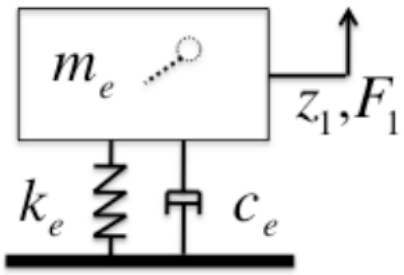
Matlab Sheet 3

Single Degree of Freedom - Forced damped system

1. We are interested in designing a mount for a diesel engine with a mass of 500 kg, and dynamic imbalance at the nominal operating speed of 1500 RPM. The forcing due to the engine imbalance is 2% of the engine weight.



(a) In the absence of damping, design the spring constant (k_e) so that its natural frequency is set at 5 Hz. Calculate the static displacement of the engine, Z_{st} when the same amount of the force due to the engine imbalance is applied statically.
(b) In the absence of damping, calculate the ratio of force transmitted to the floor to the imbalance force $|F_{TR}|/|F_1|$ at 1500 RPM. To improve isolating the base from the engine vibration, a damper c_e is added to the system corresponding to 1%, 2%, 5%, 10%, 20% and 30%. Calculate $|F_{TR}|/|F_1|$ of the damped engine mount at 1500 RPM. Does the damper improve or hinder isolation?
(c) Suppose the operating RPM fluctuates. In the absence of damping, plot $|F_{TR}|/|F_1|$ over the operating frequency of 1000 to 1600 RPM. What is the lowest RPM rendering the force ratio less than 8%?
(d) In the absence of damping, decrease the spring constant by 10% and see if Z_{st} is increased by 10% or not? Calculate $|F_{TR}|/|F_1|$ of the new engine mount at 1500 RPM. Can an extremely soft spring provide an improved design? If not, why not?