CBCS SCHEME

USN

17MT34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Distinguish between openloop and closed loop control systems with neat block diagram. **(10 Marks)**

b. In the circuit shown below Fig.Q.1(b), K is the gain of an ideal amplifier. Determine the transfer function I(S)/Vi(S). **(10 Marks)**

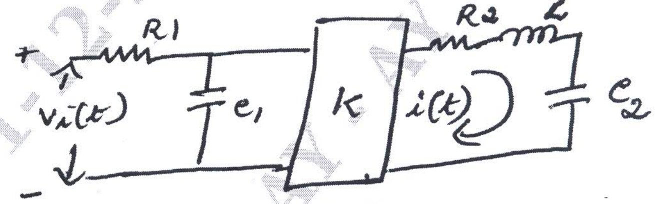

Fig.Q.1(b)

OR

2 a. Draw the equivalent mechanical system of the given system in Fig.Q.2(a). Write the set of equilibrium equation for it and obtain electrical analogous circuit using, i) F-V analogy ii) F-I analogy. **(10 Marks)**

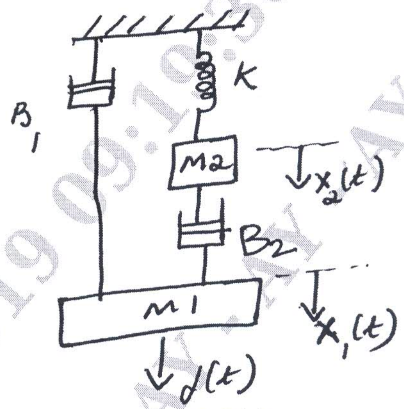

Fig.Q.2(a)

b. Determine the transfer function C(S)/R(S) of the system shown in the Fig.Q.2(b). **(10 Marks)**

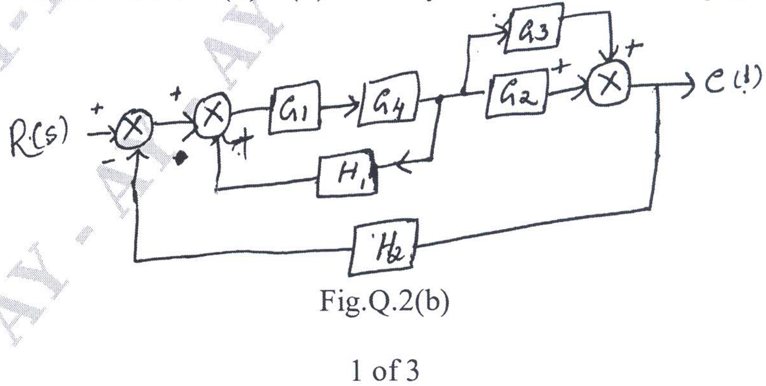

Fig.Q.2(b)

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-2

3 a. Find the transfer function C(S)/R(S) for signal flow graph shown in Fig.Q.3(a) below. **(12 Marks)**

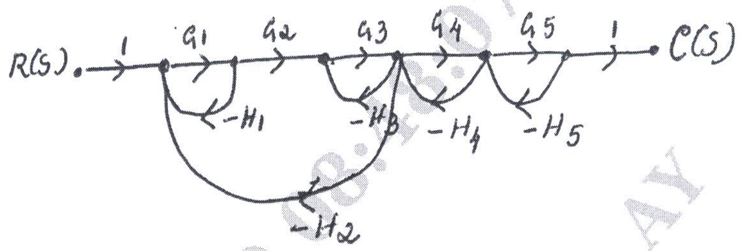

Fig.Q.3(a)

b. What are the standard test signals used in time domain analysis, represent them and also give their Laplace transform. **(08 Marks)**

OR

4 a. Define the following for second order system:
i) Delay Time
ii) Rise Time
iii) Peak Time
iv) Peak Overshoot
v) Settling Time. **(10 Marks)**

b. A second order system is represented by the transfer function $\frac{Q(S)}{I(S)} = \frac{1}{Js^2 + fs + K}$, A step input of 10Nm is applied to the system and test results are i) Maximum overshoop = 6%, ii) Time at peak overshoot = 1sec iii) The steady state value of the output is 0.5 radious. Determine the values of J, f and K. **(10 Marks)**

Module-3

5 a. Find the number of roots of this equation with positive real part, zero real part and negative real part:
$s^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$ **(10 Marks)**

b. A given system in Fig.Q.5(b) oscillates with frequency 2rad/sec. Find values of 'Kmar' and 'P'. No poles are in R.H.S. **(10 Marks)**

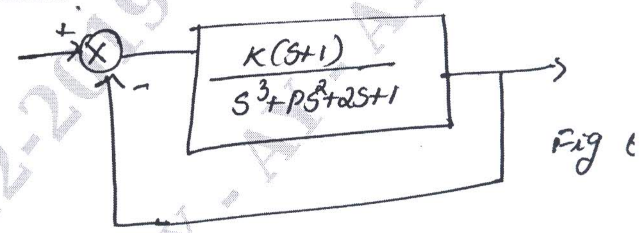

Fig.Q.5(b)

OR

6 a. Explain the terms: i) Asymptotes ii) Centroid iii) Break-way point. **(09 Marks)**

b. A feedback control system has an open loop transfer function

$G(s)H(s) = \frac{K}{s(s+3)(s^2+2s+2)}$. Draw the root locus as K various from 0 to ∞ **(11 Marks)**

Module-4

7 a. List the advantages and limitations of frequency domain approach. **(08 Marks)**

b. Construct the Bode plot for a unity feedback control system with $G(s) = \dfrac{10(s+10)}{s(s+2)(s+5)}$. Find W_{ge} and W_{pe}, GM and PM. **(12 Marks)**

OR

8 a. For a certain control system $G(s)H(s) = \dfrac{K}{s(s+2)(s+10)}$ sketch the Nyquist plot and calculate the range of values of K for stability. **(10 Marks)**

b. Consider Type 2 system with Transfer function $G(s)H(s) = \dfrac{1}{s^2(1+Ts)}$ obtain its polar plot. **(10 Marks)**

Module-5

9 a. Obtain the appropriate state model for a system represented by an electric circuit shown in Fig.Q.9(a). **(10 Marks)**

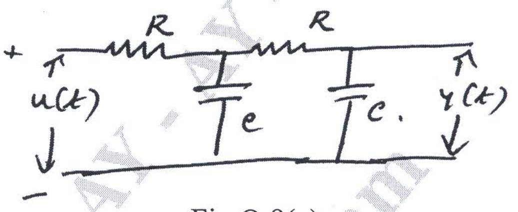

Fig.Q.9(a)

b. Find the transfer function for a system having state model as given below

$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$ & $y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$ **(10 Marks)**

OR

10 a. Obtain the state transition matrix $\phi(t)$ of the following system:

$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. Also obtain the inverse of the state transition matrix $\phi^{-1}(t)$. **(10 Marks)**

b. For a certain system, when $X(0) = \begin{bmatrix} 1 \\ -3 \end{bmatrix}$ then $X(t) = \begin{bmatrix} e^{-3t} \\ -3e^{-3t} \end{bmatrix}$ while $X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ then $X(t) = \begin{bmatrix} e^{t} \\ e^{t} \end{bmatrix}$. Determine the system matrix A. Also find state transition matrix. **(10 Marks)**

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