Syllabus for Wave Mechanics PHYS201 2009

Text:

H J Pain: *The Physics of Vibrations and Waves*
R P Feynman, R B Leighton, M Sands: *The Feynman Lectures on Physics*, Vol. III

This part of PHYS201 is intended to introduce students to the basic concepts of wave mechanics. As there is significant amount of material covered in this part of the unit that is not to be found in the textbook by Pain, the material is based principally on supplied notes.

Topics:

Below is a breakdown of the material that we will try to cover in $\sim$ 12 lectures. Not all topics will be covered in the same depth.

1. Introduction: The Einstein-Planck equation $E = \hbar\omega$, De Broglie's hypothesis $\lambda = h/p$.
2. The wave function $\Psi(x,t)$ as a 'de Broglie wave'. Wave packets in space as a superposition of de Broglie waves and Heisenberg's uncertainty relation for position and momentum.
3. Application of uncertainty relation to estimating the size of the hydrogen atom.
4. The two slit experiment defining the 'central mystery of quantum mechanics'.
5. Probability amplitudes and the probability interpretation of the wave function.
6. Expectation values and a precise definition of uncertainty.
7. The infinitely deep potential well: the role of boundary conditions. Bound states and quantized energy levels.
8. 'Derivation' of the Schrödinger wave equation: the time dependent and the time independent wave equation.
9. Stationary and non-stationary states.
10. Scattering states: the potential step and the potential barrier.
11. The finite potential well, and the simple harmonic oscillator.
12. The momentum operator.

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