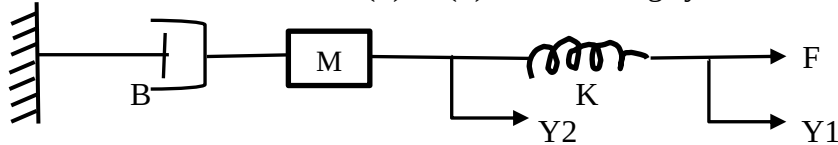


GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV EXAMINATION – SUMMER 2025****Subject Code:3142407****Date:27-05-2025****Subject Name:Control Theory****Time:10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

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.

- Q.1 (a)** Define order and type of control system from its transfer function. 03
- (b)** Give any one example of closed loop control system. 04
- (c)** Derive time response of a second order system to unit step input. 07

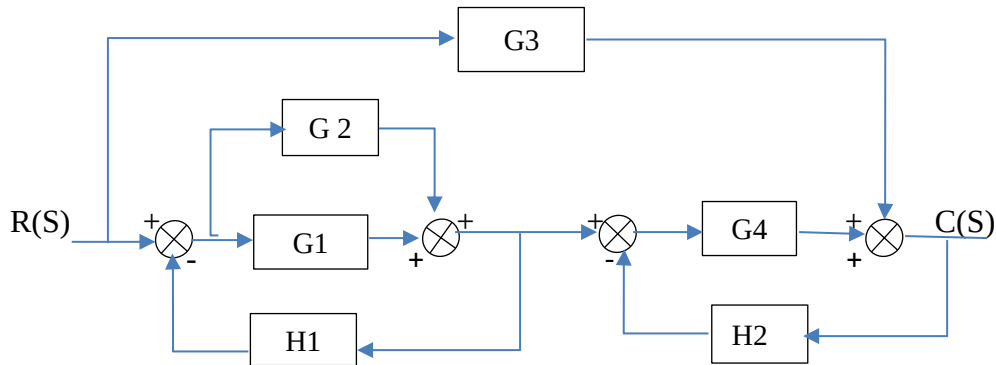
- Q.2 (a)** Give comparison of open loop and closed loop control system. 03
- (b)** Derive transfer function $Y_1(S) / F(S)$ for following system. 04



- (c)** Define rise time & peak time and derive their formulas for step response of second order system. 07

OR

- (c)** Derive transfer function of following system using Mason's gain formulae. 07



- Q.3 (a)** Describe basic principles of block diagram reduction for obtaining overall transfer function of a system. 03
- (b)** Discuss force – voltage analogy with reference to mechanical and electrical system. 04
- (c)** Determine the stability of the system whose overall transfer function is given below. 07

$$\frac{C(s)}{R(s)} = \frac{2s + 5}{s^5 + 1.5s^4 + 2s^3 + 4s^2 + 5s + 10}$$

If the system is found unstable, how many roots it has with positive real parts ?

OR

- Q.3 (a)** Draw the generalized block diagram of PID controlled system. 03
- (b)** Discuss absolute and relative stability with respect to location of poles of a closed loop control system. 04
- (c)** Determine the stability of a closed loop control system whose characteristic equation is $s^5 + s^4 + 2s^3 + 2s^2 + 11s + 10 = 0$. 07

- Q.4 (a)** Derive value of steady state velocity error coefficient. **03**
(b) Define (1) Gain Margin (2) Phase Margin (3) Gain Cross Over Frequency (4) Phase Cross Over Frequency **04**
(c) For $G(s)H(s) = K/s(s+50)$ and $r(t) = 0.5 t$, determine the value of K for steady state error $e_{ss} \leq 0.1$ **07**

OR

- Q.4 (a)** Derive steady state positional error for type 2 control system. **03**
(b) Write short note on Bode Plot. **04**
(c) Derive state space model from transfer function given below. **07**

$$\frac{Y(s)}{U(s)} = \frac{1}{s^2 + 2s + 5}$$

- Q.5 (a)** Explain lead compensation with a suitable example. **03**
(b) Define state variables, state, state vector and state space. **04**
(c) Discuss the step by step procedure for plotting root locus. **07**

OR

- Q.5 (a)** Explain lag compensation with a suitable example. **03**
(b) What is polar plot? Discuss in brief. **04**
(c) Sketch the root locus for the open loop transfer function of a unity feedback control system given below. **07**

$$G(S) = \frac{K}{s(s+1)(s+3)}$$
