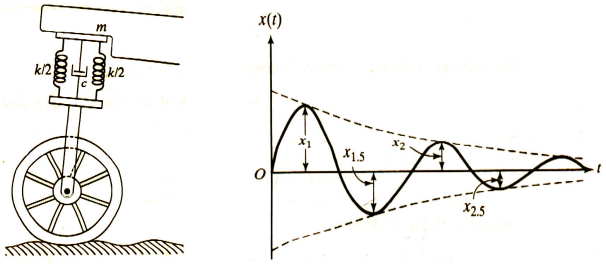
Aerospace Structural Dynamics – AE31002
Tutorial Sheet – 2

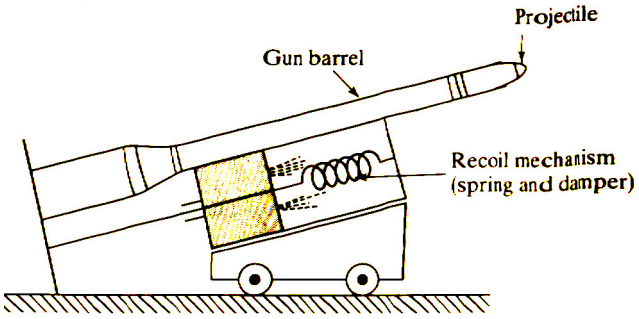
1. An undamped shock absorber is to be designed for a motor cycle of mass 200kg. When the shock absorber is subjected to an initial vertical velocity due to a road bump, the resulting displacement time curve is also indicated in the figure.



Find the necessary stiffness and damping constant of the shock absorber if the damped period of vibration is to be 2 sec and the amplitude x_1 is to be reduced to $\frac{1}{16}$ in a single cycle. Also find the minimum initial velocity that leads to a maximum displacement of 250mm.

Ans. c=554.5N-s/m, k=2358.3 N/m, v=1.43m/s

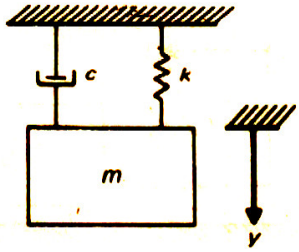
2. The schematic diagram of a large cannon is shown below. When the gun is fired, high pressure gas accelerate the projectile inside the barrel to a very high velocity. The reaction pushes the gun barrel in the opposite direction of the projectile. Since it is desirable to bring the gun barrel to rest in shortest time without oscillation, it is made to translate backward against a critically damped spring-damper system called the recoil-mechanism.



In a particular case, the gun barrel and the recoil mechanism have a mass of 500kg with a recoil spring stiffness 10,000 N/m. The gun recoils 0.4m upon firing. Find 1) the critical damping coefficient of the damper, 2) the initial recoil velocity of the gun, and 3) the time taken by the gun to return to a position 0.1m from its initial position.

Ans. c_c=4472.1N-s/m, v=4.86 m/s, t=0.8258 s

3. The amplitude of vibration of the system shown is observed to decrease 5% on each consecutive cycle of motion.



Determine the damping coefficient c of the system. k= 200 lb/in and m= 10 lb-sec^2/in.

Ans. c = 0.73 lb-sec/in

4. A platform of weight W = 4000 lb is being supported by four equal columns which are clamped to the foundation as well as to the platform. Experimentally it has been determined that a static force of F= 1000 lb applied horizontally to the platform produces a displacement of Δ=0.1 in. It is estimated that damping in the structure is of the order of 5% of the critical damping. Determine the following for this structure a) un-damped natural frequency, b) absolute damping coefficient, c) logarithmic decrement and d) the number of cycles and the time required for the amplitude of the motion to be reduced from an initial value of 0.1 in to 0.01 in.

Ans. ω = 31.06rad/sec, 32 lb-sec/in, 1.37, 1.62sec