

大學部選修課程大綱(111-114)

Elective Course Syllabus (111-114)

物理漫談 (S0547) (3,0) Review On Frontier Physics

物理與哲學、實驗物理-天文學、理論物理-氣體動力學、相對論與重力理論、理論物理-重力理論相對論、凝態物理、高能物理。

Physics and Philosophy, Experimental Physics and Astronomy, Theoretical Physics and thermodynamics, Relativity and Gravity, Condensed-matter Physics, High-energy Physics.

光電漫談 (S0640) (3,0) Review On Photonics

光學與半導體基礎知識。包含：光電半導體、顯示器裝置、光纖光學及其元件、積體光學、光電積體電路、光儲存裝置、電荷耦合元件及其應用、光子晶體、微光學元件、近場光學、非線性光學、生醫光電等。

Fundamentals of optical and semiconductor; Covers: Photoelectronic semiconductors, Display devices, Fiber optics and its components, Integrated optics, Optoelectronic integrated circuit,

Optical storage devices, Charge coupled devices and its application, Photonic crystal, Micro-optical devices, Near field optics, Nonlinear optics, Electro-optics on medicine.

計算機概論 (E1173) (3,0) 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)。

數值方法 (E0768) (2,2) Numerical Method

上學期：積分[辛普森法、Romberg integration]、線性代數 [矩陣相乘、LU decomposition、反矩陣、線性解]、內插法以及外插法、牛頓法找根、常微分方程。

下學期：傅立葉變換及其應用、蒙地卡羅、差分法以及偏微分方程、最小值的尋求以及資料的擬合。(附註：常微分方程式的數值方法可應用在二上的力學解震盪的問題，或是電路學的RLC 電路問題，差分法及偏微分方程可應用在電磁學中，授課老師可加強電腦計算與學科間的連結。)

力學(二) (S0836) (0,3) Mechanics(II) / 應用力學(二) (S0868) (0,3) Applied Mechanics(II)

中心力下的運動、多粒子系統動力學、剛體動力學、耦合振動、非線性振動 (選擇)、非慣性參考座標系中的運動 (選擇)、連續系統 (選擇)。

Central-force Motion, Dynamics of a System of Particles, Dynamics of Rigid Body, Coupled Oscillations, Nonlinear Oscillations (optional), Motion in a Noninertial Reference Frame (optional), Continuous Systems (optional).

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電路學 (E0722) (3,0) Circuit Theory / 應用電路學 (S0397) (3,0) Applied Circuit Theory

簡介、網路的組件和網路定律、網路分析與節點電壓和網目電流、網路的性質-戴維寧和諾頓的等效電源、運算放大器、三接端網路的等效電路與雙埠網路。

Introduction, Network Laws and Components, Introduction to Circuit Analysis, Network Node Voltages and Mesh Currents, Network Properties—Thevenin's and Norton's Equivalent Sources, Operational Amplifiers, Equivalent Circuits for Three-Terminal Networks and Two-port Network.

天文學 (S0041) (0,3) Astronomy

宇宙概觀、太陽系、星距量測、星的性質、分類與演化、星雲、星團、銀河、系結構分類、宇宙論、天文台及望遠鏡。

Overview of Universe; Solar System; Inter-Stellar Distance; Properties of Stars; Classification and Evolution; Star Nebulae; Star Cluster, Structure and Classification of Galaxies; Cosmology; Observatories and Telescopes.

計算物理 (S0703) (3,0) Computational Physics

使用現有的 Fortran based Package 來讓學生了解物理，並學習較大型與高級的程式撰寫技巧。授課內容：咖啡冷卻、落體運動、分子動力學模擬、電磁場、量子系統、混沌與碎形。

統計力學導論 (S0819) (0,3) Introduction To Statistical Mechanics

波茨曼統計、費米--弟格與波士--愛因斯坦分佈、理想氣體之統計、固體之熱容量、磁性材料之熱力學、波士--愛因斯坦氣體、波士--愛因斯坦凝結、費米--弟格氣體、自由電子、訊息理論。

Boltzmann statistics, Fermi-Dirac and Bose-Einstein distribution Statistical method for ideal gas, Heat capacity of solid, Thermodynamics of magnetism, Bose-Einstein gases Bose-Einstein condensation, Fermi-Dirac gases, Free electrons in metal, Information theory.

凝態物理概論 (S0869) (0,3) Introduction To Condensed Matter Physics

固態中的原子結構與鍵結、晶體中的缺陷與擴散、金屬與半導體、材料的力學與熱學性質、材料的光學性質、材料的電學與磁學性質、各種材料的介紹與應用。

Atomic structures and bindings in solids, Defects and diffusion in a crystal, Metals and semiconductors, Mechanical and thermal properties of materials, Optical properties of materials, Electric and magnetic properties of materials, Introductions and applications of various materials.

奈米科技導論 (S0885) (3,0) Introduction Of Nanotechnology

「奈米科技」是最近發展的一種跨領域的科技，它主要探討在奈米尺度下，材料嶄新的物理與化學特性，以及它未來的應用潛力。

Nanotechnology is a recently developed, inter-discipline technology. It mainly explored the new physics and chemistry of the materials, which are nano-sized, and the potential of future application.

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電子學(二) (E0689) (0,3) Electronics(II)

運算放大器、差動及多極放大器、頻率響應、回授、積體電路。

Operational Amplifiers, Differential and Multistage Amplifiers, Frequency Response, Feedback, Integrated Circuits.

半導體物理 (S0058) (0,3) Physics Of Semiconductors

介紹半導體材料以及半導體元件之物理。

Energy Bands and Carrier Concentration, Carrier Transport Phenomena, P-N Junction & Transistor.

光電系統概論 (S0770) (0,3) Introduction To Opto-Electric System

色彩學、半導體的光學性質、發光二極體、太陽能電池、雷射的基本運作原理、光纖、液晶顯示器、電漿顯示器、全像術、奈米材料、光子晶體簡介

Colors、The optical properties of semiconductors、Light emitting diodes (LED)、Solar cells、Introduction to lasers、Optical fibers、Liquid crystal displays (LCD)、Plasma display panels (PDP)、Holography、Nano-materials、Introduction to photonic crystals

物理的數學方法(一) (S0835) (3,0) Mathematical Methods For Physics (I)

機率、加論特殊函數或線性代數 (線性算子及希爾博空間)。

Probability, More on Special functions, Linear algebra (linear operators and Hilbert space).

物理的數學方法(二) (S0837) (0,3) Mathematical Methods For Physics (II)

張量分析及微分幾何、群論、格林函數或變分法。

Tensor analysis and differential geometry, Group theory, Green's functions, Variation.

生物物理概論 (S0870) (3,0) Introduction To Biophysics

重要生物大分子之功能與結構，能量、力、熵、溫度與自由能等物理概念在生物學中的應用，生物體中的擴散及耗散，生物高分子之構型與力學性質。

Introduction to important biomolecules. Applications of physical concepts, such as energy, force, entropy, temperature and free energy, to biology. Diffusion and dissipation in biomaterials. Conformation and mechanical property of biopolymers.

固態物理 (S0125) (3,0) Solid State Physics

晶體結構、反商晶格、晶體鍵結、聲子、自由電子費米氣體、能帶結構、金屬與費米面、半導體

Crystal Structure, Reciprocal Lattice, Crystal Binding, Phonon, Free Electron Fermi Gas, Energy Bands, Metal and Fermi Surface, and Semiconductor

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固態物理(二) (S0127) (0,3) Solid State Physic

元激發與準粒子介紹 (電漿子、偏振子、極化子、磁振子、激子)、介電與鐵電材料、磁性材料 (抗磁、順磁、鐵磁、反鐵磁)、磁共振、超導體。

Introduction to Elementary Excitations and Quasi-particles (including Plasmon, Polariton, Polaron, Magnon, and Exciton), Dielectrics and Ferroelectrics, Magnetic Materials (including Diamagnetism, Paramagnetism, Ferromagnetism, and Antiferromagnetism), Magnetic Resonance, and Superconductivity.

量子力學(一) (S0310) (3,0) Quantum Mechanics(I)

機率簡介、薛丁格方程式、測不準原理、一維量子系統、線性空間及矩陣、矩陣的對角化、本徵值及本徵向量、相似變換、中心場系統、氫原子系統、角動量。

Introduction of Probability, Schrodinger Equation, Uncertainty Principle, One Dimensional Quantum Systems, Linear Space and Matrices, Diagonalization of Matrices, Eigenvalues and Eigenvectors, Similarity Transformation, Central Field Systems, Helium Atoms, Angular Momentum.

量子力學(二) (S0583) (0,3) Quantum Mechanics(II)

角動量代數、角動量加成、等同粒子效應、一維週期性量子系統、量子統計簡介、定態微擾理論、精細結構、WKB 近似、變分法、Aharonov-Bohm 效應、量子躍遷。

Angular Momentum Algebra, Addition of Angular Momenta, Identical Particle Effect, One Dimensional Periodic Quantum Systems, Introduction to Quantum Statistical Mechanics, Time-independent Perturbation Theory, Fine Structure, WKB Approximation, Variational Principle, Aharonov-Bohm Effect, Quantum Transition.

計算材料 (S0399) (3,0) Computational Materials Physics

認識 3D 圖形介面與 Materials Studio 快速入門、3D 圖形介面細部操作與模型的建構、認識晶體結構、無機及有機晶體結構資料庫之使用、密度泛函理論之方法與應用、了解原子的原子軌域與目睹分子的化學鍵、預測鍵長與振動頻率以及預測晶格常數及塊體模量、能帶結構簡介、半導體及絕緣體的能帶結構、能隙與投影態密度、以及金屬的態密度與費米面、材料磁性與反鐵磁性的計算 (含虛擬晶體近似法)、聲子譜與材料比熱的計算與預測相變溫度、電子吸收光譜、折射率與介電函數、紅外線吸收光譜與靜介電常數、核磁共振與原子結構、計算表面重構、功函數、與預測 STM 影像、化學反應、活化能與自由能 (含分子動力計算)

3D GUI and Materials Studio Introduction、More 3D functions and model building、Crystal Structures, ICSD and CSD、Density Functional Theory - Methodology and Application、Atomic Orbitals and Chemical bonds、Bond length, vibration frequency, lattice parameter and bulk modulus、Band Structure theory, semiconductor, insulator and metal、magnetic properties of materials (VCA)、Phonon Spectra, specific heat calculation and phase transition temperature、electronic spectra, refractivity and dielectric function、IR absorption and static dielectric function、NMR and atomic structure、surface reconstruction, workfunction and STM image、Chemical reaction, activation barrier and free energy (Molecular dynamics).

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狹義與廣義相對論 (S0744) (3,0) The Special And General Theory Of Relativity

牛頓的相對性原理、Lorentz 轉換、Minkowski 時空、四維向量與張量、重力與彎曲時空、彎曲時空上的向量與張量、愛因斯坦場方程式、Schwarzschild 解、Friedmann- Robertson-Walker 解

Newtonian relativity, Lorentz transformation, Minkowski spacetime, four-vectors and tensors, gravitation and curved spacetime, vectors and tensors on curved spacetime, Einstein equation, Schwarzschild solution, Friedmann-Robertson-Walker solution.

光電子學 (S0082) (0,3) Optical Electronics

介紹半導體雷射、發光二極體、光檢測器與光纖等光電元件的基本理論

Fundamental theory of LED, LD, Detector, Optical fiber and opto-electronic instruments.

數位電子學 (S0373) (3,0) Digital Electronics

數位設計：二進位制、布氏代數、邏輯閘、布氏函數的化簡、組合邏輯電路。類比設計：放大器、頻率響應、反饋系統、運算放大器。

Digital Design : Binary System , Boolean Algebra , Logic Gates , Simplification of Boolean Functions , Combinational Logic. Analog Design : Amplifiers , Frequency Response , Feedback , Operational Amplifier.

半導體的光學性質 (S0734) (3,0) Optical Processes In Semiconductor

介紹半導體材料中各種載子在各能階間躍遷之過程中所發生的吸收, 輻射與非輻射機制以及受壓力, 溫度, 電場與磁場時之影響

Energy Bands, absorption, emission, radiative recombination, non-radiative recombination, pressure, temperature, electric field, magnetic field.

傅氏光學 (S0203) (0,3) Fourier Optics

二維的訊號與系統分析, 純量繞射理論, Fresnel 和 Fraunhofer 繞射, 同調光學系統的波動光學分析, 同調光學系統的頻率分析, 全像術。

Analysis of 2D Signals and Systems, Foundations of Scalar Diffraction Theory, Fresnel and Fraunhofer Diffraction, Wave Optics Analysis of Coherent Optical Systems, Frequency Analysis of Coherent Optical Systems, Holography.

量子資訊與量子計算導論 (S0829) (0,3)

Introduction To Quantum Information And Quantum Computation

量子力學原理, 量子密碼學, 量子離物傳態, 量子算法, 實驗概況

Principles of Quantum Mechanics, Quantum Cryptography, Quantum Teleportation, Quantum Computations, Experimental realizations

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專題研究 (T0136) (1,1) Research Seminar / 物理專題 (S0150) (1,1) Special Topics In Physics

我們提供學生在大四時，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 4th 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.