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, September/October 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.**	Define control system. Distinguish between open loop and closed loop control systems with examples.	**08**	(2 :1 : 1.2.1)
	b.	A dynamic vibration absorber is shown in the Fig. Q1(b). Obtain the differential equations describing the behavior of the system. Also, draw the analogous electrical circuit based on the Force - Voltage analogy. List all the Analogous elements.	**12**	(3 :1: 2.1.2)

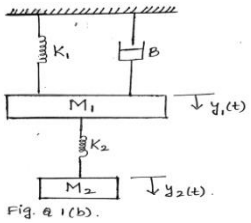

Fig. Q1(b)

OR

2.	**a.**	Classify control systems. List the advantages and disadvantages of closed loop control systems and open loop control systems.	**08**	(3 :1: 2.1.2)
	b.	For the system is as shown in the Fig Q2.(b), find the transfer function $\theta 2(s)/T(s)$. Consider J_1 = 1 Kgm^2, K_1 = 1 Nm / rad , K_2 = 1 Nm / rad , B_1 = 1 Nm / rad / Sec , B_2 = 1 Nm / rad / Sec	**12**	(3 :1: 2.1.2)

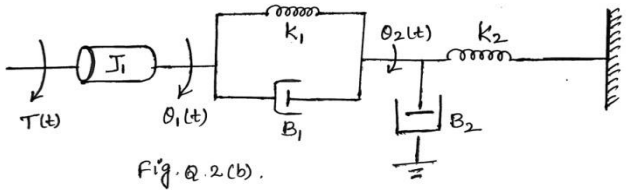

Fig Q2.(b)

Module-2

3.	**a.**	Determine the transfer function C / R of the system shown in Fig Q3.(a).	**10**	(3 :2: 2.1.2)

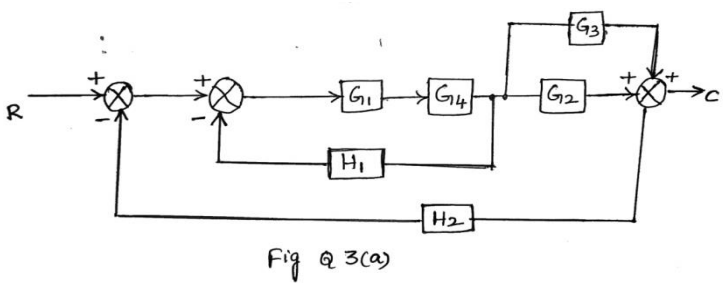

Fig Q 3(a)

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

b. Reduce the following block diagram of the system is as shown in the Fig Q3.(b) into a single equivalent block by block diagram reduction technique. **10** (3 :2: 2.1.2)

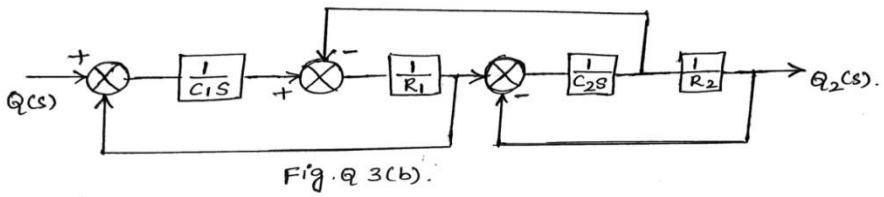

Fig. Q 3(b).

OR

4. **a.** Find C(s) / R(s) by using Mason's gain formula **10** (3 :2: 2.1.2)

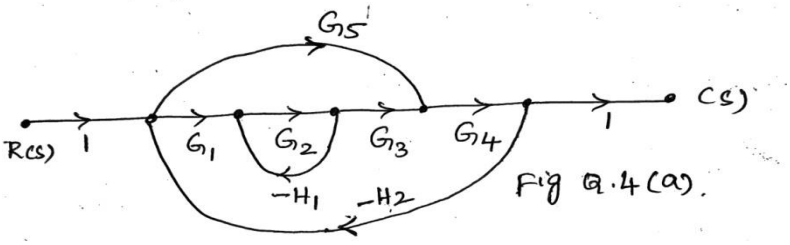

Fig Q.4(a).

b. Construct the Signal Flow Graph for the following set of system equations $Y_2 = G_1Y_1 + G_3Y_3$, $Y_3 = G_4Y_1 + G_2Y_2 + G_5Y_3$, $Y_4 = G_6Y_2 + G_7Y_3$. Where Y_4 is output. Find the Transfer Function Y_4 / Y_1 **10** (3 :2: 2.1.2)

Module-3

5. **a.** Explain the following terms related to the Second Order System subjected to Unit Step Input (i) Rise time (ii) Peak time (iii) Peak Overshoot (iv) Delay time (v) Settling time **12** (2 :3: 1.3.1)

b. A unity feedback system has $G(s) = \frac{k}{s(s+2)(s^2+2s+5)}$ **08** (2 :3: 1.3.1)

(i) For a unit ramp input, it is desired $e_{ss} \leq 0.2$. Find K (ii) Determine e_{ss} if input $r(t) = 2 + 4t + t^2/2$

OR

6. **a.** Explain the following: **10** (2 :3: 1.3.1)

(i) Step input (ii) Ramp input (iii) Impulse input (iv) Parabolic input (v) Steady state error

b. Determine the stability of the system represented by the characteristic equation **10** (2 :3: 1.3.1)

$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$ by means of the Routh-Criterion. Determine the number of roots of the characteristic equation lying in the right half of S - Plane

Module-4

7. **a.** For the Transfer Function $G(s)H(s) = \frac{k}{s(s+3)(s+5)}$. Draw the Root Locus. **14** (2 :4: 1.3.1)

b. What are the steps for constructing Root Locus? Briefly explain them **06** (3 :4: 1.3.1)

OR

8. **a.** A unity feedback control system has a transfer function given by **14** (3 :4: 1.3.1)

$$G(s) = \frac{80}{s(s+2)(s+20)}$$

Draw the Bode Plot. Determine the Gain Margin and Phase Margin

b. What are the advantages of Bode Plot **06** (2 :4: 1.3.1)

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

Module-5

9.	**a.**	A feedback control system has open loop transfer function $G(s)H(s) = \frac{1}{s(s+1)}$ Sketch the Nyquist plot and comment on the stability of the system.	**12**	(3 :5: 1.3.1)
	b.	Explain the PID controller and discuss the effects on the behaviour of the system.	**08**	(2 :5: 1.3.1)

OR

10	**a.**	Sketch the Nyquist plot and hence calculate the range of values of K for stability for a control system given by $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$	**12**	(3 :5: 1.3.1)
	b.	Write a note on Phase lag controller.	**08**	(2:5: 1.3.1)

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