

10590 – 712 (8) Lagrange and Hamilton Mechanics (1.5L, 1.5L)

2022

Course summary:

Degrees of freedom, generalised coordinates, Lagrange's equations of the first and second kind, applications, small oscillations, variational calculus, Hamilton's principle, Noether's theorem.

Module relevance in programme:

In Physics 712 the Lagrange and Hamilton formulations of Classical Mechanics are studied. It is one of the core formalisms which every Physics student should master. All relevant equations are derived from first principles. The examples are mostly taken from mechanical systems. This course also provides a theoretical foundation for more advanced studies in field theory. The Lagrange function or density, introduced in this course, plays a critical role in the path integral formulation of physical systems which is studied in Physics 721 and Physics 719. This course is also very important for Physics 755 where the concept of canonical quantization in field theory is introduced.

Outcomes of course:

This course trains the student in the techniques and use of Lagrangian- and Hamiltonian Mechanics. Legendre transformations and the variational principle.

Emphasis is placed on problem solving. This course is the basis of all further courses in classical mechanics and also lays the foundation for more advanced courses in quantum mechanics.

Lecturer:

Prof BIS Van der Ventel

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Mentor:

The Department of Physics has appointed a staff member as mentor for each year of its physics programme to be available to students for consultation. Students should feel free to discuss general issues related to the physics programme or specific modules in the programme with the relevant mentor, in addition to usual consultations with their individual lecturers of modules.

The mentor for the Honours programme and its modules is **Dr P Southey** (southey@sun.ac.za)

Course content:

The formulation of classical mechanics from a very general viewpoint in terms of generalized coordinates etc; conservation laws and their relationship to the Hamilton and Lagrange formalisms and symmetries; the analysis and approximation of many-body systems through normal modes; Lagrange and Hamilton mechanics as a formal basis of quantum mechanics.

Practical (Tutorials):

Thursday 14h00 till 17h00

Study material

Notes will be uploaded via SUNLearn to all students
Additional textbooks will be placed on reserve in the Physics library

Learning opportunities:

Lectures and Tutorials (both face-to-face)

Assessment:

Methods of Assessments

Continuous Evaluation: One test, homework assignments and tutorials tests

Venue and time of assessment opportunities

To be announced in class.

Availability of marks:

In reasonable time

Calculation of final mark for the module:

Final mark = $0.3 \times (\text{Tutorial tests}) + 0.3 \times (\text{Assignments}) + 0.4 \times (\text{Final test})$