Name:
ID. No.

<div align="center">

Eskişehir Osmangazi University - Electrical Engineering Department

Fundamentals of Control Systems- Final Examination - Summer 2016

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Duration: 90 minutes; **Allowed**: An A4 size two sided formula sheet and a calculator; **Directions**: All answers must be written below or to the right of the questions. Anything written elsewhere won't be graded. Use the back side of the exam sheet if you need scratch paper.
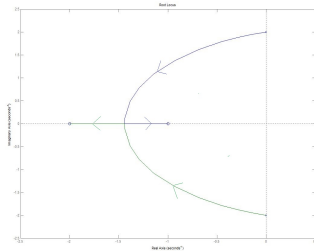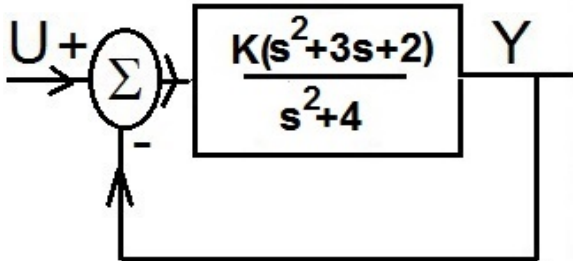
Question 1.

(**a**) Sketch the root locus of system shown below. No number on the sketch is needed. Direction arrows are needed.

(**b**) Find angle of departure in degrees at the pole $2i$.(5% error is tolerable)

(**c**) For which values of K is the closed-loop system stable. (25% error is tolerable).

$$\frac{K(s+1)(s+2)(s+3)}{(s^2+1)(s^2+4)}$$
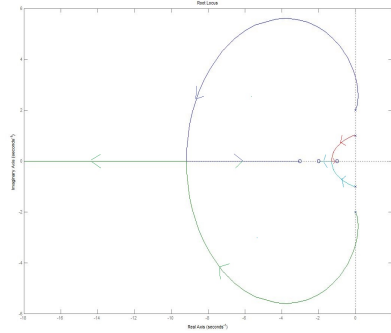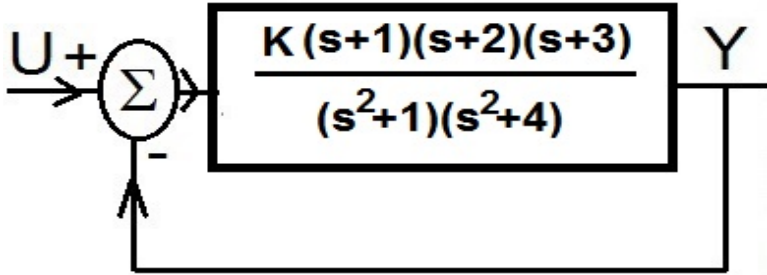
(b) 52.12 degrees (c) $K > 1.16$

Question 2.

(**a**) Sketch the root locus of system shown on the right. No number on the sketch is needed. Direction arrows are needed.

(**b**) For which values of K is the closed-loop system stable. (5% error is tolerable).

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

(b) $K > 0$

Question 3.

(**a**) Sketch the Nyquist plot of system shown on the right. No number on the sketch is needed. Direction arrows are needed

(**b**) Is this system stable?

$$\frac{150}{(s+5)(s+2)(s+1)}$$
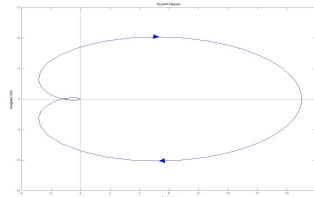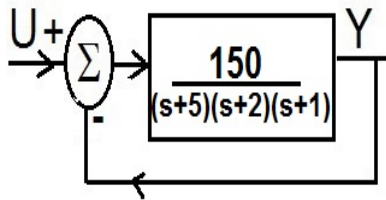
(b) Unstable

Question 4.

For the signal flow graph on the right, find the transfer function $\frac{U(s)}{X(s)}$ in the form

$$\frac{a^m + \cdots + a_1 s + a_0}{b^n + \cdots + b_1 s + b_0}$$

$$\frac{s+1}{s^2+s+1}$$