V SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION

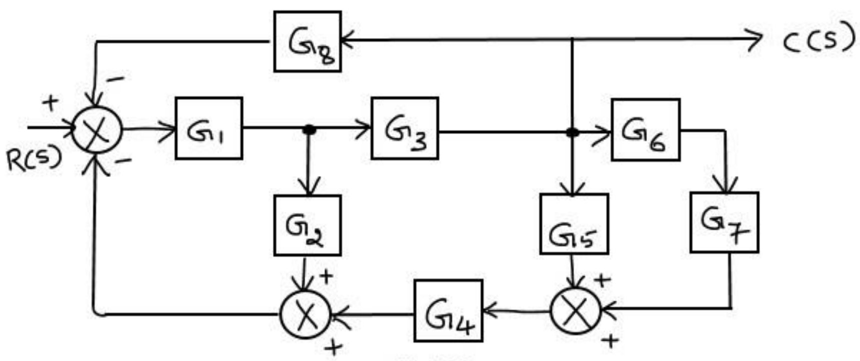
NOVEMBER 2022

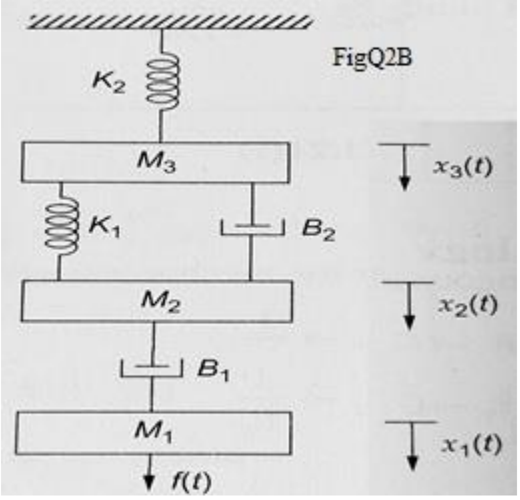
SUBJECT: LINEAR CONTROL THEORY (ECE-3152)

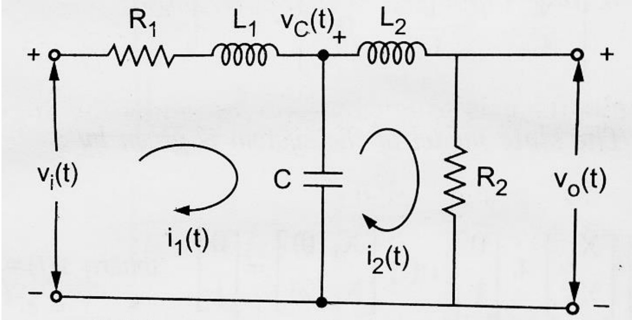
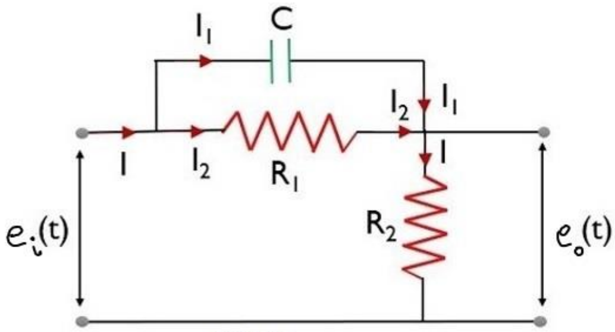
TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

Q. No.	Questions	M*	C*	A*	B*
1A	Sketch the Nyquist plot for a unity feedback system with OLTF G(S)H(S) = $\frac{1}{S(0.2S+1)(0.05S+1)}$ and determine the gain margin.	5	3	1,2,3,18	3
1B	Modify the block diagram shown in Fig.Q1B and develop the closed loop transfer function using block diagram reduction techniques.  Fig.Q1B	3	1	1,2,18	3
1C	Starting from fundamentals, express rise time of the unit step response of a second order under damped system in terms of its damping ratio.	2	2	1,2,3,18	2
2A	Identify the differential equations governing the mechanical behaviour of the system shown in Fig.Q2A. Draw the FI and FV analogous circuits along with mesh and node equations.	5	1	1,2,18	3

					
2B	Unity feedback system with G(S) = $\frac{K(S+\alpha)}{(S+\beta)^2}$ is to be designed to meet the following specifications. Damping ratio=0.5; Natural frequency= $\sqrt{10}$ rad/sec; e_{ss} due to unit step input =0.1 Calculate the value of K,α,β	**3**	**3**	**1,2,3,18**	**4**
2C	The response of a system when subjected to a unit step input is c(t)= 1 + $0.2e^{-60t} - 1.2e^{-10t}$. Calculate the undamped natural frequency and damping ratio of the system	**2**	**2**	**1,2,3,18**	**4**
3A	Using Routh Hurwitz criteria, analyse the stability of a Type-1 ,3rd order system with $K_V = 10sec^{-1}$ and open loop poles located at S= 0,-3 and -6.	**5**	**2**	**1,2,3,18**	**4**
3B	Examine whether the system characterized by the differential equation $\dddot{Y} + 7\ddot{Y} + 12\dot{Y} + 6Y + U = 0$ is controllable and observable using Kalman's method.	**3**	**5**	**1,2,18**	**4**
3C	Determine the state transition matrix of the system described by $\dot{x} = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix} x$	**2**	**5**	**1,2,18**	**3**
4A	Sketch the Root Locus for a unity feedback system with OLTF G(S)H(S) = $\frac{K}{S(S+1)(S+3)(S+5)}$ and comment on stability.	**5**	**2**	**1,2,3,18**	**3**
4B	Starting from fundamentals, express resonant frequency of a second order system in terms of ζ	**3**	**3**	**1,2,3,18**	**2**
4C	The differential equation of a system is given by $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 16y(t) = 9x(t)$. Calculate the rise time and setting time of the output response when subjected to a unit step input.	**2**	**2**	**1,2,3,18**	**4**
5A	Represent the circuit shown in Fig.Q5A in state space domain using physical variable form.	**5**	**5**	**1,2,18**	**3**

	Fig Q5A				
5B	A PD controller is cascaded to the forward path of a unity feedback system with plant transfer function $G_P(S) = \frac{9}{S(S+1.8)}$ If the proportional gain is 1, estimate the value of K_D for the system to be critically damped. Also determine the settling time	**3**	**4**	**1,2,3,18**	**2**
5C	Circuit of a Phase-Lead Compensator is shown in Fig.Q5C where R_1=1kΩ R_2=1kΩ and C= 100µF. Identify the frequency where the maximum phase lead occurs. Also locate pole and zero of the compensator on the S plane. Fig Q5C	**2**	**4**	**1,2,3,18**	**2**

M*--Marks, C*--CLO, A*--AHEP LO, B* Blooms Taxonomy Level