1.

(a) Discuss the existence condition of Laplace Transform. (5%)

(b) Discuss the existence condition of Fourier Transform. (5%)

(c) According to (a) and (b), please discuss their relation with the pole positions in the s-plane and explain if they are stable? (10%)

2.

A feedback control system is shown in Fig.1. Please find the values of the control parameters k_1 and k_2 to achieve the following conditions for the closed-loop step response. (20%)

(i) peak time $T_p = 1$ sec

(ii) settling time $T_s = 2$ sec

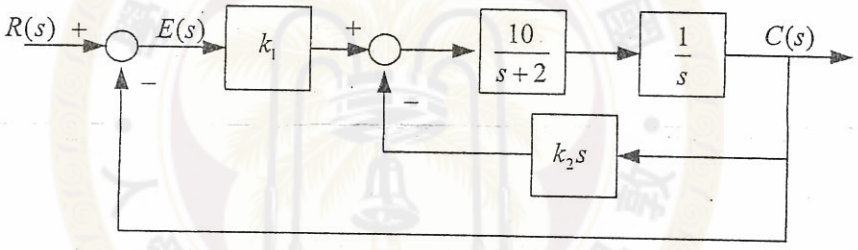

Fig. 1

3.

A control system has three closed-loop poles, including two conjugated imaginary poles and one real pole, as shown in Fig. 2.

(a) Please find the value of K according to the Routh stability criterion. (10%)

(b) Please find the values of the three poles in accordance with (a). (10%)

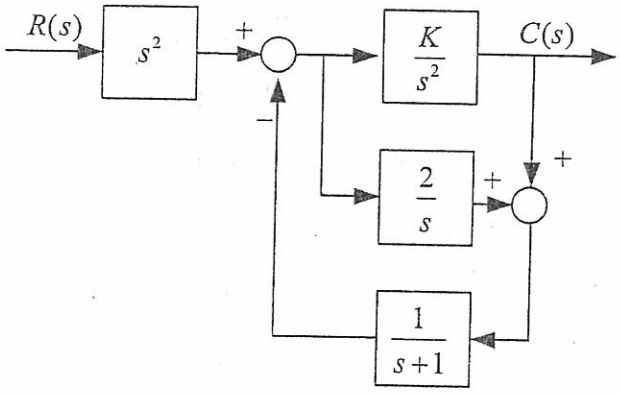

Fig. 2

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4.

A position control system is shown in Fig.3, which open-loop transfer function is

$$G(s)=\frac{10}{s(s+2)}$$

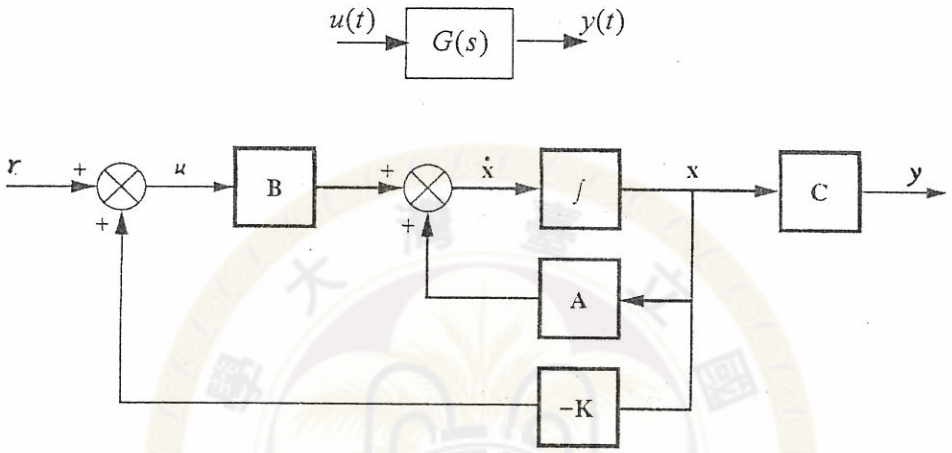

Fig. 3

(a) Derive the state space equation using the state variables $x_1 = y$ and $x_2 = dy/dt$. (5%)

(b) Design a state feedback controller **K** for $u = -\mathbf{KX}$ to match the closed-loop conditions: $\xi = 1/\sqrt{2};\ \omega_n = 2\sqrt{2}$. (8%)

(c) If an unit step function is given as reference input *r*, please solve the steady state error. (7%)

5.

An unity feedback control system has the open-loop transfer function as

$$G(s)=\frac{w_n^2}{s(s+2\xi w_n)}$$

(a) Please find the closed-loop transfer function *T*(*s*). (5%)

(b) Please find the relation between the phase margin (PM) and the damping ratio ξ. (8%)

(c) Please find the relation between $|T(jw_c)|$ and PM, where w_c is the crossover frequency of the open-loop system using the Nyquist plot. (7%)

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