Experiment 2

Controller design on MATLAB platform using analog root loci.

Background:

We have had ample briefing on **CL pole plots** in the theory course particularly in the context of ***time domain control designs***, so not much remains to be said about the concepts involved.

Here we first examine the power of MATLAB in implementation of the technique, followed by a realistic project on the same.

Objective:

The project requires design of a parameter for a given analog transfer function according to desired specifications.

A sensitivity analysis for variation of key parameters is further required.

Tutorial:

In the MATLAB platform, go through the procedural steps as described for:

- *Root locus design:* https://www.mathworks.com/help/control/ug/root-locus-design.html

Elements of the software for familiarisation:

i. ***App:*** controlSystemDesigner('rlocus',*)

ii. ***Functions/keywords:*** rlocus; rlocusplot; getoptions;setoptions; sgrid; plotoptions; tf; zpk.

Project:

The following analog OLTF is to be operated in closed loop with a choice of T such that the complex poles have a damping ratio of 0.2 to 0.25.

$$G_{OL}(s) = \frac{30}{s(1+0.1s)(1+0.2s)(1+Ts)}$$

Once the system is automated however, it is found that each of the parameters in the denominator polynomial are prone to variation up to ±20% of the original values.

Obviously, the value of T is to be selected so as to realise the required damping ratio regardless of parameter variations.

For observations and discussions:

By detailed root locus studies and results tabulated therefrom, analyse and discuss the impact of the parameter variations (considered one at a time) on the CLTF behaviour.

Your discussions should involve actual real time performance such as overshoot, underdamping/overdamping, settling, etc. (not simply a statement in terms of CL poles and zeros.) The *interpretations in terms of CL poles* are more important than the poles themselves !