

GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER – V (NEW) EXAMINATION – WINTER 2015

Subject Code: 2150909

Date: 10/12/ 2015

Subject Name: Control System Engineering

Time: 10:30am to 1:00pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- s
- Q.1** (a) What is control system? Mention the difference between the open loop and close loop control system. 07
- (b) Determine the overall transfer function for the system using block diagram reduction rules whose block diagram is shown in figure- 1. 07
- Q.2** (a) Explain transfer function and write its advantages and disadvantages 07
- (b) Define following terms in relation of signal flow graph: source node, sink node, chain node, forward path, feedback path, self-loop and non-touching loops. 07
- OR**
- (b) For the mechanical system shown in figure -2 obtain F-V analogous electrical network. 07
- Q.3** (a) Explain Type 0, Type 1 and Type 2 control system. Derive equation for the steady state error of the Type 2 control system for step, ramp and parabolic input. 07
- (b) $s^4 + 4s^3 + 13s^2 + 16s + 8 = 0$ Check the stability of the given characteristic equation using Routh's method. 07
- OR**
- Q.3** (a) The closed loop transfer function of a given second order system is given by $G(s) = \frac{1000}{s^2 + 100s + 1000}$. Determine damping ratio, natural frequency, delay time, rise time, settling time, and peak overshoot. 07
- (b) Explain correlation between time domain and frequency domain. 07
- Q.4** (a) Define the following terms: Gain margin, phase margin, bandwidth, resonant peak, resonant frequency and gain cross over frequency. 07
- (b) A unity feedback control system has $G(s) = \frac{K}{s(s+6)(s+3)}$ draw its root locus 07
- OR**
- Q.4** (a) Explain with necessary equation and diagram step response of a second order control system. 07
- (b) For a unity feedback control system $G(s) = \frac{8000(s+2)}{s^2(s+10)(s+20)}$ sketch the bode plot. 07
- Q.5** (a) State and explain nyquist stability criteria 07
- (b) Construct the polar plot for the transfer function. $G(s) = \frac{K}{s(1+2s)(1+3s)}$ 07
- OR**
- Q.5** (a) Find transfer function of $\begin{bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{bmatrix} = \begin{bmatrix} -\omega_0^2 & 0 \\ 0 & -\omega_0^2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$ 07
- $y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$
- (b) Derive the transfer function of a armature controlled D.C. motor 07

Q.1 (b)

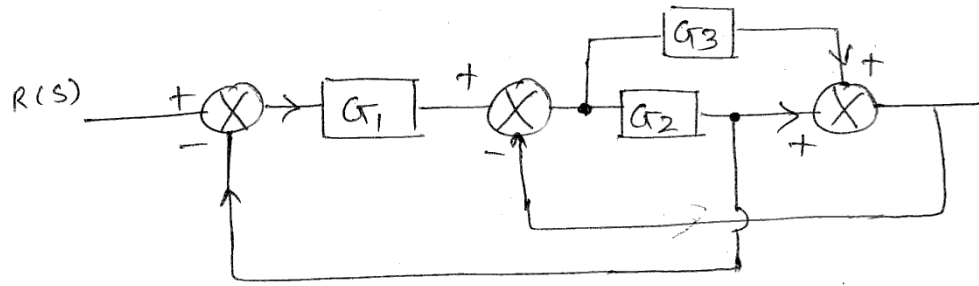


Figure: 1.

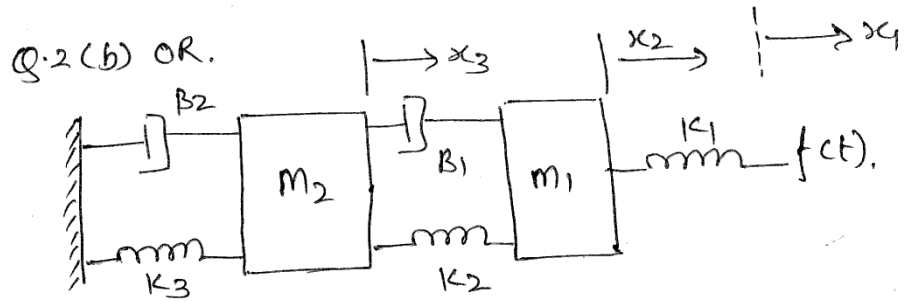


Figure: 2.