Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

Fourth Semester

Biomedical Engineering

BM3451 - Bio Control Systems

Polar graph and Nichols chart Can be Permitted

Regulations - 2021

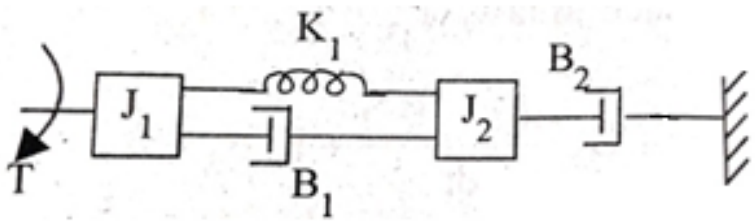
Duration : 3 Hrs *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	List the advantages of open loop system.	RE	1	2
2.	Relate any two examples for negative feedback physiological system.	RE	1	2
3.	Recall the term peak overshoot.	UN	2	2
4.	How is control systems are classified based on damping ratio?	UN	2	2
5.	State asymptotic stability.	RE	3	2
6.	What is magnitude criterion of root locus?	RE	3	2
7.	For a stable system the gain cross over occurs earlier than phase cross over. Justify.	UN	4	2
8.	Mention the advantages of Nichols chart.	RE	4	2
9.	Define Starling's law.	RE	5	2
10.	Draw the block diagram of adaptive model of the muscle stretch reflex.	RE	5	2

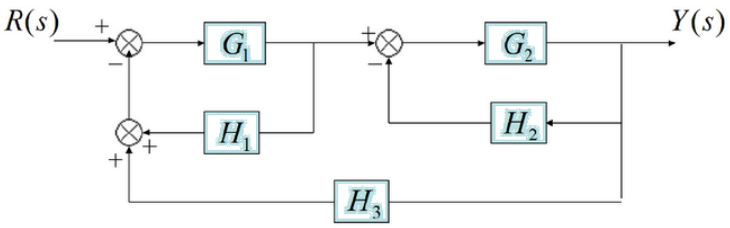
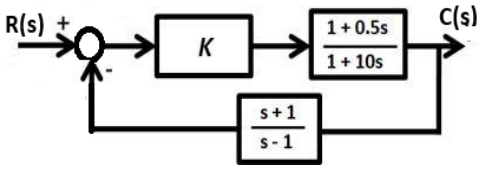
*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a	i	Write the differential equations governing the mechanical system shown in figure and also draw Torque-Voltage electrical analogous circuit and verify by writing equations.	AP	1	7



		ii	Summarize the difference between the engineering and physiological control systems.	UN	1	6

Or

	b	i	Obtain the closed loop transfer function $\frac{Y(S)}{R(S)}$ for the block diagram shown in the figure below. 	AP	1	7
		ii	Explain in detail about any one linear model of physiological system with neat diagram.	UN	1	6
12.	a		For a unity feedback control system, the open loop transfer function $G(s) = \frac{10\,(s+2)}{s^2\,(s+1)}$. Find i) the position, velocity and acceleration error constants ii) The steady state error when the input is $R(s) = \frac{3}{s} - \frac{2}{S^2} + \frac{1}{S^3}$	AP	2	13
			Or			
	b		The open loop transfer function of an unity feedback control system is given by $G(s) = \frac{100}{s(s+2)(s+5)}$. For unit step input, find the time response of the closed loop system and determine % overshoot and the rise time.	AP	2	13
13.	a		Make use of Routh-Hurwitz stability criterion to identify the range of K, so the system is stable. 	AP	3	13
			Or			
	b		Consider unity feedback control system with transfer function G(s) = $\frac{(s+2)}{s^2\,(s+1)}$. Sketch the root locus for the system.	AP	3	13
14.	a		Sketch Bode plot for the following transfer function and determine gain margin and phase margin. $G(S) = \frac{75(1+0.2S)}{S(S^2+16S+100)}$	AP	4	13
			Or			
	b		Sketch polar plot for a unity feedback system having $G(S) = \frac{1}{S(1+S)^2}$. Determine gain margin and phase margin.	AP	4	13

15.	a	Explain in detail about transient response analysis of neuromuscular reflex action.	UN	5	13
		Or			
	b	Draw the block diagram and explain in detail about stability analysis of Pupillary light reflex.	UN	5	13

*PART – C (Marks 1*15 = 15)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
16.	a	By Nyquist stability criterion determine the stability of closed loop system, whose open loop transfer function is given by, $G(S)H(S)=\frac{(S+2)}{(S+1)(S-1)}$. Comment on the stability of open loop and closed loop system.	AP	4	15
		Or			
	b	A unity feedback system has open loop transfer function $G(S)=\frac{20}{S(S+2)(S+5)}$. Using Nichols chart, determine the closed loop frequency response and estimate Mr, ωb.	AP	4	15