

MSc Physics (Specialisation: Astrophysics) - SC533 (Subject to Approval)

1. Specific Titles

- 1) MSc Physics with Specialisation in Astrophysics
- 2) Postgraduate Diploma in Physics with Specialisation in Astrophysics
- 3) Postgraduate Certificate in Physics with Specialisation in Astrophysics

2. Objectives

This Programme aims at enhancing the knowledge and skills of graduates in the established and emerging fields of physics. Graduates will thus benefit from better career prospects and a sound understanding of the physical world. It will however put more emphasis on knowledge and skills of graduates in the field of Astrophysics and thus prepare students for a PhD in Astrophysics or related fields.

With the construction of the MEERKAT radiotelescope in South Africa and the possibility of the SKA (<http://www.ska.ac.za>) project to be implemented in Africa (including Mauritius), this course will form part of the human resource development program in Africa for the SKA project. Even if the SKA project is not implemented in Africa, a student graduating with the MSc Physics with Specialisation in Astrophysics will be eligible to apply for a PhD in Astronomy/Astrophysics or related fields anywhere else.

3. General Entry Requirements

Successful completion of an undergraduate degree with

- at least a Second Class or CPA $\geq 50\%$, 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 (F/T) and/or a part-time (P/T) basis. The duration of the Postgraduate Programme should normally not exceed 2 years (4 semesters) for F/T and 4 years (8 semesters) for P/T.

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

8. **Minimum Credits Required for Awards**

Master's Degree:	39
Postgraduate Diploma:	24
Postgraduate Certificate:	12

Breakdown as follows:

	Core Taught modules	Project	Electives
Master's Degree	18	12	9 ^a
Postgraduate Diploma	18		6 ^b
Postgraduate Certificate	12		

^a A minimum of 9 credits from departmental electives including at least 6 credits from electives with a PHYAS code.

^b A minimum of 6 credits from departmental electives including at least 3 credits from electives with a PHYAS code.

9. **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 the two semesters are termed yearly modules.

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 30% to 40% of total marks. Continuous assessment may be based on laboratory works and/or assignments and/or seminars and should include at least 1 class test.

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.

An overall total of 40% for combined Continuous Assessment and Written Examination components would be required to pass a module, without minimum thresholds within the individual Continuous Assessment and Written Examination.

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
<u>CORE MODULES</u>			
PHYSI 6001(7)	Electromagnetic Phenomena	3 + 0	3
PHYSI 6002(7)	Quantum Mechanics II	3 + 0	3
PHYSI 6003(7)	Statistical Mechanics	3 + 0	3
PHYSI 6004(7)	Optics and Photonics	3 + 0	3
PHYAS 6003(7)	Stellar Astrophysics	3 + 0	3
PHYAS 6005(7)	Galactic and Extragalactic Astronomy	3 + 0	3
<u>PROJECT</u>			
PHYSI 6000Y(7)	Research Project	-	12
<u>ELECTIVES</u>			
PHYAS 6004(7)	Physical Processes in Astrophysics	3 + 0	3
PHYAS 6006(7)	Multi-wavelength Astrophysical Techniques	2.5+1	3
PHYAS 6007(7)	General Relativity & Physical Cosmology	3 + 0	3
PHYAS 6008(7)	Pulsar Astronomy	2.5+1	3

And/or other modules approved by the department.

Note: Not all electives may be on offer. The list of modules is not exhaustive.

13. Programme Plan - MSc Physics with specialisation in Astrophysics

Full-Time

YEAR 1

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
PHYSI 6000Y(7)	Research Project	-	-
PHYSI 6001(7)	Electromagnetic Phenomena	3 + 0	3
PHYSI 6002(7)	Quantum Mechanics II	3 + 0	3
PHYSI 6003(7)	Statistical Mechanics	3 + 0	3
PHYSI 6004(7)	Optics and Photonics	3 + 0	3
PHYAS 6003(7)	Stellar Astrophysics	3 + 0	3
PHYAS 6005(7)	Galactic and Extragalactic Astronomy	3 + 0	3
ELECTIVES			
PHYAS 6004(7)	Physical Processes in Astrophysics	3 + 0	3
PHYAS 6006(7)	Multi-wavelength Astrophysical Techniques	2.5+1	3
PHYAS 6007(7)	General Relativity & Physical Cosmology	3 + 0	3
PHYAS 6008(7)	Pulsar Astronomy	2.5+1	3

And/or other modules approved by the department.

Note: Not all electives may be on offer. The list of modules is not exhaustive.

Part-Time

YEAR 1

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
PHYSI 6001(7)	Electromagnetic Phenomena	3 + 0	3
PHYSI 6002(7)	Quantum Mechanics II	3 + 0	3
PHYSI 6003(7)	Statistical Mechanics	3 + 0	3
PHYSI 6004(7)	Optics and Photonics	3 + 0	3
PHYAS 6003(7)	Stellar Astrophysics	3 + 0	3
PHYAS 6005(7)	Galactic and Extragalactic Astronomy	3 + 0	3

YEAR 2

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
PHYSI 6000Y(7)	Research Project	-	-
ELECTIVES			
PHYAS 6004(7)	Physical Processes in Astrophysics	3 + 0	3
PHYAS 6006(7)	Multi-wavelength Astrophysical Techniques	2.5+1	3
PHYAS 6007(7)	General Relativity & Physical Cosmology	3 + 0	3
PHYAS 6008(7)	Pulsar Astronomy	2.5+1	3

And/or other modules approved by the department.

Note: Not all electives may be on offer. The list of modules is not exhaustive.

14. Outline Syllabus

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

CORE MODULES

PHYSI 6000Y(7) - RESEARCH PROJECT

The student must undertake a research project in an Astronomy/Astrophysics as approved by the department. The student will work under the guidance of an academic staff of the department with the possibility of a joint supervisor outside the department, depending on the topic chosen and the expertise available within or outside of the department.

PHYSI 6001(7) - ELECTROMAGNETIC PHENOMENA

Electromagnetic wave equation. Electromagnetic wave propagation. Generation (and sources) of electromagnetic waves. Polarisation. Interference. Diffraction. Electromagnetic wave scattering. Electromagnetic fields. Electromagnetic radiation.

PHYSI 6002(7) - QUANTUM MECHANICS II

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.

PHYSI 6003(7) - STATISTICAL MECHANICS

Thermodynamics. Statistical methods. Systems & particles. Statistical thermodynamics. Ensembles. Quantum statistics. Fluctuations. Phase transitions. Applications.

PHYSI 6004(7) - OPTICS AND PHOTONICS

Review of basic concepts. Geometrical optics. Coherence theory. Fourier optics. Optical systems. Lasers. Imaging. Holography. Guided optics and optical devices.

PHYAS 6003(7) - STELLAR ASTROPHYSICS

Colour magnitude diagrams. Effective temperatures of stars. Masses and radii of stars and their determination. Our Sun. Spectral classification. Population I and II stars. Stellar structure and evolution. Stellar magnetic fields. Pulsating stars. Explosive stars. Interstellar medium.

PHYAS 6005(7) – GALACTIC AND EXTRAGALACTIC ASTRONOMY

Stellar evolution in Galaxies. Morphology of galaxies. The Milky Way as a Galaxy. Structure of the Galaxy. Kinematics of the Galaxy. Scaling relations. Luminosity function of Galaxies. Galaxies as Gravitational lenses. Population synthesis. Nucleosynthesis and Chemical Evolution of Galaxies. Galaxy formation and evolution. Active Galactic Nuclei (AGNs). Clusters of galaxies. The Dark Matter problem. Candidates for dark matter.

ELECTIVE MODULES**PHYAS 6004(7) – PHYSICAL PROCESSES IN ASTROPHYSICS**

Fundamentals of radiative transfer. Different types of astrophysical processes occurring in the universe, like synchrotron radiation, thermal absorption, synchrotron self-absorption, Bremsstrahlung, Compton scattering. Plasma effects. Spectra of radio sources. Atomic structure. Molecular structure.

PHYAS 6006(7) – MULTIWAVELENGTH ASTROPHYSICAL TECHNIQUES

Brief historical development of observational astronomy. Transparency of the Earth's atmosphere and ionosphere to EM waves. Observational techniques used for different parts of the EM spectrum (Optical & Infrared, Radio & microwave, X-ray & Gamma-ray). Virtual observatories and Data Mining. Introduction to multiwavelength analysis. Other astronomical windows. Coordinate systems used in astronomy and their applications.

PHYAS 6007(7) – GENERAL RELATIVITY AND PHYSICAL 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. Standard Cosmology. Thermal history of the Universe. The Microwave Background Radiation. X-ray emission from Clusters of Galaxies. Gravitational lensing. Sunyaev-Zeldovich effect. Inhomogeneities in the Universe. Cosmological parameters. The Universe at High Redshift.

PHYAS 6008(7) - PULSAR ASTRONOMY

Star deaths and the formation of compact objects. Neutron star models. Observational properties of Pulsars. Pulsar emission mechanisms. Observational techniques in Pulsar Astronomy. Pulsar data processing and analysis.

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