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

Subject Code: 2150909 Date:10/12/ 2015 Subject Name: Control System Engineering **Total Marks: 70 Time: 10:30am to 1:00pm Instructions:** 1. Attempt all questions. 2. Make suitable assumptions wherever necessary. 3. Figures to the right indicate full marks. Q.1 (a) What is control system? Mention the difference between the open loop and close 07 loop control system. (b) Determine the overall transfer function for the system using block diagram 07 reduction rules whose block diagram is shown in figure-1. 07 Q.2 **(a)** Explain transfer function and write its advantages and dis advantages (b) Define following terms in relation of signal flow graph: source node, sink node, 07 chain node, forward path, feedback path, self-loop and non-touching loops. OR (b) For the mechanical system shown in figure -2 obtain F-V analogous electrical 07 network. 0.3 (a) Explain Type 0, Type 1 and Type 2 control system. Derive equation for the steady 07 state error of the Type 2 control system for step, ramp and parabolic input. (b) $s^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$ Check the stability of the given 07 characteristic equation using Routh's method. OR Q.3 The closed loop transfer function of a given second order system is given by 07 (a) $G(s) = \frac{100}{s^2 + 10s + 100}$. Determine damping ratio, natural frequency, delay time, rise time, settling time, and peak overshoot. (b) Explain correlation between time domain and frequency domain. 07 **Q.4** (a) Define the following terms: Gain margin, phase margin, bandwidth, resonant 07 (a) Define the following terms of an end of the peak, resonant frequency and gain cross over frequency. (b) A unity feedback control system has $G(s) = \frac{K}{s(s+6)(s+9)}$ draw its root locus 07 OR **Q.4** Explain with necessary equation and diagram step response of a second order 07 (a) control system. (b) For a unity feedback control system $G(s) = \frac{800 (s+2)}{s^2 (s+10)(s+40)}$ sketch the bode plot. 07 0.5 State and explain nyquist stability criteria 07 (a) (b) Construct the polar plot for the transfer function. $G(s) = \frac{K}{s(1+T1s)(1+T2s)}$ 07 (a) Find transfer function of $\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} r(t)$ 07 Q.5 $y = \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} x1\\ x2 \end{bmatrix}$

(b) Derive the transfer function of a armature controlled D.C. motor

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