BSc (Hons) Physics - SC340 (Optional Minor: Biology/ Chemistry/ Mathematics) (Under Review)

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.

Our BSc (Honours) degree programme has been developed to provide a solid grounding in physics as a fundamental discipline while providing a secure foundation to a wide range of careers. To enhance accessibility to the various existing and probable future career opportunities, apart from modules in core areas of physics, we also offer a variety of electives in applied and theoretical areas of physics as well as in other optional scientific disciplines. Overall, our programme combines the study of a fundamental discipline with the opportunity to develop skills in experimental and theoretical methods of problem solving.

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 analytical and problem solving skills of physicists are also appreciated worldwide in areas like computing and even in areas like management, finance and law. In addition, our programme offers the appropriate background for specialisation through further studies, or research at postgraduate level, both locally and overseas. Some of our successful BSc graduates have pursued Masters in Physics, Computer Applications, Medical Physics and PhDs in Solid State Physics, Radio Astronomy (related to the Mauritius Radio Telescope), High Energy Physics and Functional Magnetic Resonance Imaging.

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 Semester

Minimum: 9 credits; Maximum (including retake modules): 27 credits

6. Minimum Credits Required for Award of Undergraduate Degree: 103

Breakdown as follows:

	Credits from			
Degree	**Core Taught Modules**	**Project/Dissertation**	**Electives[a]**	**GEM**
BSc (Hons) Physics	75	8	Minimum 14	6

[a] A minimum of 14 credits to be obtained from either departmental electives (with a minimum of 11 credits in PHYS modules) or electives in one of the following optional Minors : Biology, Chemistry and Mathematics.

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 module will be assessed 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 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 semester modules will be held in the semester they are taught in. Yearly modules will be examined at the end of the year.

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.

In case of yearly 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; credits will be assigned on a pro-rata basis.

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

Physics Lab I – PHYS 1006Y(3)
Physics Lab II – PHYS 2106(3)
Experiment Design – PHYS 2206(3)
Numerical and Scientific Computing I – PHYCO 1001Y(1)
Operating Systems and Softwares – PHYCO 1000(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 Core Modules (75 + 8 credits)

Code	Module Name	Hrs /Wk L+P	Credits
PHYS 1101(1)	Mathematical Techniques for Physicists I	3+0	3
PHYS 1201(1)	Mathematical Techniques for Physicists II	3+0	3
PHYS 1002Y(1)	Mechanics & Oscillations	2.5+0	5
PHYS 1203(1)	Physics of Matter	3+0	3
PHYS 1104(1)	Optics I	3+0	3
PHYS 1204(1)	Electromagnetism I	3+0	3
PHYS 1105(1)	Electric Circuits & Electronics	3+0	3
PHYS 1006Y(3)	Physics Lab I	0+3	3
PHYS 1107(1)	Thermal Physics	3+0	3
PHYS 1208(1)	Quantum Physics	2.5+0	2.5
PHYS 2101(3)	Maths for Physicists I	3+0	3
PHYS 2201(3)	Maths for Physicists II	3+0	3
PHYS 2001(3)	Mechanics & Relativity	3+0	3
PHYS 2104(3)	Electromagnetism II	3+0	3
PHYS 2204(3)	Optics II	3+0	3
PHYS 2005(3)	Quantum Mechanics	3+0	3
PHYS 2106(3)	Physics Lab. II	0+3	1.5
PHYS 2206(3)	Experiment Design	0+3	1.5
PHYS 2100(3)	Physics Integrated Paper I	1.5+0	1.5
PHYS 3000Y(5)	Project/Dissertation	–	8
PHYS 3001(5)	Nuclear Physics	3+0	3
PHYS 3102(5)	Atomic & Molecular Physics	3+0	3
PHYS 3003(5)	Elementary Particle Physics	3+0	3
PHYS 3104(5)	Statistical Physics	3+0	3
PHYS 3100(5)	Physics Integrated Paper II	3+0	3
PHYCO 1000(1)	Operating Systems and Scientific Softwares	2+2	3
PHYCO 1001Y(1)	Numerical & Scientific Computing I	1+1	3

B. Physics Electives (Not all electives may be on offer)

PHYS 2007Y(3)	Electronics & Communications	2+1	5
PHYS 2008(3)	Astrophysics	3+0	3
PHYS 2009(3)	Astronomical Techniques	2+2	3
PHYS 2010(3)	Computational Physics	2+2	3
PHYS 2011(3)	Renewable Energy Resources	3+0	3
PHYS 2012(3)	Atmospheric Physics	3+0	3
PHYS 3005(5)	Classical Mechanics	3+0	3
PHYS 3006(5)	Solid State Physics	3+0	3
PHYS 3007(5)	Medical Physics	3+0	3
PHYS 3008(5)	Quantum Electronics	3+0	3
PHYS 3009(5)	Electromagnetic Theory	3+0	3

C. Other Electives

And/or modules offered by other units/departments

D. General Education Module (GEM)

GEM	To be chosen from the list of GEMs	6

9. Programme Plan - BSc (Hons) Physics

YEAR 1

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
PHYS 1101(1)	Mathematical Techniques for Physicists I	3+0	3
PHYS 1201(1)	Mathematical Techniques for Physicists II	3+0	3
PHYS 1002Y(1)	Mechanics & Oscillations	2.5+0	5
PHYS 1203(1)	Physics of Matter	3+0	3
PHYS 1104(1)	Optics I	3+0	3
PHYS 1204(1)	Electromagnetism I	3+0	3
PHYS 1105(1)	Electric Circuits & Electronics	3+0	3
PHYS 1006Y(3)	Physics Lab I	0+3	3
PHYS 1107(1)	Thermal Physics	3+0	3
PHYS 1208(1)	Quantum Physics	2.5+0	2.5
PHYCO 1000(1)	Operating Systems and Scientific Softwares	2+2	3
PHYCO 1001Y(1)	Numerical & Scientific Computing I	1+1	3

YEAR 2

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
PHYS 2101(3)	Maths for Physicists I	3+0	3
PHYS 2201(3)	Maths for Physicists II	3+0	3
PHYS 2001(3)	Mechanics & Relativity	3+0	3
PHYS 2104(3)	Electromagnetism II	3+0	3
PHYS 2204(3)	Optics II	3+0	3
PHYS 2005(3)	Quantum Mechanics	3+0	3
PHYS 2106(3)	Physics Lab. II	0+3	1.5
PHYS 2206(3)	Experiment Design	0+3	1.5
PHYS 2100(3)	Physics Integrated Paper I	1.5+0	1.5

ELECTIVES

PHYS 2007Y(3)	Electronics & Communications	2+1	5
PHYS 2008(3)	Astrophysics	3+0	3
PHYS 2009(3)	Astronomical Techniques	2+2	3
PHYS 2010(3)	Computational Physics	2+2	3
PHYS 2011(3)	Renewable Energy Resources	3+0	3
PHYS 2012(3)	Atmospheric Physics	3+0	3

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

YEAR 3

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
PHYS 3000Y(5)	Project/Dissertation	–	8
PHYS 3001(5)	Nuclear Physics	3+0	3
PHYS 3102(5)	Atomic & Molecular Physics	3+0	3
PHYS 3003(5)	Elementary Particle Physics	3+0	3
PHYS 3104(5)	Statistical Physics	3+0	3
PHYS 3100(5)	Physics Integrated Paper II	3+0	3
ELECTIVES			
PHYS 3005(5)	Classical Mechanics	3+0	3
PHYS 3006(5)	Solid State Physics	3+0	3
PHYS 3007(5)	Medical Physics	3+0	3
PHYS 3008(5)	Quantum Electronics	3+0	3
PHYS 3009(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.

IMPORTANT NOTE: The student will be allowed to opt for the BSc (Hons) Physics, BSc (Hons) Physics with Computing, or any other future Physics undergraduate programme, offered by the department after the common first year, subject to the programme being offered by the department.

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)*

PHYS 1002Y(1) - MECHANICS & OSCILLATIONS (PR: A-Level Physics & Maths)
Vectors, Statics, Frames of reference, Kinematics, Dynamics & Forces, Newton's laws of motion, Momentum, 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.

PHYS 1203(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.

PHYS 1105(1) - ELECTRIC CIRCUITS AND ELECTRONICS (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.

PHYS 1006Y(3)Y(3) - 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.

PHYS 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 differential equations.

PHYS 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.

PHYS 1201(1) - MATHEMATICAL TECHNIQUES FOR PHYSICISTS II (PQ: PHYS 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.

PHYS 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.

PHYS 1107 (1) - THERMAL PHYSICS (PR: A-Level Physics & Maths)
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.

PHYS 1208(3) - QUANTUM PHYSICS (PR: A-Level Physics & Maths)
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. Introduction to the Schrödinger equation.

PHYS 2100(3) - PHYSICS INTEGRATED PAPER I (PR: YEAR 1 CORE MODULES WITH A PHYS CODE)
This paper will consist of problems on material drawn from the core modules covered in the first year of the course. The comprehensive nature of the paper will aim at assessing the general understanding of basic physics and/or their applications.

PHYS 2001(3) - MECHANICS & RELATIVITY (PQ: PHYS 1002Y(1), PHYS 1201(1))
Angular momentum. Rigid body mechanics. Inertial and non-inertial frames of reference. Special Relativity.

PHYS 2005(3) - QUANTUM MECHANICS (PQ: PHYS 1208(3))
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 .

PHYS 2007Y(3) - ELECTRONICS & COMMUNICATIONS (PQ: PHYS 1105(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.

PHYS 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.

PHYS 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.

PHYS 2010(3) - COMPUTATIONAL PHYSICS (PQ: PHYS 1201(1), PHYCO 1001Y(1))
Phase space, computational aspects of phase space diagrams, spectral methods of analysis, Optimisation procedures, simulation methods, Applications to physical systems.

PHYS 2011(3) - RENEWABLE ENERGY RESOURCES (PQ: PHYS 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.

PHYS 2012(3) - ATMOSPHERIC PHYSICS (PQ: PHYS 1002Y(1), PHYS 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.

PHYS 2101(3) - MATHS FOR PHYSICISTS I (PQ: PHYS 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.

PHYS 2104(3) - ELECTROMAGNETISM II (PR: A-Level Physics & Maths; PQ: PHYS 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.

PHYS 2106(3) - PHYSICS LAB II (PR: PHYS 1006Y(3))
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.

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

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

PHYS 2206(3) - EXPERIMENT DESIGN (PR: PHYS 1006Y(3))
Mini-project on experiment design and testing in physics.

PHYS 3000Y(5) - PROJECT (MR: 39 CREDITS IN YEAR I AND YEAR II CORE MODULES COMBINED)
Project work on a topic approved by the Department.

PHYS 3006(5) - SOLID STATE PHYSICS (PQ: PHYS 2005(3))
Crystal diffraction and the reciprocal lattice, Lattice vibrations, Thermal properties, Free electron Fermi gas, Band theory, Semi-conductors, Fermi surfaces.

PHYS 3104(5) - STATISTICAL PHYSICS (PR: PHYS 1107(1))
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.

PHYS 3007(5) - MEDICAL PHYSICS (PR: A-Level Physics)
Aspects of dosimetry, nuclear medicine, radiotherapy, medical instrumentation, ultrasound, magnetic resonance imaging and radiology.

PHYS 3008(5) - QUANTUM ELECTRONICS (PQ: PHYS 2204(3), PHYS 2005(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.

PHYS 3009(5) - ELECTROMAGNETIC THEORY (PR: PHYS 2201(3); PQ: PHYS 2104(3), PHYS 2001(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.

PHYS 3100(5) - PHYSICS INTEGRATED PAPER II (PR: PHYS 2101(3), PHYS 2201(3), PHYS 2001(3), PHYS 2104(3), PHYS 2204(3), PHY2005(3), PHYS 2100(3))
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.

PHYS 3001(5) - NUCLEAR PHYSICS (PQ: PHYS 2005(3))
Nuclear structure and size. Binding energy and semi-empirical mass formula. Nuclear forces and nuclear models. Radioactivity (natural and artificial). Fission and fusion. Theories of alpha, beta and gamma decay. Nuclear reactions. Fission and fusion reactors. Controlled fusion. Fusion processes inside stars.

PHYS 3003(5) - ELEMENTARY PARTICLE PHYSICS (PQ: PHYS 2005(3))
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.

PHYS 3005(5) CLASSICAL MECHANICS (PQ: PHYS 2001)
Lagrangian formulation, Applications to physical examples, Hamiltonian formulation,
Variational principles, Phase space, Poisson Brackets, Transition to quantum mechanics,
Introduction to Hamilton-Jacobi equations.

PHYS 3102(5) - ATOMIC & MOLECULAR PHYSICS (PQ: PHYS 2005(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.

PHYCO 1000(1) – OPERATING SYSTEMS & SCIENTIFIC SOFTWARES
Introduction to Windows, and Internet. Use of office softwares for document processsing and spreadsheets.

GNU, Graphic User Interfaces with Linux: KDE, Gnome, X-Window, Shells, File systems, Processes, I/O redirection, Editors, Home directory. Introduction to Latexχ and free scientific softwares.

PHYCO 1001Y(1) - NUMERICAL & SCIENTIFIC COMPUTING (PR: A-Level Physics & Maths)
Fundamentals of C/Fortran programming. Interpolation. Numerical integration and differentiation. Applications to physical systems.

June 2009

BSc (Hons) Physics with Computing - SC342 (Under Review)

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.

The Physics with Computing programme provides a solid grounding in physics, mathematics, and computing. The programme combines the study of a fundamental and widely applicable subject with the opportunity to acquire high-level skills in experimental, theoretical and computational methods of problem solving. It also includes state of the art topics like bioinformatics and data mining. As such, the programme provides a secure foundation for a very wide range of careers including teaching, computing and finance, as well as in the more obvious technical areas of research and development in industry, government laboratories and universities. The analytical and problem solving competences of physicists are also appreciated worldwide in less obvious areas like management and law.

IN ADDITION, OUR PROGRAMME OFFERS THE APPROPRIATE BACKGROUND FOR SPECIALISATION THROUGH FURTHER STUDIES, OR 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 Semester

Minimum: 9 credits; Maximum (including retake modules): 27 credits

6. Minimum Credits Required for Award of Undergraduate Degree: 103

Breakdown as follows:

	Credits from			
Degree	**Core Taught Modules**	**Project/Dissertation**	**Electives[a]**	**GEM**
BSc (Hons) Physics with Computing	75	8	Minimum 14	6

[a] A minimum of 14 credits from departmental electives including at least 6 credits from electives with a PHYCO code.

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 module will be assessed 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 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 semester modules will be held in the semester they are taught in. Yearly modules will be examined at the end of the year.

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.

In case of yearly 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; 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 – PHYS 1006Y(3)
Physics Lab II – PHYS 2106(3)
Experiment Design – PHYS 2206(3)
Numerical and Scientific Computing I – PHYCO 1001Y(1)
Operating Systems and Softwares – PHYCO 1000(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 Core Modules (75 + 8 credits)

Code	Module Name	HRS /WK L+P	Credits
PHYS 1101(1)	Mathematical Techniques for Physicists I	3+0	3
PHYS 1201(1)	Mathematical Techniques for Physicists II	3+0	3
PHYS 1002Y(1)	Mechanics & Oscillations	2.5+0	5
PHYS 1203(1)	Physics of Matter	3+0	3
PHYS 1104(1)	Optics I	3+0	3
PHYS 1204(1)	Electromagnetism I	3+0	3
PHYS 1105(1)	Electric Circuits & Electronics	3+0	3
PHYS 1006Y(3)	Physics Lab I	0+3	3
PHYS 1107(1)	Thermal Physics	3+0	3
PHYS 1208(1)	Quantum Physics	2.5+0	2.5
PHYS 2101(3)	Maths for Physicists I	3+0	3
PHYS 2201(3)	Maths for Physicists II	3+0	3
PHYS 2001(3)	Mechanics & Relativity	3+0	3
PHYS 2104(3)	Electromagnetism II	3+0	3
PHYS 2204(3)	Optics II	3+0	3
PHYS 2005(3)	Quantum Mechanics	3+0	3
PHYS 2100(3)	Physics Integrated Paper I	1.5+0	1.5
PHYS 3000Y(5)	Project/Dissertation	–	8
PHYS 3001(5)	Nuclear Physics	3+0	3
PHYS 3104(5)	Statistical Physics	3+0	3
PHYS 3100(5)	Physics Integrated Paper II	3+0	3
PHYCO 1000(1)	Operating Systems and Scientific Softwares	2+2	3
PHYCO 1001Y(1)	Numerical & Scientific Computing I	1+1	3
PHYCO 2001(3)	Numerical & Scientific Computing II	2+2	3
PHYCO 2002(3)	Computer Simulation Methods	2+2	3
PHYCO 3001(5)	Signal & Image Processing	2+2	3

B. Physics With Computing Electives (Not all electives may be on offer)

PHYS 2007Y(3)	Electronics & Communications	2+1	5
PHYS 2008(3)	Astrophysics	3+0	3
PHYS 2009(3)	Astronomical Techniques	2+2	3
PHYS 2011(3)	Renewable Energy Resources	3+0	3
PHYS 2012(3)	Atmospheric Physics	3+0	3
PHYS 3003(5)	Elementary Particle Physics	3+0	3
PHYS 3005(5)	Classical Mechanics	3+0	3
PHYS 3102(5)	Atomic & Molecular Physics	3+0	3
PHYS 3006(5)	Solid State Physics	3+0	3
PHYS 3007(5)	Medical Physics	3+0	3
PHYS 3008(5)	Quantum Electronics	3+0	3
PHYS 3009(5)	Electromagnetic Theory	3+0	3

PHYCO 2003(3)	Bioinformatics	2+2	3
PHYCO 2004(3)	Computing Case Study Module	1+4	3
PHYCO 3002(5)	Databases & Data Mining	2+2	3
PHYCO 3003(5)	Microprocessor & Microcontroller Systems	2+2	3

C. Other Electives

And/or modules offered by other units/departments

D. General Education Module (GEM)

GEM	To be chosen from the list of GEMs	6

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

YEAR 1

Code	Module Name	HRS/WK L+P	Credits
CORE			
PHYS 1101(1)	Mathematical Techniques for Physicists I	3+0	3
PHYS 1201(1)	Mathematical Techniques for Physicists II	3+0	3
PHYS 1002Y(1)	Mechanics & Oscillations	2.5+0	5
PHYS 1203(1)	Physics of Matter	3+0	3
PHYS 1104(1)	Optics I	3+0	3
PHYS 1204(1)	Electromagnetism I	3+0	3
PHYS 1105(1)	Electric Circuits & Electronics	3+0	3
PHYS 1006Y(3)	Physics Lab I	0+3	3
PHYS 1107(1)	Thermal Physics	3+0	3
PHYS 1208(1)	Quantum Physics	2.5+0	2.5
PHYCO 1000(1)	Operating Systems and Scientific Softwares	2+2	3
PHYCO 1001Y(1)	Numerical & Scientific Computing I	1+1	3

YEAR 2

Code	Module Name	HRS/WK L+P	Credits
CORE			
PHYS 2101(3)	Maths for Physicists I	3+0	3
PHYS 2201(3)	Maths for Physicists II	3+0	3
PHYS 2001(3)	Mechanics & Relativity	3+0	3
PHYS 2104(3)	Electromagnetism II	3+0	3
PHYS 2204(3)	Optics II	3+0	3
PHYS 2005(3)	Quantum Mechanics	3+0	3
PHYS 2100(3)	Physics Integrated Paper I	1.5+0	1.5
PHYCO 2001(3)	Numerical & Scientific Computing II	2+2	3

ELECTIVES

PHYS 2007Y(3)	Electronics & Communications	2+1	5
PHYS 2008(3)	Astrophysics	3+0	3
PHYS 2009(3)	Astronomical Techniques	2+2	3
PHYS 2011(3)	Renewable Energy Resources	3+0	3
PHYS 2012(3)	Atmospheric Physics	3+0	3
PHYCO 2003(3)	Bioinformatics	2+2	3
PHYCO 2004(3)	Computing Case Study Module	1+4	3

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

YEAR 3

Code	Module Name	HRS/WK L+P	Credits
CORE			
PHYS 3000Y(5)	Project/Dissertation	–	8
PHYS 3001(5)	Nuclear Physics	3+0	3
PHYS 3104(5)	Statistical Physics	3+0	3
PHYS 3100(5)	Physics Integrated Paper II	3+0	3
PHYCO 3001(5)	Signal & Image Processing	2+2	3
ELECTIVES			
PHYS 3003(5)	Elementary Particle Physics	3+0	3
PHYS 3005(5)	Classical Mechanics	3+0	3
PHYS 3102(5)	Atomic & Molecular Physics	3+0	3
PHYS 3006(5)	Solid State Physics	3+0	3
PHYS 3007(5)	Medical Physics	3+0	3
PHYS 3008(5)	Quantum Electronics	3+0	3
PHYS 3009(5)	Electromagnetic Theory	3+0	3
PHYCO 3002(5)	Databases & Data Mining	2+2	3
PHYCO 3003(5)	Microprocessor & Microcontroller Systems	2+2	3

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

Note: Not all electives may be on offer.

IMPORTANT NOTE: The student will be allowed to opt for the BSc (Hons) Physics, BSc (Hons) Physics with Computing, or any other future Physics undergraduate programme, offered by the department after the common first year, subject to the programme being offered by the department.

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)*

PHYS 1002Y(1) - MECHANICS & OSCILLATIONS (PR: A-Level Physics & Maths)
Vectors, Statics, Frames of reference, Kinematics, Dynamics & Forces, Newton's laws of motion, Momentum, 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.

PHYS 1203(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.

PHYS 1105(1) - ELECTRIC CIRCUITS AND ELECTRONICS (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.

PHYS 1006Y(3) - 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.

PHYS 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 differential equations.

PHYS 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.

PHYS 1201(1) - MATHEMATICAL TECHNIQUES FOR PHYSICISTS II (PQ: PHYS 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.

PHYS 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.

PHYS 1208(1) - QUANTUM PHYSICS (PR: A-LEVEL PHYSICS & MATHS)
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. Introduction to the Schrödinger equation.

PHYS 1107 (1) - THERMAL PHYSICS (PR: A-Level Physics & Maths)
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.

PHYS 2100(3) - PHYSICS INTEGRATED PAPER I (PR: YEAR 1 CORE MODULES WITH A PHYS CODE)
This paper will consist of problems on material drawn from the core modules covered in the first year of the course. The comprehensive nature of the paper will aim at assessing the general understanding of basic physics and their applications.

PHYS 2001(3) - MECHANICS & RELATIVITY (PQ: PHYS 1002Y(1), PHYS 1201(1))
Angular momentum. Rigid body mechanics. Inertial and non-inertial frames of reference. Special Relativity.

PHYS 2005(3) - QUANTUM MECHANICS (PQ: PHYS 1208(3))
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.

PHYS 2007Y(3) - ELECTRONICS & COMMUNICATIONS (PQ: PHYS 1105(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.

PHYS 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.

PHYS 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.

PHYS 2011(3) - RENEWABLE ENERGY RESOURCES (PQ: PHYS 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.

PHYS 2012(3) - ATMOSPHERIC PHYSICS (PQ: PHYS 1002Y(1), PHYS 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.

PHYS 2101(3) - MATHS FOR PHYSICISTS I (PQ: PHYS 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.

PHYS 2104(3) - ELECTROMAGNETISM II (PR: A-LEVEL PHYSICS & MATHS; PQ: PHYS 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.

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

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

PHYS 3000Y(5) - PROJECT (MR: 39 CREDITS IN YEAR I AND YEAR II CORE MODULES COMBINED)
Project work on a topic approved by the Department.

PHYS 3006(5) - SOLID STATE PHYSICS (PQ: PHYS 2005(3))
Crystal diffraction and the reciprocal lattice, Lattice vibrations, Thermal properties, Free electron Fermi gas, Band theory, Semi-conductors, Fermi surfaces.

PHYS 3104(5) - STATISTICAL PHYSICS (PR: PHYS 1107(1))
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.

PHYS 3007(5) - MEDICAL PHYSICS (PR: A-Level Physics)
Aspects of dosimetry, nuclear medicine, radiotherapy, medical instrumentation, ultrasound, magnetic resonance imaging and radiology.

PHYS 3008(5) - QUANTUM ELECTRONICS (PQ: PHYS 2204(3), PHYS 2005(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.

PHYS 3009(5) - ELECTROMAGNETIC THEORY (PR: PHYS 2201(3); PQ: PHYS 2104(3), PHYS 2001(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.

PHYS 3100(5) - PHYSICS INTEGRATED PAPER II (PR: PHYS 2101(3), PHYS 2201(3), PHYS 2001(3), PHYS 2104(3), PHYS 2204(3), PHY2005(3), PHYS 2100(3))
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.

PHYS 3001(5) - NUCLEAR PHYSICS (PQ: PHYS 2005(3))
Nuclear structure and size. Binding energy and semi-empirical mass formula. Nuclear forces and nuclear models. Radioactivity (natural and artificial). Fission and fusion. Theories of alpha, beta and gamma decay. Nuclear reactions. Fission and fusion reactors. Controlled fusion. Fusion processes inside stars.

PHYS 3003(5) - ELEMENTARY PARTICLE PHYSICS (PQ: PHYS 2005(3))
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.

PHYS 3102(5) - ATOMIC & MOLECULAR PHYSICS (PQ: PHYS 2005(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.

PHYCO 1000(1) – OPERATING SYSTEMS & SCIENTIFIC SOFTWARES
Introduction to Windows, and Internet. Use of office softwares for document processsing and spreadsheets.
GNU, Graphic User Interfaces with Linux: KDE, Gnome, X-Window, Shells, File systems, Processes, I/O redirection, Editors, Home directory. Introduction to Late$f$Ô and free scientific softwares.

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

PHYCO 2001(3) - NUMERICAL AND SCIENTIFIC COMPUTING II (PQ: PHYS 1201(1) & PHYCO 1001Y(1))
Introduction to Matlab. Numerical solution of differential equations. Matrix manipulations. Applications to physical systems.

PHYCO 2002(3) - COMPUTER SIMULATION METHODS (PQ: PHYS 1002Y(1) & PHYS 2101(3))
Selected topics from: Molecular dynamics, Monte Carlo simulations, Neural networks, Genetic algorithms, and/or other advanced/new topics.

PHYCO 2003(3) - BIOINFORMATICS (PQ: PHYCO 1000(1), PHYS 1002Y(1) & PHYS 1201(1); PR: PHYCO 1001Y(1))
Introductory bioinformatics. Fundamentals of molecular biology. Object oriented programming. Analysis of gene sequences. Human genome. Proteomics, Genomics and Pharmacogenomics. Introduction to molecular modelling and molecular docking.

PHYCO 2004(3) - COMPUTING CASE STUDY MODULE (PQ: PHYCO 1000(1), PHYCO 1001Y(1))
Case study/Mini-project.

PHYCO 3001(5) - SIGNAL AND IMAGE PROCESSING (PQ: PHYS 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.

PHYCO 3002(5) - DATABASES AND DATA MINING (PQ: SCI 1010(1))
Information & data. Architecture. Relational database systems, MySQL. Database management systems. Introductory data mining. Data warehouse. Data mining techniques. Security. Recovery. Novel concepts.

PHYCO 3003(5) - MICROPROCESSOR AND MICROCONTROLLER SYSTEMS (PQ: PHYS 2007Y(3))
Chip architecture of microprocessor and microcontroller devices – ALU – registers - memory maps - addressing modes – interrupts - serial and parallel I/O ports - timers – program memory - assembly language programming - high-level language programming - hardware interfacing - PC Interfacing – applications.

January 2010