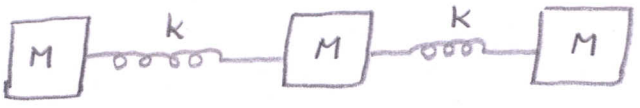
# PHY102 : Waves and Matter

## Assignment - 4

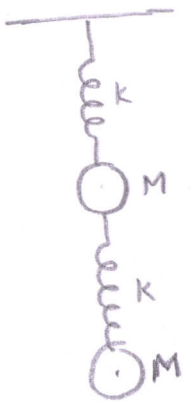
### Optional. You do not have to submit it.

1. Do the following problems from the book "The physics of vibrations and waves" (6th edition) by H. J. Pain. Problems 4.4, 4.7, 4.21, 4.23, 5.1, 5.2

2. Consider the following system of three blocks connected by two springs. Assuming that the vibrations of this system are only along the axial direction and harmonic in nature, write down the equations of motion for this system.




3. For the configuration of spring and block system shown here, set up the equations of motion. Both the springs have spring constant $k$ and mass of each block is $M$.




4. Two harmonic oscillators $A$ and $B$, of mass $m$ and spring con- stants $k_A$ and $k_B$, respectively, are coupled together by a spring of spring constant $k_c$. Find the normal frequencies and describe the normal modes of oscillation if $k_C^2 = k_A k_B$.

5. Consider a system of $N$ coupled oscillators driven at a frequency $\omega < 2\omega_0$ (i.e., $Y_0 = 0, Y_{N+1} = h\cos\omega t$). Find the resulting amplitudes of the $N$ oscillators. [Hint: The differential equations of motion are the same as in the undriven case (only the boundary conditions are different). Hence try $A_p = C\sin\alpha p$, and determine the necessary values of $\alpha$ and $C$.

6. Consider a system with 5 beads on a string. Each of the bead is of mass $m$ and are placed equidistant from each other. The ends of the string is tied to a rigid wall. Obtain all the 5 normal mode frequencies and sketch the modes of oscillation.

(Some of these problems are based on the problems given in 'Vibration and waves' by A. P. French).