12546-744(8) Laser spectroscopy (1.5l, 1.5p)

2018

Course summary:

Optical spectroscopic diagnostic instrumentation and techniques. Laser spectroscopy techniques for atoms, molecules and plasmas. High-frequency and time-resolved spectroscopy and related diagnostic instrumentation and methods. Attosecond spectroscopy, spectroscopy of organic molecular solids.

Module relevance in programme:

This module builds on the undergraduate modules in quantum mechanics. The module is linked to modules in quantum mechanics 714, Quantum Optics and laser technology 745, molecular physics 747, and atomic physics 716. The module introduces basic techniques for atomics and molecular spectroscopy and prepares the student for project work in the laser programme (741).

Outcomes of course:

To skill students at an advanced level in the concepts, techniques, methods and apparatus needed in laser spectroscopy research.

Lecturer:

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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 the Honours programme and its modules is Prof KK Müller-Nedebock kkmn@physics.sun.ac.za.

Course content:

RADIATION PARAMETERS:
a) Einstein A and B transition probabilities,
b) Relationship with line-strength an oscillator strength,
c) Intensity, radiance, radiation density.

POPULATION OF ENERGY LEVELS:

a) Radiational excitation and decay,
b) Dissociation of molecules,
c) Ionisation.

SPECTRAL LINE PROFILES:
a) Natural broadening - Lorentz profile,
b) Thermal motion, Doppler broadening and Gauss profiles,
c) Convolution of line profiles,
d) Line broadening mechanisms.

SPECTROSCOPIC INSTRUMENTATION:
a) Laboratory radiation sources,
b) Spectrometer configurations,
c) Radiation detectors and measurement systems.

SPECTROSCOPIC TECHNIQUES:
a) Atomic emission,
b) Atomic absorption,
c) Atomic fluorescence.

LASER SPECTROSCOPY TECHNIQUES:
a) Laser induced fluorescence
b) Non-linear laser spectroscopy
c) Raman and IR spectroscopy
d) femto- and attosecond spectroscopy
e) x-ray spectroscopy and Free Electron Laser Physics

Practical (Tutorials):

Not applicable

Study material:

Laser Spectroscopy by W Demtroeder, Third Edition, Springer, **"Molecular physics and elements of quantum chemistry"** (Springer) Haken and Wolf.

Learning opportunities:

Lectures

Assessment:

Methods of Assessments
Homework problems
Oral presentations

Venue and time of assessment opportunities

As discussed with students.

Availability of marks:
As soon as possible

Calculation of final mark for the module:
50% homeworks + 50% oral presentations

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