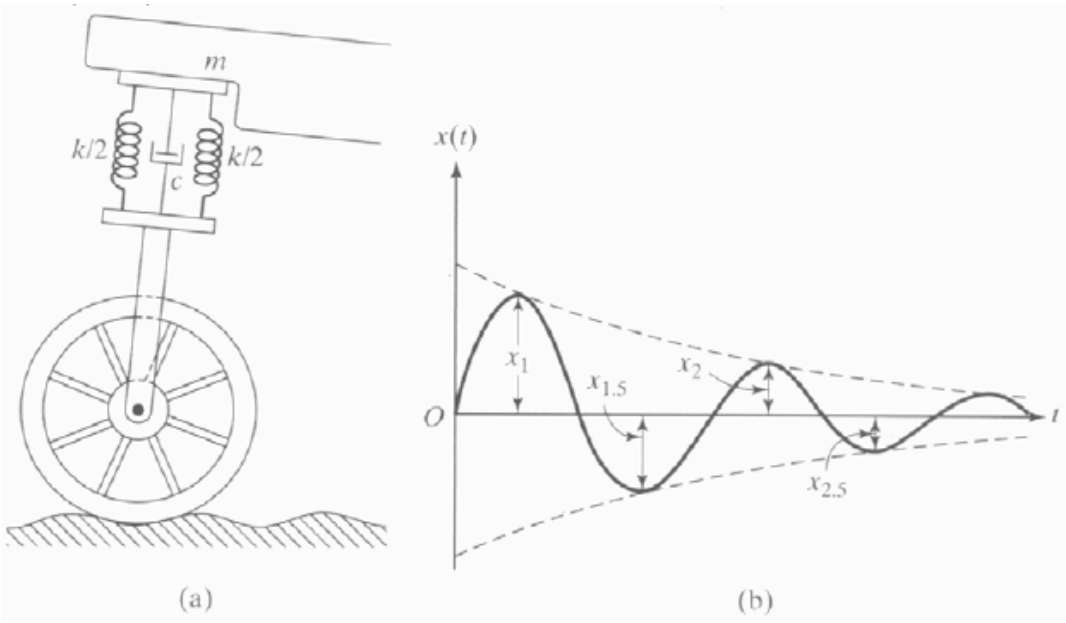
AS 3030 Vibrations (Aug- Dec 2010)

Assignment 2 (12.09.2010)

1. An underdamped shock absorber assembly is to contain both a spring and damper and is to be designed for a motorcycle of mass 200kg which is shown below in Figure (a). When the shock absorber is subjected to an initial vertical velocity due to a road bump, the resulting displacement-time curve is to be as shown in Figure (b). Determine the necessary stiffness and damping coefficients of the shock absorber if the damped period of vibration is to be 2 seconds and the maximum amplitude has to be immediately reduced to one-fourth in one-half cycle. Also, determine the minimum initial velocity that produces a maximum displacement of 250 mm and the length of time required for the amplitude of oscillation to decay to one tenth this value.



2. Statistics have shown that the average human leg in its rigid (knee locked) position has a measured natural frequency around 20 Hz in the direction along the length of the bone with a damping ratio of $\zeta = 0.224$. Suppose you were to land on your feet from a height of around 18.3mm with the knees locked, calculate the response if the impact induces a vibration with an initial velocity of 0.6m/s and zero initial displacement. What is the maximum acceleration experienced by the leg assuming no damping ?

3. Use either the force approach or simple conservation of energy approach to obtain the equation of motion and natural frequency of a spring-mass system if the spring has a total mass m_s.

Problems 1.4, 1.6, 1.16, 1.20, 1.25 from Meirovitch's text.