General Physics (I)
Classic Mechanics and Thermodynamics

Fall 2022

INSTRUCTOR: Congjun Wu (Office: E4-235)

Email: wucongjun@westlake.edu.cn

Time/Place: Monday and Wednesday Classes 2-3 (8:50 -10:35), E10-212

Instructor Office hour: 1:00-2:00pm, Tuesday (office: E4-235)

Course webpage: https://wucj.lab.westlake.edu.cn/teach/GeneralPhysicsI/GeneralPhysicsI.html

TA: Ke, Chenhang; Wang, Yue (office: E4-204)

Recitation: Friday Class 12 E10-215 (19:20-20:05)

TA office hour: 1:00-2:00pm Thursday (office: E4-204)

Text Books:

1. R. P. Feynman, *Feynman lecture notes of physics (I)*, New Millennium edition (January 4, 2011).

Reference Books:

1. C. Kittel, W. D. Knight, & M. A. Ruderman, Mechanics: Berkeley Physics Course, McGraw-Hill Book Company; Volume 1 (January 1, 1965).
2. Heat and Thermodynamics, M. W. Zemansky, R. H. Dittman, McGraw-Hill College; Subsequent edition (November 1, 1996).

Grade Policy:

25% Problem sets; 30% Midterm; 30% Final exam; 15% Labs.

Please note: In addition to this class, every student is required to also enroll in a corresponding lab section. The lab grade will factor into the grade for the class. The grade you receive for the lab course will be the same as the grade for the lecture course. In addition, if one fails the lab, they also fail the class.

Homework Assignments:

Homework will be assigned every week. Points will be deducted if assignments are submitted late depending on how late they are.

Class Schedule

Part I: Classic Mechanics

1. **Fundamental concepts**

   Lecture 1: Perspectives of physics, matter and space-time scales

   Lecture 2: Vectors, scalar and cross products, rotation, eigenvalues — *elements of Linear algebra*

   Lecture 3: Motion and Zeno's paradox: displacement, velocity, acceleration — *elements of Calculus*

   Lecture 4: Galilean relativity principle, space-time symmetries

2. **Newtonian mechanics and conservation laws**

   Lecture 5: Newton's laws of motion and gravitation, historical developments of Newtonian mechanics

   Lecture 6: Projectile motion, harmonic oscillation — *elements of differential equations*

   Lecture 7: Energy conservation — work and potential

   Lecture 8: Momentum conservation — rocket

   Lecture 9: Angular momentum conservation, Kepler's prolem

   Lecture 10: Forced harmonic oscillator, resonance, transient

   Lecture 11: Coupled oscillators

   Lecture 12: Momentum and angular momentum of multi-particle systems

   Lecture 13: Fixed axis rotation, moment of inertial, rolling

   Lecture 14: 3D rotation, gyroscope

3. **More developments**

   Lecture 15: Wave equation – *elements of partial derivatives and partial differential equations*

   Lecture 16: Normal modes – *elements of Fourier analysis*

   Lecture 17: Shock wave, water wave (tsunami), light wave

   Lecture 18: Wave interference

   Lecture 19: Wave diffraction

Part II: Thermodynamics

4. Lecture 20: Perspectives of thermodynamics – Emergentism

   Lecture 21: The 1st law (energy) – the impossibility of the Perpetual Motion Machine of the first kind

Lecture 22: The 2nd law (entropy) – the impossibility of the Perpetual Motion Machine of the 2nd kind

Lecture 23: Free energy, Gibbs function, maximal work

Lecture 24: Applications of thermodynamics – specific heat, cooling, rachet, etc

Lecture 25: Phase transition, van der Waals theory, Clausius-Clapeyron equation

Lecture 26: Application of kinetic theory – diffusion, drift, conductivity

Lecture 27: The statistical meaning of entropy, Boltzmann distribution

Lecture 28: Information entropy

Part III: Supplemental Materials

5. Lecture* 1: LC circuit — analogous to mechanical oscillators

   Lecture* 2: Fermat principle of geometric optics –*elements of variational methods*

   Lecture* 3: Maupertuis's principle, Catenary, and Brachistochrone curve

   Lecture* 4: Random work, normal distribution, Bayesian statistics, Markov v.s Martingale — *elements of Probability*