# 课程详述
## COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

| | | |
|---|---|---|
| 1. | 课程名称 Course Title | 分析力学 Analytical Mechanics |
| 2. | 授课院系<br>**Originating Department** | 物理系 Department of Physics |
| 3. | 课程编号<br>**Course Code** | PHY205-15 |
| 4. | 课程学分 Credit Value | 3 |
| 5. | 课程类别<br>**Course Type** | 专业基础课 Major Foundational Courses |
| 6. | 授课学期<br>**Semester** | 秋季/春季 Fall |
| 7. | 授课语言<br>**Teaching Language** | 中英双语 English & Chinese |
| 8. | 授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师）<br>**Instructor(s), Affiliation& Contact**<br>（**For team teaching, please list all instructors**） | 1. 夏钶，教授，物理系<br>台州楼 502-11<br>XIA Ke, Professor, Department of Physics<br>Rm.502-11, Taizhou Hall<br>xiak@sustech.edu.cn<br><br>2. 梅佳伟，助理教授，物理系<br>第二科研楼 123<br>MEI Jiawei, Assistatn Professor, Department of Physics<br>Rm. 123, Research Building 2，<br>meijw@sustech.edu.cn<br>0755-8801-8217 |
| 9. | 实验员/助教、所属学系、联系方式<br>**Tutor/TA(s), Contact** | 待公布 To be announced |
| 10. | 选课人数限额(可不填)<br>**Maximum Enrolment**<br>（**Optional**） | |

| 11. | 授课方式<br>Delivery Method | 讲授<br>Lectures | 习题/辅导/讨论<br>Tutorials | 实验/实习<br>Lab/Practical | 其它(请具体注明)<br>Other（Please specify） | 总学时<br>Total |
|-----|-----|-----|-----|-----|-----|-----|
| | 学时数<br>Credit Hours | 48 | | | 复习、考试（2周，不占用<br>上课时间） | 48 |

| 12. | 先修课程、其它学习要求<br>Pre-requisites or Other Academic Requirements | 大学物理 B(下) General Physics B (II) PHY105B |
|-----|-----|-----|
| 13. | 后续课程、其它学习规划<br>Courses for which this course is a pre-requisite | 本课程为物理专业基础课，是大部分专业核心课的先修课程。<br>This course is a major basic course, a pre-requisite for most major core courses of physics. |
| 14. | 其它要求修读本课程的学系<br>Cross-listing Dept. | |

## 教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程讲授经典力学的基本概念和基本方法，包括运动方程，对称性与守恒律，运动方程的积分，中心力场问题，碰撞问题，微振动，刚体运动，正则方程等。
In this course, we introduce the fundamentals of classical mechanics, including: equation of motion, symmetry and conservation, integration of equation of motion, central field problem, collision, small oscillation, the motion of rigid body, the canonical equations, etc.

16. 预达学习成果 Learning Outcomes

修完本课程，要求学生掌握拉格朗日力学与哈密顿力学的基本概念和框架，并能灵活运用于分析处理各种力学系统。
Students passing this course should understand the Lagrange's and Hamilton's form of analytical mechanics and be able to use the skills to deal with various mechanical problems.

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
**Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)**

1. 运动方程

1. The equation of motion

第一周：广义坐标，最小作用量原理

Week 1: Generalized coordinates, The principle of least action

第二周：伽利略相对性原理，自由粒子拉式量，质点组拉式量

Week 2: Galileo's relativity principle, The Lagrangian for a free particle, The Lagrangian for a system of particles

2. 守恒律

2. Conservation laws

第三周：能量，动量，质心

Week 3: Energy, Momentum, Centre of Mass

第四周：角动量，力学相似性

Week 4: Angular momentum, Mechanical similarity

3. 运动方程的积分

3. Integration of the equation of motion

第四周：一维运动，根据振动周期决定势能

Week 4: Motion in one dimension, Determination of the potential energy from the period of oscillation

第五周：约化质量，中心立场中的运动，开普勒问题

Week 5: The reduced mass, Motion in a central field, Kepler's problem

4. 质点碰撞

4. Collisions between particles

第 6 周：粒子分解，弹性碰撞，散射

Week 6: Disintegration of particles, Elastic collisions, Scattering

第 7 周：卢瑟福公式，小角散射

Week 7: Rutherford's formula, Small-angle scattering

5. 微振动

5. Small oscillations

第 7 周：一维自由振动

Week 7: Free oscillations in one dimension

第 8 周：强迫振动，多自由度系统振动，阻尼振动

Week 8: Forced oscillations, Oscillations of systems with more than one degree of freedom, Damped oscillations

第 9 周：有摩擦的强迫振动，参数共振，非简谐振动

Week 9: Forced oscillations under friction, Parametric resonance, Anharmonic oscillations

6. 刚体运动

6. Motion of a rigid body

第 10 周：角速度，惯量张量，刚体的角动量

Week 10: Angular velocity, The inertia tensor, Angular momentum of a rigid body

第 11 周：刚体运动方程，欧拉角，欧拉方程

Week 11: The equations of motion of a rigid body, Eulerian angles, Euler's equations

第 12 周：非对称陀螺，刚体接触，非惯性系中的运动

Week 12: The asymmetrical top, Rigid bodies in contact, Motion in a non-intertial frame of reference

7. 正则方程

7. The canonical equations

第 13 周：哈密顿方程，罗斯函数，泊松括号

Week 13: Hamilton's equations, The Routhian, Poisson brackets

第 14 周：作为坐标函数的做用量，莫培督原理，正则变换

Week 14: The action as a function of the coordinates, Maupertuis's principle, Canonical transformations

第 15 周：刘维尔定理，哈密顿-雅克比方程，分离变量

Week 15: Lionville's theorem, The Hamilton-Jacobi equation, Separation of the variables

第 16 周：绝热不变量，正则变量，绝热不变量守恒的准确度，条件周期运动

Week 16: Adiabatic invariables, Canonical variables, Accuracy of conservation of the adiabatic invariant, Conditionally periodic motion

**18.** **教材及其它参考资料 Textbook and Supplementary Readings**

指定教材 (Textbook): Mechanics, Third Edition, L. D. Landau and E. M. Lifshitz, 世界图书出版社
推荐参考书 (References):
(1) Classical Mechanics, Third Edition, H. Goldstein, 高等教育出版社
(2) Classical Mechanics: The Theoretical Minimum，Leonard Susskind，Penguin Books
(2) 理论力学教程，第三版，周衍柏，高等教育出版社

## 课程评估 ASSESSMENT

**19.**

| 评估形式 Type of Assessment | 评估时间 Time | 占考试总成绩百分比 % of final score | 违纪处罚 Penalty | 备注 Notes |
|---|---|---|---|---|
| 出勤 Attendance | | | | |
| 课堂表现 Class Performance | | | | |
| 小测验 Quiz | | 20% | | |
| 课程项目 Projects | | | | |

| 平时作业<br>Assignments | | 20% | | |
|---|---|---|---|---|
| 期中考试<br>Mid-Term Test | | | | |
| 期末考试<br>Final Exam | | 60% | | |
| 期末报告<br>Final Presentation | | | | |
| 其它（可根据需要改写以上评估方式）<br>Others (The above may be modified as necessary) | | 可根据需要改写以上评估方式<br>The above may be modified as necessary | | |

20.　　　记分方式 GRADING SYSTEM

☑ A. 十三级等级制 Letter Grading
☐ B. 二级记分制（通过/不通过） Pass/Fail Grading


## 课程审批 REVIEW AND APPROVAL

21.　　　本课程设置已经过以下责任人/委员会审议通过
　　　　This Course has been approved by the following person or committee of authority

物理系教学指导委员会
Education Instruction Committee of Physics department