

12998-224(16) Classical Mechanics, Waves and Optics (3ℓ, 3p)

2017

Course summary:

Velocity-dependent non-conservative force, conservative systems in three-dimensional space, central force motion, planetary and satellite motion, scattering of particles, multi-particle systems, dynamics of rigid bodies, geometrical optics, free and forced linear oscillations with damping, one-dimensional wave motion with boundary conditions, Doppler effect, interference and diffraction, physical optics.

Method of assessment: Flexible assessment

Prerequisite pass modules: Physics 114, 144

Prerequisite modules: Mathematics 114, 144

Language policy:

Afrikaans and English in the same class groups:

During each lecture, all information is conveyed at least in English. Summaries and/or explanation of the core concepts will also be given in Afrikaans. Questions in Afrikaans and English will, at the least be answered in the language of the question. Students will be supported in Afrikaans and English during a combination of appropriate facilitated learning opportunities.

Module relevance in programme:

Mechanics as presented in the first year is considered in a more generalised form shifting the emphasis to understanding symmetries and conservation laws. This is closely related to expressing physics laws through extremum principles. Along the way we spend time investigating the harmonic and inverse-square force systems, that are foundations for many calculations in physics. A second goal is to introduce the mathematics and basic concepts of waves and light, so as to form a preparatory basis for the upcoming electrodynamics and introductory quantum mechanics modules where electromagnetic waves and quantum mechanical wave functions will be explored. We also explore geometrical optics, where an extremum principle may also be used.

Outcomes of course:

Students are introduced to more advanced concepts in Newtonian classical mechanics. Students are introduced to concepts regarding wave phenomena in various facets of Physics, with emphasis on applications in optics. Students will be expected to gain abilities in calculations on these systems as well as in the conceptual understanding of the physics.

Lecturer:

Prof KK Müller-Nedebock: Mechanics

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Dr JN Kriel: Waves & Optics

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Mentor:

For each year of our physics programme the Department of Physics has appointed a staff member as mentor to be available to students. You are always invited to discuss general issues in the physics programme or its modules with this mentor, in addition to usual consultations with your individual lecturers.

For this module your mentor is Dr PH Neethling pietern@sun.ac.za

Course content:

Mechanics

Conservative forces and conservation laws within the Lagrangian formulation of dynamics. Applications to classical systems with gravity. Nonconservative, velocity-dependent forces. Many-particle systems.

Waves & Optics

1. Free oscillations of simple systems
2. Harmonically forced oscillations
3. Free oscillations of systems with many degrees of freedom
4. One dimensional wave motion
5. Interference and diffraction
6. Interference by division of amplitude

Practicals & Tutorials:

Experiments and tutorials will expand upon and complement the lectures. Experiments may include: Studies of forced and damped oscillator, elastic and inelastic collisions, determination of the velocity of light, simple spectroscopic investigations as well as investigations of standing waves. The experimental part of this module is integral to the course. Both the active participation during practicals as well as subsequent reports will be assigned a mark.

Study material:

Prescribed textbook: "Mechanics" (3rd edition) by LD Landau and E.M Lifshitz, Elsevier
Prescribed textbook: **Vibrations and Waves by George C. King**

Assessment:

Methods of Assessments

Continuous Assessment

Mechanics Section (First term): The continuous assessment includes multiple in-class **assignments**, **problem-solving sessions (including the use of Mathematica)**, and at least 1 **practical essay** as well as a **written test and oral exam**.

Waves and Optics Section (Second term): The continuous assessment includes **homework**, **tests**, **tutorial tests** and **practical reports**.

Venue and time of assessment opportunities

See **timetable** on Physics home page as well as official University webpage

Availability of marks:

Papers, assignment and feedback are returned as soon as possible.

Calculation of final mark for the module:

The final mark will be calculated as follows:

Mechanics:

For ½ of final module mark; made up as follows: at least 4 assessments of various types with weights (20% practical, 20% oral exam, 30% written test, 30% other assignments).

Waves and Optics:

For ½ of final module mark; made up as follows: tests and tutorial tests 2/5, homework 2/5, practical 1/5