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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2004.

Fourth Semester

Electrical and Electronics Engineering

EE 235 — CONTROL SYSTEMS

(Common to Mechatronics Engineering)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

Instructions : Polar, Semi Log, Centimeter graph sheets are to be supplied.

PART A — (10 × 2 = 20 marks)

1.   What do you mean by Linear Time–Invariant Systems?

2.   Define transfer function?

3.   Define resistance and capacitance of liquid level system.

4.   What is root locus?

5.   What do you mean by minimum phase system?

6.   Give two disadvantages of feedback in control.

7.   Why did Bode suggest plotting the magnitude of a frequency response on log–log coordinates?

8.   Why do we need to know before hand the number of open loop unstable poles in order to tell stability from the Nyquist plot?

9.   What are the units of K_p, K_v and K_a?

10.   Why might a designer wish to put the derivative term in the feedback rather than in the error path?

11. (i) Simplify the block diagram shown in Figure 11(i), then obtain the closed loop transfer function C(s)/R(s). (8)
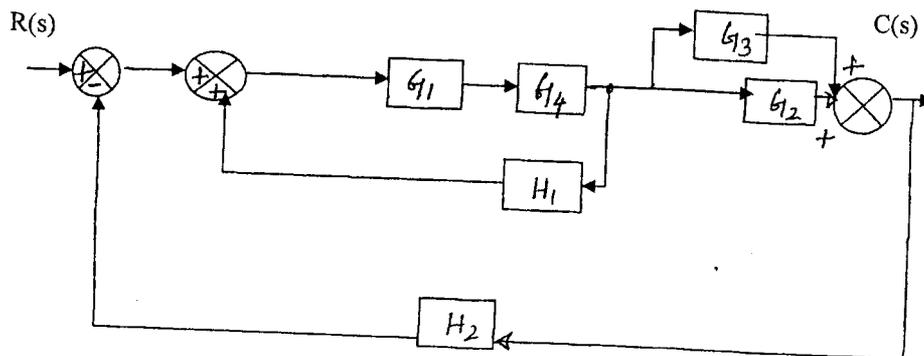

Figure 11(i)

(ii) Derive the transfer functions of the systems shown in Figure 11(ii) and show these systems are analogous. (8)
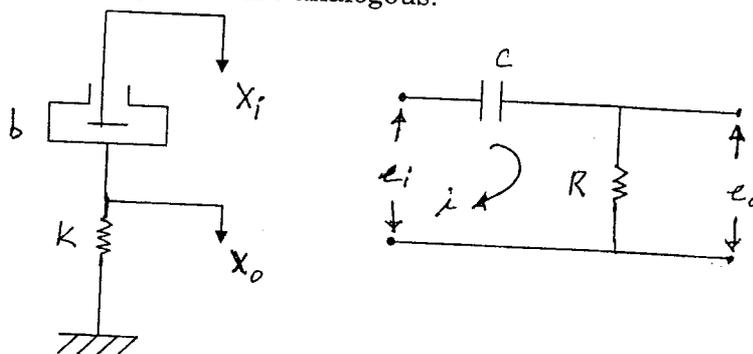

Figure 11(ii)

12. (a) (i) Determine the values of K and a, of the closed loop system shown in Figure 12.a(i), so that the maximum overshoot in unit step response is 25% and the peak time is 2 seconds. Assume that $J = 1\,\text{kg} - \text{m}^2$. (8)
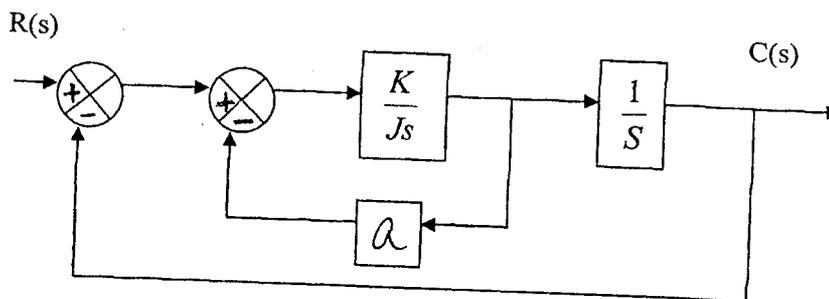

Figure 12.a(i)

(ii) Define delay time, rise time, peak time and settling time. (8)

Or

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(b) (i) Derive the unit step and unit ramp response of first order system and plot the responses. (12)

(ii) Define resistance and capacitance of pressure systems. (4)

13. (a) For the following open loop transfer function sketch the Bode magnitude and phase plot for

$$G(s)H(s) = \frac{10(s+50)}{s(s+5)}.$$ (16)

Or

(b) Draw the polar plot for the transfer function

$$G(s) = \frac{10(s+1)}{(s+10)}.$$ (16)

14. (a) Draw the Nyquist plot for the following and determine the stability

$$G_0(s) = \frac{10}{(s+1)(2s+1)(3s+1)}.$$ (16)

Or

(b) (i) Consider the characteristic equation $s^4 + Ks^3 + s^2 + 1 = 0$.

Using the Routh method, determine the range of K for stability. (12)

(ii) Explain on–off control action. Give an example. (4)

15. (a) Discuss in detail about Lead and Lag networks. (16)

Or

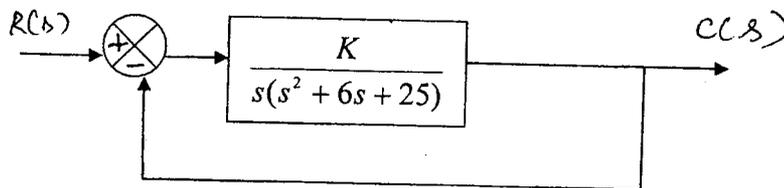(b) Sketch the root loci of the control system shown in Figure 15(b). (16)

Figure 15(b)