ECE317
HW #4

1) Why are pole locations of a transfer function important?

2) How do you determine if a transfer function is stable, marginally stable or unstable?

3) Determine the stability of following transfer functions:

$G(s)$	Stable/ marginally stable /unstable
$\frac{5(s+2)}{(s+1)(s^2+s+1)}$	?
$\frac{5(-s+2)}{(s+1)(s^2+s+1)}$	?
$\frac{5}{(s-2)(s^2+3)}$	?
$\frac{s^2+3}{(s+1)(s^2-s+1)}$	?
$\frac{1}{(s+1)(s^2+1)^2}$	?
$\frac{1}{(s^2-1)(s+1)}$	?
$\frac{20}{(s+1)(s+2)(s+3)}$	?
$\frac{20(s+1)}{(s-1)(s^2+2s+3)}$	?
$\frac{10(s-1)e^{-s}}{(s+5)(s^2+3)}$	?
$\frac{1}{(s+5)(s^2+2)^2}$	?

4) The relationship between three variables, v, v_g and d is given by the following:

$$v = \frac{1}{1-d} v_g$$

As this relationship is nonlinear we are interested in finding a linearized model by considering small-signal deviations around a steady state operating point. To this end we consider each of the variables to consist of a steady state value plus a small deviation from the steady state such that

$$v = V + \hat{v} \quad \text{where} \quad \hat{v} << V$$

$$v_g = V_g + \hat{v}_g \quad \text{where} \quad \hat{v}_g << V_g$$

$$d = D + \hat{d} \quad \text{where} \quad \hat{d} << D$$

Capitalized terms represent steady state values and terms with a caret '^' indicate a small deviation from the steady state. Find the transfer functions: $\frac{\hat{v}}{\hat{d}}$ and $\frac{\hat{v}}{\hat{v}_g}$.