EE380 (Control Systems) Prelab work of Experiment 3.

Student Name	Roll No.	Bench No.

Q1 Write down the voltage-to-speed TF identified in Experiment 1.
Note: This TF is the u-to-ω TF in Figure 4.1.

Q2 Prefix $H(s) = \frac{29}{s^2+10s+29}$ to this TF.

Second ZNT method

Q3 Determine k_{cr} using `rlocus` of GNU Octave upto the resolution of the human eye. Simulate the CL system in GNU Octave and determine k_{cr} and P_{cr}. Fill the following table. You can use such GNU Octave functions as `series`, `feedback`, `cloop`, `conv`, etc. For example,

```
step(feedback(series(tf(1,[1,1]),tf(1,[2,1])),tf(1,1)));
```

Value of k_{cr}	From `rlocus`	
	From simulation	
Value of P_{cr} [s]	From `rlocus`	
	From simulation	

Q4 Determine the three controllers (P, PI, PID).

$C(s)$		
P	PI	PID
(k_p)	$\left(K_p + \frac{K_I}{s}\right)$	$\left(K_p + \frac{K_I}{s} + \frac{K_d s}{\tau s+1}\right)$

Q5 In GNU Octave, simulate the CL step response using any of `tf`, `conv`, `step`, `feedback`, `series`, `sysmult`, `sysadd`, etc with each of these controllers, and fill the following table.

	Value of $C(s)$	t_s [s] (for 2% tube)	e_{ss} [%]	M_p [%]	$\frac{2^{\text{nd}}\text{ overshoot}}{1^{\text{st}}\text{ overshoot}}$
P					
PI					
PID					

Q6 Based on the values of t_s that you have in the above table, and given that the sampling interval is 2 ms, do you think the CL system under digital control will be stable?

Q7 Repeat Q5 using `easysim.m` and $T_s = 2$ ms. Is the CL system stable?

Note that the PID controller is $k_p\left(1+\frac{1}{T_I s}+\frac{T_D s}{\tau s+1}\right)$, and not $k_p\left(1+\frac{1}{T_I s}+\frac{T_D}{\tau s+1}\right)$.

Discretization is made easy by treating each branch of the PID controller separately.

	Value of $C(s)$	t_s [s] (for 2% tube)	e_{ss} [%]	M_p [%]	$\frac{2^{\text{nd}}\text{ overshoot}}{1^{\text{st}}\text{ overshoot}}$
P					
PI					
PID					

Q8 From the above table, which controller would you select to control your plant?

Q9 Is the design specification of QAD satisfied by any of the three controllers?

Q10 Write the Euler's approximation-based descretized versions of each of the three controllers and $H(s)$ in C code. You will take these codes to the lab.