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12MAR22

Second Semester M.Tech. Degree Examination, June/July 2014

Modern Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Determine the transfer function $\frac{X(s)}{E_1(s)}$ for the system shown in Fig.Q1(a).

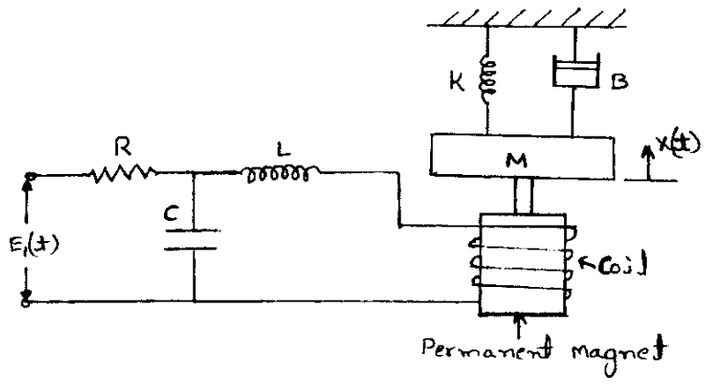

Fig.Q1(a) **(12 Marks)**

b. The transfer function of a closed loop system with unity feedback system is $\frac{K(s+2)(s+1)}{(s+0.1)(s-1)}$. Comment on stability. **(08 Marks)**

2 Consider the system shown in Fig.Q2. Draw the locus of the poles of the overall system as K is varied from zero to infinity.

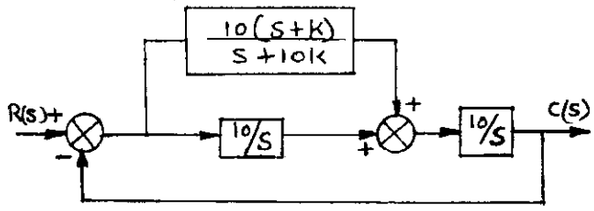

Fig.Q2 **(20 Marks)**

3 Construct the Bode plot for a unity feedback control system having $G(s) = \frac{10(s+10)}{s(s+2)(s+5)}$. From the plot obtain the gain margin and phase margin. Comment on the stability of the system. **(20 Marks)**

4 a. Plot the general shapes of polar plots of the following transfer function indicating the magnitudes at $\omega = 0, \infty$.

i) $\frac{1}{(1+T_1 j\omega)(1+T_2 j\omega)}$ ii) $\frac{1}{(1+T_1 j\omega)(1+T_2 j\omega)(1+T_3 j\omega)}$

iii) $\frac{1}{j\omega(1+T_1 j\omega)(1+T_2 j\omega)}$ iv) $\frac{(1+T_2 j\omega)}{j\omega(1+T_1 j\omega)(1+T_3 j\omega)}$ **(12 Marks)**

b. Find the transfer function of a system whose approximate bode plot is shown in Fig.Q4(b). Assume no right half plane poles or zeros present.

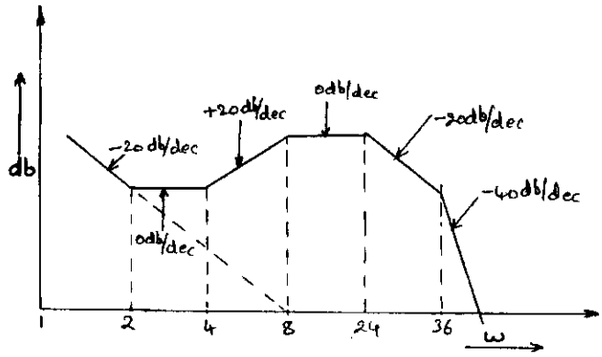

Fig.Q4(b) **(08 Marks)**

5 The open loop transfer function of a closed loop control system is given by

$$G(s)H(s) = \frac{K(1+0.5s)(1+s)}{(1+10s)(s-1)}.$$

Sketch the Nyquist plot and find the range of K for which the system is stable. **(20 Marks)**

6 a. Define system compensation, and explain the following system compensations with example:
i) Lead compensation
ii) Lag compensation
iii) Lag-Lead compensation **(12 Marks)**

b. Discuss state space analysis and explain clearly controllability and observability. **(08 Marks)**

7 a. Obtain the state space representation of armature controlled DC motor. **(10 Marks)**

b. For the given transfer function,

$$\frac{Y(s)}{U(s)} = \frac{b_0}{a_0 s^3 + a_1 s^2 + a_2 s + a_3}.$$

Draw the signal flow graph and obtain the state model. **(10 Marks)**

8 a. Define filters and discuss the frequency response of a zero order hold filters. **(10 Marks)**

b. The z transform for a digital control system is

$$C(z) = z\frac{(z+2)}{(z-1.0)(z+0.5)(z-0.2)}.$$

Determine the inverse z transform. **(10 Marks)**

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