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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FOURTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER DEGREE EXAMINATIONS, JUNE - 2018

SUBJECT: LINEAR CONTROL THEORY [ICE 2203]

Duration: 3 Hour Max. Marks:50

Instructions to Candidates:

- Answer **ALL** the questions.
- Semilog and X-Y graph sheets may be provided.

1A Write the dynamical equations and derive the transfer function of an Armature controlled DC servomotor considering the load angular velocity as the output and armature input voltage as input. Differentiate the operation with that of field controlled DC servomotor. 04

1B For the system shown in Fig. Q 1B, determine the overall transfer function using Block diagram reduction technique. Verify the answer using Signal flow graph. 06

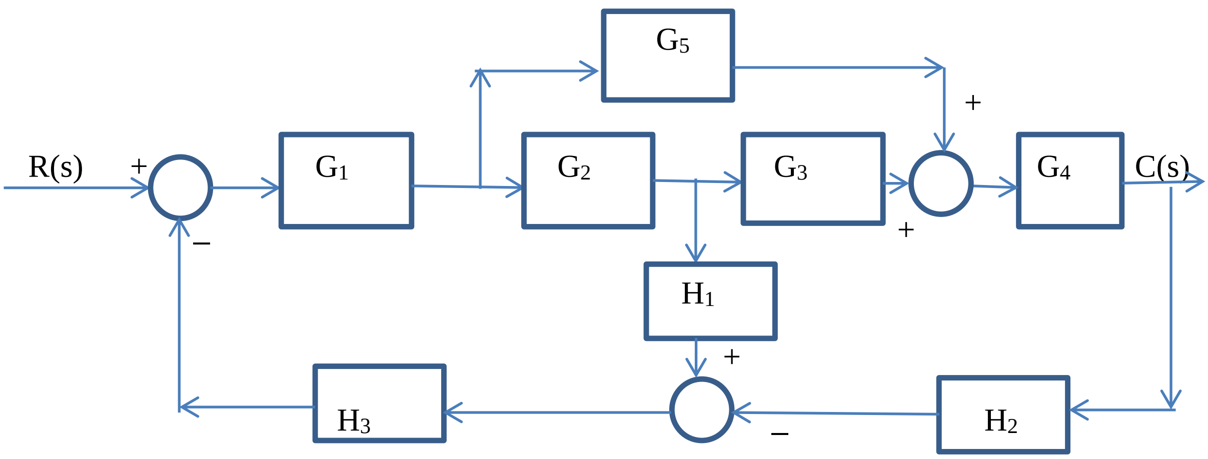

Fig. (Q1B)

2A Mark on the step response of a second order under damped system following time response specifications 2

i) Rise time ii) Peak time iii) Settling time iv) Delay time.

Define Rise time and Settling time.

2B For a second order system with transfer function $\frac{X(s)}{F(s)} = \frac{1}{Ms^2 + Bs + K}$, a force f(t) of 2 N is applied at t=0. The displacement x(t) exhibits a response having a rise time of 1.5s and peak value of 0.55m. The steady state value of the response is 0.5m. Find the element values of M, B, and K. 5

2C For the unity feedback system having open loop transfer function G(s) = $\frac{K(s+2)}{s(s^3+7s^2+12s)}$, determine type of the system, static error coefficients and steady state error for unit parabolic input. 3

3A For the system with unity negative feedback having forward path transfer function G(s) = $\frac{K(s+6)}{s(s+1)(s+3)}$, determine the range of K for stability. Also determine the frequency of sustained oscillation when K is set to marginal stability. 4

3B Construct Asymptotic Bode magnitude and phase plot for the system having open loop transfer function $G(s)=\frac{100(s+10)}{s(1+s)(s+100)}$. From the plot comment on closed loop stability. 6

4A For the system with open loop transfer function $G(s)H(s)=\frac{K(s+2)(s+3)}{s(1+s)}$, draw the root locus plot for positive K. 6

4B For a second order system having closed loop transfer function G(s)= $\frac{K}{(s^2+K.ks+K)}$, determine K and k, such that the resonant peak is 2.66dB and resonant frequency is 1.41r/s. 4

5A Sketch the Nyquist plot for $G(s)H(s)=\frac{K}{s(s+1)(s+2)}$. Using Nyquist stability criteria, determine the range of K for closed loop stability. 5

5B Explain the characteristics of a Lag compensators along with its pole-zero diagram and frequency response. Given the open loop transfer function G(s)H(s) having its gain adjusted to meet the steady state error criteria, how is the lag compensator design carried out to meet the desired phase margin requirement in the frequency domain? 5