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CBCS SCHEME

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

15AE71

Seventh Semester B.E. Degree Examination, June/July 2019
Control Engineering

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. Explain open loop and closed loop control system with block diagrams. What are the advantages and disadvantages of a closed loop system over an open loop system? **(10 Marks)**

b. What are the requirements of an ideal control system? **(06 Marks)**

OR

2 a. Obtain the transfer function $\frac{E_0(s)}{E_i(s)}$ of the electrical circuit shown below in Fig Q2(a)

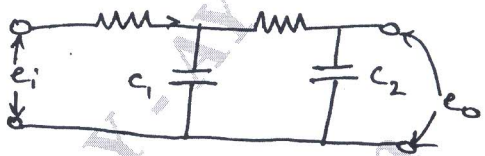

Fig Q2(a) **(08 Marks)**

b. For the mechanical system shown in Fig Q2(b) draw the
i) Mechanical equivalent system
ii) Analogous electrical N/w

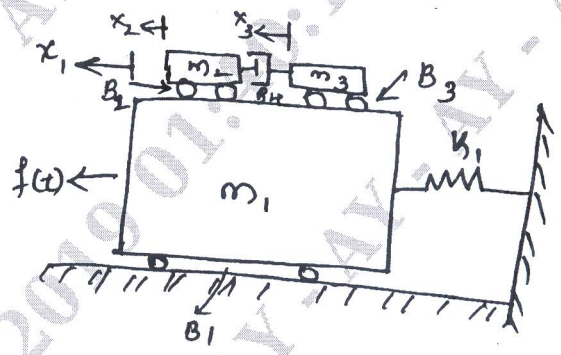

Fig Q2(b) **(08 Marks)**

Module-2

3 a. Reduce the BD, shown in Fig Q3(a). Find over all TF $\frac{C}{R}$

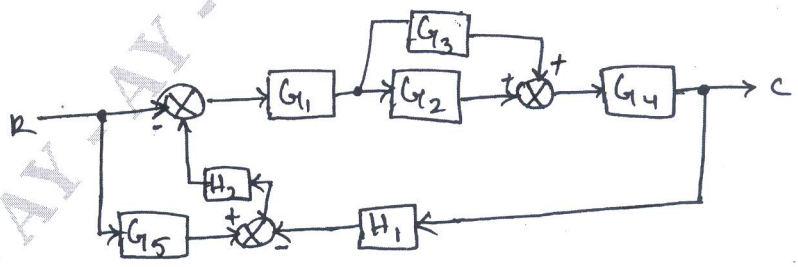

Fig Q3(a) **(06 Marks)**

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b. Obtain the overall the TF $\frac{C}{R}$ for SFG shown in Fig Q3(b)

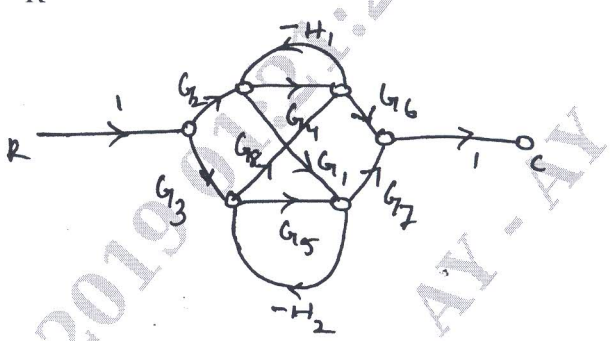

Fig Q3(b) **(10 Marks)**

OR

4 a. Determine the type and order of the following system for which open loop transfer function are given as follows :

i) $G(s)H(s) = \frac{k}{s(1+s)(1+10s)(1+20s)}$

ii) $G(s)H(s) = \frac{100(s-1)}{s^2(s+5)(s+6)}$ **(08 Marks)**

b. Unity feedback control system is characterized by an OLTF $G(s)H(s) = \frac{k}{s(s+10)}$.

Determine the system gain k, so that the system will have damping ration of 0.5, for this value of k, find the rise time, peak time, settling time and peak over shoot. Assume that the system is subjected to a step of 1V. **(08 Marks)**

Module-3

5 Draw the complete root lows plot for the system with OLTF $G(s)H(s) = \frac{k}{s(s^2+4s+7)}$,

Hence determine the range of variation of k over which the system remain stable and what is the range of damping factor for dominant poles. **(16 Marks)**

OR

6 a. Sketch the bode plot for TF

$$G(s) = \frac{ks^2}{(1+0.02s)(1+0.2s)}$$

Determine the value of k for the gain cross over frequency to be 5 rad/sec. **(10 Marks)**

b. The following readings were observed from a control system whose Bode plot is plotted

Corner freq	0	5	20	200	1000
Slope of curve dB/decode	−40	−20	0	−20	−40

Find the value of OLTF for the above unity feedback control system. **(06 Marks)**

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Module-4

7 a. Differentiate between time domain and frequency domain. **(08 Marks)**

b. Obtain polar plot for OLTF

$G(s)H(s) = \frac{1}{1+T_s}$ where T is constant. **(08 Marks)**

OR

8 a. Apply Nyquist stability criterion to the system with TF

$G(s)H(s) = \frac{4s+1}{s^2(1+s)(1+2s)}$. **(10 Marks)**

b. Obtain the equations of circle with centre $x = \frac{M^2}{1+M^2}$ and $y = 0$ with radius $= \left|\frac{M}{1-M^2}\right|$ **(06 Marks)**

Module-5

9 a. Explain PID controller with the block diagram. **(06 Marks)**

b. A PI controller is used to control a certain process. The setting of the controller are $k_p = 2\%$ and $k_i = 4\%$ per min while $p(0) = 50\%$. The error signal is found to be $3t + 7$ where t is the time. Find the controller output in % after 1.5 minutes. **(05 Marks)**

c. What will be the output of derivative controller having gain $K_D = 4$ and error input of 2.2 sin (0.04t)? **(05 Marks)**

OR

10 a. Derive the state model for the TF given below

$\frac{Y(s)}{U(s)} = \frac{12}{6s^3+12s^2+3s+24}$ **(08 Marks)**

b. Find the observabality of the state Model

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 1\end{bmatrix} U$$

$$y = [3,4,1]\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

Using i) Kalman's test ii) Gilbert's test. **(08 Marks)**

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