

**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**

$$G(s) = \frac{k}{s(s+1)(s+3)(s+4)}$$

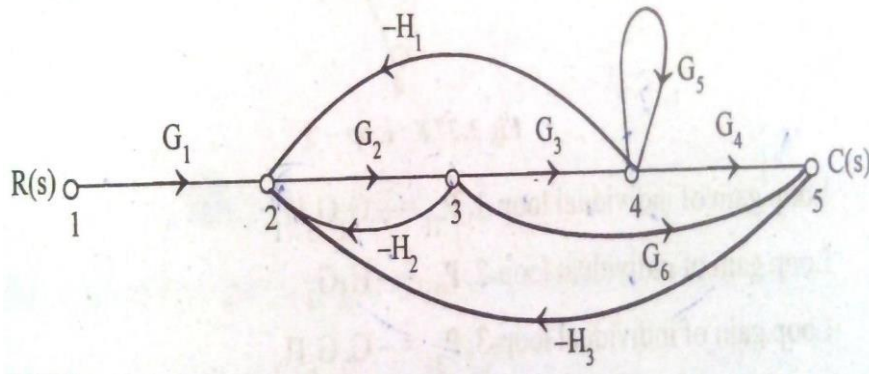
- Q.4** (a) Write a short note on open loop control systems. **03**  
 (b) Derive the equation of steady state error for closed loop transfer function. **04**  
 (c) Explain phase lag compensator in detail. **07**

**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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