Modules offered on Physics programmes in 2025-26

Contents

Level 1 Modules

- **PHY1001 Foundation Physics (Full Year) (40)**

Pre-Requisites: A-level Physics & A-level Mathematics or equivalent

Lecturers: **Semester 1**: Dr Sam Grant, Prof David Jess, Prof Chris Watson

Semester 2: Dr Mark Yeung, Dr David Wilkins, Dr Sam Grant

Course Content:

Classical Mechanics: Linear Motion, Newton's Laws, Force and Energy, Conservation Laws, Two-Body Dynamics, Centre of Mass, Reduced Mass, Collisions, Elasticity, Simple Harmonic Motion, Damped and Forced Oscillations, Rotational Motion, Torque, Angular Momentum, Moment of Inertia, Central Forces, Gravitation, Kepler's Laws.

Special Relativity: Lorentz Transformations, Length Contraction and Time Dilation, Paradoxes, Velocity Transformations, Relativistic Energy and Momentum

Waves: Wave Equation, Travelling Waves, Superposition, Interference, Beats, Standing Waves, Dispersive Waves, Group Velocity, Doppler Effect

Electricity and Magnetism: Static electric and magnetic fields. Time varying magnetic fields and motional emf. Electrical circuit analysis including dc and ac theory and circuit transients.

Light and Optics: Electromagnetic waves, dispersion by prisms and diffraction gratings, interference, diffraction, polarization, X-rays.

Quantum Theory: Wave-particle duality, Heisenberg uncertainty principle, photoelectric effect, Compton effect, pair production, blackbody radiation, hydrogen spectra, Bohr model, fundamental forces and particles, the Standard Model

Thermodynamics: Kinetic theory of gases, Van der Waal's equation, first and second laws of thermodynamics, internal energy, heat capacity, entropy. Thermodynamic engines, Carnot cycle. Changes of state.

Solid State: Solids, crystal structure, bonding and potentials, thermal expansion. Introduction to band structure of metals, insulators and semiconductors. Origin and behaviour of electric and magnetic dipoles.

Compulsory Element:

Examination must be passed.

Assessment: Examination 60% Tutorials 20% Group Project 10% Skill test 10%

Exams will take place in December and May

- **PHY1002 Mathematics for Scientists and Engineers (Full Year) (40)**

Pre-Requisites: A-level Mathematics or equivalent

Lecturers: **Semester 1**: Dr Peter Keys, Prof Mihalis Mathioudakis.

Semester 2: Prof Chris Watson, Dr Solveig Felton

Course Content:

Fundaments of trigonometry: Sine, cosine, tangent functions. Their graphs in one dimension, their representation on the unitary circle, and representation as complex exponentials. Fundamental trigonometric identities.

Elements of Vectors: Vectors in the plane and space. Coordinates, scalar product, projections, and cross product.

Elements of linear algebra: Definition of matrices and operations. Determinant of a matrix. Solution of a system of linear equations. Gauss' elimination method. Eigenvalues/eigenvectors. Vector/scalar products and identities.

Complex numbers: Concept of complex plane, vectorial and exponential representation of complex numbers. Real part and imaginary part. Fundamental operations with complex numbers: sum, subtraction, product, division, power and roots, and complex conjugate, Euler and de Moivre's theorems

Euclidean geometry: equation of a line and a plane. Equation of the circle and the ellipse.

Analysis of a single-variable function: Definition of a function. Definition of limit and derivative. Methods to calculate limits and derivatives. Definition of continuity and singularities. Study of a function.

Elements of discrete calculus: Series with their limit and convergence theorems and methods.

Taylor and MacLaurin series and approximation of single-variable function: definition of orders of expansion

Integration in one variable: definition of definite and indefinite integral, integration by parts and by substitution, integral of a rational function, Gaussian integrals.

Ordinary differential equations: Definition of linearity and order of differential equations. Solutions for linear differential equations and main properties. Solution of specific non-linear cases.

Elements of multi-variable differential calculus: Definition of gradient, nabla, and practical use of these operators.

Curvilinear coordinates, Jacobian, Multi-variable integration, Stoke's Theorem, Divergence theorem and Green's theorem in the plane.

Compulsory Element:

Examination must be passed.

Assessment:

Examination 70% Tutorials 30% **Exams will take place in December and May.**

- **PHY1003 Computational Modelling in Physics (Full Year) (20)**

Pre-Requisites: A-level Mathematics or equivalent

Lecturers: Dr Thomas Field, Dr Charlotte Palmer, Dr Ernst De Mooij

Course Content:

Introduction to computation and coding.

Introduction to the use of numerical methods to, for example, solve equations (e.g., find roots, numerical integration) and model systems by numerically solving ordinary differential equations.

Introduction to working with experimental data with computer by, for example, fitting data, interpolation, and extrapolation.

Introduction to Monte Carlo methods for computer simulation

Compulsory Element:

None

Assessment:

5 Assignments - 100% (2 Short Assignments 25%, and 3 Standard Assignments 75%)

- **PHY1004 Scientific Skills (Full Year) (20)**

Pre-Requisites: A-level Mathematics or equivalent

Lecturers: Prof Gianluca Sarri, Prof David Jess, Dr Charlotte Palmer, Dr Mark Yeung, Prof Marco Borghesi, Dr Sam Grant, Prof Mihalis Mathioudakis, Dr Peter Keys, Dr Mathew Streeter

Course Content:

Experimental Methods: Uncertainties, statistics, safety, using standard instruments.

Experimental Investigation: Performing experiments on a range of phenomena in Physics, recording observations and results.

Writing Skills: Scientific writing, writing abstracts, writing reports, writing for a general audience

Oral Communication: Preparing and executing oral presentations.

Computer Skills: Using high level computing packages to analyse and present data and solve problems computationally.

Students spend 3 hours every week in the School Teaching Centre doing experimental or computational investigations and developing specific or transferrable skills. Pairs of students will do 8 experiments throughout the year writing short abstracts for each and two longer reports.

Compulsory Element:

Lab work must be passed.

Assessment:

Lab Performance 50% Computational 20% Lab Report (2) 10% AI Skills 10% Oral Presentation 10%

Level 2 Modules

- **PHY2001 Quantum and Statistical Physics (Autumn) (20)**

Pre-Requisites: PHY1001 and PHY1002, or MTH1011 and MTH1021

Lecturers: Dr Satya Kar, Dr Ray McQuaid, Dr Jason Greenwood

Lab Supervisors: Prof Robert Bowman, Dr Ryan Milligan

Course Content:

Quantum Mechanics: Quantum history, particle waves, uncertainty principle, quantum wells, Schrödinger wave equation SWE

1D SWE Solutions: Infinite and finite square potential well, harmonic potential well, particle wave at a potential step, particle wave at a potential barrier, quantum tunnelling

3D Solutions of SWE: Particle in a box, hydrogen atom, degeneracy

Statistical Mechanics: Pauli exclusion principle, fermions, bosons, statistical distributions, statistical entropy, partition function, density of states. Examples of Boltzmann, Fermi-Dirac, Bose-Einstein distributions

Compulsory Element: None

Assessment: Examination 60% Assignments (3) 20% Lab Work 20%

Exam will take place in May

- **PHY2002 Physics of the Solid State (Spring) (20)**

Pre-Requisites: PHY1001 and PHY1002, or MTH1011 and MTH1021

Lecturers: Prof Marty Gregg, Dr Raymond McQuaid

Lab Supervisors: Prof Marty Gregg, Dr Fumin Huang

Course Content:

Periodicity and symmetry, basic crystallographic definitions, packing of atomic planes, crystal structures, the reciprocal lattice, diffraction from crystals, Bragg condition and Ewald sphere. Lattice waves and dispersion relations, phonons, Brillouin zones, heat capacity, density of vibrational states, Einstein and Debye models of heat capacity, thermal conductivity and anharmonicity. Concepts related to phase transitions in materials such as: free energy, enthalpy, entropy, order parameter, classification of phase transitions, Landau theory. Bonding classification of materials, metals, insulators and semiconductors, Fermi energy and density of electron states, energy bands, intrinsic and extrinsic semiconductors, donors and acceptors, carrier transport properties, p-n junction

Compulsory Element: None

Assessment: Examination 60% Assignments (2) 20% Lab Work 20%

Exam will take place in May

- **PHY2003 Astrophysics I (Autum) (20)**

Pre-Requisites: PHY1001 and PHY1002, or MTH1011 and MTH1021

Lecturers: Dr Meg Schwamb, Dr Peter Keys, Dr Ernst de Mooij

Lab Supervisors: Dr Meg Schwamb, Dr Ernst de Mooij

Course Content:

Introduction to Astronomy: Units of measurement, telescopes and detecting photons.

From planets to galaxies: Size and scale of the visible Universe, Stellar and galactic motion.

The Solar system: The Sun as a star*,* Newtonian gravity; basic concepts in orbital dynamics; planets and our solar system.

Stars – observational properties/characterization: Stellar luminosities, colours, the Hertzsprung-Russell diagram, stellar classification, fundamental stellar properties, Stefan Boltzmann equation, mass-luminosity relations.

Stars – stellar structure: Equation of hydrostatic support (including use of mass coordinate), gravitational binding and thermal energy of stars, Virial theorem, energy generation, energy transport by photon diffusion, convection.

Stars – formation, stellar evolution, binary-star evolution, stellar death: single star evolution, post-H burning, binary-star evolution concepts and accretion, stellar end-states and compact objects.

Compulsory Element: None

Assessment: Examination 40%, Assignments (4) 40%, Lab Work 20%

Exam will take place in January

- **PHY2004 Electricity, Magnetism and Optics (Spring) (20)**

Pre-Requisites: PHY1001 and, PHY1002 or MTH1011 and MTH1021

Lecturers: Prof Gianluca Sarri, Dr Charlotte Palmer, Dr Fumin Huang,

Lab Supervisors: Dr Peter Keys, Dr Sam Grant

Course Content:

Electrostatics and magnetostatics

Coulomb, Gauss, Faraday, Ampère, Lenz and Lorentz laws

Wave solution of the Maxwell's equations in vacuum and the Poynting vector

Polarisation of E.M. waves and behaviour at plane interfaces

Propagation of light in media (isotropic dielectrics). Faraday and Kerr effects.

Temporal and spatial coherence of light. Interference and diffraction

Geometrical optics and matrix description of optic elements

Optical cavities and laser action

Compulsory Element: None

Assessment: Examination 60% Assignments (3) 20% Lab Work 20%

Exam will take place in May

- **PHY2005 Atomic and Nuclear Physics (Spring) (20)**

Pre-Requisites: PHY1001 and, PHY1002 or MTH1101 and MTH1021

Lecturers: Prof Stuart Sim, Prof David Riley

Lab Supervisors: Prof Stuart Sim, Prof David Riley

Course Content:

Atomic:

Hydrogenic quantum numbers, spin-orbit interaction, fine structure, central field approximation, LS coupling, Hund's rules, theory of the helium atom, selection rules, atomic spectra and transition probabilities, first order perturbation theory, Zeeman effect.

Nuclear:

Observation of nuclear properties, nuclear radius, mass (semi-empirical formula), inter-nucleon potential, radioactive decay mechanisms, fission and fusion, interactions of particles with matter.

Compulsory Element: None

Assessment: Examination 60% Assignments (2) 20% Lab Work 20%

Exam will take place in May

- **PHY2006 Mathematical Physics (Autumn) (20)**

Pre-Requisites: PHY1001 and PHY1002, or MTH1101 and MTH1021

Lecturers: Dr Thomas Field, Dr Jason Greenwood

Course Content:

Advanced linear algebra: Definition and basic properties of a generic vectorial space, isomorphisms and homomorphisms. Generalised definition of scalar product and norm, base of a vectorial space, orthonormality.

Fourier series and Fourier transform. The Dirac delta function, Parseval's theorem and the convolution theorem.

Partial differential equations: PDE classification, analytical solutions - method of characteristics, separation of variables.

Numerical Solutions to Differential Equations:
ODE – Euler, Midpoint, Runge-Kutta
PDE – Finite difference methods, forward, backward, Crank-Nicolson, relaxation techniques

Compulsory Element: None

Assessment: Examination 60%, Assignments 20%, Group Work 20%

Exam will take place in January

- **PHY2010 Employability for Physics**

Pre-Requisites: None

Lecturers: Prof Robert Bowman

This is a 0 CAT point module that is compulsory for students planning to take a placement year. The module consists of 6 lectures and 2 workshops and is assessed through attendance and completion of online learning activities.

Course Content:

Introduction to placement for Physics students, CV building, international options, interview skills, assessment centres, placement approval, health & safety and wellbeing. Workshops on CV building and interview skills. This module is delivered in-house with the support of the QUB Careers Service and external experts.

Compulsory Element: Students must attend at least five of the six lectures, and both workshops.

Learning Outcomes: To identify gaps in personal employability skills. To plan a programme of work to result in a successful work placement application.

Skills: Plan self-learning and improve performance, as the foundation for lifelong learning/CPD. Decide on action plans and implement them effectively. Clearly identify criteria for success and evaluate their own performance against them.

Assessment: Attend at least five of the six lectures and complete the two workshops.

Level 3 Modules

- **PHY3001 Quantum Mechanics and Relativity (Autumn) (20)**

Pre-Requisites: PHY2001

Lecturers: Dr Ryan Milligan, Prof Gianluca Sarri

Course Content:

Relativity:

Einstein's postulates. The Lorentz transformation and consequences. 4-vector formulation. Relativistic particle dynamics. Relativistic wave dynamics. Relativistic electrodynamics.

Quantum Mechanics:

The Lagrangian and Hamiltonian formalism. Wavefunctions and operators. The Schrödinger equation. The harmonic oscillator. Three-dimensional systems: angular momentum. Three-dimensional system: spherical harmonics. Composition of angular momenta and spin. The Hydrogen atom. Special distributions: Bose-Einstein and Fermi-Dirac statistics. Bell inequality and quantum entanglement. Perturbation theory: time-independent perturbations. Perturbation theory: periodic perturbations

Compulsory Element: None

Assessment: Examination 80% Assignments (3) 20%

Exam will take place in January

- **PHY3002 Advanced Solid-State Physics (spring) (20)**

Pre-Requisites: PHY2002

Lecturers: Prof Marty Gregg, Dr Solveig Felton, Dr Amit Kumar

Course Content:

Electrons in metals, including Drude classical theory, Sommerfeld quantum free electron model, nearly free electron model, effective mass, tightly bound electron model, Brillouin zones and energy bands, quantum wells and 2D electron gases, quantum hall effect, introductions to spintronics and superconductivity.

Magnetism, including underlying origin of magnetism, the link between dipole moment and angular momentum, diamagnetism, paramagnetism (classical and quantum treatments), ferromagnetism and the Weiss molecular field, antiferromagnetism.

Dielectrics, including concepts of polarization, polarisability, Mossotti field, contributions to polarization, the Mossotti catastrophe, ferroelectricity, soft mode descriptions of ferroelectricity and antiferroelectricity, Landau-Ginzburg-Devonshire theory, displacive versus order-disorder ferroelectrics.

Compulsory Element: None

Assessment: Examination 80% Assignments (2) 20%

Exam takes place in May

- **PHY3003 Astrophysics II (Spring) (20)**

Pre-Requisites: PHY2003

Lecturers: Dr Peter Keys, Prof Michail Mathioudakis, Prof Stuart Sim

Course Content:

Advanced stellar structure and evolution: physics of stellar interiors; concepts of single-star evolution; end points of stellar evolution

Radiative transfer: radiative transfer in solar and stellar atmospheres; statistical and ionization equilibrium, plasma diagnostics and line broadening processes

Galaxies: The Milky Way galaxy; galaxy properties and structure; physics of the interstellar medium; stellar dynamics and gravitational potentials; theories of galaxy formation and evolution.

Compulsory Element: None

Assessment: Examination 80% Assignments (3) 20%

Exam takes place in May

- **PHY3004 Advanced Electromagnetism and Optics (Autumn) (20)**

Pre-Requisites: PHY2004

Lecturers: Dr Jason Greenwood, Dr Mark Yeung

Course Content:

Maxwell's equations, propagation of EM waves in dielectrics, conductors, anisotropic media, non-linear optics. Polarisation, reflection and transmission at boundaries, Fresnel's equations. Thin/thick optical lenses, matrix methods, aberrations and diffraction. Optical fibres/waveguides.

Compulsory Element: None

Assessment: Examination 80% Assignments (2) 20%

Exam will take place in January.

- **PHY3005 Nuclear and particle Physics (Spring) (20)**

Pre-Requisites: None

Lecturers: Prof Dave Riley, Prof Stuart Sim

Course Content:

Nuclear reaction classifications, scattering kinetics, cross sections, quantum mechanical scattering, nuclear shell model and scattering experiments, partial waves. Beta decay and neutrino mass, Fermi theory of beta decay and parity violation. Elementary particles; symmetry principles, unitary symmetry and quark model, particle interactions.

Compulsory Element: None

Assessment: Examination 80% Assignments (3) 20%

Exam will take place in May

- **PHY3006 Physics in Medicine (Spring) (20)**

Pre-Requisites: None

Lecturers: Dr Satya Kar, Prof Marco Borghesi

Course Content:

Fundamental principles, and technical and clinical applications of interaction of electromagnetic radiation (ionising and non-ionising) with the body, lasers for therapy and imaging, ultrasound, magnetic resonance imaging, radiation imaging techniques, radiotherapy, computed tomography, nuclear medicine.

Compulsory Element: None

Assessment: Examination 60% Assignments (2) 20% Group Project 20%

Exam will take place in May

- **PHY3007 Physics Single Project (Can be taken in Autumn or Spring) (20)**

Pre-Requisites: None

Module Coordinator: Dr Ryan Milligan

Course Content:

Students will undertake a single physics project in one of the semesters involving an open-ended experimental or computational investigation of a specific area of physics. Outcomes of the studies will be reported through oral, written and poster presentations.

Compulsory Element: None

Assessment: Project Report 50% Lab Performance 25% Chalk and Talk 10% Poster Presentation 10% Risk Assessment 5%

- **PHY3008 Professional Skills (Autumn)**

Pre-Requisites: None

Lecturers: Prof David Jess, Prof Brendan Dromey

Course Content:

Development of oral presentation skills. Presentations to large groups/peers in a research or popular science context. Probing scientific understanding, critiquing presentations, peer review. Entrepreneurship, career guidance, CV writing, interview techniques. Essay writing and scientific writing skills.

Compulsory Element: None

Assessment: Abstract and research record book 30%, Oral presentation 40%, Poster presentation 20%, Peer assessment 5%, Attendance 5%

- **PHY3009 Computational Projects (Autumn)**

Pre-Requisites: PHY1003 or equivalent

Lecturers: Dr Tom Field, Dr Ernst De Mooij

Course Content:

Numerical methods for Partial Differential Equations (PDEs). Classification of PDEs. von Neumann stability analysis. Numerical solutions to advection & diffusion problems and elliptic equations. Concepts of how to fit a model to data: Bayesian statistics, likelihood functions, parameter estimation.

Learning outcomes:

Proficient computing skills, algorithm development, familiarity with statistical methods, problem solving.

Skills:

Problem solving and algorithm development with computing methods and computer programming. Searching for and evaluating information from a range of sources. Communicating scientific concepts in a clear and concise manner both orally and in written form. Working independently and with a group of peers. Time management and the ability to meet deadlines.

Compulsory Element: None

Assessment: assignments (2) 5%, Computational Projects (2) 95%

- **PHY3010 Physics Projects (Full Year)**

Pre-Requisites: None

Module Coordinator: Dr Ryan Milligan

Course Content:

Students will undertake two different physics projects (one in each semester). Each will involve an open-ended experimental or computational investigation of a specific area of physics. Outcomes of the studies will be reported through oral, written and poster presentations.

Compulsory Element: None

Assessment: Project Report 50% Lab Performance25% Chalk and Talk 10% Poster Presentation 10% Risk Assessment 5%

Level 4 Modules

- **PHY4001 Physics Research Project (Autumn) (60)**

Pre-Requisites: None

Module Coordinator: Dr Ernst De Mooij

Course Content:

Students will undertake a single research project within a Research Centre in the School or at an appropriate external organisation. Safety, risk assessment, and ethics training. Searching and evaluating scientific literature.

Compulsory Element: Safety/Risk Assessment must be passed.

Assessment: Project Report 45%, Lab Performance 30%, Oral Presentation 15%, Literature Review 10%, Safety/Risk Assessment 0%

- **PHY4003 Ionising Radiation in Medicine (Spring) (10)**

Pre-Requisites: PHY3006

Lecturers: Dr Jason Greenwood

Course Content:

Interactions of radiation with matter; Introduction to radiobiology; Interaction of Charged Particles with Biological Matter; Modern approaches to Radiotherapy; Selected Modern Radiation Research Topics

Compulsory Element: None

Assessment: Computer Test 40%, Written project report 60%

- **PHY4004 Medical Radiation Simulation (Spring) (10)**

Pre-Requisites: None

Co-Requisites: PHY4003

Lecturers: Dr Stephen McMahon

Course Content:

Introduction to a basic Linux scientific computational environment. Introduction to Monte-Carlo radiation transport simulation. Proton and photon interactions with matter. Applications of radiation transport to simulate aspects of medical imaging and radiotherapy. Validation of simulations and assessment of errors

Compulsory Element: None

Assessment: Assignment 30%, Written Report 70%

- **PHY4005 Planetary Systems (Spring) (10)**

Pre-Requisites: PHY3003

Lecturers: Prof Chris Watson, Dr Ernst de Mooij

Course Content:

Understand the structure of planetary systems and protoplanetary disks and describe how they are formed through the comparison of observations and theory.

Understand different techniques for exoplanet discovery and calculate the values of planetary system parameters required for this.

Use knowledge of physics to constrain the orbital evolution of planets and their interior structure.

Describe the observed properties of planetary atmospheres by combining measurements with theory and explain how these properties allow possible habitats for life to be evaluated.

Compulsory Element: None

Assessment: Assignment 40%, Written Report 60%

- **PHY4006 High-energy Astrophysics (Spring) (10)**

Pre-Requisites: PHY3003

Lecturers: Dr Ryan Milligan

Course Content:

Observational overview, Accreting neutron stars and pulsars, Pulsar emission mechanisms, Black holes, active galactic nuclei, explosive transients (gamma-ray bursts, supernovae), and supernova remnants, Role of jets, non-electromagnetic processes; cosmic rays, gravitational waves, Particle acceleration, Radiation processes (e.g., Bremsstrahlung, inverse Compton, etc.), Stellar dynamos, Flux emergence, Magnetic topologies, Zeeman + Hanle effects, Magnetic reconnection and flares.

Compulsory Element: None

Assessment: Assignment 30%, Examination 70%

Exam takes place in May

- **PHY4007 Laser Physics (Spring) (10)**

Pre-Requisites: None

Lecturers: Prof Brendan Dromey

Course Content:

Basic laser physics: Population inversion and laser materials, gain in a laser system, saturation, transform limit, diffraction limit.

Short pulse oscillators: Cavities, Q-switching, cavity modes, mode locking

Amplification: Beam transport considerations (B-Integral), chirped pulse amplification, stretcher and compressor design, white light generation, optical parametric chirped pulse amplification.

Different types of lasers: Fiber lasers, laser diodes, Dye lasers, high performance national and international laser facilities

Applications of state-of-the-art lasers: Intense laser-matter interactions, high harmonic generation: perturbed atoms to relativistic plasmas, generation of shortest pulses of electromagnetic radiation

Compulsory Element: None

Assessment: Assignment 30%, Examination 70%

Exam will take place in May

- **PHY4008 Plasma Physics (Spring) (10)**

Pre-Requisites: None

Lecturers: Dr Satya Kar

Course Content:

Introduction to Plasmas: applications, fundamental concepts

Single particle orbit theory: Motion of charged particles in constant/varying electric and magnetic fields, particle drift.

Plasma as Fluid: Two fluids model, Plasma oscillations and frequency.

Waves in Plasma: Electron plasma wave, Ion acoustic wave, electromagnetic wave propagation in plasma

Collisions and Resistivity: Concept of plasma resistivity, Collisional absorption of laser in plasma

Intense laser plasma Interaction: Resonance absorption, Landau damping, Ponderomotive force, Interaction in the relativistic regime, particle (electron and ion) acceleration mechanisms

Compulsory Element: None

Assessment: Assignment 30%, Examination 70%

Exam Will take place in May

- **PHY4009 Physics of Materials Characterisation (Spring) (10)**

Pre-Requisites: None

Lecturers: Dr Amit Kumar

Course Content:

Fundamental physics underlying electron microscopy-based analysis to investigate the delicate link between crystal structure and chemical composition at the nanoscale, and its impact on properties, with special focus on functional oxides and semiconductors. Physical principles of spectroscopy, Infrared and Raman spectroscopy/microscopy, scanning nonlinear optical microscopy and scanning probe microscopy with specific applications towards study of phase transitions, domains and ferroic materials.

Compulsory Element: None

Assessment: Assignment 30%, Examination 70%

Exam Will take place in May

- **PHY4010 Physics of Nanomaterials (Spring) (10)**

Pre-Requisites: None

Lecturers: Dr Hamidreza Siampour, Dr Fumin Huang

Course Content:

The module will cover the physics of nanomaterials with the emphasis on fabrication of materials and applications in magnetic recording and photonics. Magnetic recording materials including bit patterned media and spin valves. Nanostructures for surface plasmon detection. Optical properties of metal nanoparticles and nanostructures. Concept of metamaterials and negative refractive index materials. Examples of applications of nanophotonic devices e.g., in imaging, sensing and data storage.

The second half of this module will focus on the physics of nanomaterials when they are confined to two-dimensions (such as single layer atomic sheets). The underpinning physics associated with 2D electron transport in graphene (such as Dirac-cones), 2D-chalcogenides and heterointerfaces (e.g., LAO-STO) will be discussed. The novel phenomena of conducting ferroelectric domain walls with implications for Domain-Wall based nanoelectronics and the associated physics will also be covered.

Compulsory Element: None

Assessment: Assignment (2) 30%, Examination 70%

Exam Will take place in May

- **PHY4016 Cosmology (Spring) (10)**

Pre-Requisites: None

Lecturers: Dr Matt Nicholl

Course Content:

Observational overview, Distance scale and redshift, Friedmann equation and expansion, and Universal geometry, Cosmological models, Observational parameters, The cosmological constant, Age of the universe, Density of the universe and dark matter, Cosmic microwave background, Early universe, Nucleosynthesis – the origin of light elements, Inflationary universe and the Initial singularity

Compulsory Element: None

Assessment: Group Project Report 50%, Online test 50%

PHYSICS MODULES

- Physics - Level 1 Modules
- Physics - Level 2 Modules
- Physics - Level 3 Modules
- Physics - Level 4 Modules