PHYS30101 APPLICATIONS OF QUANTUM PHYSICS

Prerequisites: PHYS 20101

Classes: 22 lectures in S3

Assessment: 1 hour 30 minutes examination in January

Feedback will be offered by tutors in examples classes. These classes will be based on weekly examples sheets; solutions will be issued.

Recommended text:

Rae, A. I. M. *Quantum Mechanics* (Chapman and Hall)

Supplementary reading:

Gasiorowicz, S. *Quantum Physics* (Wiley)

Mandl, F. *Quantum Mechanics* (Wiley)

Aims:

To develop the basic concepts of quantum mechanics and apply them to a variety of physical systems.

Learning outcomes:

On completion successful students will be able to:

1. calculate the probability of tunnelling through a barrier,
2. solve simple eigenvalue problems for trapped particles,
3. solve eigenvalue problems for two-state systems,
4. add angular momenta in quantum mechanics and calculate the fine-structure of atomic energy levels,
5. calculate first-order shifts in energy levels produced by external fields,
6. define entangled states in quantum mechanics and use these to describe simple ideas of quantum information.

SYLLABUS

1. Barriers and tunnelling

Applications to nuclear physics

Applications to layered semiconductors

2. Trapped particles

Quantum dots and artificial atoms

Quantum wires and quantum wells

First-order perturbation theory

3. Spin and other two-state systems

Angular momentum without angles

Spin and Pauli matrices

Adding angular momenta

Other two-state systems

4. Atoms in magnetic fields

Spin-orbit coupling and fine structure

Zeeman effect and Landé g-factor

Spectra and selection rules

Quantum dots in magnetic fields

Precession and NMR

5. Quantum information

Measurement in quantum mechanics

Entanglement

Quantum cryptography