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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Mechanical Engineering

Semester End Examination; Jan. / Feb. - 2021

Automatic Control Engineering

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. With a neat block diagram, explain the difference between open loop and closed loop control system. 8

b. Draw the equivalent mechanical system of the given system shown in Fig. Q1(b).

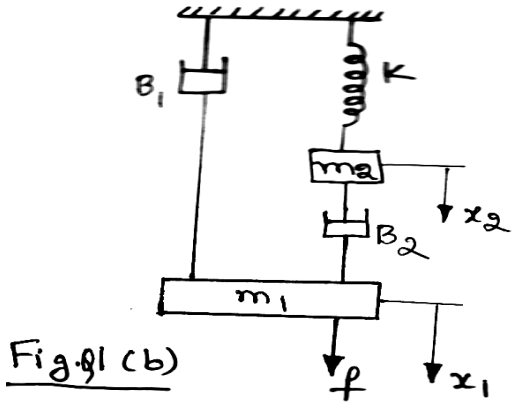

Fig.Q1 (b) 12

Write the set of equilibrium equation for the system and obtain electrical analogous circuits using, i) F - V analogy ii) F - I analogy

2 a. Explain the following with block diagram:

i) Human body temperature control system 10

ii) Home heating system

b. Obtain the transfer function of Armature controlled DC servomotor. 10

UNIT - II

3 a. Define transfer function. Derive the transfer function for canonical or simple form of closed loop control system. 8

b. Using Mason's gain formula, determine the overall transfer function of the system shown in Fig. Q3(b).

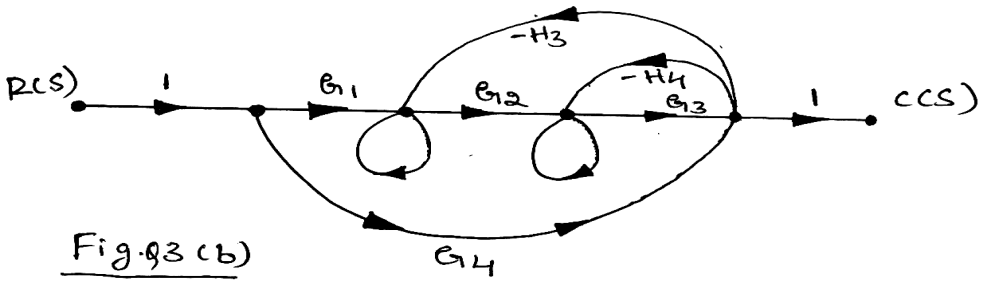

Fig.Q3 (b) 12

Contd…2

4 a. With neat block diagrams, explain block diagram reduction techniques. 10

b. Reduce the block diagram shown in Fig. Q4(b) to canonical form and determine transfer function $\frac{C(S)}{R(S)}$. 10

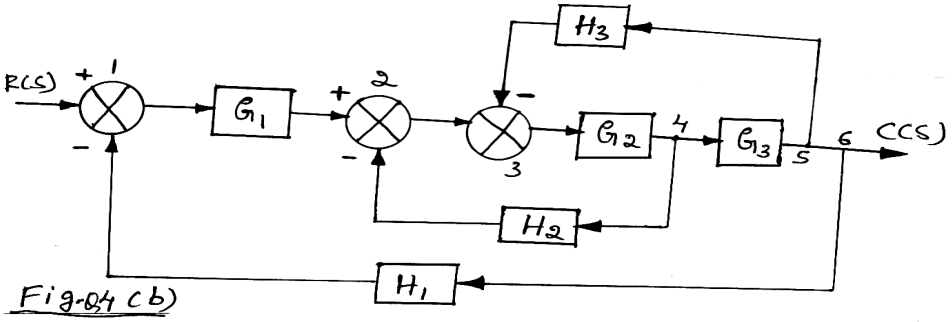

Fig-Q4 (b)

UNIT - III

5 a. Derive the transient response of a first order system, subjected to unit step function input. 8

b. A unity feedback system is characterized by an openloop transfer fucntion $G(S)=\frac{10}{S^2+2S+6}$. Determine the following, when the system is subjected to a unit step input? 12

i) Un-damped natural frequency ii) Damping ratio iii) Peak

iv) Over shoot v) Peak time vi) Settling time

6 a. With a neat sketch, explain transient response specifications. 10

b. The characteristics equation of a system is given by $S^3+3KS^2+(K+2)S+4=0$. Using Routh's criteria conditionally determine the value of K at which the system is stable. 10

UNIT - IV

7 a. State principle of Argument. Explain Nyquist stability criterion. 10

b. For a certain control system, $G(S)H(S)=\frac{K}{S(S+2)(S+10)}$. Sketch the Nyquist plot. 10

8. For a control system having $G(S)=\frac{K(1+0.5S)}{S(1+2S)(1+0.05S+0.125S^2)}$. Draw a bode plot with $K = 4$ and find; i) Gain crossover and phase cross over frequencies 20

ii) Gain margin and phase margin

UNIT - V

9. Construct root locus for the open loop transfer fucntion, $G(S)H(S)=\frac{K}{S(S+2)(S+4)}$. Determine the value of K at which system is stable. 20

10 a. Explain the concept of root locus with a suitable example. 10

b. Determine the state controllability and observability of the system described by 10

$$\dot{X}=\begin{bmatrix}-3 & 1 & 1\\ -1 & 0 & 1\\ 0 & 0 & 1\end{bmatrix}X+\begin{bmatrix}0 & 1\\ 0 & 0\\ 2 & 1\end{bmatrix}u, \quad Y=\begin{bmatrix}0 & 0 & 1\\ 1 & 1 & 0\end{bmatrix}x.$$

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