國立成功大學 104 學年度碩士班招生考試試題

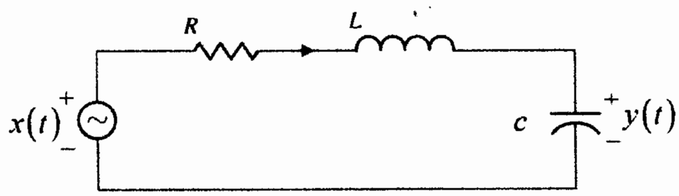
系所組別：航空太空工程學系丙組

考試科目：自動控制

考試日期：0211，節次：1

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (30%) An RLC circuit is shown in the figure below.



(a.) Obtain the differential equation to describe the relationship between the input ($x(t)$) and the output ($y(t)$).

(b.) Plot the control system block diagram of this system.

(c.) Find the transfer function of this system with zero initial conditions and $R=2,\ L=2,\ C=1$.

(d.) Look at the characteristic function of the transfer function, what kind of system modes will you expect? Please sketch the expected responses and explain them.

(e.) Determine the DC gain of the system.

(f.) Determine the final value of the system to a step input.

2.

(a.) (10%) Find the time function corresponding to the transfer function below:

$$G(s)=\frac{2s+4}{s^3+s^2+4s+4}$$

using partial fraction expansions and sketch each of the system modes.

(b.) (10%) The unity feedback is applied to the open-loop system below:

$$G(s)=\frac{K}{s(s+1)(s+2)}$$

When root loci cross the $j\omega$-axis, what is the K?

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3. The transfer function of a control system is given as

$$G_{cl}(s) = \frac{K(s+1)}{s^2 + (K-2)s + (K+2)}, \qquad K > 0$$

a) Draw the root-locus plot and find the crossing points, the break away or arrival points, the departure angles, and the range of *K* for the system to be stable. (17%)

b) Find the *K* so that the ξ, damping ratio, of the complex roots of the characteristic equation is approximately $1/\sqrt{2}$. (8%)

4. A closed-loop system has a loop transfer function of

$$G_c(s)G_p(s) = \frac{\mathrm{k}(s^2 + 2s + 2)}{s^2(s-1)}$$

a) Draw the Nyquist plot and determine the range of k for the system to be stable. (15%)

b) On the Nyquist plot in a), mark and explain the gain margin and the phase margin of the system. (10%)

Note: $\sqrt{2} = 1.414$; $\sqrt{3} = 1.732$; $\sqrt{5} = 2.236$; $\sqrt{7} = 2.646$.