CBCS SCHEME

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

18EE61

Sixth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Control Systems

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Distinguish between open loop and closed loop control system with examples. **(06 Marks)**

b. Find the transfer function of the electrical network shown in Fig.Q1(b) in phase load form:

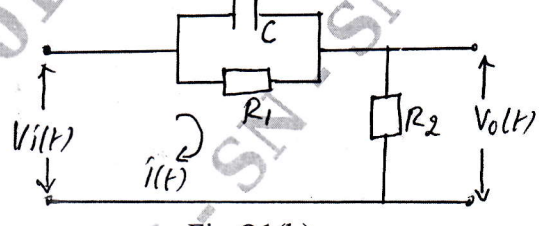

Fig.Q1(b) **(06 Marks)**

c. For the mechanism system shown in Fig.Q1(c):
(i) Draw the mechanical network
(ii) Write the differential equations
(iii) Draw electrical network by force voltage analogy.

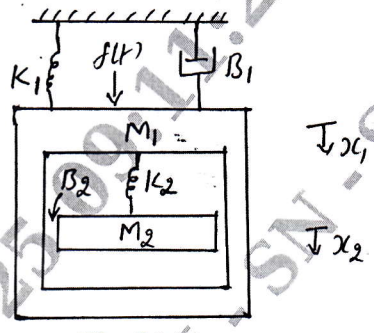

Fig.Q1(c) **(08 Marks)**

OR

2 a. Define servo motor. Compare AC servomotor and DC servo motor. **(04 Marks)**

b. For the mechanical system shown in Fig.Q2(b), obtain the equation of motion for masses M_1 and M_2 and find $\frac{X_2(s)}{F(s)}$.

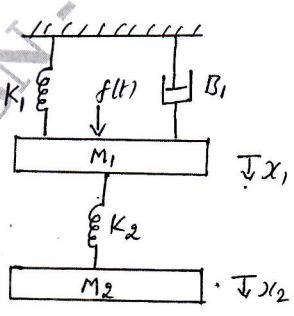

Fig.Q2(b) **(08 Marks)**

c. For the rotational system shown in Fig.Q2(c), draw electrical network based on torque current analogy.

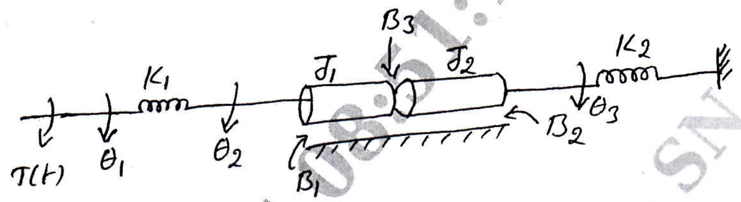

Fig.Q2(c) **(08 Marks)**

Module-2

3 a. Define the following terms in connection with signal flow graph:
(i) Node
(ii) Forward path gain
(iii) Feedback loop
(iv) Non touching loops **(04 Marks)**

b. For the block diagram shown in Fig.Q3(b), determine the transfer function $\frac{C(s)}{R(s)}$ using block diagram reduction technique.

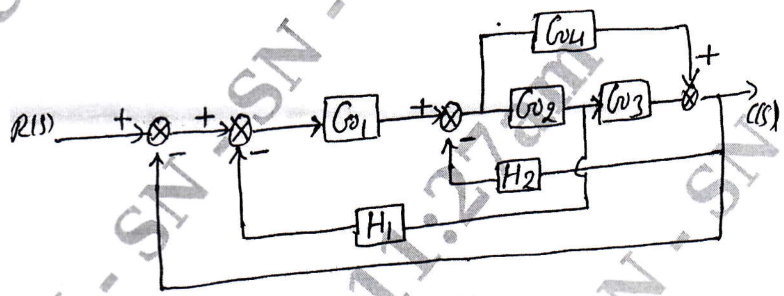

Fig.Q3(b) **(08 Marks)**

c. For the signal flow graph shown in Fig.Q3(c), determine the transfer function $\frac{C(s)}{R(s)}$ using Mason's gain formula.

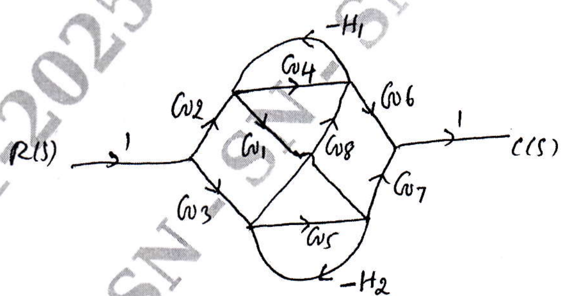

Fig.Q3(c) **(08 Marks)**

OR

4 a. A system is represented by following set of equations, find $\frac{X(s)}{U(s)}$ using signal flow graph technique:

$X(t) = x_1(t) + \beta_3 u(t)$

$\dot{X}_1(t) = -a_1 x_1(t) + x_2(t) + \beta_2 u(t)$

$\dot{X}_2(t) = -a_2 x_1(t) + \beta_1 u(t)$ **(08 Marks)**

b. Draw the corresponding signal flow graph of given block diagram shown in Fig.Q4(b) and find $\frac{C(s)}{R(s)}$.

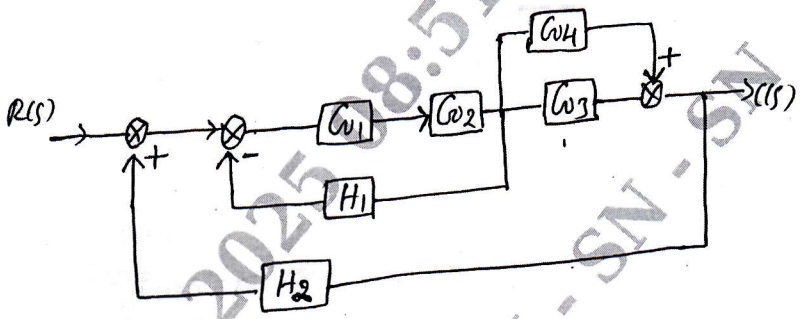

Fig.Q4(b) **(08 Marks)**

c. Explain Mason's gain formula indicating each term. **(04 Marks)**

Module-3

5 a. Define the following for an under damped second order system:
(i) Rise time (ii) Peak overshoot (iii) Settling time **(06 Marks)**

b. Derive an expression for under damped response of a second order feedback control system for unit step input. **(08 Marks)**

c. The characteristic equation of the system is given by $s^4 + 22s^3 + 10s^2 + 2s + K = 0$. Using RH criterion, find the range of K for which the system is stable. **(06 Marks)**

OR

6 a. What are the difficulties encountered while assessing R-H criteria and how do you eliminate these difficulties? Explain with examples. **(06 Marks)**

b. Derive an expression for rise time and peak time for a second order system excited by a step input. **(08 Marks)**

c. Evaluate the static error constants for unity feedback system with $G(s) = \frac{10}{s(1+0.1s)}$. Obtain the steady state error when the input is $r(t) = a_0 + a_1 t + \frac{a_2 t^2}{2}$. **(06 Marks)**

Module-4

7 a. Write notes on: (i) Break away point (ii) Asymptotes **(04 Marks)**

b. Show that part of root locus of a system with $G(s)H(s) = \frac{K(s+3)}{s(s+2)}$ is a circle having centre $(-3, 0)$ and radius at $\sqrt{3}$. **(08 Marks)**

c. Sketch the root locus plot for the open loop transfer function $G(s)H(s) = \frac{K}{s(s+2)(s+3)}$. **(08 Marks)**

OR

8 a. Explain the angle and magnitude condition of root locus. **(06 Marks)**

b. Sketch the bodes magnitude and phase diagram for

$$G(s)H(s) = \frac{5}{s(1+0.5s)(1+0.05s)}$$ **(08 Marks)**

c. Find the open loop transfer function of a system whose approximate plot is as shown in Fig.Q8(c).

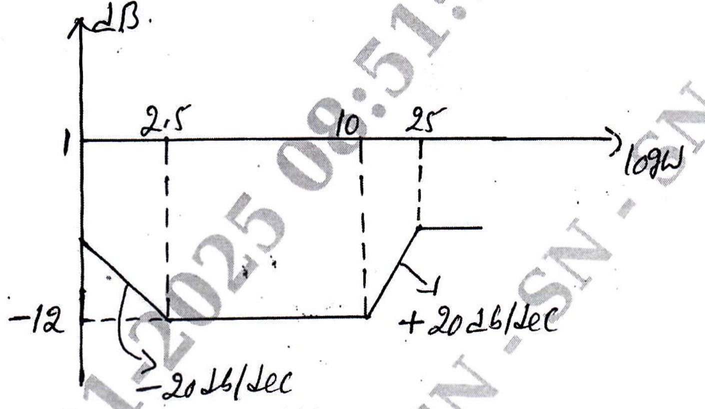

Fig.Q8(c) **(06 Marks)**

Module-5

9 a. Discuss the advantages of Nyquist plot. **(06 Marks)**

b. What is controller? Explain the effect of PI and PD controller on second order system. **(08 Marks)**

c. What are the limitations of single phase lead control? **(06 Marks)**

OR

10 a. A feedback control system has loop function $GH(s) = \frac{5}{s(s+1)}$. Sketch the Nyquist plot and comment on the stability of a system. **(08 Marks)**

b. Explain Nyquist stability criteria. **(05 Marks)**

c. Explain the principle of argument in Nyquist stability criteria. **(07 Marks)**

* * * * *