CBCS SCHEME

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15AE71

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Control Engineering

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 system. **(02 Marks)**

b. Differentiate between open loop control system and closed loop control system. Give examples. **(06 Marks)**

c. Derive the differential equation and obtain the Transfer function $\frac{\theta(s)}{E_0(s)}$ for armature controlled D.C. motor coupled to mechanical load having inertia J and friction coefficient b_0. **(08 Marks)**

OR

2 a. What are the requirements of ideal control system? **(08 Marks)**

b. Draw the equivalent mechanical system and analogous system based on Force-Voltage method for the given system shown in the Fig.Q2(b).

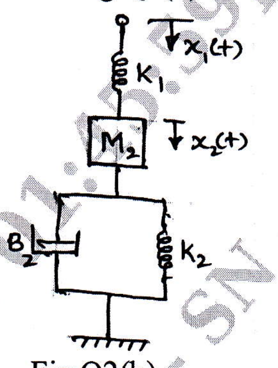

Fig.Q2(b) **(08 Marks)**

Module-2

3 a. Define transfer function. **(02 Marks)**

b. Use block diagram reduction to obtain the overall transfer function of the system shown in Fig.Q3(b).

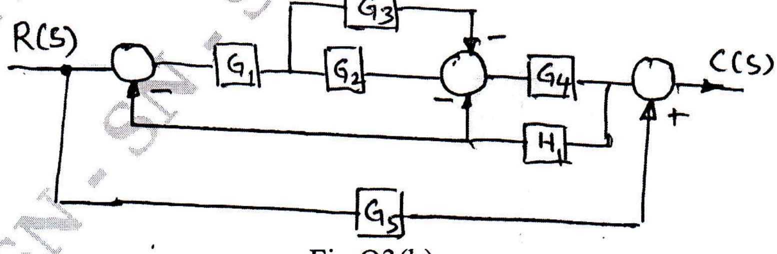

Fig.Q3(b) **(10 Marks)**

c. Obtain the expression for time response of I[st] order system subjected to unit step input. **(04 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.

OR

4 a. For the signal flow shown in the Fig.Q4(a), find $\frac{C(s)}{R(s)}$ using Mason's gain formula.

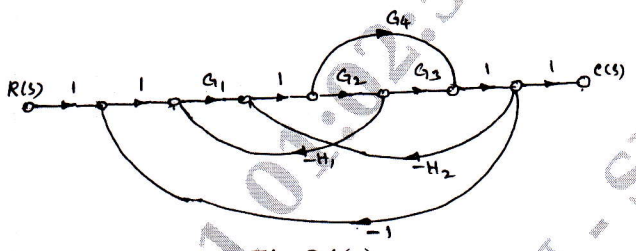

Fig.Q4(a) **(08 Marks)**

b. Explain transient response specification. **(08 Marks)**

Module-3

5 a. Ascertain the stability of the system given by the characteristic equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ by Routh's-Hurwitz criterion. **(06 Marks)**

b. Sketch the root locus of the system whose open loop transfer function is given by

$$G(S)H(S) = \frac{K(S+2)}{S^2 + 2S + 3}$$ **(10 Marks)**

OR

6 a. Draw the Bode plot for the open loop transfer function

$$G(s)H(s) = \frac{40(s+5)}{s(s+2)(s+10)}$$

Determine the following:

(i) Gain margin (ii) Phase margin (iii) Phase cross over frequency

(iv) Gain cross over frequency (v) Comments on the stability **(12 Marks)**

b. Explain various rules to sketch Root locus. **(04 Marks)**

Module-4

7 a. Explain the frequency response specification. **(08 Marks)**

b. Draw the polar plot for the Transfer function $G(S) = \frac{1}{(1+ST_1)(1+ST_2)}$, find the frequency and magnitude at which the polar plot cuts the imaginary axis. **(08 Marks)**

OR

8 a. Sketch the Nyquist and show (i) Gain margin (ii) Phase margin (iii) Gain cross over frequency (iv) Phase cross over frequency on the plot and comment on the stability. **(06 Marks)**

b. Draw the Nyquist plot for the open loop transfer $G(s)H(s) = \frac{12}{s(1+s)(s+2)}$, comments on stability. **(10 Marks)**

Module-5

9 a. Classify different types of controller with block diagram. **(08 Marks)**

b. Explain lead-lag compensators. **(08 Marks)**

OR

10 a. A system is governed by the differential equation $\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt} + 11\frac{dy}{dt} + 10y = 8u(t)$ where 'y' is the output and u is the input of the system. Obtain a state space representation of the system. **(08 Marks)**

b. Explain the term (i) Controllability (ii) Observability **(08 Marks)**