

FOURTH SEMESTER B. TECH. (Electronics and Instrumentation Engg.) GRADE IMPROVEMENT EXAMINATION AUGUST - 2021

SUBJECT: LINEAR CONTROL THEORY [ICE 2253]

TIME: 2 HOURS	11-08-2021	MAX. MARKS: 40
Instructions to candidates		
	• Answer ANY FOUR FULL question	IS.
	• Missing data may be suitably assumed	d.

1A. Write the dynamical equations describing the mechanical translation system shown in Fig 5 Q1A and derive transfer function of the system relating displacement X₂(s) with applied force F(S).



1B. Using block diagram reduction technique obtain C(s)/R(S).



Fig. Q1B

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2A. Derive the expression for response of undamped second order system for unit step input.
 6 The signal flow graph of a feedback control system is shown in the Fig. Q2A. Solve for closed loop transfer function.



- **2B.** Using the Routh-Hurwitz's criterion, predict the stability of the following system **4** $s^{5}+s^{4}+2s^{3}+2s^{2}+3s+15 = 0$.
- 3A. A unity feedback system has open loop transfer function G(s) = 10 /s(s+2). Find the rise time, 5 percentage overshoot, peak time and settling time of closed loop step response with a step input of 12 units.
- **3B.** Calculate angle of departure and break in point and hence draw the root locus for positive K **5** of a unity feedback closed loop system with forward path transfer function $G(s) = \frac{K(S+5)}{s^2+4S+9}$ Show all key points on the Root locus.
- 4A. Derive an expression for resonant frequency and resonant peak in the frequency response of 4 a second order system.
- 4B. For the unity feedback system, having forward path transfer function G(s)= 80/s(s+2)(s+20)
 6 sketch the Polar plot and estimate the closed loop stability using GM and PM.
- 5. For the system with open loop transfer function $G(s)H(s) = \frac{20(1+0.1s)}{s^2(1+0.01s)}$. Draw the Bode

magnitude and phase plot. Determine the gain which results in a desired phase margin of approximately 55°.

- 6A. Derive the transfer function of lag compensator using RC network. Draw its magnitude and 5 Phase characteristics. Also mark its pole and zero on s plane. Which property of it is exploited in the reshaping of frequency response of overall compensated system?
- 6B. What are compensators? Illustrate the characteristics of lead compensator and its design 5 procedure using root locus.
