PHYS 110: Mechanics, Optics and Thermal Physics

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a) Academic Quality of the Module

1. Title of module: Mechanics, Optics and Thermal Physics

2. **Module code:** Physics 110

3. **NQF Level:** 5 (1st year, 1st semester)

4. **Credit value of the module:** 16

5. **Field / sub-field:** Physical, mathematical, computer & life sciences / Mechanics, Optics and Thermal Physics.
Discipline PHYSICS

6. School, Faculty and Centre from which the module is offered
School Of Chemical and Physical Sciences, Faculty Of Science And Agriculture, Pietermaritzburg

7. Programme(s) on which the module is offered and the status of the module on each programme
PHYSICS: Computational Physics

8. 8.1 Date of submission (to Faculty/ College Board)

8.2 Date of 1st offering: 2000
8.3 Date of evaluation and review

9. Purpose of the module

The purpose of this module is to introduce some of the basic laws of mechanics, optics and thermal physics. The content is sufficiently general to cater for students having diverse educational requirements. Mathematical complexity is kept to a minimum, but students will need to be reasonably proficient in matric algebra, geometry and trigonometry. The course is heavily biased towards applying new knowledge in problem solving.

The fundamental principles of scientific report writing, the proper presentation of experimental results and the ability to make the best use of measuring apparatus is taught in the laboratory component. Students also have the opportunity to verify experimentally many of the laws introduced in lectures.

The content of this module is essential for Physics 112 for which it serves as a co-requisite.

10. Statement of specific learning outcomes for the module. On completion of this module the student should be able to:

1. Outline in a simple way the historical development of classical mechanics,
2. Explain the essential features of newton's laws, set up and solve the equation of motion for constant acceleration,
3. Apply the laws of hydrostatics,
4. Apply the conservation laws of classical mechanics to simple physical systems,
5. Apply the conditions for equilibrium under coplanar forces,
6. Understand the difference between geometrical and physical optics,
7. Determine the position of images formed by mirrors and thin lenses,
8. Determine the conditions for (1) constructive/destructive interference and (2)
9. Diffraction maxima/minima in various situations,
10. Calculate the effect of (1) heat in changing the temperature or phase of a system and (2) temperature in changing the dimensions of a solid or liquid,
11. Calculate the transfer of heat by conduction and by radiation,
12. Apply the first law of thermodynamics to simple systems,
13. make accurate measurements of length, mass and time using suitable instruments,
14. tabulate experimental results and perform calculations with measured data, and
15. Verify experimentally some important physical laws.

11. List of content topics

1. Vectors and scalars. Adding and subtracting vectors. Resolving vectors into components.
2. Kinematics. Motion with constant acceleration.
3. Circular motion.
4. Newton = s laws of motion and the law of universal gravitation.
5. Kinetic energy and the work-energy theorem, potential energy and conservation of energy.
6. Momentum and impulse. Conservation of momentum. Elastic and inelastic collisions.
7. Rotational kinematics and dynamics. Conservation of angular momentum.
8. Conditions for equilibrium.
9. Hooke=s law, elasticity and simple harmonic motion.
10. Archimedes principle and some basic facts of hydrostatics.
11. The electromagnetic spectrum and the wave nature of light.
12. The laws of reflection and refraction. Applications to plane and spherical mirrors; thin lenses and prisms.
13. Interference effects: Young's double-slit; Newton's rings; thin films.
14. Diffraction effects: Single slit; diffraction grating.
15. Temperature, heat and calorimetry.
16. Thermal expansion of solids, liquids and gases.
17. Conduction and radiation of heat.
18. Elementary kinetic theory.
19. Work and internal energy; the first law of thermodynamics.
20. Experimental work includes: use of basic measuring instruments; measurements of the acceleration due to gravity; measurements of relative density; ray tracing experiments with lenses and prisms; experiments on interference and diffraction; measurement of the focal lengths of lenses; experimental test of Boyle's law and Charle's law.

12. Types of delivery and estimated notional study hours per type

Student activity	Number of notional study hours (for the whole module)
Lectures	36
Practicals	36
Tutorials	9
Field-trips	

Placements		
Tests / exams	8	
Other (specify)		
Sub-total: No. of contact hours	89	
Resource-based learning	26	
Self-directed study		
Study on assignments	15	
Exam preparation	30	
Other (specify)		
Sub-total: No. of notional self-study hours	71	
Total: No. of notional study hours required to complete the module		160

13. Teaching-learning methods used on the module

1. Lectures – formal note taking of material.
2. Tutorials – interactive problem solving.
3. Practicals- small group skills learning.

14. Statement of assessment criteria against which the specific learning outcomes for the Module are assessed

Learning outcomes (a) – (l) are assessed in two ¾ hour tests and one 3 hour exam.

Learning outcomes (m) – (o) are assessed through performance in the laboratories and associated report writing, and in one 1½ hour test and a 2 hour exam.

15. Methods of assessment to be used in the module (indicate the weighting for each method)

Class record (2 theory tests, 1 prac test and prac reports)	25%
Practical exam	25%
Theory exam	50%

16. What educational provision is made on the module to support students from diverse /disadvantaged backgrounds?

Wherever possible simple English is used in both the written and spoken word.

1 Problem sets taken from American and European textbooks have been re-written in terms of a South African context.
2 Students may elect to attend Saturday-morning revision sessions; these classes are aimed at those who are weak in physics.
3 Before the first test, examination technique is discussed in detail with the students thereby giving a clear idea of what is expected from them.
4 Before the prac exam, the laboratory is open for five afternoons of optional revision. Staff and student demonstrators are in attendance.
5 Staff members have an open-door policy and students are free to consult staff at any stage.