

Mechanics

1 Course Description

Code: 321001

Title: Mechanics

Course type: compulsory course

Total class hours: 68

Credit: 4

Duration: 2 semesters

Restricted to: undergraduates majoring in Physics

Introduction to the course:

Mechanics is a basic course for studying the laws of mechanical movement. It is widely applied in the field of science and technology, such as precision instrument, large-scale engineering, rocket launching and artificial satellite. Mechanics is the foundation for all branches of Physics, and it is the first basic course for Physics undergraduates after admission. To study Physics, it is important to learn Mechanics well in the beginning. This course consists of three parts: Mechanics theories, solving typical Mechanics problems and spatial-temporal structure. The Mechanics theories include the classification of basic knowledge fields of Physics and curriculum system, the brief history of Physics development, the basic motion law and derived law of point mass. Typical problems include the rigid body, the fluid, vibration and wave motion. The spatial-temporal structure contains brief introductions to Special Relativity, to General Relativity and to Cosmology and Astrophysics.

Objectives:

Mechanics is a basic course for studying the laws of mechanical movement. Through this course, students can acquire knowledge, and more importantly, master the subject system and the methods of solving problems. This course will help students to develop logical thinking and to cultivate the ability of accepting new ideas, laying a solid foundation for subsequent courses. The basic teaching requirement of this course is to clarify the logical structure and knowledge system of Mechanics. Through resources such as the application cases, 55 AR demos, 60 animation demos, 51 video recordings, and the audio recordings of biographies of 25 scientific giants in the field of mechanical movement, students will appreciate the beauty of Mechanics and the truth of human civilization, as well as master the general methods of solving mechanical problems. Furthermore, a brief history of the development of Physics and some concepts in modern Physics are incorporated into the relevant chapters to stimulate students' thinking and cultivate their ability to accept new ideas.

Assessment:

Assessment will be based on participation, midterm examination (closed-book) and final examination (closed-book).

Course type: compulsory course

Textbook and references:

Textbook:

Mechanics (4th edition), Higher Education Press, 2019, Zhang Hanzhuang

References:

Mechanics, Higher Education Press, 2002, Zheng Yongling

Mechanics, Higher Education Press, 1997, Qi Anshen

Mechanics, Higher Education Press, 2004, Zhao Kaihua

Mechanics and Theoretical Mechanics, Science Press, 2008, Yang Guozhen

Online resources:

<http://zhanghz.jlu.edu.cn>

2.Contents of each chapter and allocation of class hours

Part	Chapter	Objective	Allocation of class hours	
			Theory lectures	Seminars on cases
Module 1: Introduction	Introduction	Giving students a general idea of the structure and brief history of Physics	2	0
Module 2: Basic movement laws of point mass	Chapter 1: Kinematics of point mass	To grasp basic parameters of the motion of point mass and their relationships, to learn the decomposition in the coordinate system for operation, and to master the relative relation of velocity and acceleration.	4	2
	Chapter 2: Dynamics of point mass in the inertial system	To know the establishment process of Newton's Law of Gravitation, Newton's Three Laws and their application in practice.	4	2
	Chapter 3: Dynamics of point mass in non-inertial system	Extending the dynamic equation of point mass in the inertial to the non-inertial system. Explaining the nature of the inertial force, and its usage in daily life.	2	2
Part 2: Motion theorems and conservation laws of point mass group	Chapter 4: Momentum theorem and conservation law of point mass group	The relation between the time accumulation effect of external force and the momentum of point mass system is given and applied to solve practical problems.	4	2
	Chapter 5: Work-energy	The relation between the space accumulation effect of external force and the kinetic energy or mechanical energy of point mass system is given	4	2

	principle and conservation law of point mass group	and applied to solving practical problems.		
	Chapter 6: Angular momentum theorem and conservation law of particle point mass group	The theorem of rotation effect caused by external torque is given and applied to solving practical problems.	4	2
Part 3: The motion of special point mass groups and general motion forms of point mass groups	Chapter 7: Rigid body	Applying basic laws of Mechanics to a special point mass system-rigid body, and mastering basic motion laws of rigid body.	6	2
	Chapter 8: Fluid	Applying basic laws of Mechanics to a special point mass system-fluid, and mastering basic motion laws of fluid.	2	2
	Chapter 9: Vibration	Applying basic laws of Mechanics to a general form of motion-vibration, and mastering basic motion laws of vibration.	4	2
	Chapter 10: Fluctuation	Applying basic laws of Mechanics to a general form of motion-mechanical waves, and mastering basic motion laws of mechanical waves.	6	2
Part 4: Spatial-temporal structure	Chapter 11: Special relativity	Understanding the limitations of the classical spatial-temporal view, giving basic assumptions and establishing modern spatial-temporal transformation. Thus, deriving the kinematic phenomena in modern spatial-temporal view and Dynamics of point mass.	4	0
	Chapter 12: General relativity and introduction to cosmology	Analyzing problems left by the special relativity and giving solutions, therefore arriving at the relationship between gravity and the geometry of space-time. Thus, deriving the phenomena predicted by general relativity, and fundamental phenomena and laws of cosmology.	2	0

Written by: Zhang Hanzhuang

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Reviewer: