# 12998-334(16) Quantum Mechanics A
## (Quantum mechanics with applications) (3l, 3p)

## 2016

### Course summary:

Schrödinger equation in three dimensions; particle in a box; spherically symmetric potentials, orbital angular momentum: Eigenvalues and spherical harmonic functions. The hydrogen atom. Electrons in periodic crystal potentials, time-independent perturbation theory, spin and application to the atom.

*Continuous assessment*
*PP Physics 224*
*P Physics 254*
*P Mathematics 214, 244*

### Outcomes of course:

The student is skilled in the practical application of quantum mechanical principles in three dimensional microscopic systems like nuclei, atoms and crystals.

### Lecturer:

Prof H Weigel
Telephone number: (021) 808-3378
E-mail address: weigel@sun.ac.za
Office: Room number 1025 in the Merensky Physics Building.
Course information: http://www.physics.sun.ac.za/~weigel/announce_334.html

### Mentor:

The Department of Physics has appointed a staff member as mentor for each year of its physics programme to be available to students for consultation. Students should feel free to discuss general issues related to the physics programme or specific modules in the programme with the relevant mentor, in addition to usual consultations with their individual lecturers of modules.

The mentor for third year programme and its modules is Dr CM Steenkamp cmsteen@sun.ac.za

### Course content:

**Revision**
 - Mathematical basics: complex numbers, simple differential equations, delta function
 - Uncertainty principle
 - Statistical interpretation
 - Schroedinger equation
 - Stationary states

**Quantum mechanics in three dimensions**
 - Schroedinger equation in spherical coordinates

 - Angular momentum and spherical harmonic functions
 - Hydrogen atom
 - Spin

**Identical particles**
 - Two and more particle systems
 - Bosons and fermions—Pauli's exclusion principle
 - Periodic table of elements
 - Applications in solids
   - Free electron gas
   - Band structure

**Time-independent perturbation theory**
 - Non-degenerate perturbation theory
 - Degenerate perturbation theory
 - Applications
   - Fine structure of Hydrogen
   - Zeeman effect
   - Hyperfine splitting

**Variational principle**
 - Theory
 - Applications
   - Ground state of Helium atom

## Practical (Tutorials):

One tutorial per week for 13 weeks

## Study material:

DJ Griffiths: *Introduction to Quantum Mechanics*
Important note: There are many other, maybe even better, textbooks in the library!

## Assessment:

### Methods of Assessments
Continuous assessment with the following components:
(approx. weekly) homework assignments:    25%
short oral exams (2):                     25%
1st test (March):                         25%
2nd test (May):                           25%

### Venue and time of assessment opportunities
See *timetable* on Physics home page and http://www.physics.sun.ac.za/~weigel/announce_334.html

### Availability of marks:
As soon as possible.