The University Of Sheffield.

DEPARTMENT OF PHYSICS AND ASTRONOMY

PHY349	***Further Quantum Mechanics***
Spring	***10 Credits***
Staff contact	***Prof David Whittaker - d.m.whittaker@shef.ac.uk***

Outline Description	This module builds on the quantum mechanics learned in the perquisites PHY250 and PHY251. The Heisenberg matrix formulation of the theory is developed from the Schrodinger wave picture. Approximately methods (perturbation theory and variational method) are derived and applied. Methods for solving time dependent problems are developed. Problems involving magnetic fields and spin are treated. Many particle wavefunctions for fermions and bosons are introduced.
Restrictions	None
Prerequisites	PHY250, PHY251 Recommended: Mathematical ability required.
Co requisites	None
Approx Time allocation (hours)	Lectures - 22, Problem Solving - 12, Independent - 64, Examination - 2
Assessment (%)	Examination 100%
Aims	1. To develop the students' skills and knowledge of quantum mechanics from the position reached at level 2. 2. To apply these skills to solving real problems in physics. 3. To strengthen the students' ability to solve physical and mathematical problems.
Outcomes	On successful completion of this module the student should be able to: 1. understand the connection between Schrodinger differential equation formulation of quantum mechanics and the Heisenberg matrix formulation; 2. be able to use perturbation theory and the variational method to find approximate solutions to problems in quantum mechanics; 3. be familiar with time dependent perturbation theory; 4. know how to solve problems in quantum mechanics involving magnetic fields; 5. be able to use the matrix formulation to describe spin; 6. understand how a many particle wavefunction is affected by the symmetries required for identical bosons and fermions.
Recommended Books	"Quantum Physics" by Gasiorowicz “Quantum Mechanics” by Zettilli,
Syllabus	1. Revision of level 2 quantum mechanics and mathematical techniques. 2. Matrix formulation of quantum mechanics; operators and state vectors. 3. Approximate methods; first and second order perturbation theory; degenerate state perturbation theory; variational method.

	4. Time dependent perturbation theory; Fermi's golden rule. 5. Magnetic fields in the Schrodinger equation; Landau levels; gauge invariance. 6. Mathematical description of spin; magnetic fields and spin. 7. Many particle systems; symmetry of wavefunction for bosons and fermions; helium atom.
Academic Notes	PHY349 is for Level 3 students only at F6 level assessment. PHY449 Further Quantum Mechanics is the Level 4 version of the same module with Level 4 requiring additional material at F7 level. This will take the form of an assessed experiment in the Quantum Lab. *For reference: The Level 3 version of this module in 2013-14 was PHY309.*