

### 普通物理 (4,0) General Physics

概論(含數量級估計、測量值的有效數字與誤差表示)、向量內積、外積複習與微分運算、力與運動、牛頓運動定律、功與能、機械能守恆、線動量守恆、轉動慣量、剛體定軸旋轉、純滾動、角動量、靜力學平衡、溫度與熱力學第零定律、熱力學第一定律、理想氣體動力論、熱力學第二定律、卡諾循環與熱力學溫標。

(時間分配: 力學 11-12 週; 熱力學 3-4 週)

Introduction (including order of magnitude estimation, significant figures of measured values and error representation), vector inner product, outer product review and differential operations, force and motion, Newton's laws of motion, work and energy, conservation of mechanical energy, conservation of linear momentum, moment of inertia, rigid body rotation about a fixed axis, pure rolling, angular momentum, static equilibrium, temperature and the zeroth law of thermodynamics, the first law of thermodynamics, kinetic theory of ideal gases, the second law of thermodynamics, Carnot cycle and thermodynamic temperature scale.

(Time allocation: Mechanics 11-12 weeks; Thermodynamics 3-4 weeks)

### 普通物理 (0,4) General Physics

振盪與波動、靜電場 (高斯定律)、電位、電容及介電質、靜磁場 (Biot-Savart 定律與安培環路定律)、電磁感應 (法拉第感應定律)、電感、馬克斯威爾方程式、近代物理 (普朗克量子原理、物質波、波-粒二象性、定態薛丁格波動方程式、對應原理)。

(時間分配: 振盪與波動 3-4 週; 電磁學 8-9 週; 近代物理 2-3 週)

Oscillation and wave, electrostatic field (Gauss's law), electric potential, capacitance and dielectric, static magnetic field (Biot-Savart law and Ampere's circuit law), electromagnetic induction (Faraday's law of induction), inductance, Maxwell's equations, modern physics (Planck's quantum principle, matter wave, wave-particle duality, stationary Schrödinger wave equation, correspondence principle).

(Time allocation: Oscillation and wave 3-4 weeks; Electromagnetism 8-9 weeks; Modern physics 2-3 weeks)

### 基礎物理數學(0,2) Fundamental Mathematical Physics

正交曲線坐標系(圓柱座標系、球座標系)、向量分析(向量場、梯度、散度及散度定理、旋度及斯托克斯定理)、常係數常微分方程式(一階、二階微分方程式)、 $\delta$ -函數與 Levi-Civita 符號。

Orthogonal curvilinear coordinates (Cylindrical coordinates, Spherical coordinates), Vector analysis

(Vector field, Gradient, Divergence and Divergence theorem, Curl and Stokes' theorem), Ordinary differential equations with constant coefficients (First-order, Second-order differential equations), Delta function and Levi-Civita symbol.

### 計算機概論 (E1173) (0,3) Introduction To Computers

基本的Linux操作以及指令、Fortran的宣告以及基本運算、流程的控制、迴圈、輸出與輸入、檔案、陣列、副程式與函數、繪圖軟體學習(Gnuplot, pgplot, IDL, Matlab 由授課老師決定)。

### AI數值方法 (E0768) (2,0) Numerical Methods and Artificial Intelligence (I)

學生將使用 Python 學習數值技術來解決涉及積分、內插法、線性代數等常見的物理問題，並利用常見的人工智慧及機器學習的方法來增加解決問題的效率。

Students will use Python to implement and apply numerical techniques to solve problems in integration, interpolation, ordinary differential equations, and linear algebra. They will also learn to enhance problem-solving efficiency using machine learning and AI-related techniques.

### 物理數學 (3,0) Mathematical Physics

常微分方程式及邊界值問題，矩陣及本徵值問題，傅利葉分析，拉普拉斯轉換。

Ordinary differential equation with boundary value problems, Matrices and Eigen-value problems, Fourier analysis, Laplace transform.

### 電磁學 (S0338) (3,3) Electromagnetism

向量分析、靜電學、電位能之計算、物質內之靜電場、靜磁學、物質內之靜磁學、電動學、電磁波。

Vector Analysis, Electrostatics, Special Techniques for Calculating Potentials, Electrostatic fields in Matter, Magnetostatics, Magnetostatics field in Matter, Electrodynamics, Electromagnetic Waves.

### 力學 (S0003) (0,3) Mechanics

牛頓定律、守恆定律、線性振動、重力、變分法、拉格蘭及漢米爾頓力學。

Newton's Laws, Conservation Laws, Oscillations, Gravitation, Some Methods in the Calculus of Variations, Lagrangian and Hamiltonian Dynamics.

### 光學 (S0084) (3,0) Optics

光的性質、波動光學、幾何光學、光的干涉、相干性、光的偏振、光的繞射。 Nature of Light, Geometrical Optics, Wave Optics, Interference, Coherence, Polarization, Diffraction.

### 量子物理 (S0312) (3,3) Quantum Physics

普朗克的黑體輻射理論，光電效應，康普吞效應，物質波，原子的各種模型，薛丁格的量子力學理論，薛丁格方程式-簡單例題，薛丁格方程式-氫原子，斯特恩和格拉赫實驗，自旋和軌道交互作用，塞曼效應，多電子的原子，分子。

Planck's Theory of Blackbody Radiation, The Photoelectric Effect, The Compton Effect, Matter Waves, Different Models of the Atom, Schrodinger's Theory of Quantum Mechanics, Time Independent Schrodinger Equations for Simple Examples, Time Independent Schrodinger Equations for Hydrogen Atom, The Stern-Gerlach Experiment, The Spin-Orbit Interaction, The Zeeman Effect, Multielectron Atoms, Molecules.

### 熱力學 (S0434) (0,3) Thermodynamics

溫度及熱力學第零定律，簡單熱力學系統，功，熱及熱力學第一定律，理想氣體動力論，熱力學第二定律，卡諾循環與熱力學溫標，熵，純物質的相圖，一階與二階相變，統計力學簡介(包括: 正則系綜的配分函數，馬克斯威爾-玻茲曼分布，費米-狄拉克分布，玻色-愛因斯坦分布等)，固體的熱性質。

Temperature and the Zeroth Law of Thermodynamics, Simple Thermodynamic System, Work, Heat and First Law of Thermodynamics, Kinetic Theory of the Ideal Gases, The Second Law of Thermodynamics, The Carnot Cycle and the Thermodynamic Temperature, Entropy, Phase Diagram of a Pure Substances, First-Order and Second-Order Phase Transitions, Introduction to Statistical Mechanics (including Partition for Canonical Ensemble, M-B、F-D、B-E distributions), Thermal Properties of Solids.

### 電子學 (E0961) (3,0) Electronics

半導體簡介、二極體、雙極電晶體、場效電晶體、電晶體放大器電路。

Introduction to Semiconductor, Diodes, Bipolar Junction Transistors, Field-Effect Transistors, Transistor Amplifier Circuits

### 普通物理實驗 (S0291) (1,1) General Physics Lab.

基本量測、靜力實驗、碰撞運動實驗、單擺實驗、簡諧運動實驗、力學波共振實驗、轉動慣量測定、熱功當量實驗、熱電電動勢實驗、玻璃折射率測定、面鏡與透鏡成像、光的狹縫實驗、靜電綜合實驗、電力線分佈實驗、電阻定律實驗、電阻溫度係數測定、電子元件的特性、平行板電容器、電流天平、載流線圈的磁場量測、螺線管的電感量測、變壓器的原理、電子荷質比測定、光電效應實驗。

Basic Measurement, Force & Equilibrium, One Dimensional Collision, Pendulum, Simple Harmonic Motion, Mechanical Resonance, Moment of Inertia, Equivalence of heat and work, Thermoelectric Conversion. Refractive Index of Glass Prism, Laws of Imaging, Optical Diffraction, Basic Electrostatics, Field Lines & Equipotential Lines, Resistance & Resistivity, Temperature-Dependency of Resistors, Characteristics of Diodes and Transistors, Plate Capacitor, Current Balance, Magnetic Fields of Current-Carrying Coils, Self-Inductance of a Long Solenoid, Transformer,  $e/m$  ratio of electron, Photoelectric Effect.

### 電磁學實驗 (S0339) (1,1) Electromagnetic Physics Lab.

基本電子零件、直流電路，示波器與信號產生器的認識與使用，電容、電感的電路特性，整流與濾波，倍壓整流電路，歐姆定律實驗，電容、電感的電路特性，電阻、電容、電感的電路特性，二極體的特性實驗(一)，二極體的特性實驗(二)、電場力效應實驗、電流天平實驗、電流力效應實驗、螺線管磁場實驗、赫姆霍茲磁場實驗、霍爾效應實驗、法拉第感應電動勢實驗、感應線圈變壓實驗、微波實驗一、微波實驗二。

Multi-meter operations and Basic DC circuits, Oscilloscope Operation, Function, Generator Operations, RC circuits, RL circuits, Rectifier circuits, Rectifier circuits and Voltage doublers, Ohm's Law, RC、RL Circuit, RLC Circuit, Diode Lab - Part 1, Diode Lab - Part 2, Measurement of Force Effects in the Electric Field, Basic Current Balance, Force Effect of Currents, Measurement of Magnetic Field of Single Coils, Magnetic Fields of Paired Coils in Helmholtz Arrangement, Hall Effect in p-Ge/n-Ge, Faraday's Law, Transformers, Microwave I, Microwave II.

### 電子學實驗 (S0704) (1,1) Electronics Lab.

電壓源和電流源、戴維寧定理、故障排除、二極體特性曲線、二極體近似模型、整流電路、電容-輸入型濾波器、倍壓電路、限制器電路和峰值檢測電路、直流定位器與峰對峰檢測器、齊納二極體、齊納二極體整流器、光電元件、集射極接面、集極特性曲線、基極偏壓、LED 驅

動器、建立一個穩定的工作點 Q、PNP 電晶體偏壓、電晶體偏壓、耦合及旁路電容、交流射極電阻、共射極放大器、其他 CE 放大器、串接共射極放大器、交流負載線、射極隨耦器、B 類推挽式放大器、JFET 特性曲線、JFET 偏壓、JFET 放大器、VMOS 電路、差動放大器、運算放大器、非反向電壓回授、負回授。

Voltage Source and Current Source, Thevenin Theory, Trouble Shooting, Characteristic Curve of Diode, Diode Models, Rectifier Circuits, Input Filtering Capacitor, Voltage Multiplier Circuits, Limiter and Clipper Circuits, DC Clampers and Peak-to-peak Detectors, Zener Diode, Zener Diode Rectifier, Photoelectric Devices, Collector-Emitter Junction, Transistor Characteristics of common-emitter, Base Bias, LED Driver, Establishing a Stable Q-point, PNP Transistor Biasing, Transistor Biasing, Coupling and By-Pass Capacitors, AC Emitter Resistance, Common-Emitter Amplifier, Other Common-Emitter Amplifiers, Cascaded Common-Emitter Amplifiers, AC Load Line, Emitter Follower, Class B Push-pull Amplifiers, JFET Characteristic Curve, JFET Biasing, JFET Amplifier, VMOS Circuit, Differential Amplifier, Operational Amplifier, Non-inverting Feedback, Negative Feedback.

#### 光學實驗 (S0553) (0,1) Optics Lab.

光偏振實驗、自成像實驗、Fresnel 繞射實驗、Fraunhofer 繞射實驗、光學系統設計、全像術實驗、光纖特性測量、法拉第實驗、聲光調制實驗。

Polarization, Self-imaging, Fresnel diffraction, Fraunhofer diffraction, Optical design, Holography, Fiber Optics, Faraday effect, Acousto-optic modulation.

#### 專題研究 (T0136) (1, 1) Research Seminar

我們提供學生在大二時，參與系上老師研究之相關課題。透過實際參與，讓學生瞭解如何分析及解決物理問題；另一方面，也提供物理各領域之最新發展。

In the 2nd year, we provide students to do real research on a variety of active subject areas in our department. Students will obtain the ability to analyze and solve the realistic problems as well trained physicists. Furthermore, frontiers in different physics fields will also be highlighted in this course.

#### 近代物理實驗 (S0164) (1,1) Modern Physics Lab

法蘭克-赫茲實驗、黑體輻射實驗、光電效應實驗、氫原子光譜-巴爾曼系列、精細結構、結晶過程、半導體能帶量測、基曼效應、電子自旋共振、磁性材料磁化係數的測量、熱分析法—鉛錫合金相圖之測量、布朗運動&波茲曼分佈、光的相干性。

Franck-Hertz Experiment, Stefan-Boltzman Radiation Law, Photoelectric Effect, Emission Line Spectra for Hydrogen Atom, Fine Structure, Crystallization Processes, Energy Gap Measurements of a Semiconductor, Zeeman Effect, Electron Spin Resonance, Magnetic Susceptibility Measurements of Magnetic Materials, Thermal Analysis-Determination of Phase Diagram for Pb-Sn Alloy, Brownian Motion and Boltzmann Distribution, Coherence of Light.