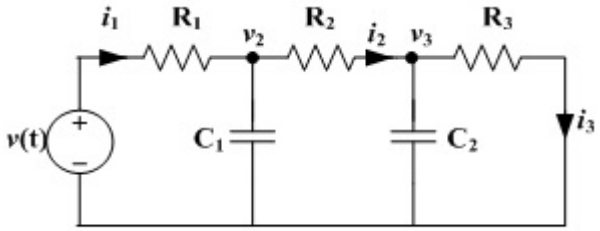
R16

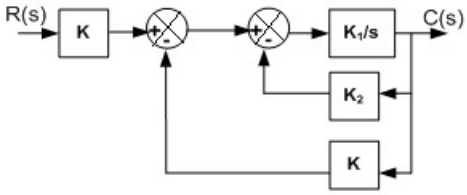
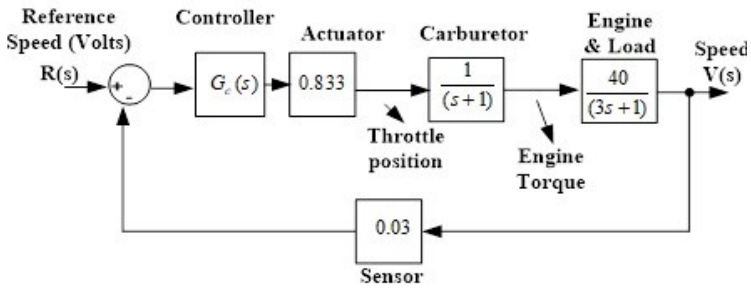
Code No: 134AM

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, 2019
CONTROL SYSTEMS

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.

PART A (25 Marks)		
Q.No	**Questions**	**Bloom's Level**
1.a)	Define open loop and closed loop system by giving suitable examples	L1
b)	Explain the significance of a transfer function stating its advantages and features.	L2
c)	List two differences between steady state and transient response of a control system?	L1
d)	Compare the following systems sketching their output waveform for a unit step input: (i) Underdamped system (ii) Undamped system (iii) Overdamped system (iv) Critically damped system	L2
e)	What are the necessary conditions to have all the roots of a characteristic equation in the left half of s-plane?	L1
f)	A second order system has overshoot of 30% and oscillation period of 0.5 second in the step response. Summarise the values of M_r and ω_r and band width in the frequency response.	L2
g)	What information is obtained from root locus diagram?	L1
h)	Summarize the effects of Derivative control and Integral Control on the performance of a second order control system?	L2
i)	Explain the linearization of a state equation	L2
j)	Illustrate state, state variables and state model of a linear system.	L2
	PART B (50 Marks)	
2.	For the circuit shown, develop the performance equations considering the voltages and currents shown as variables and hence represent by block diagram and Signal Flow Graph.  	L3
	OR	
3.	Deduce the transfer function model relating the speed and armature voltage for an armature controlled D.C. Servomotor and represent it using block diagram.	L3

4.	Figure shows the depth control system of a submersible vehicle, where K=0.5.(i) If K2=0.5 and gain K1 has limits $5 \leq K1 \leq 20$, obtain the unit step response with K1 selected for fasted response.(ii) If gain K1 is varied from 1.0 to 7.0 in steps of 1.0, determine the gain K2 values that give time constant ≤ 0.1 and plot in the parameter plane K1 - K2. Also compute the corresponding equivalent gain (Ke) and steady-state errors and comment on the effect of K1 variations on the steady-state error. 	L4
	OR	
5.	Assuming under-damped output response of a second order system for unit step input, deduce expressions for peak-time, rise time and peak overshoot.	L3
6.	The open loop transfer function of a system is G(s)H(s)=K/(s+2)(s+4)(s2+6s+30). Using RH criterion, discuss the stability of the closed loop system as a function of K > 10. Determine the value of K which will cause sustained oscillations and the corresponding oscillation frequencies.	L4
	OR	
7.	Define gain margin and phase margin. Explain how these can be determined from polar plots? For a unity negative feedback control system, $G(s)=K/s(s+p_1)(s+p_2)$, solve the gain margin is given as $p_1p_2(p_1+p_2)/K$.	L3
8.	Figure depicts the simplified model of an automobile cruise control system. Design a PID controller that places two dominant closed loop poles at (-2±j4). Choose the integral gain setting (Ki) as 10. If Ki is varied as 10, 20 and 30, Examine the location of third closed loop pole and comment on its effect on overall system response 	L4
	OR	
9.	For the given open loop transfer function G(s)H(s)=K/s(s+2)(s+10) of a system, sketch the Nyquist plot and calculate the range of K for stability.	L4
10.a)	Develop the state model of armature controlled separately excited dc motor.	L3
b)	Identify the Eigen values and modal matrix for the given matrix $A = \begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$	L3
	OR	

11.a)	Develop the step wise procedure to obtain the transfer function from a state model of a control system	**L3**
b)	For a system with the following state model, Solve for its transfer function $\begin{bmatrix}\dot{X}_1\\ \dot{X}_2\end{bmatrix} = \begin{bmatrix}-2 & -3\\ 4 & 2\end{bmatrix}\begin{bmatrix}X_1\\ X_2\end{bmatrix} + \begin{bmatrix}3\\ 5\end{bmatrix} U$ and $Y = \begin{bmatrix}1 & 1\end{bmatrix}\begin{bmatrix}X_1\\ X_2\end{bmatrix}$	**L3**