks)**

Module-4

7 a. $G(s)\ H(s) = \dfrac{K}{s(s+3)(s+5)}$. Draw Root Locus. Determine for damping ratio = 0.6
i) Closed loop dominant poles ii) Damped natural frequency. **(10 Marks)**

b. For a system having
$G(s)\ H(s) = \dfrac{K}{s(s+3)(s^2+3s+11.25)}$, find the angle of departure. **(04 Marks)**

c. Write a note on co-relation between time domain and frequency domain for second order system. **(06 Marks)**

OR

8 a. For unity feedback system with $G(s) = \dfrac{100}{s(s+5)}$, determine: i) Resonant peak ii) Resonant frequency. **(08 Marks)**

b. A unity feedback control system has $G(s) = \dfrac{80}{s(s+2)(s+20)}$. Draw the Bode plot. Determine GM, PM, W_{gc} and W_{pc}. Comment on the stability. **(12 Marks)**

Module-5

9 a. Explain Nyquist stability criterion. **(06 Marks)**

b. For a control system
$G(s)\ H(s) = \dfrac{K}{s(s+2)(s+10)}$. Sketch the Nyquist plot and hence calculate the values of K for stability. **(10 Marks)**

c. What is lead – lag compensator? **(04 Marks)**

OR

10 a. Define analytic function and singularities. **(04 Marks)**

b. With a neat circuit diagram derive the transfer function of a lead compensator. **(08 Marks)**

c. Write a note on PID controller. **(08 Marks)**

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