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```
%Control needs analysis of 12V Pittman 8224 motor with G35A wide-faced gear box
```

Set-up and motor variables

```
clc
clear all
Ke = 0.01;%[V/rad/s]
Kt = Ke;%Due to SI units
Km = Kt;%Therefore we have only one constant, a motor constant Km
Bm = 1.34e-6;% Viscous damping factor,[Nm*s/rad]
Jm = 1.62e-6;%Inertia of rotor, [kg*m^2]
La = 0.58e-3;%Armature Inductance, [H]
Ra = 1.17;%Armature Resistance, [Ohm]
n = 60.5;% Ratio of G35A gear box => wm/wl
Eff = 0.66;% Efficeincy of gear-box, losses due to gear box gear friction
neff = n*Eff;%Effective gear ratio of gear-box due to friction losses
Inl = 0.37;%No load current draw[A]
Tloss = Inl*Kt;% Torque loss due to the motor shaft [Nm]
```

Moments of Intertia and Damping due to load (average of all parts)

```
J_load = 0.0059;%[kg*m^2]
B_load = 0.0166;%[N*m*s/rad]
```

Mathematical modeling of motor transfer function

Load is reffered to motor via effective gear ratio Model obtained from Journey from Robot to Digital Human, pg. 298 By: Edward Y.L. Gu, Springer, 2013

```
Jeff = Jm + (J_load/(neff)^2);%Effective inertia experienced by motor
Beff = Bm + (B_load/(neff)^2);%Effective damping experienced by motor
num = [(-La*Tloss) (Ra+Km)];
den = [(Jeff*La) ((Jeff*Ra) + (Beff*La) - (Km*Tloss)) ((Beff*Ra) + (Km^2) - (Ra*Tl
Sys = tf(num, den)%System TF
% Transfer function:
%   -2.146e-006 s + 1.18
% ----------------------------------------
% 3.086e-009 s^2 - 3.077e-005 s + 7.046e-005
w_n = sqrt(((Beff*Ra) + (Km^2) - (Ra*Km*Tloss))/(Jeff*La))
```

```
% resonant frequnecy
% w_n =
%
%   151.1057
z = (0.5*((Jeff*Ra)+ (Beff*La) - (Km*Tloss))/sqrt(((Beff*Ra)+(Km^2)-(Ra*Km*Tloss))
%damping factor
% z =
%
%  -1.0181e-007

%Graph of system step response
figure(1);
step(Sys)
```

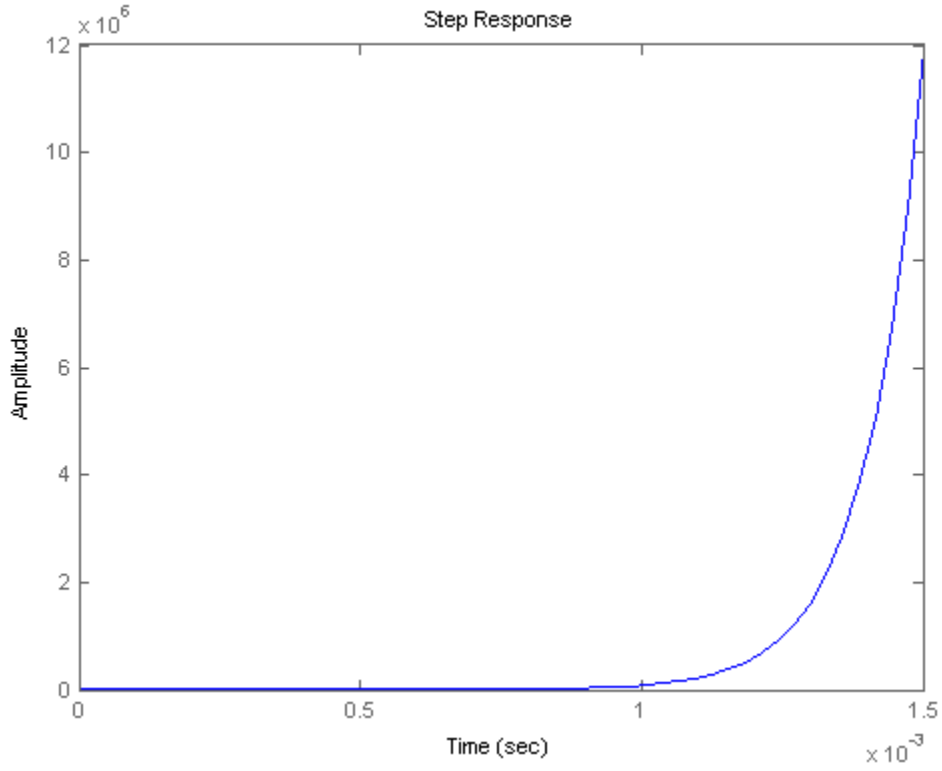
```
Transfer function:
           -2.146e-006 s + 1.18
-----------------------------------------
3.086e-009 s^2 - 3.077e-005 s + 7.046e-005


w_n =

  151.1057


z =

 -1.0181e-007
```



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