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

2020

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 Langrangian 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, that 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.

Lecturer:

Prof. KK Müller-Nedebock: Mechanics
Tel: (021) 808-3386 E-mail: kkmn@sun.ac.za
Office: Room 1027 in the Merensky Physics Building

Dr. JN Kriel: Waves & Optics
Tel: (021) 808-3658 E-mail: hkriel@sun.ac.za
Office: Room 1014 in the Merensky Physics Building.

Prof. H Weigel: Mathematical Methods for Physicists
Tel: (021) 808-3378 E-mail: weigel@sun.ac.za
Office: Room 1025 in the Merensky Physics Building

Dr. GW Bosman: Experiments
Tel: (021) 808-2525 E-mail: gwb@sun.ac.za

Office: Room 1028 in the Merensky Physics Building

Mr. G Andrews: Experiments
Tel: (021) 808-2522 E-mail: glandrews@sun.ac.za
Office: Room 1015 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.

For this module your mentor is Dr P. Southey southey@sun.ac.za

Course content:

Mechanics
Conservative forces and conservation laws within the Lagrangian formulation of dynamics. Applications to classical systems with gravity, scattering and Rotational dynamics.

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, and 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.

Mathematical Methods for Physicists:

We recommend that all second-year (and third-year) physics students attend sessions in mathematical methods for physics. During these sessions topics including complex numbers, eigenanalysis of matrices, differential equations, introductory vector calculus, and others, that are particularly relevant to physicists will be covered. The sessions are intended to strengthen the connection to physics of these tools which you have encountered or will encounter in your mathematics or applied mathematics modules. Sessions will occur every two weeks at times to be determined. Students' performance in these sessions will not count towards the module's final mark.

Study material:

Prescribed textbook: "*A Student's Guide to Analytical Mechanics*" by J.L. Bohn, Cambridge University Press, 2018.

Assessment:

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:
25% test, 25% assignments, tutorial tests and practical work.

Waves and Optics:
25% test, 25% assignments, tutorial tests and practical work.