Reg. No.



FIFTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION MARCH 2021 SUBJECT: LINEAR CONTROL THEORY (ECE-3152)

TIME: 3 HOURS	MAX. MARKS: 50
Instructions to candidates	
• Answer ALL questions.	

- Missing data may be suitably assumed.
- 1A. Write the differential equations governing the mechanical behaviour of the system shown in **Fig. Q1A**. Draw the FI and FV analogous circuits and verify by writing mesh and node equations.
- 1B. Find the State Transition Matrix of a system with $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$.

(6+4)

2A. 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 Find the value of *K*, α , β

2B. For a negative UFB system with forward path gain of G(s), find the 3^{rd} order OLTF so that steady state error due to ramp input is 1.5 and the characteristics equation has roots at $-1\pm j1$.

- 3A. For the SFG shown in **Fig. Q3A**, find $\frac{V_5}{V_1}$ using Mason's gain formula
- 3B. Transfer function of the system is given by $\frac{Y(S)}{U(S)} = \frac{S+2}{S^3+9S^2+26S+24}$ Test whether the system is controllable and observable using Kalman's test.

(6+4)

- 4A. Open loop transfer function of a system is given by $G(S) = \frac{5K}{S(S+2)}$ Design a lead compensator so that static velocity error constant is $20sec^{-1}$; Phase margin of atleast 55^o; Gain margin of atleast 12dB
- 4B. A system is represented by the differential equation $\ddot{Y} + 5\dot{Y} + 6Y = U$. Find the transfer function using stare variable representation. Also find the Eigen values.

(6+4)

- 5A. A system is defined by the characteristic equation S^2 -(*K*+2)*S*+(2*K*+5)=0. Find the value of K for which the system is
 - i. Stable, unstable, marginally stable

- ii. Undamped, Overdamped, critically damped
- 5B. Sketch the Root Locus of the system shown in Fig. Q5B for $0 < K < \infty$ and comment on stability.

$$(6+4)$$





