CBCS SCHEME

USN | | | | | | | | | | |

15ME73

Seventh Semester B.E. Degree Examination, Dec.2023/Jan.2024
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. Explain open and closed loop control systems with examples. **(08 Marks)**

b. With block diagram, explain:
i) Proportional controller
ii) Integral controller
iii) Proportional plus differential controller. **(08 Marks)**

OR

2 a. List the advantages and disadvantages of open loop and closed loop control system. **(08 Marks)**

b. Explain requirements of automatic control system. **(08 Marks)**

Module-2

3 a. Write differential equations for the system shown in fig.Q3(a). The force (F) produced by the Solenoid, when coil is connected to voltage source is F = (t) = K i(t). and determine x(s) /e(s). **(08 Marks)**

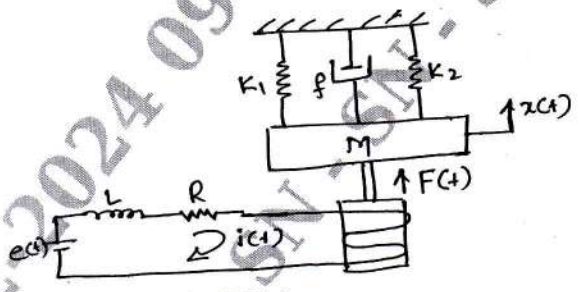

Fig.Q3(a)

b. Reduce the following block diagram and determine control ratio fig.Q3(b). **(08 Marks)**

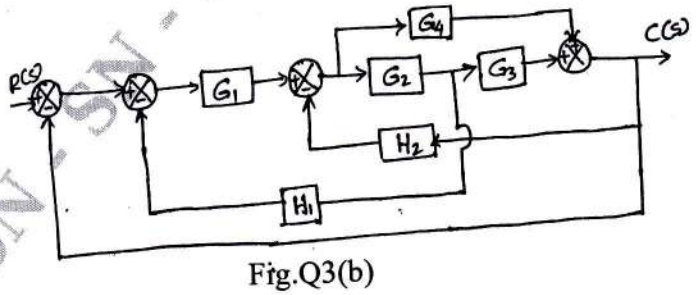

Fig.Q3(b)

OR

4 a. Derive the transfer function of an armature controlled DC motor , where output parameter is the angle turned by motor shaft and input is the applied voltage to the armature circuit. **(08 Marks)**

b. Using Masons gain formula, find the gain of the following system shown in Fig.Q4(b). **(08 Marks)**

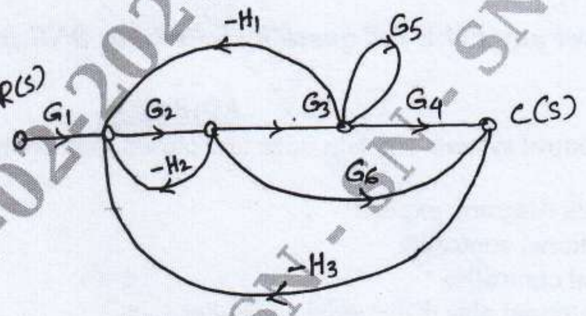

Fig.Q4(b)

Module-3

5 Obtain the expressions for Peak time, Rise time, Maximum overshoot and settling time for a second order control system in terms of damping factor and nature frequency. **(16 Marks)**

OR

6 Sketch the root locus of unity feedback system whose forward path transfer function is

$$G(s) = \frac{k}{s(s^2 + 5s + 6)}$$

Determine the range of k for the system to be stable. **(16 Marks)**

Module-4

7 a. Sketch Polar plot for the transfer function :

$$G(S) = \frac{1}{S^2(S+1)(2S+1)}.$$ **(06 Marks)**

b. Apply Nyquist stability criteria to the system with transfer function :

$$G(S)\ H(S) = \frac{(4S+1)}{S^2(S+1)(2S+1)}.$$ **(10 Marks)**

OR

8 Sketch Bode plot for

$$G(S)\ H(S) = \frac{10}{S(1+0.4S)(1+0.1S)}.$$

and obtain Gain and Phase cross over frequency. **(16 Marks)**

Module-5

9 Obtain the transfer functions of the following types of compensators:

i) Lag compensator

ii) Lead compensator **(16 Marks)**

OR

10 a. Explain the following :

i) Kalman's test of controllability

ii) Kalman's test of observability **(06 Marks)**

b. Determine the controllability and observability of the systems represented by

$$\dot{x} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}.$$

(10 Marks)

* * * * *