UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

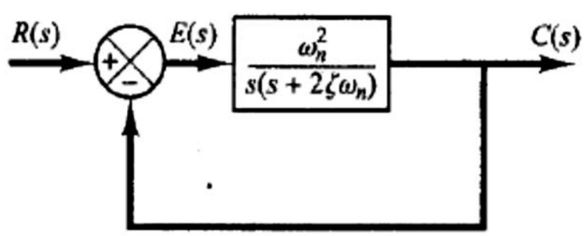
End Semester Examination, Dec 2021

Course: Control System Engineering **Semester: V**

Program: B. Tech electronics and communication engineering **Time 03 hrs**

Course Code: ECEG 4007 **Max. Marks: 100**

SECTION A (5Q x 4M= 20M)

S. No.		**Marks**	**CO**
Q 1	Differentiate between transient and steady state stability?	**4**	**CO2**
Q 2	What do you understand by frequency response analysis? What is minimum phase system.	**4**	**CO3**
Q 3	What do you understand by control system design. Explain the types of control system design?	**4**	**CO1**
Q 4	For the block diagram shown in figure 1? Find the value of transfer function Classify the system output behavior based on the value of damping ratio.  Figure 1 Block Diagram	**4**	**C01**
Q 5	Explain the types of standard test signals?	**4**	**CO1**

SECTION B [4Q X 10M=40 M]

Q 6	Obtain mathematical model for speed control of Armature controlled DC Servomotor. Consider the model as shown in figure 2.	**10**	**CO2**

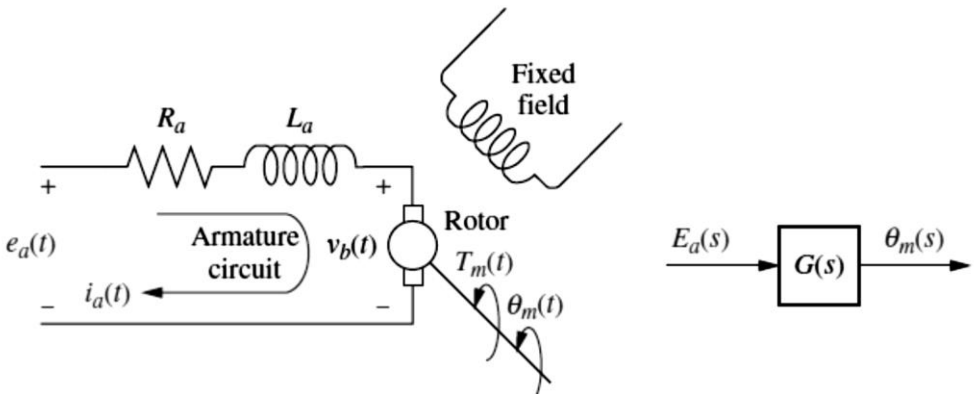
<table>
<tr><td></td><td>

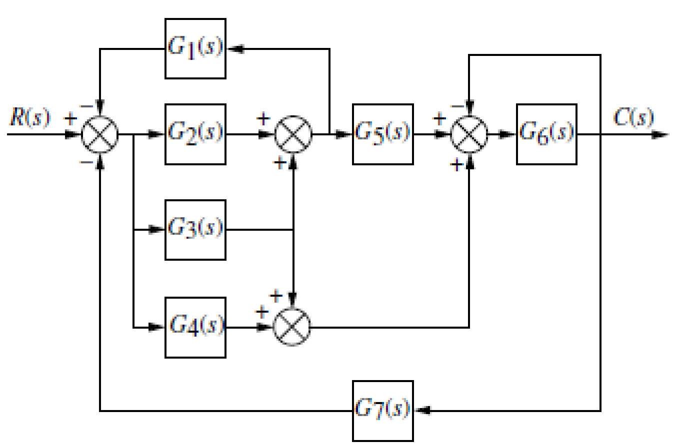
Figure 2 . Armature controlled DC Servomotor</td><td></td><td></td></tr>
<tr><td>Q 7</td><td>The characteristics equation of a system in differential form is

$$\ddot{x} - (K+2)\dot{x} + (2K+10)x = 0$$

Find the values of K for which the system is (i) stable (ii) limited stable and (iii) unstable. For stable case, for what values of K is the system (i) underdamped (ii) overdamped</td><td>10</td><td>CO2</td></tr>
<tr><td>Q8</td><td>Elucidate the mathematical equation of PID controller. What is the advantage of PI controller over PD controller?</td><td>10</td><td>CO3</td></tr>
<tr><td>Q 9</td><td>Find the transfer function of a second-order system that yields a 12.3% overshoot and a settling time of 1 second?

OR

Find the equivalent transfer function T(s)= C(s)/ R(s) for the system as shown in figure?


</td><td>10</td><td>CO3</td></tr>
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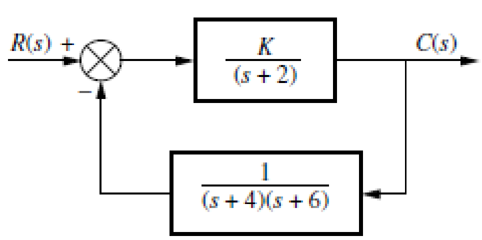
	SECTION C [2Q X 20M=40]		
Q 10 (a) (b)	Obtain the transfer functions for the following systems with state-space models available as: a. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u\,; \quad y = \begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + [0]u$ Explain the concepts of observability and controllability with reference to linear time invariant systems. Find the controllability of the system described by the state equation. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \left[\begin{pmatrix}0 & 1\\ -2 & 0\end{pmatrix}\right]\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 3\end{bmatrix}u$	**10** **10**	 **CO3**
Q 11	Design the complete root locus for $G(s)H(\mathrm{s}) = \dfrac{K}{s(s+2)(s+4)}(K>0)$ From the root locus plot find the range of value of K for which the system will have damped oscillatory response. **OR** Using the Nyquist criterion ,find the range of K for stability for the system shown in figure?  	**20**	**CO4**