

12998 – 224 (16) Classical Mechanics (3L, 3P)

2021

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, harmonic oscillator, free and forced linear oscillations with damping, introductory Lagrangian and Hamiltonian dynamics, conservation laws, one-dimensional wave motion with boundary conditions, 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, which are foundations for many calculations in physics. An equally important 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.

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.

Lecturers:

Prof BIS van der Ventel: Mechanics

Tel: (021) 808-3388

E-mail: bventel@sun.ac.za

Office: Room 1019 in the Merensky Physics Building

Dr JN Kriel: Waves & Vibrations

Tel: (021) 808-3658

E-mail: hkriel@sun.ac.za

Office: Room 1014 in the Merensky Physics Building.

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.

The mentor for second year programme and its modules is **Mr. GL Andrews** glandrews@sun.ac.za

Course content:

Mechanics

Conservative forces, conservation laws, non-conservative and velocity-dependent forces. Applications to classical systems with gravity.

Waves & Vibrations

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

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.

First term: All tutorial questions and solutions will be uploaded to SUNLearn. However, the lecturer will be available during the tutorial sessions for face-to-face classes.

Second term: Face-to-face tutorials and practicals.

Study material:

Mechanics: class notes will be provided.

Prescribed textbook: "A Student's Guide to Analytical Mechanics" by J.L. Bohn, Cambridge University Press, 2018. A number of copies of this textbook is available in the Physics library.

Learning opportunities:

Tutorials
Homework

Lectures:

First term: All lectures will be available as video lectures which will be uploaded to SUNLearn. However, the lecturer will be available for face-to-face classes during the formal contact periods.

Second term: Face-to-face lectures, with materials, as appropriate available on SUNLearn. Please observe all relevant protocols, and only come to class if you are without Covid-19 symptoms, and not self-isolating or not quarantined. In these cases contact your lecturer, who will assist with the materials.

Assessment:

Tutorial tests for the first quarter will be online.

Tests for this module are sit-down (not online).

Methods of Assessments

Continuous Assessment

Continuous assessment includes multiple homework assignments, in-class **assignments**, tutorial tests, **problem-solving sessions**, and practical reports. There are also two tests.

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:

50% of total mark for course: Tutorial tests and test covering the work of the first quarter.

Waves and Vibrations:

50% of total mark for course: 25% test, 25% assignments, tutorial tests and practical work.