CBCS SCHEME

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

17EE61

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
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. Define Control System. Explain with example open loop and closed loop control systems. **(06 Marks)**

b. Write the differential equations governing the mechanical system shown in fig. Q1(b). Draw the force – voltage and force – current electrical analogous circuits and verify by writing mesh and node equations. **(14 Marks)**

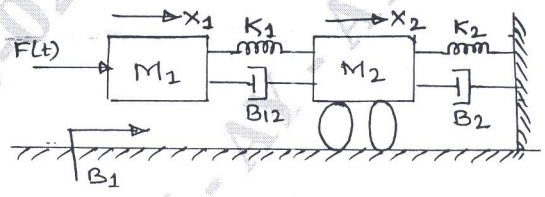

Fig.Q1(b)

OR

2 a. Define Servo Motor. Compare AC servo motor and DC servo motor. **(08 Marks)**

b. Derive an expression for the transfer function of an Armature controller DC motor and also construct the block diagram of DC motor. **(12 Marks)**

Module-2

3 a. Determine the overall transfer function $\frac{C(s)}{R(s)}$ for the system shown in fig. Q3(a). **(12 Marks)**

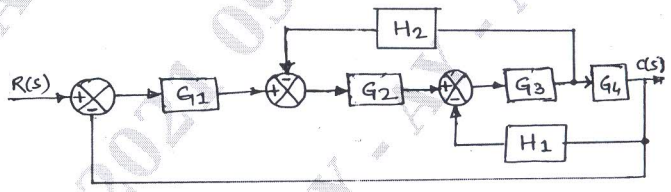

Fig.Q3(a)

b. Find the overall transfer function of the system whose signal flow graph is shown in fig. Q3(b). **(08 Marks)**

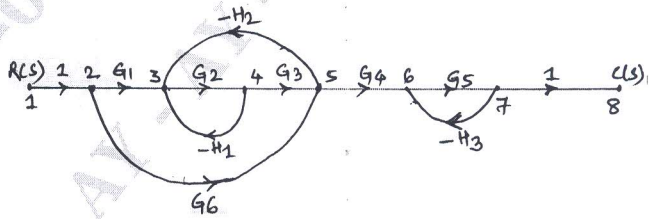

Fig.Q3(b)

OR

4 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. Convert the block diagram to signal flow graph and determine C(s) / R(s) as shown in fig. Q4(b). **(10 Marks)**

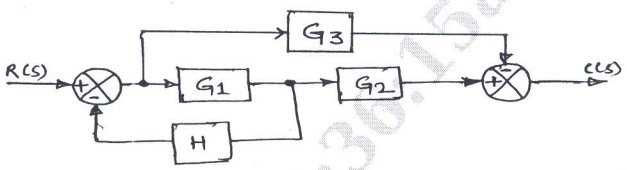

Fig.Q4(b)

c. Explain Block Reduction Technique rules. **(06 Marks)**

Module-3

5 a. Derive the expression for under damped second order system for unit step input. **(08 Marks)**

b. The unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the gain 'K', so that the system will have a damping ratio 0.5, for this value of K. Determine peak overshoot and time at peak overshoot for a unit step input. **(07 Marks)**

c. Define the following time response specifications for an under damped second order system
i) Rise time (t_r) ii) Peak time (t_p) iii) Peak over shoot (M_p)
iv) Settling time (t_s) v) Delay time (t_d). **(05 Marks)**

OR

6 a. Construct the Routh array and determine the stability of the system represented by the characteristic equation, $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$. Comment on the location of roots of characteristic equation. **(08 Marks)**

b. Determine the range of 'K' for stability of unity feedback system whose open loop transfer function is $G(s) = \frac{K}{s(s+1)(s+2)}$. **(08 Marks)**

c. Determine the expression for i) Rise time (t_r) ii) Peak overshoot (M_p). **(04 Marks)**

Module-4

7 a. Explain various steps in the procedure for construction of Root locus. **(08 Marks)**

b. A unity feedback control system has an open loop transfer function, $G(s) = \frac{K}{s(s^2+4s+13)}$, sketch the root locus. **(12 Marks)**

OR

8 a. Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$. **(15 Marks)**

b. Discuss the procedure to evaluate Gain Margin and Phase margin using Bode plots. **(05 Marks)**

Module-5

9 a. Explain Nyquist stability criterion. **(05 Marks)**

b. Draw the Nyquist plot and access the stability of the closed loop system whose open – loop transfer function is $G(s)\,H(s) = \frac{(s+4)}{(s+1)(s-1)}$. **(15 Marks)**

OR

10 a. Explain the phase lag compensator with neat circuit diagram and derive expression for the transfer function of a lag compensator. **(12 Marks)**

b. Explain PID controller and discuss the effect on the behavior of the system. **(08 Marks)**