Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FOURTH SEMESTER B.Tech. (I & C E) DEGREE END SEMESTER EXAMINATION
May/June 2016
SUBJECT: LINEAR CONTROL THEORY (ICE - 2203)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **All** the questions.
- Missing data may be suitably assumed.

1A. Write the dynamical equations of an armature controlled DC motor and develop the block diagram for the system representing each component as a separate block. Derive the transfer function between armature speed and applied voltage using block diagram reduction technique and verify the result by Mason's gain formula.

1B. Write the dynamical equations and derive the transfer function for the mechanical rotational system shown in Fig. Q (1B).

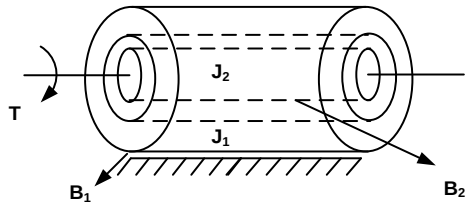

Fig. Q(1B)

1C. For the mechanical translational system shown in Fig. Q(1C), draw the force voltage electrical analogous circuit.

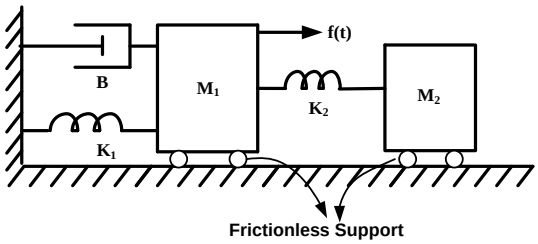

Fig. Q(1C)

(5+3+2)

2A. Draw the root locus plot for positive values of K for a system having the characteristic equation $3s^4+10s^3+21s^2+K(s - \frac{2}{3})=0$

2B. Derive error transfer function. How static error coefficients are defined? Derive the expression for the same and steady state error when a system is subjected to input $R_u+R_vt+R_at^2$.

2C. Determine the closed loop transfer function of a second order system whose closed loop step response when subjected to an input of r(t)=5.0 is as shown in Fig. Q(2C).

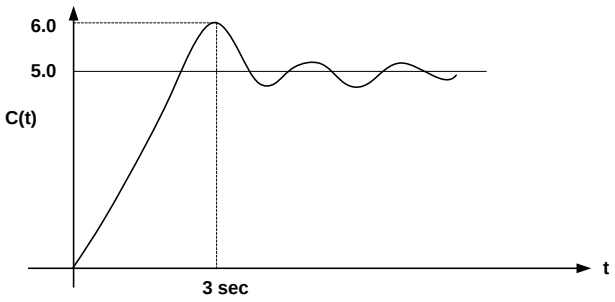

Fig. Q(2C)

(5+3+2)

3A. For the system with open loop transfer function G(s)H(s)= $\frac{20(1+0.1s)}{s^2(1+0.01s)}$. Draw the Bode magnitude and phase plot. Determine the gain which results in a desired phase margin of approximately 55^0.

3B. Using Routh-Hurwitz test determine the number of roots of the characteristic polynomial $F(s)=s^4+13s^3+59s^2+107s+60$ lying to the right of vertical line passing through (-2,0).

3C. Illustrate the marginal stability of a system highlighting the location of poles and steady state response.

(5+3+2)

4A. For the system with open loop transfer function, G(s)H(s)= $\frac{10}{s(s+1)(1+2s)}$, draw polar plot and comment on closed loop stability. Also determine the gain margin and phase margin.

4B Considering the minimum phase open loop system, define gain cross over frequency, phase cross over frequency, gain margin and phase margin. How are they assessed for stability?

4C. Determine resonant peak and resonant frequency in the closed loop frequency response of a system having the forward path transfer function G(s) = $\frac{10}{s(s+3)}$ and unity negative feedback.

(5+3+2)

5A. Illustrate design steps for designing a Lag compensator using Bode plot for the specified steady state error margin and specified phase margin, taking suitable example.

5B. What are compensators? Illustrate the characteristics of lead compensator and its design procedure using root locus.

5C. List advantages and disadvantages of using PI controller.

(4+4+2)

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