REGULATIONS FOR THE DEGREES OF
MASTER OF SCIENCE (MSc) AND MASTER OF SCIENCE IN ENVIRONMENTAL MANAGEMENT (MSc[EnvMan])
For students admitted in 2023-24 and thereafter

(See also General Regulations and Regulations for Taught Postgraduate Curricula)

Any publication based on work approved for a higher degree should contain a reference to the effect that the work was submitted to the University of Hong Kong for the award of the degree.

The degree of Master of Science is a postgraduate degree awarded for the satisfactory completion of a prescribed course of study in one of the following five fields: Applied Geosciences, Food Industry: Management and Marketing, Food Safety and Toxicology, Physics and Space Science.

The degree of Master of Science in Environmental Management is a postgraduate degree awarded for the satisfactory completion of a prescribed course of study in Environmental Management.

Admission requirements

Sc21

(a) To be eligible for admission to the courses leading to the degree of Master of Science or Master of Science in Environmental Management, a candidate

(i) shall comply with the General Regulations and the Regulations for Taught Postgraduate Curricula;
(ii) shall hold a Bachelor’s degree with honours of this University; or another qualification of equivalent standard of this University or another University or comparable institution accepted for this purpose;
(iii) in respect of the courses of study leading to the degree of Master of Science in the field of Space Science, shall hold a Bachelor’s degree in a relevant science or engineering discipline, and prior knowledge expected in basic college-level physics, mathematics, statistics, and computer programming;
(iv) in respect of the courses of study leading to the degree of Master of Science in the field of Physics, a Bachelor’s degree with honours in a relevant science (e.g. physics, astronomy, earth science, mathematics) or engineering, and prior knowledge expected in university-level electromagnetism, quantum mechanics and thermodynamics, university-level linear algebra and multi-variable calculus, basic statistics, and some computer programming experience (e.g. coding in C++, Mathematica, Matlab or Python); and
(v) shall satisfy the examiners in a qualifying examination if required.

(b) A candidate who does not hold a Bachelor’s degree with honours of this University or another qualification of equivalent standard may in exceptional circumstances be permitted to register if the candidate demonstrates adequate preparation for studies at this level and satisfies the examiners in a qualifying examination.

Qualifying examination

Sc22

(a) A qualifying examination may be set to test the candidate's academic ability to follow the course of study prescribed. It shall consist of one or more written papers or equivalent and may include a project proposal.

(b) A candidate who is required to satisfy the examiners in a qualifying examination shall not be permitted to register until he/she has satisfied the examiners in the examination.

Award of degree

Sc23 To be eligible for the award of the degree of Master of Science or Master of Science in Environmental Management, a candidate

(i) shall comply with the General Regulations and the Regulations for Taught Postgraduate Curricula; and

(ii) shall complete the curriculum and satisfy the examiners in accordance with these regulations and syllabuses.

Advanced standing

Sc24 In recognition of studies completed successfully before admission to the Master of Science in Environmental Management, Master of Science in the field of Applied Geosciences and Master of Science in the field of Space Science, advanced standing of up to 12 credits may be granted to a candidate with appropriate qualification and professional experiences, on production of appropriate certification, subject to the approval of the Board of the Faculty. Credits gained for advanced standing shall not be included in the calculation of the GPA but will be recorded on the transcript of the candidate. The candidate should apply before commencement of the first year of study via the Department and provide all the supporting documents.

Period of study

Sc25

(a) The curriculum of the Master of Science (except Master of Science in the field of Food Industry: Management and Marketing) or the Master of Science in Environmental Management shall normally extend over one academic year of full-time study or two academic years of part-time study. Candidates in either degree shall not be permitted to extend their studies beyond the maximum period of registration of two academic years of full-time study or three academic years of part-time study, unless otherwise permitted or required by the Board of the Faculty.

(b) The curriculum of the Master of Science in the field of Food Industry: Management and Marketing shall normally extend over one academic year of full-time study. Candidates shall not be permitted to extend their studies beyond the maximum period of registration of two academic years of full-time study, unless otherwise permitted or required by the Board of the Faculty.

Completion of curriculum

Sc26 To complete the curriculum of the Master of Science or Master of Science in Environmental Management, a candidate

(a) shall satisfy the requirements prescribed in TPG 6 of the Regulations for Taught Postgraduate Curricula;

(b) shall follow courses of instruction and complete satisfactorily all prescribed written, practical and field work;

(c) shall complete and present a satisfactory dissertation or project on an approved subject or complete courses with equivalent credits as a replacement; and

(d) shall satisfy the examiners in all courses prescribed in the respective syllabuses.

Dissertation or Project

Sc27 The title of the dissertation or project shall

(a) for the full-time mode of Master of Science (except MSc in Environmental Management and MSc in the field of Food Industry: Management and Marketing), be submitted for approval by October 15 and the dissertation or project report shall be submitted not later than August 15 in the subsequent year;

(b) for the full-time curriculum of MSc in the field of Food Industry: Management and Marketing, be submitted by April 30 and the dissertation or project report shall be submitted not later than August 15 of the first year of study, unless otherwise permitted or required by the course coordinator(s);

(c) for the full-time curriculum of MSc in Environmental Management, be submitted by October 30 and the dissertation or project report shall be submitted not later than the last Friday in June of the first year of study, unless otherwise permitted or required by the course coordinator(s);

(d) for the part-time curriculum (except Master of Science in the field of Applied Geosciences, Master of Science in the field of Physics and MSc in Environmental Management), be submitted for approval by March 15 of the first year of study and the dissertation or project report shall be submitted not later than July 1 of the second year of study;

(e) for the part-time curriculum of MSc in Environmental Management, be submitted by June 30 of the first academic year, unless otherwise permitted or required by the course coordinator(s). The dissertation shall be submitted not later than the last Friday in May of the second year of study and the project report shall be submitted not later than the last Friday in June of the second year of study, unless otherwise permitted or required by the course coordinator(s);

(f) for the full-time curriculum of Master of Science in the field of Physics, be submitted by November 30 and the dissertation or project report shall be submitted not later than the first Friday in June of the first year of study;

(g) for the part-time curriculum of Master of Science in the field of Physics, be submitted by November 30 of the first academic year and the dissertation or project report shall be submitted not later than the first Friday in June of the second year of study.

Sc 28 A candidate shall submit a statement that the dissertation or project represents his/her own work (or in the case of co-joint work, a statement countersigned by his/her co-worker, which shows his/her share of the work) undertaken after registration as a candidate for either degree.

Assessments

Sc29 The assessment in any course shall consist of elements prescribed by the course teachers, and will normally comprise either written coursework alone, or coursework combined with formal examinations; in either case participation in field work or practical work may form part of the assessment.

Sc30 A candidate who has failed to satisfy the examiners

(a) at his/her first attempt in any course in the examination held during any of the academic years of study may be permitted to present himself/herself for re-examination in the course or courses at a specified subsequent examination, with or without repeating any part of the curriculum;

(b) at his/her first submission of dissertation or project report may be permitted to submit a new or revised dissertation or project report within a specified period;

(c) in any prescribed fieldwork or practical work may be permitted to present himself/herself for re-examination in fieldwork or practical work within a specified period.

Sc31 Failure to take the examination as scheduled, normally results in automatic course failure. A candidate who is unable because of illness to be present at any examination of a course, may apply for permission to be present at some other time. Any such application shall be made on the form prescribed within seven calendar days of the examination concerned.

Discontinuation

Sc32 A candidate who

(a) has failed to satisfy the examiners in more than half the number of credits of courses during any of the academic years or in any course at a repeated attempt, or

(b) is not permitted or fails to submit a new or revised dissertation or project report, or

(c) has failed to satisfy the examiners in their dissertation or project report at a second attempt,

may be recommended for discontinuation of studies.

Assessment results

Sc33 On successful completion of the curriculum, candidates who have shown exceptional merit may be awarded a mark of distinction, and this mark shall be recorded in the candidates’ degree diploma.

Grading systems

Sc34 Individual courses shall be graded according to one of the following grading systems as determined by the Board of Examiners:

(a) Letter grades, their standard and the grade points for assessments as follows:

Grade	Standard	Grade Point
A+	Excellent	4.3
A		4.0
A-		3.7
B+	Good	3.3
B		3.0
B-		2.7
C+	Satisfactory	2.3
C		2.0
C-		1.7
D+	Pass	1.3
D		1.0
F	Fail	0

or

*(b) 'Pass' or 'Fail'

Courses which are graded according to (b) above will not be included in the calculation of the GPA.

*Only applies to certain courses in MSc in the field of Applied Geosciences and MSc in the field of Physics

SYLLABUSES FOR THE DEGREE OF
MASTER OF SCIENCE IN THE FIELD OF PHYSICS
(for students admitted in 2023-24 and thereafter)

A. COURSE STRUCTURE

To be eligible for the award of the MSc in the field of Physics, a student shall complete at least 60 credits of courses. Courses with 3 or 6 credits are offered in the first and/or second semesters while courses with 9 credits are year-long courses spanning both the first and second semesters. If a student selects a course whose contents are similar to a course (or courses) which he/she has taken in his/her previous study, the Department may not approve the selection in question.

CURRICULUM
(applicable for both full-time and part-time modes)

Compulsory Courses (9 credits)	
PHYS8201	Basic Research Methods In Physical Science (6 credits)
PHYS8970	Physics Seminar (3 credits)
Disciplinary Electives (42 credits)	
Take at least 42 credits from Lists A and B with at least 18 credits must be chosen from List A:	
List A:	
PHYS8150	Computational Physics and its Contemporary Applications (6 credits)
PHYS8351	Graduate Quantum Mechanics (6 credits)
PHYS8450	Graduate Electromagnetic Field Theory (6 credits)
PHYS8550	Graduate Statistical Mechanics (6 credits)
PHYS8701	Physics Experimental Techniques (6 credits)
List B:	
PHYS8352	Quantum Information (6 credits)
PHYS8551	Topics in Solid State Physics (6 credits)
PHYS8552	Condensed Matter Physics (6 credits)
PHYS8654	General Relativity (6 credits)
PHYS8656	Topics in Astrophysics (6 credits)
PHYS8751	Device Physics (6 credits)
PHYS8850	Topics in Particle Physics (6 credits)
PHYS8852	Photonics and Metamaterials (6 credits)
SPSC7007	Data Analysis in Space Science (6 credits)
SPSC7014	Big Data, AI and Machine Learning in Space Science (6 credits)
Capstone Requirement (9 credits)	
PHYS8971	Capstone Project (9 credits)

B. COURSE CONTENTS

Compulsory Courses

PHYS8201 Basic Research Methods in Physical Science (6 credits)

This course introduces basic research methods commonly used in various sub-fields in physics. It comprises of four modules, each introducing commonly used research methods in physics. Students are required to take two out of the four modules. They are

1. *Astrophysical techniques*: Commonly used techniques and packages in astrophysical data gathering and data analysis are introduced.
2. *Computational physics and modelling techniques*: Commonly used computational physics and physical modelling methods are introduced.
3. *Experimental physics techniques*: Commonly used experimental physics apparatus and techniques are introduced.
4. *Theoretical physics*: Commonly used techniques in mathematical and theoretical physics are introduced.

Assessment: coursework (100%)

PHYS8970 Physics Seminar (3 credits)

This course aims to initiate students into research culture and to develop a capacity for communication with an audience of varied background. Students attend and take part in a specified number of colloquia and seminars organized by the Department of Physics to expose themselves to various topics of contemporary physics research and to learn the technique of professional physics presentations. Students are also required to give an oral presentation, normally on materials related to their Capstone Project. Students are also required to submit assignments based on the colloquia attended to receive a pass in this course.

Assessment: written assignments (50%), oral presentation (50%)

Disciplinary Electives

PHYS8150 Computational Physics and its Contemporary Applications (6 credits)

This course shows the power of computational approach to solving physics and related problems, which is complimentary to the traditional experimental and theoretical approaches. Students are expected to spend a significant fraction of their time in actual programming. Topics include: Introduction to computational physics; ordinary differential equation for classical physical problems; partial differential equation for classical and quantum problems; matrix method and exactly diagonalization for classical and quantum problems; Monte Carlo methods for statistical physics and quantum many-body physics; numerical methods for phase transitions and machine learning approaches to physics problems.

Assessment: coursework (70%) and examination (30%)

PHYS8351 Graduate Quantum Mechanics (6 credits)

This course introduces postgraduates to the theory and advanced techniques in quantum mechanics, and their applications to selected topics in condensed matter physics. The course covers the following topics: Dirac notation; quantum dynamics; the second quantization; symmetry and conservation laws; permutation symmetry and identical particles; perturbation and scattering theory; introduction of relativistic quantum mechanics.

Assessment: coursework (50%) and examination (50%)

PHYS8352 Quantum Information (6 credits)

This course covers the theory of quantum information and computation and its applications in physics and computer science. Topics include: Quantum computer; quantum algorithms; quantum error correction; quantum information processing; quantum entanglement and quantum cryptograph.

Assessment: coursework (50%) and examination (50%)

PHYS8450 Graduate Electromagnetic Field Theory (6 credits)

The aim of this course is to provide students with the advanced level of comprehending on the theory of classic electromagnetic field, enabling them to master key analytical tools for solving real physics problems. This course introduces and discusses the following topics: Boundary-value problems in electrostatics and Green's Function method; electrostatics of media; magnetostatics; Maxwell's equations and conservation laws; gauge transformations; electromagnetic waves and wave guides.

Assessment: coursework (50%) and examination (50%)

PHYS8550 Graduate Statistical Mechanics (6 credits)

This course covers advanced topics in equilibrium statistical physics. Topics include: Ensemble theory; theory of simple gases, ideal Bose systems, ideal Fermi systems; statistical mechanics of interacting systems; statistical field theory; some topics in the theory of phase transition may be selected.

Assessment: coursework (50%) and examination (50%)

PHYS8551 Topics in Solid State Physics (6 credits)

This course covers a broad introduction to modern theory of the solid-state physics. Some selected advanced topics will also be discussed. Topics include: Crystal structures and symmetry; the reciprocal lattice and X-ray diffraction; lattice vibration and thermal properties; free electron of metals; band structures and Bloch theory; nearly free electrons and tight binding approximations; semi-classical model of electron dynamics; Boltzmann equation; transport and optical properties of metals and semiconductors; interaction and collective excitations. If time permits, magnetism and superconductivity will also be covered.

Assessment: coursework (50%) and examination (50%)

PHYS8552 Condensed Matter Physics (6 credits)

This course introduces many-body physics in quantum matter. Systems consisting of many particles (bosons or fermions) display novel collective phenomena that individual particles do not have, for example, ferromagnetism and superfluidity. It aims to introduce students to the general principles behind these phenomena, such as elementary excitations, spontaneous symmetry breaking, adiabatic theorems, emergent topological phases of matter, etc. Theoretical language useful in the interpretation of experiments, such as linear response theory and response functions, will be discussed. This course will focus on the phenomena of emergent many-body states that require not only the effect of quantum statistics but also that of inter-particle interaction. Examples include: Ferromagnetism, Fermi liquid, superfluidity, superconductivity, and the quantum Hall states. Some general themes related to these quantum states, such as elementary excitation, Ginzburg-Landau description, spontaneous symmetry breaking, and topological phases of matter will be discussed. This course is intended for both experimentalists and theorists. While there are no official prerequisites, students who would like to take this course are assumed to have sufficient knowledge on quantum mechanics and statistical mechanics.

Assessment: coursework (100%)

PHYS8654 General Relativity (6 credits)

This course serves as a graduate level introduction to general relativity. It provides conceptual skills and analytical tools necessary for astrophysical and cosmological applications of the theory. Topics include: The principle of equivalence; inertial observers in a curved space-time; vectors and tensors; parallel transport and covariant differentiation; the Riemann tensor; the stress-energy tensor; the Einstein gravitational field equations; the Schwarzschild solution; black holes; gravitational waves detected by LIGO, and Freidmann equation.

Assessment: coursework (50%) and examination (50%)

PHYS8656 Topics in Astrophysics (6 credits)

This course covers high energy processes, basic theory of stellar structure and evolution, and introduction to compact objects. It follows a vigorous mathematical treatment that stresses the underlying physical processes. Topics include: Radiation mechanisms; stellar structure equations;

polytropic model; elementary stellar radiation processes; simple stellar nuclear processes; stellar formation; late stage of stellar evolution; supernova explosion; compact stellar; cosmic rays; numerical solving of stellar structure equation; if time permits, additional selected topics will be covered.

Assessment: coursework (50%) and examination (50%)

PHYS8701 Physics Experimental Techniques (6 credits)

This course provides a detailed account of some common experimental techniques in physics research. It introduces the basic working principles, the operational know-how, and the strength and limitations of the techniques. It will discuss and train students of the following techniques:

1. Noise and Data Analysis
2. Computer Grid
3. Raman spectroscopy and photoluminescence
4. Temporal characterization of ultrashort laser pulses
5. Chirped Pulse Amplification – Technique to amplify laser pulses
6. Cryogenics and low-noise electrical measurements
7. Nanofabrication techniques
8. Free-Electron Nanophotonics
9. Scanning Probe Microscopy
10. Electron and X-Ray Diffraction
11. Photoemission Spectroscopy
12. Transmission Electron Microscopy
13. Radiation Detection and Measurements in Nuclear Physics

Assessment: coursework (100%)

PHYS8751 Device Physics (6 credits)

The growth in the past 70 years of modern electronics industry has had great impact on society and everyday life, the foundation of which rests upon the semiconductor physics and devices. This course aims at presenting a comprehensive introductory account of the physics and operational principles of some selected and yet classic semiconductor devices, microelectronic and optoelectronic. The course is primarily designed for postgraduates but can be of interest to senior undergraduates in physics, electrical and electronic engineering and materials science. Students are assumed to have acquired some basic knowledge of quantum mechanics, statistical mechanics, and solid-state physics, though a review of the physics of semiconductors will be given in the beginning of the course. This course begins by giving a review of solid-state physics, particularly of the physics of semiconductors. It is then followed by discussions of the fundamentals and practical aspects of PN-junctions and rectifying diodes, amplifying and switching devices like bipolar and field-effect transistors (e.g. MOSFET), light-emitting and detection devices such as LEDs, laser diodes, and photodetectors. If time allows, a brief discussion of some special devices will be presented.

Assessment: coursework (50%) and examination (50%)

PHYS8850 Topics in Particle Physics (6 credits)

This course covers selected topics in both theoretical and experimental aspects of particle physics. Topics include: Fundamental particles; symmetry and conservation law; Feynman diagrams; electromagnetic interaction; weak interaction; strong interaction; particle accelerator and detector.

Assessment: coursework (50%) and examination (50%)

PHYS8852 Photonics and metamaterials (6 credits)

In the last two decades, tremendous progress has been made in the manipulation of light propagation using structured photonic media – metamaterials, with negative refraction, super-imaging and invisibility cloaking as the most well-known examples. These new discoveries are paving ways towards many potential applications of photonic structures, including imaging, display, holography and information processing. This course aims at providing the fundamental understanding of the interaction of light with structured media whose unit cells are much smaller than the wavelength of light, and the design and functionalities of various metamaterial-based photonic devices. The course text is primarily designed for senior undergraduate students and postgraduate students and requires some knowledge on electromagnetism and optics. On the other hand, it will also be of interest to graduate students since it includes some of the most recent results in the field of metamaterials and nanophotonics. Topics include: Modeling of interaction of light with periodic structures, gratings, photonic crystals; coupled mode theory; interaction of light with metals, covering both propagating and localized surface plasmon polaritons; effective-medium description of the unconventional electromagnetic properties of metamaterials, such as negative permeability and negative refraction, zero refractive index, hyperbolic metamaterial, chirality and bi-anisotropy; design of the unit cells of the metamaterials based on plasmonic structures for achieving various electromagnetic properties and functionalities; transformation optics and invisibility cloaks; metamaterial devices, including super-imaging lenses, meta-lenses, metasurface holography etc.; nonlinear optical properties of metamaterials and metasurfaces; photonic systems with Parity-time symmetry; metamaterial approach for designing the topological properties for light.

Assessment: coursework (50%) and examination (50%)

SPSC7007 Data Analysis in Space Science (6 credits)

This course introduces concepts of data analysis in space science. Techniques ranging from traditional statistical methods to recent machine learning algorithms will be introduced. Applications of these techniques in space science will be the focus in this course for students to understand how they are actually deployed in solving practical problems in space science.

Assessment: coursework (50%) and examination (50%)

SPSC7014 Big Data, AI and Machine Learning in Space Science (6 credits)

Artificial Intelligence (AI), Machine Learning and Big Data analytics are interdependent disciplines that are increasingly influential in the real world under the broad umbrella of data science. They have found widespread applications in all branches of science and technology and have direct application in space and satellite technologies. This course introduces the basics of all these areas. Data analytics is the science of analysing raw data to make conclusions, a particular challenge in the big data era, while Machine Learning (ML) is a technique enabling computers to learn without being explicitly programmed and is part of the broader concept of Artificial Intelligence. Key concepts across these fields will be explored including practical processes, techniques and algorithms. There will be a focus on real-world examples with specific emphasis on applications in space and planetary sciences. The course will also cover some ML software packages in Python and R. Examples in all areas will be drawn from fields such as astrophysics, particle physics and complex systems, including rare source identification from vast data, training sets, smart classification, time series, imaging and spectral analyses.

Assessment: coursework (50%) and examination (50%)

PHYS8971 Capstone Project (9 credits)

This capstone course provides students with the opportunity to study a specific research-type problem by themselves, either theoretical, experimental or numerical, under the supervision of an academic staff using the knowledge the student gained in their entire MSc study.

For theoretical and numerical projects: Students will receive training in research literature reading and reviewing, and make investigation, which is close to research work in nature, under the supervision of a staff member. Students may need to perform some original calculations, to fill in mathematical gaps of some sophisticated derivations, or a combination of both. For numerical projects, students also need to use computers to find numerical or simulation results.

For experimental projects: Students will carry out experiments in research labs under the supervision of a staff member. Students will receive a comprehensive training in advanced experimental techniques, including preparation of samples, determination of physical properties, measurement of small signals obscured by noise, laser, high-vacuum and low-temperature techniques and so on. Wide reading of the relevant scientific literature and originality in experimental design are expected.

It is expected that most of the projects would involve team work.

Pre-requisites: Pass or already enrolled in PHYS8201 Basic Research Methods in Physical Science and PHYS8970 Physics Seminar

Assessment: oral presentation (30%) and written report (70%)
