CBCS SCHEME

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

15EE61

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Control System

Time: 3 hrs. Max. Marks: 80

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. Define Control System. Distinguish between open-loop and closed loop control system with an examples. **(06 Marks)**

b. For the mechanical system shown in Fig.Q1(b), write the differential equation relating to the force F(t). Also obtain the analogous electrical circuits based on i) Force-current analogy ii) Force-voltage analogy. **(10 Marks)**

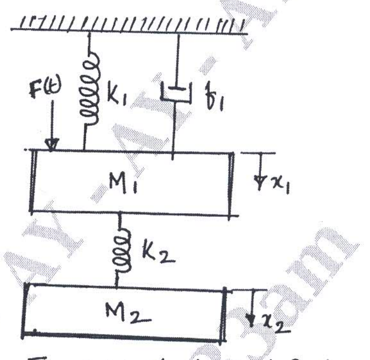

Fig 1(b) Mechanical System.
Fig.Q.1(b)

OR

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

b. Derive an expression for the transfer function of an armature controlled D.C. motor and also construct the block diagram of d.c. motor. **(12 Marks)**

Module-2

3 a. For the system represented by the following equations and find the transfer function X(s)/U(s) by the signal flow graph technique.

$$x = x_1 + \alpha_0 u \,;\ \frac{dx_1}{dt} = -\alpha_1 x_1 + x_2 + \alpha_2 u \,;\ \frac{du_2}{dt} = -\alpha_2 x_1 + \alpha_1 u$$ **(08 Marks)**

b. Using block diagram reduction technique. Obtain the transfer function of C(s)/R(s) as shown in Fig.Q.3(b). **(08 Marks)**

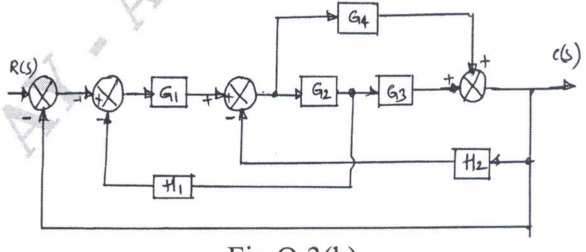

Fig.Q.3(b)

OR

4 a. State the Mason's gain formula. Find the transfer function $\frac{X_5}{X_1}$ of the system described by the signal flow graph (SFG) shown in Fig.Q.4(a). **(08 Marks)**

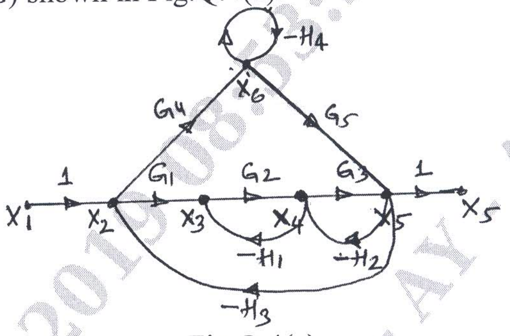

Fig.Q.4(a)

b. For the network shown in Fig.Q.4(b), construct the signal flow graph and determine the transfer function using Mason's gain formula. **(08 Marks)**

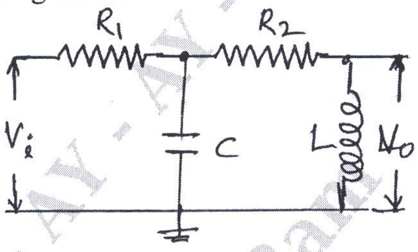

Fig.Q.4(b)

Module-3

5 a. Derive an expression for rise time and peak-time for a second order system excited by a step input (under-damped case). **(08 Marks)**

b. A unity feedback control system is characterized by an open-loop T.F. $G(s) = \frac{K}{s(s+\alpha)}$.

Where K and α are positive constant,
By what factor the amplifier gain K should be reduced so that the peak osvershoot of the unit step response reduces from 75% to 25%. **(08 Marks)**

OR

6 a. A unity feedback system having open-loop T.F. of $G(s) = \frac{K(2s+1)}{S(s+1)(s+1)^2}$. The input $r(t) = 1 + 6t$ is applied to the system. Determine the minimum value of K, if the steady state error is to be less than 0.1. **(04 Marks)**

b. A unity feedback control system has $G(s) = \frac{K(s+4)}{s(s+1)(s+2)}$ using Routh Hurwitz criterion. Find the range of K for which system to be stable and also determine the frequency of oscillations. **(06 Marks)**

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

Module-4

7 a. What do you means by (i) breakaway point and (ii) break in point. How can they be determined with an example? **(04 Marks)**

b. Sketch the roots locus plot for the system $G(s)H(s) = \frac{K}{s(s+2)(s+4)}$. Determine the range of K for which the system will have damped oscillating response. **(07 Marks)**

c. Show that part of root locus for the open loop T.F. $G(s)H(s) = \frac{K(s+2)}{S(s+1)}$ is a circle. **(05 Marks)**

OR

8 a. Derive an expression for resonant peak and resonant frequency for a second order system. **(06 Marks)**

b. Sketch the Bode-plot for the open-loop transfer function $G(s)H(s) = \frac{K}{s(s+1)(0.1s+1)}$ and determine the value of K for which system is to be stable. Also find the gain margin and phase margin. **(10 Marks)**

Module-5

9 a. State and explain the Nyquist stability criterion. **(06 Marks)**

b. Sketch the Nyquist plot and comment on the stability of the closed loop system whose open-loop transfer function is $G(s)H(s) = \frac{K(s-4)}{(s+1)^2}$. **(10 Marks)**

OR

10 a. Explain the pharse lag compensator with neat circuit diagram and derive expression for the transfer function of a lag compensator. **(06 Marks)**

b. What are the limitations of single stage phase lead control? **(04 Marks)**

c. Write notes on PID controller. **(06 Marks)**

* * * * *