

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-III (NEW) EXAMINATION – SUMMER 2021**

Subject Code:3131101

Date:08/09/2021

Subject Name:Control Systems

Time:10:30 AM TO 01:00 PM

Total Marks:70

Instructions:

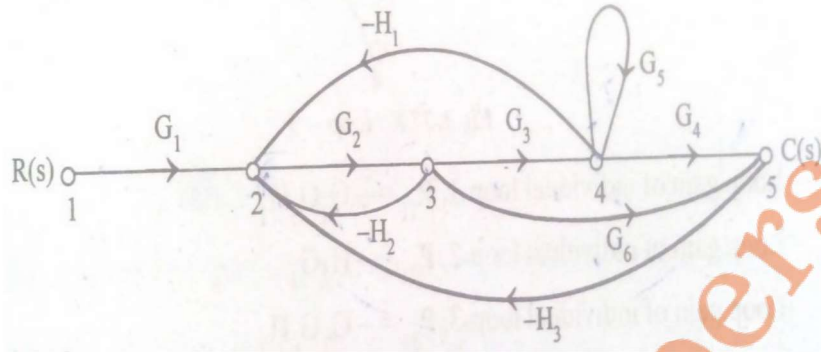
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

MARKS

- Q.1** (a) Define : i) State variable ii) State space iii) State 03  
 (b) Discuss Force-Voltage (F-V) analogous system with analogous quantity. 04  
 (c) Define Routh's stability criterion. 07  
 Construct Routh array and determine the stability of the system whose characteristic equation is  $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$
- Q.2** (a) Discuss Nyquist criteria for stability. 03  
 (b) Write a short note on closed loop control systems. 04  
 (c) Derive the expression for unit step response of underdamped second order system. 07
- OR**
- (c) Draw Nyquist plot for unity feedback system having following open loop transfer function. Comment on stability. 07
- $$G(s) = \frac{1}{s(s+4)(s+8)}$$
- Q.3** (a) Discuss Hurwitz's stability criteria. 03  
 (b) Write a short note on PID controller. 04  
 (c) Determine gain margin & phase margin by sketching Bode plots of a unity feedback control system, having open loop transfer function 07
- $$G(s) = \frac{10}{s(1+0.1s)(1+0.05s)}$$
- OR**
- Q.3** (a) What is polar plot? 03  
 (b) Derive an expression for the peak overshoot for a 2<sup>nd</sup> order control system subjected to a unit step input. 04  
 (c) Sketch root locus for unity feedback control system, having following open loop transfer function . 07
- $$G(s) = \frac{k}{s(s+1)(s+3)(s+4)}$$
- Q.4** (a) Write a short note on open loop control systems. 03  
 (b) Derive the equation of steady state error for closed loop transfer function. 04  
 (c) Explain phase lag compensator in detail. 07
- OR**
- Q.4** (a) What is angle of departure? Explain with necessary equations. 03  
 (b) Write properties of transfer function. 04  
 (c) Explain phase lead compensator in detail. 07
- Q.5** (a) Explain standard test signals used in control systems. 03  
 (b) Explain effect of adding a pole at origin. 04  
 (c) Describe Correlation between transfer function and state space equations with suitable examples. 07

OR

- Q.5 (a) Derive an expression for the rise time for a 2<sup>nd</sup> order control system subjected to a unit step input. **03**
- (b) Determine type of system and error coefficients for unity feedback system having following open loop transfer function. **04**
- $$G(s) = \frac{10(s + 1)}{s^2(s + 10)(s + 2)}$$
- (c) For a signal flow graph shown in figure, determine transfer function using Mason's Gain Formula. **07**



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