理 學 院
108 學年度第一學期模組化課程

分析力學習題演練
Exercise in Analytical Mechanics

授課教師：

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課程類別	學分數	選必修	開課人數	注意事項
講義+演習	1	選修	15	Lecture in English 本課程英文授課

先修課程或先備能力：

建議修課年級：

大二、大三、大四、碩士班

建議修課學生背景：

理學院、工學院

教學方法：

講授 80%，課堂練習 20%

評量方式：

問題考試 50%，其他 50%

補充說明：
Final exam： 4-5:30pm on Friday June 28th, 2019

The other 50% will be in class exercise problems. Four of them, 12.5% each.

學習規範：

無

課程概述：

For most of the students in physical sciences and engineering, analytical mechanics tends to appear as an abstract subject. In this proposed course, we would like to master basic Lagrangian and Hamiltonian mechanics by "solving" standard (senior to graduate level) analytical mechanics problems. A compact in-class exercise problem will be prepared every day (plans to return the next day).

~NEXT~

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課程進度：

Period	Hours	Syllabus
6/24	14:00-17:35	Variational principle and Lagrangian mechanics.
6/25	14:00-17:35	Lagrangian mechanics to Hamiltonian mechanics.
6/26	14:00-17:35	Canonical transformation and Action-Angle variables.
6/27	14:00-17:35	Perturbation theory based on Hamiltonian formalism
6/28	14:00-17:40	Introduction to Hamiltonian chaos.

課程學習目標：

1. Learn backgrounds (why they are needed) and basic theory of Lagrangian and Hamiltonian Mechanics.

2. Become familiar with Lagrangian and Hamiltonian mechanics by solving a few paradigmatic example problems.

3. Understand that analytical mechanics constitute an underlying structure of physical sciences (quantum mechanics and dynamical systems theory, for example).

課程的重要性、跨域性與時代性：

Analytical mechanics constitute an underlying structure of physical sciences. Quantum mechanics, for example, is built upon Hamiltonian mechanics. However, there are not many opportunities to learn analytical mechanics systematically in particular for non-physics major students. Departure from Newtonian mechanics can provide the students with much wider view of analytical techniques.

[1] Completeness :

The minimum required knowledge (how to reach equation of motion from Lagrangian and Hamiltonian, canonical transformation to action-angle variables in a cyclic system) will be provided.

[2] Focus of discussions:

We focus on the very essence of Lagrangian and Hamiltonian mechanics (see the completeness part) so that the students can immediately move on to related disciplines such as quantum mechanics and dynamical systems theory.

[3] Cross-disciplinary nature:

Mechanics is _the_ basic of all the physical sciences and engineering. Application of Lagrangian/Hamiltonian mechanics is not limited to quantum mechanics (which then becomes the basis of photonics, solid state mechanics, and electronics) and dynamical systems theory (chaos theory for example); Nowadays, fluid mechanics and wave dynamics, for example, are described by Hamiltonian formalism. Departure from traditional Newtonian mechanics can provide the students (in Science, Engineering, and possibly in Medicine) with much versatile analytical techniques.

[4] Timeliness/Contemporariness:

Quite antithetical to "timeliness or contemporariness", analytical mechanics has been a ubiquitous analytical tool (as proven in the historical development of physical and mathematical sciences; celestial mechanics, quantum mechanics, differential geometry, and theory of relativity, to name a few) for many disciplines in physical sciences and engineering.

其他備註:

參考書目：

Landau and Lifshitz “Mechanics”, Chap.1 and Chap.7.