Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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

Course Code 2 1 E E 5 1

Fifth Semester B.E. Degree Examinations, April/May 2024

CONTROL SYSTEMS

Duration: 3 hrs **Max. Marks: 100**

Note: ***1. Answer any* FIVE *full questions choosing ONE full Question from each Module.***
2. Missing data, if any, may be suitably assumed.

Q. No		***Question***	***Marks***	*(RBTL:CO:PI)*
		Module-1		
1.	**a.**	With examples explain open loop and closed loop control systems.	**08**	(2 :1: 1.6.1)
	b.	Write the differential equations for the mechanical system shown in Fig.Q1 (b). Obtain analogous electrical system based on Force-Voltage analogy.	**12**	(3 :1: 1.2.1)

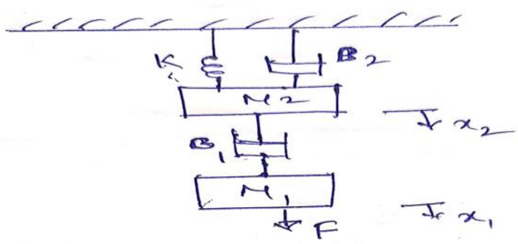

Fig. Q.1 (b)

(OR)

2.	**a.**	Classify control systems. Compare the merits and de-merits of closed loop control systems with open loop control systems.	**08**	(2 :1: 1.6.1)
	b.	Write the differential equations governing the mechanical system shown in Fig.Q2 (b). Draw equivalent electrical system based on Force-Current analogy.	**12**	(3 :1: 1.2.1)

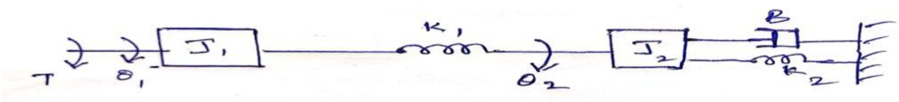

Fig. Q2 (a)

Module-2

3.	**a.**	Determine the closed loop transfer function of the block diagram shown in Fig.Q3 (a) using block diagram reduction technique.	**10**	(3 :2: 1.2.1)

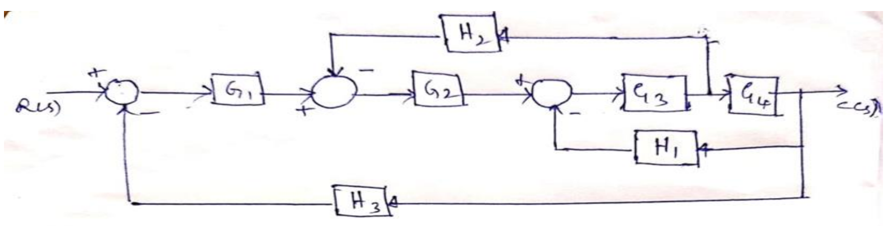

Fig. Q3(a)

b. Determine the transfer function C/R for the signal graph shown in Fig.Q3 (b), using Mason's gain formula. **10** (3 :2: 1.2.1)

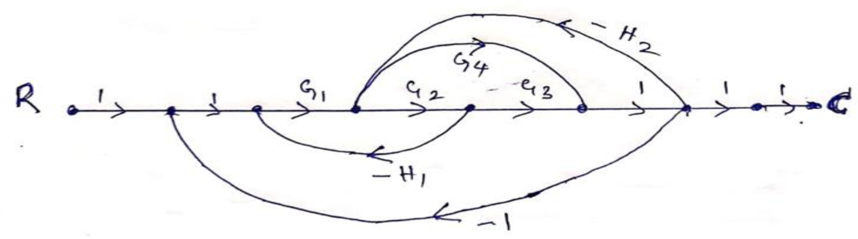

Fig. Q3 (b)

(OR)

4. a. Using block diagram reduction rules, determine the transfer function C(s)/R(s) of the block diagram shown in Fig.Q4 (a). **10** (3 :2: 1.2.1)

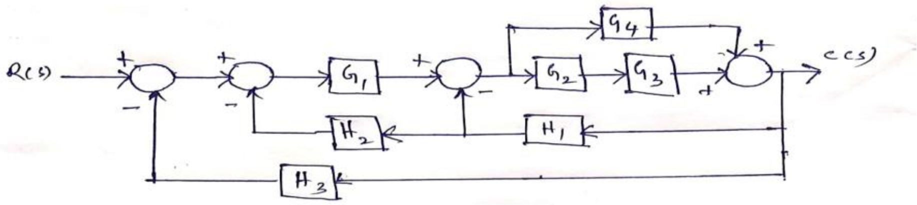

Fig. Q4 (a)

b. For the electrical system shown in Fig.Q4 (b), construct signal flow graph and hence determine the transfer function **10** (3 :2: 1.2.1)

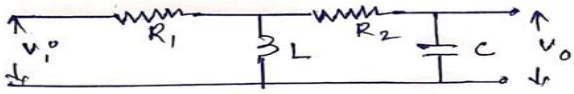

Fig. Q4 (b)

Module-3

5. a. Explain step input , ramp input and impulse input signals **06** (2 :3: 1.6.1)

b. A unity feedback system has open loop transfer function **08** (3 :3: 2.6.3)

$$G(s) = \frac{25}{s(s+6)}$$

Determine peak time, peak overshoot and settling time of the system when subjected to unit step input. Use 2% criterion

c. Determine whether the system having the characteristic equation **06** (3 :3: 2.6.3)
$s^5 + 2s^4 + 3s^3 + 6s^2 + 3s + 2 = 0$ is stable.

(OR)

6. a. Explain the terms rise time, peak time and peak overshoot of second order control system subjected to unit step input. **06** (2 :3: 1.6.1)

b. The open loop transfer function of a system is given by **08** (3 :3: 2.6.3)

$$G(s)H(s) = \frac{k}{(s+4)(s^2+s+1)}$$

Determine (i) the value of k for the system to be stable.
(ii) value of k which makes the system to oscillate and corresponding frequency of oscillations.

c. A unity feedback system has forward path transfer function **06** (3 :3: 2.6.3)

$$G(s) = \frac{k\,(s+3)}{s(s^2+6s+15)}$$

Determine the static error constants and steady state error when the system is subjected to unit step input.

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)

Module-4

7.	**a.**	A unity feedback system has forward path transfer function $$G(s)H(s) = \frac{k}{s(s+1)(s^2+4s+13)}$$ Sketch the complete root locus as k is varied from 0 to infinity.	**14**	(3 :4: 2.6.3)
	b.	Explain the terms gain crossover frequency, gain margin, phase crossover frequency and phase margin.	**06**	(2 :4: 1.6.1)

(OR)

8.	**a.**	Sketch the Bode plot for a unity feedback system with forward path transfer function $$G(s)H(s) = \frac{2000}{s(s+1)(s+100))}$$ From the plot determine gain crossover frequency, gain margin, phase crossover frequency and phase margin.	**14**	(3 :4: 2.6.3)
	b.	Explain the terms asymptotes, centroid and breakaway points with respect to root locus.	**06**	(2 :4: 1.6.1)

Module-5

9.	**a.**	The open loop transfer function of a closed loop system is given by $$G(s)H(s) = \frac{k}{s(s+4)(s+5)}$$ Sketch the Nyquist plot and assess the stability	**12**	(3 :4: 2.6.3)
	b.	Explain proportional plus derivative controller. What are its effects on system performance?	**08**	(2 :5: 1.6.1)

(OR)

10	**a.**	The open loop transfer function of a closed loop system is given by $$G(s)H(s) = \frac{k}{(s+2)(s+8)}$$ Sketch the Nyquist plot and determine the range of k for stability.	**12**	(3 :4: 2.6.3)
	b.	Write a note on phase lead controller.	**08**	(2 :5: 1.6.1)

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Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)