Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

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

END SEMESTER EXAMINATIONS, APRIL - 2018

SUBJECT: LINEAR CONTROL THEORY [ICE 2203]

Duration: 3 Hour Max. Marks:50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A List four functional differences between open loop system and closed loop system. 2

1B For the mechanical translational system shown in Fig Q1B, write dynamical equations describing the system. Draw analogous circuit based on Force-current analogy, indicating analogous quantities. 3

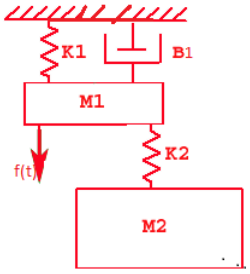


Fig. Q1B

1C Determine $\frac{C(s)}{R(s)}$ for the block diagram shown in Fig. Q1C, using Block diagram reduction algebra. Verify the result using Mason's gain formula. 5

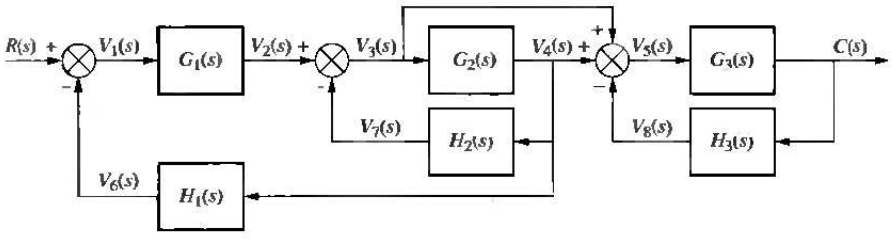


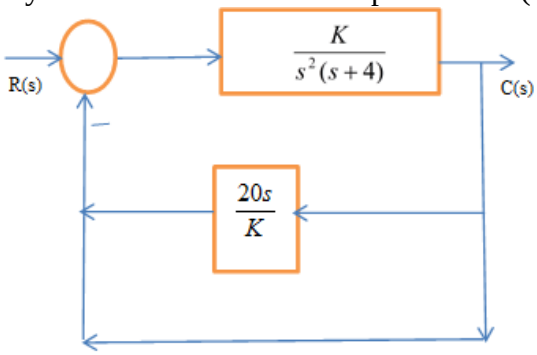
Fig. Q1C

2A Define static error coefficients. Relate them to system type and nature of inputs. 2

2B A unity negative feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+6)}$. Determine the gain K, so that the system will have a damping ratio of 0.6. For 4

this value of K, determine settling time with 2% tolerance, Peak overshoot, Peak time for unit step input.

2C Determine type and relevant static error coefficient for the system represented in Fig. Q2C. Design a value of K, so that the steady state error is 0.1 for an input of 10t u(t). 4



3A Derive an expression for impulse response of a second order critically damped system. 2

3B Draw the loci of closed loop poles of the system described by an open loop transfer function $G(s)=\frac{K(s+2)}{s(s^2+4s+16)}$. Compute the gain K, which results in a damping ratio of 0.6. 4

3C Construct Asymptotic Bode magnitude and phase plot for the system having open loop transfer function $G(s)=\frac{800}{s(s+4)(s+40)}$. From the plot comment on closed loop stability. 4

4A Comment on correlation between time domain and frequency domain performance of a second order system. 2

4B For the system described by the characteristic equation $s^5+2s^4+24s^3+48s^2-25s-50=0$, determine the number of roots on RHS of s-plane and on imaginary axis. 3

4C Determine range of K for closed loop stability of the system having open loop transfer function $G(s)=\frac{K}{(s+1)(s+2)(s+4)}$ using Nyquist stability criteria. 5

5A List the characteristics of P-I and P-D controllers. 2

5B Determine the open loop transfer function from the approximate magnitude response shown in Fig. Q5B. Assume a minimum phase system consisting of only first order terms. 3

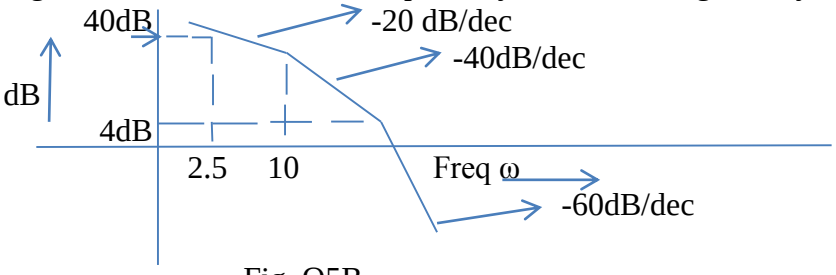


Fig. Q5B

5C Explain the characteristics of a Lead 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 lead compensator design carried out to meet the desired phase margin requirement in the frequency domain? 5