MSc Physics - SC530

1. Specific Titles

1) MSc Physics
2) MSc Physics with specialisation in Physics of Materials
3) MSc Physics with specialisation in Astrophysics
4) MSc Physics with specialisation in Communications
5) MSc Physics with specialisation in Signal/Image Processing Applications

2. Objectives

This Programme aims at enhancing the knowledge and skills of graduates in the established and emerging fields of physics. The multiple exit nature of the Programme together with the specialisation options provide the Programme with a flexibility much needed in the context of a dynamic economic environment. Graduates will thus benefit from better career prospects and a sound understanding of the physical world.

3. General Entry Requirements

Successful completion of an undergraduate degree with

- at least a Second Class or 50%, whichever is applicable or
- a GPA not less than 2.5 out of 4 or equivalent, from a recognised higher education institution.

OR alternative qualifications acceptable to the University of Mauritius.

4. Programme Requirements

BSc (Hons) Physics or BSc **(**Joint Hons) Degree with Physics as one of the subjects or equivalent qualifications acceptable to the University of Mauritius.

5. General and Programme Requirements – Special Cases

The following may be deemed to have satisfied the General and Programme requirements for admission:

(i) Applicants who do not satisfy any of the requirements as per Regulations 3 and 4 above but who submit satisfactory evidence of having passed examinations which are deemed by the Senate to be equivalent to any of those listed.

(ii) Applicants who do not satisfy any of the requirements as per Regulations 3 and 4 above but who in the opinion of Senate submit satisfactory evidence of the capacity and attainments requisite to enable them to pursue the programme proposed.

(iii) Applicants who hold a full practising professional qualification obtained by examination.

6. Programme Duration

The Programme is offered either on a full-time and/or a part-time basis. The duration of the Postgraduate Programme should normally not exceed 4 years (8 semesters) for P/T and 2 years (4 semesters) for F/T.

	Part-Time		Full-Time	
	Normal	**Maximum**	**Normal**	**Maximum**
Master's Degree:	4 Semesters	8 Semesters	2 Semesters	4 Semesters
Postgraduate Diploma:	4 Semesters	8 Semesters	2 Semesters	4 Semesters
Postgraduate Certificate:	4 Semesters	8 Semesters	2 Semesters	4 Semesters

7. Credits per Semester: Minimum 3 credits subject to Regulation 6.

8. Minimum Credits Required for Awards

Master's Degree: 36
Postgraduate Diploma: 24
Postgraduate Certificate: 12

Breakdown as follows:

(i) MSc Degree

(a) MSc Physics

Core modules: 18 credits
+ Project: 9 credits
+ Elective modules: 9 credits with a maximum of 6 credits from any specialising Option.

(b) MSc Physics with specialisation in Option A or B or C or D

Core modules: 18 credits
+ Project*: 9 credits
+ Elective modules: 9 credits with a minimum of 6 credits from the specialising Option.

*** The Project must pertain to the specialisation Option.**

(ii) Postgraduate Diploma in Physics

Core modules: 15 credits
+ any other modules: 9 credits

(iii) Postgraduate Certificate in Physics

Core modules (at least 3): 9 credits
+ any other module: 3 credits

9. Assessment

Each module will carry 100 marks and will be assessed as follows (unless otherwise specified):

Assessment will be based on a written examination of 3-hour duration and continuous assessment carrying a range of 10% to 30% of total marks except for a programme where the structure makes for other specific provision(s). Continuous assessment may be based on laboratory works, and/or assignments and should include at least 1 class test.

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.

PHY 6050(1) will be assessed solely by Continuous Assessment.

10. Plan of Study

Students are required to submit at the end of Semester 1 a Plan of Study for their whole Programme of Studies, indicating the list of electives modules and in which semester each of them will be taken.

The University reserves the right not to offer a given elective module if the critical number of students is not attained and/or for reasons of resource constraints.

11. Important Note

The rules as stipulated in this Programme Structure and Outline Syllabus will replace all other rules and regulations found in previous Programme Structures.

12. List of Modules

Code	Module Name	Hrs/Wk L+P	Credits
CORE MODULES			
PHY 6001(1)	Mechanics	3+0	3
PHY 6002(1)	Fields and Waves	3+0	3
PHY 6003(1)	Quantum Mechanics	3+0	3
PHY 6004(1)	Statistical Physics	3+0	3
PHY 6005(1)	Optics and Applications	3+0	3
PHY 6006(1)	Physics of Fluids	3+0	3
PROJECT			
PHY 6000(1)	Research Project	-	9
ELECTIVES			
OPTION A - PHYSICS OF MATERIALS			
PHY 6010(1)	Solid State Physics	3+0	3
PHY 6011(1)	Microwaves and Materials	3+0	3
PHY 6012(1)	Physics & Applications of Semiconductors	3+0	3
PHY 6013(1)	Thin Films	3+0	3
PHY 6014(1)	Polymer Physics & Applications	3+0	3
OPTION B - ASTROPHYSICS			
PHY 6020(1)	General Relativity and Cosmology	3+0	3
PHY 6021(1)	Astronomical Techniques	3+0	3
PHY 6022(1)	Physical Cosmology	3+0	3
PHY 6023(1)	Stellar Astrophysics	3+0	3
PHY 6024(1)	Physical Processes in Astrophysics	3+0	3
PHY 6025(1)	Galaxies (content and evolution)	3+0	3
OPTION C - COMMUNICATIONS			
PHY 6030(1)	Microwave, Radio & Optical Communications	3+0	3
PHY 6031(1)	Communications Systems 1	3+0	3
PHY 6032(1)	Communications Systems 2	3+0	3
PHY 6033(1)	Digital Satellite Communications	3+0	3

OPTION D - SIGNAL/ IMAGE PROCESSING APPLICATIONS

PHY 6040(1)	Advanced Signal Processing	3+0	3
PHY 6041(1)	Imaging Materials and Processes	3+0	3
PHY 6042(1)	Image Processing and Computer Vision	3+0	3

OPTION E - OTHER ELECTIVES

PHY 6050(1)	Advanced Practicals	0+9	3
PHY 6051(1)	Dynamical Systems and Chaos	3+0	3
PHY 6052(1)	Artificial Intelligence Tools	3+0	3
PHY 6053(1)	Alternative Energy Resources	3+0	3

Note: Some electives/options may not be an offer. The list of modules is not exhaustive. Options A, B, C and D are specialised options. Option E is not a specialisation option.

13. Programme Plan - MSc Physics

Full-Time:

YEAR 1

Semester 1 Code	Module Name	Hrs/Wk L+P	Credits	Semester 2 Code	Module Name	Hrs/Wk L+P	Credits
CORE				**CORE**			
PHY 6000(1)	Project	-	-	PHY 6000(1)	Project	-	9
PHY 6001(1)	Mechanics	3+0	3	PHY 6004(1)	Statistical Physics	3+0	3
PHY 6002(1)	Fields and Waves	3+0	3	PHY 6005(1)	Optics and Applications	3+0	3
PHY 6003(1)	Quantum Mechanics	3+0	3	PHY 6006(1)	Physics of Fluids	3+0	3
ELECTIVES	**CHOOSE FROM**			**ELECTIVES**	**CHOOSE FROM**		
PHY 6010-6014(1)	SPECIALISATION IN OPTION A			PHY 6010-6014(1)	SPECIALISATION IN OPTION A		
PHY 6020-6025(1)	SPECIALISATION IN OPTION B			PHY 6020-6025(1)	SPECIALISATION IN OPTION B		
PHY 6030-6033(1)	SPECIALISATION IN OPTION C			PHY 6030-6033(1)	SPECIALISATION IN OPTION C		
PHY 6040-6042(1)	SPECIALISATION IN OPTION D			PHY 6040-6042(1)	SPECIALISATION IN OPTION D		
PHY 6050-6053(1)	OTHER ELECTIVES IN OPTION E			PHY 6050-6053(1)	OTHER ELECTIVES IN OPTION E		

NOTE: Normally, the programme plan will be as above, but the Department reserves the right to choose the cores and electives to be run in each semester. Some electives/options may not be on offer. The list of modules is not exhaustive. Options A, B, C and D are specialisation options. Option E is not a specialisation option.

Part-Time

YEAR 1

Semester 1 Code	Module Name	Hrs/Wk L+P	Credits	Semester 2 Code	Module Name	Hrs/Wk L+P	Credits
CORE				**CORE**			
PHY 6001(1)	Mechanics	3+0	3	PHY 6003(1)	Quantum Mechanics	3+0	3
PHY 6002(1)	Fields and Waves	3+0	3	PHY 6004(1)	Statistical Physics	3+0	3
ELECTIVES	**CHOOSE FROM**			**ELECTIVES**	**CHOOSE FROM**		
PHY 6010-6014(1)	SPECIALISATION IN OPTION A			PHY 6010-6014(1)	SPECIALISATION IN OPTION A		
PHY 6020-6025(1)	SPECIALISATION IN OPTION B			PHY 6020-6025(1)	SPECIALISATION IN OPTION B		
PHY 6030-6033(1)	SPECIALISATION IN OPTION C			PHY 6030-6033(1)	SPECIALISATION IN OPTION C		
PHY 6040-6042(1)	SPECIALISATION IN OPTION D			PHY 6040-6042(1)	SPECIALISATION IN OPTION D		
PHY 6050-6053(1)	OTHER ELECTIVES IN OPTION E			PHY 6050-6053(1)	OTHER ELECTIVES IN OPTION E		

YEAR 2

Semester 1				**Semester 2**			
Code	**Module Name**	**Hrs/Wk L+P**	**Credits**	**Code**	**Module Name**	**Hrs/Wk L+P**	**Credits**
CORE				**CORE**			
PHY 6000(1)	Project	-	-	PHY 6000(1)	Project	-	9
PHY 6005(1)	Optics and Applications	3+0	3				
PHY 6006(1)	Physics of Fluids	3+0	3				
ELECTIVES	**CHOOSE FROM**			**ELECTIVES**	**CHOOSE FROM**		
PHY 6010-6014(1)	SPECIALISATION IN OPTION A			PHY 6010-6014(1)	SPECIALISATION IN OPTION A		
PHY 6020-6025(1)	SPECIALISATION IN OPTION B			PHY 6020-6025(1)	SPECIALISATION IN OPTION B		
PHY 6030-6033(1)	SPECIALISATION IN OPTION C			PHY 6030-6033(1)	SPECIALISATION IN OPTION C		
PHY 6040-6042(1)	SPECIALISATION IN OPTION D			PHY 6040-6042(1)	SPECIALISATION IN OPTION D		
PHY 6050-6053(1)	OTHER ELECTIVES IN OPTION E			PHY 6050-6053(1)	OTHER ELECTIVES IN OPTION E		

NOTE: Normally, the programme plan will be as above, but the Department reserves the right to choose the cores and electives to be run in each semester. Some electives/options may not be on offer. The list of modules is not exhaustive. Options A, B, C and D are specialisation options. Option E is not a specialisation option.

14. Outline Syllabus

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

PHY 6000(1) - PROJECT
The student must undertake a research project work. For those opting for specialisation, the research work must be necessarily related to the specialisation option.

PHY 6001(1) - MECHANICS
A brief survey of the basic principles. Variational principles and Lagrange's equations. Central conservative forces. Kinematics of rigid bodies. Dynamics of a rigid body. Hamilton's equations of motion. Canonical transformations. Hamilton-Jacobi equation. Relativistic mechanics.

PHY 6002(1) - FIELDS AND WAVES
Wave equation. Wave propagation. Polarisation. Interference. Diffraction. Electromagnetic fields. Electromagnetic radiation.

PHY 6003(1) - QUANTUM MECHANICS
Introduction: concepts of quantum mechanics and conservation laws in quantum mechanics. Perturbation theory: time independent and time dependent. Spin. Identity of particles. Radiation from atoms. Some selected topics.

PHY 6004(1) - STATISTICAL PHYSICS
Thermodynamics. Statistical methods. Systems & particles. Statistical thermodynamics. Ensembles. Quantum statistics. Fluctuations. Phase transitions. Applications.

PHY 6005(1) - OPTICS AND APPLICATIONS
Review of basic concepts. Geometrical optics. Coherence theory. Fourier optics. Optical systems. Lasers. Imaging. Holography. Guided optics and optical devices**.**

PHY 6006(1) - PHYSICS OF FLUIDS
Fluid statics. Fluid motion. Boundary layer flow. Flow in open channels. Flow in pipes and ducts. Incompressible & compressible flows. Turbulence. Non-Newtonian fluids. Hydraulic machines. Applications.

PHY 6010(1) - SOLID STATE PHYSICS
Review: The free electron model and its failures. Electrons in periodic potentials. Band model. Approximate methods of band structure calculations. Lattice dynamics. Accurate methods of band structure calculations. Beyond the independent electron approximation. Many-body theory (an introduction). Magnetism in solids. Advanced theories of dielectric solids. Elementary excitations. Superconductivity. Quantum Hall effect.

PHY 6011(1) - MICROWAVES AND MATERIALS
Dielectrics. Polarisation in dielectrics. Dielectric losses. Relaxation models. Permittivity tensor. Magnetic permeability. Magnetic losses. Ferrites. Permeability tensor. Faraday rotation. Transmission lines. Propagation constant and attenuation constant. Characteristic impedance. Smith chart. Field analysis of waveguides. Propagation modes. Rectangular circular and coaxial guides. Waveguide discontinuities. Scattering matrix theory. Passive components.

PHY 6012(1) - PHYSICS & APPLICATIONS OF SEMICONDUCTORS
Free electron model. Nearly free electron model. Tight binding model. Observable properties of semiconductor materials. Technologically important semiconductors. Semiconductor interfaces. Quantum wells. Superlattices. Quantum wires and dots. Microstructures: Electron transport, Optical properties, Fabrication/Characterization, Applications in devices.

PHY 6013(1) - THIN FILMS
Boundary conditions for electromagnetic waves at interfaces. Reflection at an interface. Matrix theory for the propagation of waves in thin film structures. Application to a single layer. Multilayers. Thin film interference filters. Quasiperiodic thin films. Thin film fabrication. Film uniformity and thickness monitoring techniques. Use of thin films in semiconductor industry.

PHY 6014(1) - POLYMER PHYSICS & APPLICATIONS
Polymer States: Solutions, Gels, Elastomers, Solids. Polymer characterisation. Spectroscopy & photophysics. Structure-property relations. Applications of electro-active polymers.

PHY 6020(1) - GENERAL RELATIVITY AND COSMOLOGY
Brief review of Special Relativity. Introduction to General Relativity. General tensor calculus. Riemannian space. The General Theory of Relativity. Some predictions and tests of General Relativity.

PHY 6021(1) - ASTRONOMICAL TECHNIQUES
Limitations of classical telescopes. Principles used in different types of telescopes (covering the whole of the electromagnetic spectrum) and their importance. Interferometry and Fourier imaging in astronomy. Simulation of array techniques. Problems of interferometry at optical frequencies. Intensity interferometers. Techniques used in different types of radiotelescopes.

PHY 6022(1) - PHYSICAL COSMOLOGY
Introduction to the observed Universe. Standard Cosmology. The thermal history of the Universe. Big-Bang nucleosynthesis. The dark matter problem. Galaxies as building blocks of large scale structure. The Microwave Background Radiation. Statistics and dynamics of clusters of galaxies. X-ray emission from clusters. Gravitational lensing. Sunyaev-Zeldovich effect. High-redshift objects: Quasars and radio galaxies. The X-ray Background. Recent determinations of cosmological parameters.

PHY 6023(1) - STELLAR ASTROPHYSICS
Coordinate systems. Distances of stars. Brightness of stars. Colour magnitude diagrams. Measurement of radii of stars. Effective temperatures of stars. Masses and radii of stars. Our sun. Spectral classification. Population I and II stars. Stellar evolution. Stellar magnetic fields. Pulsating stars. Explosive stars. Interstellar medium.

PHY 6024(1) - PHYSICAL PROCESSES IN ASTROPHYSICS
Different types of astrophysical processes occurring in the universe, like synchrotron radiation, thermal absorption, synchrotron self-absorption, Bremsstrahlung, Compton scattering, Plasma effects, etc. Understanding the spectra and morphology of the different astronomical objects using the laws and theories of physics.

PHY 6025(1) - GALAXIES (CONTENT AND EVOLUTION)
Stellar evolution in galaxies. Morphology of galaxies. The Milky Way as a Galaxy. The Dark Matter problem. Potential theory. Collisionless systems. Disk dynamics. Collisions of stellar systems. Galaxy formation. Clusters of galaxies. Galaxies at high red shift.

PHY 6030(1) - MICROWAVE, RADIO & OPTICAL COMMUNICATIONS
Review of electromagnetic wave propagation and transmission. Elements of antenna theory. From Maxwell's equations to microwave, radio and optical communications.

PHY 6031(1) - COMMUNICATIONS SYSTEMS 1
Review of Fourier transforms. Analogue modulation: amplitude and angle modulation. Noise in angle modulation. Data transmission. Pulse code modulation. Noise in digital communication systems.

PHY 6032(1) - COMMUNICATIONS SYSTEMS 2
Information theory. Source and channel coding. Spread spectrum communication. Digital communication networks.

PHY 6033(1) - DIGITAL SATELLITE COMMUNICATIONS
Orbits. Earth stations. Links. Multiple access technique. Antennas. Mobile satellite networks.

PHY 6040(1) - ADVANCED SIGNAL PROCESSING
Continuous and discrete signals. Correlation. Transforms. Convolution & deconvolution. Noise. Filtering. Component analysis. Applications.

PHY 6041(1) - IMAGING MATERIALS AND PROCESSES
Images & imaging. Colour & photography. Imaging materials & systems. Scanning. Digitisation. Compression. Transmission. Recording. Storage. Stability & preservation. Applications.

PHY 6042(1) - IMAGE PROCESSING & COMPUTER VISION
Imaging and image representation. Image fundamentals. Transformations and operations. Noise. Component analysis. Image analysis. Shape analysis and object recognition. Image filtering and enhancement. Segmentation. Matching. Image sequences. Image databases. Perceiving 3D from 2D images. Virtual reality. Applications.

PHY 6050(1) - ADVANCED PRACTICALS
This module aims at developing and enhancing experimental expertise. The practicals will be based on the various fields of physics.

PHY 6051(1) - DYNAMICAL SYSTEMS AND CHAOS
Phase space description of dynamical systems. Critical points in phase space. Non-linear deterministic systems. Chaos. Routes to chaos. Strange attractors. Poincaré maps. Characterisation of strange attractors. Applications to physical systems.

PHY 6052(1) - ARTIFICIAL INTELLIGENCE TOOLS
Fuzzy set: Theory and applications. Fuzzy systems. Neural network. Supervised and unsupervised learning architectures. Genetic algorithm and evolutionary computing.

PHY 6053(1) - ALTERNATIVE ENERGY RESOURCES
Brief review of the different sources of renewable energy and types of collectors. Solar energy. Wind energy. Tidal energy. Wave energy. Geo-thermal energy. Brief review of some other sources. Applications.