Coupled Oscillations Shortcourse
Saudi Physical Society
Syllabus (3-1433)

1- Introduction to the Course (what is it about, motivation/ applications)
2- Introduction to Mathematica
3- Mathematical Introduction to Linear Algebra:
   a. Solving simultaneous algebraic equations
   b. Solving coupled differential equations
   c. Vector basis
   d. Diagonalization of matrices
   e. Eigenvalue problem
   f. Help me Mathematica!! ☺
4- The harmonic oscillator
   a. Simple
   b. Not so simple harmonic oscillator
   c. Springs in series/ parallel
   d. Two masses/ one spring
   e. Two masses connected to opposite walls without coupling
5- Introduction to Lagrange Mechanics
6- Coupled oscillators
   a. Intro: Two masses connected to opposite walls with (weak/ strong) coupling
   b. General case ("n" masses co-linear/ non-co-linear in 3-D
   c. Normalizing coupled oscillators
7- Practical examples:
   a. Double pendulum
   b. CO_2 molecule
8- Raman Spectroscopy
9- Misc.
   a. The role of symmetry and the importance of Group Theory
   b. Coupled oscillators (two dipoles) as in solid state physics and the 6-12 potential