Quantum Mechanics H.T. 2001

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Synopsis

This course of 8 lectures is the completion of the M.T. 2000 second year QM course. The *Aims* and *Objectives* are the same as stated in the M.T. 2000 Synopsis.

Contents

The approximate *lecture-by-lecture schedule* is given below. There will be three *problem sets*, numbers 6, 7 and 8, following on from the five sets issued last term. The numbers in brackets [...] in the lecture schedule refer to problems in the sets: e.g. [6.3] means problem 3 of set 6. As before, there are likely to be more problems than many students can comfortably manage for one tutorial, so there is an element of choice. There is also a "Supplementary" set of problems containing more challenging examples, many of them outside the Part A syllabus. As usual, I should be very grateful if all errors could be reported to me as soon as they are detected.

1. Reminder of separation of variables in polar coordinates for the one-particle Schrödinger equation with a spherically symmetric potential. The radial equation: solutions for the free particle, the spherical box, the radial well, the hydrogen atom. Constants of the motion. [6.1, 6.2, 6.3, 6.4]

2, 3. The Schrödinger equation for two particles. Independent motion. Motion under a mutual potential energy: separation of centre of mass and relative motion; relative orbital angular momentum. The addition of angular momentum (qualitative). [6.5, 6.6, 6.7]

4. Introduction to the matrix formulation of q.m. Matrix elements. Angular momentum matrices. [7.1, 7.2, 7.3, 7.4, 7.5, 7.6]

5, 6. First order time-independent non-degenerate perturbation theory. The variational principle. [8.1, 8.2, 8.3, 8.4, 8.5]

7, 8. Qualitative introduction to the theory of transitions, and the formula for transition probabilities (Fermi's Golden Rule). [8.6, 8.7, 8.8, 8.9]

Books

As before, the recommended text is Rae "Quantum Mechanics" (Institute of Physics

Publishing), with McMurry "Quantum Mechanics" (Addison-Wesley) as an alternative which includes the disk which I used several times in the M.T. lectures. A slightly more advanced text is Mandl "Quantum Mechanics" (Wiley) which is recommended for the Part A Theory Option Quantum Mechanics course. Vol. III of the Feynman Lectures on Physics is a very stimulating read, and chapters 1 and 2 are a classic physical introduction to the essence of quantum mechanics. Dirac's "Principles of Quantum Mechanics" is the only quantum mechanics textbook written by one of the founders of quantum mechanics, and well worth study once you have got a basic grip of the subject.