Name:
Student ID:

ROOT LOCUS DESIGN

A process is described by its transfer function

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

and an integral controller by

$$G_C(s) = \frac{1}{T_I s}$$

Consider feedback control with unity feedback (that is, the input to the controller is Y(s)-X(s)). The goal of this problem is to examine closed-loop stability for variable T_I.

1. Determine the open-loop transfer function in a form suitable for the root locus method (in other words, determine P(s) so that $1 + k \cdot P(s) = 0$ describes the poles of the closed-loop system for variable *k*. What is *k*?

2. Draw the asymptotes of the root locus diagram in the s-plane. Determine the number of branches, their angle with respect to the positive real axis, and the intersection point of the asymptotes.

3. Determine the value of *k* where the poles just start to become conjugate-complex (formation of one double-pole on the real axis).

4. Sketch the complete root locus curve.

5. Determine the stable range for T_I.

Score: (1) 5 points, (2) 3 points, (3) 5 points, (4) 2 points, (5) 5 points.