BSc (Hons) Physics with Electronics - SCE341

1. Objectives

One of the most important concepts in physics is that, behind the apparent complexity of the world around us, nature has an underlying simplicity and unity which can be expressed in terms of all-embracing fundamental principles and laws. As well as being concerned with such fundamental questions, physics is a widely applicable subject and forms the basis of much of modern and, more importantly, future technologies. Moreover, the distinction between certain traditional branches of other disciplines and physics is rapidly fading out, resulting in an increasing number of employment opportunities in technical areas requiring expertise at the interface of physics and these disciplines.

The BSc (Hons) Physics with Electronics programme has been developed to provide students simultaneously with a solid theoretical grounding in physics and competency in the technological area of Electronic Engineering. This is achieved by combining modules from BSc (Hons) Physics offered by the Faculty of Science with modules offered by the Faculty of Engineering (BEng (Hons) Electrical and Electronic Engineering / BEng (Hons) Electronic and Communication Engineering). The programme structure puts a heavy emphasis on the acquisition of practical skills and also offers a wide range of choice of subject areas.

Depending on their specific interests and aptitudes, our graduates may opt for traditional careers like teaching or for jobs in technical areas of research and development in industry, laboratories and universities. The programme also offers adequate background for specialisation through further studies/research at postgraduate level both locally and overseas.

2. General Entry Requirements

As per General Entry Requirements for admission to the University for undergraduate degrees.

3. Programme Requirement

Passes at GCE 'A' Level in Mathematics and Physics.

4. Programme Duration

	Normal	**Maximum**
Degree:	6 Semesters *(i.e. 3 years)*	10 Semesters *(i.e. 5 years)*

5. Credits per Year

Minimum: 18 credits; Maximum (including retake modules): 50 credits

6. Minimum Credits Required for Award of Undergraduate Degree: 104.5

Breakdown as follows:

	Credits from			
Degree	**Core Taught Modules**	**Project/Dissertation**	**Electives[a]**	**GEMs[b]**
BSc (Hons) Physics with Electronics	72.5	8	Minimum 15	9

[a] A minimum of 15 credits to be obtained from the programme plan including at least 12 credits from elective modules with an ELEC code.

[b] GEMs are to be taken within years 1 & 2, and must include SCI 1010(1).

7. Assessment

Each module can either be taught in semester 1 only or in semester 2 only or throughout the two semesters.

Modules wholly taught in one semester are termed semester modules whereas modules taught throughout two semesters are termed yearly modules.

Each yearly module will be assessed over 100 marks whereas each semester module may either be assessed singly over 100 marks or it may be combined with another semester module and assessed jointly over 100 marks with details as follows (unless otherwise specified).

Assessment will be based on a written examination of a paper of 2 to 3-hour duration (normally a paper of a 2 hour duration for modules carrying less or equal to 3 credits, 2½ hour paper for modules carrying 3.5-4.5 credits and 3 hour paper for modules carrying 5 to 6 credits) and on continuous assessment done during the semester or year.

Written examinations for all Physics modules, whether taught in semester 1 or in semester 2 or both, will be carried out at the end of the academic year, except *Mathematical Techniques for Physicists I* (PHY 1101(1)) and *Maths for Physicists I* (PHY 2101(3)) which will be examined at the end of semester 1. The corresponding follow-up modules *Mathematical Techniques for Physicists II* (PHY 1201(1)) and *Maths for Physicists II (*PHY 2201(3)) will be taught in semester 2 and 4 respectively and examined at the end of the respective years.

The following pairs of semester modules will be assessed jointly over 100 marks:

PHY 1104(1) / PHY 1204(1)
PHY 2104(3) / PHY 2204(3)

The continuous assessment will count for 10-40% of the overall percentage mark for the module(s) unless specified otherwise. Continuous assessment may be based on laboratory work, seminars and/or assignments and should include at least 1 class test.

There will be a compulsory class test for all modules taught in semester 1 at the end of semester 1 of the given academic year unless stated otherwise in the Programme Structure.

A minimum of at least 30% should be attained in each of continuous assessment and written examination, with an overall total of 40% for a candidate to pass a module. For modules being assessed jointly, a minimum of at least 30 % should be attained in each of continuous assessment and written examination, with an overall total of 40 % for a candidate to pass the two modules. Note that the marks for the two modules will be considered together and not the individual marks for each of the two modules.

Special examinations (e.g. class tests) will be arranged at the end of semester 1 or semester 2 for exchange students who have registered only for one semester. In case of yearly modules, credits will be assigned on a pro-rata basis.

The following module will be assessed over 50% continuous assessment and 50% written exam:

Signal and Image Processing – PHYCO 3001(5)

The following modules will carry 100 marks each and will be assessed solely by continuous assessment:

Physics Lab I – PHY 1006Y(1)
Physics Lab II – PHY 2106(3)
Numerical and Scientific Computing I – PHYCO 1001Y(1)
Computing Environments and Tools for Scientific Reporting – SCI 1010(1).

Modules will carry the weightings of 1, 3 or 5 depending on their status (Introductory, Intermediate or Advanced). Weighting for a particular module is indicated within parentheses in the module code.

Projects/Dissertations will carry 8 credits for degree award. They will be carried out normally in the area of specialisation.

8. List of Modules

A. Physics with Electronics Core Modules (72.5 + 8 credits)

Code	Module Name	Hrs /Wk L+P	Credits
PHY 1101(1)	Mathematical Techniques for Physicists I	3+0	3
PHY 1201(1)	Mathematical Techniques for Physicists II	3+0	3
PHY 1002Y(1)	Mechanics & Oscillations	2.5+0	5
PHY 1003(1)	Physics of Matter	3+0	3
PHY 1104(1)	Optics I	3+0	3
PHY 1204(1)	Electromagnetism I	3+0	3
PHY 1005(1)	Electric Circuits & Electronics	3+0	3
PHY 1006Y(1)	Physics Lab I	0+3	3
PHY 2101(3)	Maths for Physicists I	3+0	3
PHY 2201(3)	Maths for Physicists II	3+0	3
PHY 2002Y(3)	Classical & Relativistic Mechanics	2.5+0	5
PHY 2003Y(3)	Thermal & Statistical Physics	3+0	6
PHY 2104(3)	Electromagnetism II	3+0	3
PHY 2204(3)	Optics II	3+0	3
PHY 2005Y(3)	Quantum Mechanics	2.5+0	5
PHY 2106(3)	Physics Lab. II	0+3	1.5
PHY 2007Y(3)	Electronics & Communications	2+1	5
PHY 3000Y(5)	Project/Dissertation	–	8
PHY 3203(5)	Physics Problem Paper	3+0	3
PHY 3004(5)	Solid State Physics	3+0	3
PHYCO 1001Y(1)	Numerical & Scientific Computing I	1+1	3
PHYCO 3001(5)	Signal & Image Processing	2+2	3

B. Physics with Electronics Electives (Not all modules may be on offer)

ELEC 2006Y(3)	Electrical Machines	2+1	5
ELEC 3001Y(5)	Microprocessors	2+2	6
ELEC 3004Y(5)	Digital Communications	2+1	5
ELEC 4014Y(5)	Optoelectronics	2+0	4
ELEC 4015Y(5)	RF and Microwave Engineering	2+0	4
ELEC 4032Y(5)	Optical Fiber Communications	2+0	4
PHY 2008(3)	Astrophysics	3+0	3
PHY 2009(3)	Astronomical Techniques	2+2	3
PHY 2011(3)	Renewable Energy Resources	3+0	3
PHY 2012(3)	Atmospheric Physics	3+0	3
PHY 3101(5)	Nuclear & Elementary Particle Physics I	3+0	3
PHY 3102(5)	Atomic & Molecular Physics	3+0	3
PHY 3005(5)	Medical Physics	3+0	3
PHY 3006(5)	Quantum Electronics	3+0	3
PHY 3007(5)	Electromagnetic Theory	3+0	3

C. General Education Module (GEM)

SCI 1010(1)	Computing Environments and Tools for Scientific Reporting	2+2	3

D. Other Electives

Approved modules offered by the Physics department or by other units/departments.

9. Programme Plan - BSc (Hons) Physics with Electronics

YEAR 1

Code	Module Name	Hrs /Wk L+P	Credits
CORE			
PHY 1101(1)	Mathematical Techniques for Physicists I	3+0	3
PHY 1201(1)	Mathematical Techniques for Physicists II	3+0	3
PHY 1002Y(1)	Mechanics & Oscillations	2.5+0	5
PHY 1003(1)	Physics of Matter	3+0	3
PHY 1104(1)	Optics I	3+0	3
PHY 1204(1)	Electromagnetism I	3+0	3
PHY 1005(1)	Electric Circuits & Electronics	3+0	3
PHY 1006Y(1)	Physics Lab I	0+3	3
PHYCO 1001Y(1)	Numerical & Scientific Computing I	1+1	3
GEM			
SCI 1010(1)	Computing Environments and Tools for Scientific Reporting	2+2	3

And at least one additional GEM from selection by department.

YEAR 2

Code	Module Name	Hrs /Wk L+P	Credits
CORE			
PHY 2101(3)	Maths for Physicists I	3+0	3
PHY 2201(3)	Maths for Physicists II	3+0	3
PHY 2002Y(3)	Classical & Relativistic Mechanics	2.5+0	5
PHY 2003Y(3)	Thermal & Statistical Physics	3+0	6
PHY 2104(3)	Electromagnetism II	3+0	3
PHY 2204(3)	Optics II	3+0	3
PHY 2005Y(3)	Quantum Mechanics	2.5+0	5
PHY 2106(3)	Physics Lab. II	0+3	1.5
PHY 2007Y(3)	Electronics & Communications	2+1	5
ELECTIVES			
ELEC 2006Y(3)	Electrical Machines	2+1	5
ELEC 3001Y(5)	Microprocessors	2+2	6
PHY 2008(3)	Astrophysics	3+0	3
PHY 2009(3)	Astronomical Techniques	2+2	3
PHY 2011(3)	Renewable Energy Resources	3+0	3
PHY 2012(3)	Atmospheric Physics	3+0	3

At least one GEM from selection by department

and/or modules to be chosen from any other units/departments.

YEAR 3

Code	Module Name	Hrs /Wk L+P	Credits
CORE			
PHY 3000Y(5)	Project/Dissertation	–	8
PHY 3203(5)	Physics Problem Paper	3+0	3
PHY 3004(5)	Solid State Physics	3+0	3
PHYCO 3001 (5)	Signal & Image Processing	2+2	3
ELECTIVES			
ELEC 3004Y(5)	Digital Communications	2+1	5
ELEC 4014Y(5)	Optoelectronics	2+0	4
ELEC 4015Y(5)	RF and Microwave Engineering	2+0	4
ELEC 4032Y(5)	Optical Fiber Communications	2+0	4
PHY 3101(5)	Nuclear & Elementary Particle Physics I	3+0	3
PHY 3102(5)	Atomic & Molecular Physics	3+0	3
PHY 3005(5)	Medical Physics	3+0	3
PHY 3006(5)	Quantum Electronics	3+0	3
PHY 3007(5)	Electromagnetic Theory	3+0	3

and/or modules to be chosen from any other units/departments.

NOTE: Not all electives may be on offer.

10. Outline Syllabus

This outline syllabus is not prescriptive and is intended to serve as a guide only.

PQ: Prerequirement *(must have followed module & sat for exams)*
PR: Prerequisite *(must have attained a minimum of grade E or G)*
RQ: must register for the module, or must have followed the module & sat for exams
MR: Minimum Requirement *(must have the required number of credits)*

ELEC 2006Y(3) - ELECTRICAL MACHINES (L/P - 5) (PQ: PHY 1005(1))
Magnetic Circuits and Energy Conversion in Machines. Transformer Theory, Connection and Operation. DC Machines: Principles and Characteristics/Operation of DC Motor and Generators. Induction Machines: Principles, Applications and Operation. Special Machines: Servomotors, Stepper Motors, Reluctance Motors and others.

ELEC 3001Y(5) - MICROPROCESSORS (L/P - 6) (PQ: PHY 1005(1))
Binary and Hexadecimal representation of numbers. Binary arithmetic. Architecture of 8085 microprocessor. Introduction to Assembly level and Machine Code programming. Internal Registers. Software Concepts Addressing Modes, Data transfers. Instruction sets for 8085. Data Processing. Further Programming. Test and Branch. Stack (software and hardware), subroutines, CALL instructions. Encoder/decoder, tristate, interfacing. Memory Systems RAM and ROM type of memories, EPROM and EEPROM, commercial memory chips. Memory and bit maps, address decoding, memory interfacing. Microprocessor timing and instruction design timing diagram and conventions, T-states, M-cycles, I-cycles, Instruction length and execution time.
Interrupts: RST Instructions and implementation of interrupts. Multiple interrupts and priorities, RIM and SIM Instructions. A/D and D/A conversions. Successive Approximation A/D converters. Programmable Interface chips: Intel 8155 and 8255 and their different modes of operation. Interfacing A/D converters and printers via Intel 8255. DMA. Serial communication, Standards: RS-232C. Asynchronous serial I/O. Data transmission to TTY and data reception from TTY. Serial I/O using programmable chip, Intel 8251A Programmable Communication Interface

ELEC 3004Y(5) - DIGITAL COMMUNICATIONS (L/P - 5) (PQ: PHY 2104(3), PHY 2007Y(3))
Introduction to digital communications systems, Performance criteria and limits of a communication system. Introduction to Information theory, Source and Channel coding, Bandpass modulation and demodulation, Digital modulation and demodulation techniques, Cryptography, Optical fibre communications.

ELEC 4014Y(5) - OPTOELECTRONICS (L - 4) (PQ: PHY 2104(3), PHY 2204(3))
Light and Electromagnetic waves, Review of semiconductor devices, Electroluminescence, Optical Sources. Heterostructures, Electro-Optic Modulation, Detection of Optical Signals, Optical cavities, Fiber optical waveguides.

ELEC 4015Y(5) - RF AND MICROWAVE ENGINEERING (L - 4) (PQ: PHY 2007Y(3))
Basic theory of high frequency circuits, transmission line theory, propagation coefficient, reflection coefficient for a terminated line, impedance transformation, impedance matching, VSWR, Smith Chart, two-port networks (z, y and h parameters), Interconnected two-port networks, s-parameters, insertion and return loss.

ELEC 4032Y(5) - OPTICAL FIBRE COMMUNICATIONS (L - 4) (PQ: PHY 2004Y(3), PHY 2007Y(3))
Introduction to Optical Fibber Transmission and Communication Systems, Optical fibres: structure and waveguiding, Signal degradation in optical fibres, Optical transmitters: LEDs and Lasers, Power launching and coupling, Optical Receivers: photodiodes, PIN and APD, Noise. Digital transmission systems, Analogue systems, Coherent Optical Systems.

PHY 1002Y(1) - MECHANICS & OSCILLATIONS (PR: A-LEVEL PHYSICS & MATHS)
Vectors, Statics, Frames of reference, Kinematics, Dynamics & Forces, Newton's laws of motion, Momentum, Angular momentum, Torque, Conservation laws, Newton's law of gravitation, Oscillatory motion, Resonance, Vibrations and Waves, Wave equation, Transverse and longitudinal waves, Wave in strings, Sound waves, Superposition, Standing waves, Beats, Doppler effect.

PHY 1003(1) - PHYSICS OF MATTER (PR: A-LEVEL PHYSICS & MATHS)
States of matter, Interatomic and intermolecular forces, X-ray diffraction and the crystal lattice, Cohesive & Elastic properties, Thermal motion & Boltzmann principle, Thermal properties of crystalline solids and gases, Transport properties. Polarisation in dielectrics, permittivity and dielectric susceptibility. Magnetism in matter: Magnetisation, magnetic susceptibility and permeability. Elements of fluid mechanics. Concepts of fluid flow.

PHY 1005(1) - ELECTRIC CIRCUITS AND ELECTRONICS I (PR: A-LEVEL PHYSICS & MATHS)
Ohm's law and Kirchoff's laws. Basic electrical components. Steady state DC. Linear circuit analysis and Network theorems. Single phase a.c. Circuits. Three-phase AC systems. Semiconductor diodes and circuits. Transistors. Boolean algebra. Karnaugh table. Logic gates. Transients.

PHY 1006Y(1) - PHYSICS LAB I (PR: A-LEVEL PHYSICS)
Lectures on measurement systems and methods, characteristics and uses of instruments, data analysis and presentation, report writing.
Practical training sessions will consist of a variety of experiments closely related to level/year 1 core Physics modules and will cover topics like heat, optics, sound, electricity, mechanics and properties of matter.

PHY 1101(1) - MATHEMATICAL TECHNIQUES FOR PHYSICISTS I (PR: A-LEVEL MATHS)
Vector algebra: vector addition, scalar and vector products, triple products. Vector equation: differentiation and integration of vectors. Polar coordinates. Introduction to complex numbers. Calculus of several variables: partial derivatives, scalar and vector fields. Coordinate systems: cylindrical, spherical. Vector Analysis: gradient, divergence and curl. Line and multiple integrals. Green's theorem in the plane, Divergence theorem and Stokes' theorem. Ordinary differential equations: methods of solution for first order and second order differential equations.

PHY 1104(1) - OPTICS I (PR: A-LEVEL PHYSICS & MATHS)
Fundamentals of geometrical optics; Optical path; Fermat's principle; Corpuscular theory versus Wave theory; Reflection and refraction at plane surfaces; Prisms; Refraction through spherical surfaces and through lenses; Chromatic aberration; Spherical aberration; Plane and spherical mirrors; Optical instruments. Determination of the velocity of light. Introduction to optical fibres.

PHY 1201(1) - MATHEMATICAL TECHNIQUES FOR PHYSICISTS II (PQ: PHY 1101(1))
Further differential equations. Further complex numbers. Hyperbolic functions. Limits. Curve sketching. Infinite series: comparison test and ratio test for non-negative series. Introduction to Fourier Series.
Matrix Algebra: Matrices, determinants, inverses; solutions of linear systems of equations. Eigenvalues and eigenvectors.

PHY 1204(1) - ELECTROMAGNETISM I (PR: A-LEVEL PHYSICS & MATHS)
Electrostatics: Coulomb's Law and the electric field; Electric flux and Gauss's Law. Electric potential, and the relationship between field and potential. Capacitors and electrical energy storage. Calculations of the electric field, electric potential and capacitance in simple cases.
Magnetostatics: Magnetic fields and forces generated by a conductor; Biot-Savart and Ampere's Laws and applications to calculation of magnetic fields; Forces between currents, torque on a current loop. The magnetic dipole, torque and P.E in a magnetic field. Displacement current.

PHY 2002Y(3) - CLASSICAL & RELATIVISTIC MECHANICS (PQ: PHY 1002Y(1), PHY 1201(1))
Angular momentum. Rigid body mechanics. Inertial and non-inertial frames of reference. Introduction to relativistic mechanics. Lagrangian formulation, Applications to physical examples, Hamiltonian formulation, Variational principles, Phase space, Poisson Brackets. Special Relativity.

PHY 2003Y(3) - THERMAL & STATISTICAL PHYSICS (PR: A-LEVEL PHYSICS & MATHS; PQ: PHY 1201(1))
State variables, equilibrium states, PVT surface temperature, Zeroth law of thermodynamics, Thermometers, temperature scales. Thermal expansion, thermal conductivity in solids, Specific heat, phase changes. Laws of thermodynamics. Entropy and the second law. Heat engines and reversible processes. Kinetic theory of gases. Specific heats of gases, Law of equipartition of energy, atomicity. Adiabatic processes, speed of sound in gases. Free energies and Maxwell's relations. Black-body radiation.
Entropy and its relation to microscopic properties of a system. Basic methods of Statistical Mechanics – concept of Statistical ensembles. Microcanonical and canonical ensembles and their application for discrete systems. Classical systems: the Equipartition theorem, Ideal Classical gas. Introduction to Quantum Statistical Mechanics.

PHY 2005Y(3) - QUANTUM MECHANICS (PR: A-LEVEL PHYSICS & MATHS; RQ: PHY 2101(3))
Some problems of classical physics: black body radiation, photoelectric effect and stability of atoms. Energy quantisation. Particle nature of radiation. Compton effect. Rutherford model of the atom. Bohr model of the hydrogen atom. Wave-particle dualism. The Uncertainty Principle.
Development of the Schrödinger wave equation (SWE), Wave functions, Eigenfunctions and eigenvalues, 1-D potentials, Angular momentum, 3-D SWE, Operator methods in quantum mechanics, General structure of wave mechanics.

PHY 2007Y(3) - ELECTRONICS & COMMUNICATIONS (PQ: PHY 1005(1))
Field Effect Transistors, Transistor circuits, Operational Amplifiers. Analogue to Digital Conversion and Digital to Analogue Conversion. Combinational circuits, Sequential circuits, Flip Flops, Registers, Counters, Serial and parallel data transfer. Communication theory – Analogue Modulation Schemes - AM and FM - Signal detection and demodulation. Digital modulation schemes. Noise.

PHY 2008(3) - ASTROPHYSICS (PR: A-LEVEL PHYSICS & MATHS)
Introduction to astronomy: astronomical objects and their distributions in the Universe.
Stellar observational data (magnitude systems, HR diagram, binary stars, stellar distances and masses). Stellar interiors (Hydrostatic equilibrium, temperature and pressure inside stars, the Sun, energy transport and nucleosynthesis inside stars). Stellar populations. Formation and evolution of stars. Determination of age of star clusters. The end-states of stars (degenerate stars).

Overview of galactic astronomy, extra-galactic astronomy and cosmological concepts.

PHY 2009(3) - ASTRONOMICAL TECHNIQUES (PR: A-LEVEL PHYSICS & MATHS)
Introduction to observational techniques used for different astronomical windows. Coordinate systems used in astronomy and their applications. Optical Astronomy - optical telescopes and their accessories. Radioastronomy - basic concepts behind the design of radio telescopes (including Aperture Synthesis) and their use for imaging. Practical Applications.

PHY 2011(3) - RENEWABLE ENERGY RESOURCES (PQ: PHY 1002Y(1))
Principles of renewable energy. Solar radiation; Solar water heating and other uses; Photovoltaic generation. Hydro power. Power from the wind. Biofuels. Wave energy. Tidal power. Ocean thermal energy conversion. Geothermal energy.

PHY 2012(3) - ATMOSPHERIC PHYSICS (PQ: PHY 1002Y(1), PHY 1201(1))
Physical properties and evolution of planetary atmospheres. Radiative transfers and energy balance. Atmospheric motion-trade winds, cyclones, turbulence, etc. and accompanying transport phenomena. Relationship between velocity and pressure gradients. Physics of water and ice clouds, distribution of condensation and freezing nuclei clouds droplets and ice crystals. Rain and snow formation. Earth's electric field, charge generation lightning. Remote sensing of atmospheric properties. Radar and sonar detection. Satellite observations.

PHY 2101(3) - MATHS FOR PHYSICISTS I (PQ: PHY 1201(1))
Theory of linear vector spaces: basis vectors, linear operators, matrix representation of linear operators. Inner product spaces. Fourier series, Some equations of mathematical physics, Series solution and some special functions. Applications.

PHY 2104(3) - ELECTROMAGNETISM II (PR: A-LEVEL PHYSICS & MATHS; PQ: PHY 1204(1))
Time varying fields: Magnetic Induction, Faraday's Law and Lenz's Law; generators and alternators. Inductance and energy storage in inductors. Self and mutual inductance. Dielectric permittivity, Magnetic susceptibility, and permeability. Maxwell's equations. The electromagnetic wave equation in lossless or lossy media: Plane waves, effects of boundaries. Energy and momentum of electromagnetic waves - the Poynting theorem. Coaxial lines and wave guides.

PHY 2106(3) - PHYSICS LAB II (PR: PHY 1006Y(1))
Sessions will consist of a variety of experiments closely related to level/year 1 / level/year 2 Physics modules. Students will be exposed to the use of computers for experiments.

PHY 2201(3) - MATHS FOR PHYSICISTS II (PQ: PHY 2101(3))
Complex variable theory, Calculus of residues. Dirac delta function, Fourier and Laplace Transforms, Parseval's Theorem, Convolution Theorem, applications.

PHY 2204(3) - OPTICS II (PR: A-LEVEL PHYSICS & MATHS; PQ: PHY 1104(1))
Wave nature of light. Wave motion and wave superposition. Electromagnetic waves. Polarisation. Interference and Interferometry. Diffraction and diffraction gratings. Introduction to lasers.

PHY 3000Y(5) - PROJECT (MR: 39 credits in YEAR I and Year II core modules combined)
Project work on a topic approved by the Department.

PHY 3004(5) - SOLID STATE PHYSICS (PQ: PHY 2005Y(3))
Crystal diffraction and the reciprocal lattice, Lattice vibrations, Thermal properties, Free electron Fermi gas, Band theory, Semi-conductors, Fermi surfaces.

PHY 3005(5) - MEDICAL PHYSICS (PR: A-LEVEL PHYSICS)
Aspects of dosimetry, nuclear medicine, radiotherapy, medical instrumentation, ultrasound, magnetic resonance imaging and radiology.

PHY 3006(5) - QUANTUM ELECTRONICS (PQ: PHY 2204(3), PHY 2005Y(3))
Interaction of radiation and atomic systems, Laser-Physics, Non-linear optics, Parametric oscillation, Electro-modulation, Interaction of light with sound, Phase conjugation, Two-laser applications.

PHY 3007(5) - ELECTROMAGNETIC THEORY (PR: PHY 2201(3); PQ: PHY 2104(3), PHY 2002(3))
Special relativity; Lorentz transformation; Lorentz scalars, vectors and tensors. Maxwell equations recast in relativistically covariant form; Electromagnetic field tensor; transformation laws for the electric and magnetic fields; invariants; Lienard-Wiechert potentials Lorentz force; Energy-momentum tensor; Radiation from accelerating charges.

PHY 3101(5) - NUCLEAR & ELEMENTARY PARTICLE PHYSICS I (PQ: PHY 2005Y(3))
Nuclear structure and size. Binding energy and semi-empirical mass formula. Nuclear forces and nuclear models. Radioactivity (natural and artificial). Fission and fusion.
The standard model. Leptons, quarks, hadrons and gauge bosons. Strong, Electromagnetic and Weak interactions and transmission. Particle properties and quantum numbers. Conservation laws in particle physics. Introduction to Feynman diagrams.

PHY 3102(5) - ATOMIC & MOLECULAR PHYSICS (PQ: PHY 2005Y(3))
Review of Bohr's theory - observations in support of the theory, its limitations. QM approach for spinless one-electron atoms. The Stern Gerlach expt - Space quantisation and the electron spin. Spin effects in one electron atoms. Many electron atoms. The periodic table. The Zeeman Effect. Molecular Spectra.

PHY 3203(5) - PHYSICS PROBLEM PAPER (PQ: YEARS 1 & 2 CORE MODULES WITH A PHY CODE)
This paper will consist of problems on material drawn from the core modules normally covered in the first two years of the course. The comprehensive nature of the paper will aim at assessing the general understanding of physical principles and their applications.

PHYCO 1001Y(1) - NUMERICAL & SCIENTIFIC COMPUTING I (PR: A-LEVEL PHYSICS & MATHS)
Introduction to C/Fortran programming. Interpolation. Numerical integration and differentiation. Applications to physical systems.

PHYCO 3001(5) - SIGNAL AND IMAGE PROCESSING (PQ: PHY 2201(3))
Continuous and discrete signals. Noise. Signal-to-noise ratio. Effects of sampling (Nyquist theorem). Digitisation of analogue signals. Correlation and convolution. Spectral analysis. Imaging. Deconvolution techniques. Image enhancement.

SCI 1010(1) - COMPUTING ENVIRONMENTS & TOOLS FOR SCIENTIFIC REPORTING
Introduction to Windows, Linux and Internet.
Word processing: Document Layout – Outlining, Templates, Wizards, and Add-Ins. Streamlining Formatting with Styles, Automating Processes, Master Documents - Control and Share Large Documents.
Spreadsheets: Creating a spreadsheet. Importing data into a spreadsheet, Sorting and Linking data in a spreadsheet. Formatting. Use of Excel Macros, reference and mathematical functions, statistical and database functions. Customising charts. Sharing and protecting spreadsheets.
Technical Writing and Presentations.