

# University of Pretoria Yearbook 2025

## Waves, thermodynamics and modern physics 255 (PHY 255)

<b>Qualification</b>	Undergraduate
<b>Faculty</b>	Faculty of Natural and Agricultural Sciences
<b>Module credits</b>	24.00
<b>NQF Level</b>	06
<b>Programmes</b>	BEd in Senior Phase and Further Education and Training Teaching BSc in Applied Mathematics BSc in Chemistry BSc in Chemistry 4-year programme BSc in Mathematics BSc in Mathematics 4-year programme BSc in Meteorology BSc in Meteorology 4-year programme BSc in Physics BSc in Physics 4-year programme
<b>Service modules</b>	Faculty of Education
<b>Prerequisites</b>	[PHY114 and PHY124] or [PHY171] or [PHY143 and PHY153 and PHY163] and [WTW211#] and [WTW218#]
<b>Contact time</b>	1 practical per week, 4 lectures per week, 2 discussion classes per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Physics
<b>Period of presentation</b>	Semester 1

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## Module content

### Vibrating systems and waves

Simple harmonic motion (SHM). Superposition (different frequencies, equal frequencies). Perpendicular vibrations (Lissajous figures). Damped SHM. Forced oscillations. Resonance. Q-value. Transverse wave motion. Plane wave solution using method of separation of variables. Reflection and transmission at a boundary. Normal and eigenmodes. Wave packets. Group velocity.

### Modern physics

Special relativity: Galilean and Lorentz transformations. Postulates. Momentum and energy. 4 vectors and tensors. General relativity. Quantum physics. Failure of classical physics. Bohr model. Particle-wave duality. Schrödinger equation. Piece-wise constant potentials. Tunneling. X-rays. Laser. Nuclear physics: Fission. Fusion. Radioactivity.

### Heat and thermodynamics

Heat. First Law. Kinetic theory of gases. Mean free path. Ideal, Clausius, Van der Waals and virial gases. Entropy. Second Law. Engines and refrigerators. Third Law. Thermodynamic potentials: Enthalpy Helmholtz and Gibbs free energies, Chemical potential. Legendre transformations (Maxwell relations). Phase equilibrium. Gibbs phase rule.

### Modelling and simulation (practical sessions)

Introduction to programming in a high level system: Concept of an algorithm and the basic logic of a computer programme. Symbolic manipulations, graphics, numerical computations. Applications: Selected illustrative examples.

### Error Analysis (practical sessions)

Experimental uncertainties. Propagation of uncertainties. Statistical analysis of random uncertainties. Normal distribution. Rejection of data. Least-squares fitting. Covariance and correlation.

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## General Academic Regulations and Student Rules

The [General Academic Regulations \(G Regulations\)](#) and [General Student Rules](#) apply to all faculties and registered students of the University, as well as all prospective students who have accepted an offer of a place at the University of Pretoria. On registering for a programme, the student bears the responsibility of ensuring that they familiarise themselves with the General Academic Regulations applicable to their registration, as well as the relevant faculty-specific and programme-specific regulations and information as stipulated in the relevant yearbook. Ignorance concerning these regulations will not be accepted as an excuse for any transgression, or basis for an exception to any of the aforementioned regulations. The G Regulations are updated annually and may be amended after the publication of this information.

## Regulations, degree requirements and information

The faculty regulations, information on and requirements for the degrees published here are subject to change and may be amended after the publication of this information.

## University of Pretoria Programme Qualification Mix (PQM) verification project

The higher education sector has undergone an extensive alignment to the Higher Education Qualification Sub-Framework (HEQSF) across all institutions in South Africa. In order to comply with the HEQSF, all institutions are legally required to participate in a national initiative led by regulatory bodies such as the Department of Higher

Education and Training (DHET), the Council on Higher Education (CHE), and the South African Qualifications Authority (SAQA). The University of Pretoria is presently engaged in an ongoing effort to align its qualifications and programmes with the HEQSF criteria. Current and prospective students should take note that changes to UP qualification and programme names, may occur as a result of the HEQSF initiative. Students are advised to contact their faculties if they have any questions.