REGULATIONS FOR THE DEGREES OF
MASTER OF SCIENCE (MSc) AND MASTER OF SCIENCE IN ENVIRONMENTAL MANAGEMENT (MSc[EnvMan])
For students admitted in 2021-22 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 first year of study via the Department and provide all the supporting documents.

Period of study

Sc25 The curriculum of the Master of Science 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.

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), 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 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);

(c) 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;

(d) 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);

(e) for the full-time curriculum of Master of Science in the field of Physics, be submitted by October 15 and the dissertation or project report shall be submitted not later than the last Friday in May of the first year of study;

(f) for the part-time curriculum of Master of Science in the field of Physics, be submitted by October 15 of the first academic year and the dissertation or project report shall be submitted not later than the last Friday in May 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 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 two weeks of the examination.

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 SPACE SCIENCE
(for students admitted in 2021-22 and thereafter)

A. COURSE STRUCTURE

Each student must complete at least 60 credits of courses, split into 36 credits of core courses, 18 credits of electives, and 6 credits of a capstone project.

Core Courses	
SPSC7002	Introduction to space weather (6 credits)
SPSC7003	Remote sensing in space science (6 credits)
SPSC7004	Radiation detection and measurement (6 credits)
SPSC7005	Space science entrepreneurship (6 credits)
SPSC7007	Data analysis in space science (6 credits)
SPSC7015	Introduction to planetary science (6 credits)
Elective Courses*	
SPSC7006	Small satellite design (6 credits)
SPSC7011	Introduction to space plasma physics (6 credits)
SPSC7014	Big data, AI and machine learning in space science (6 credits)
SPSC7016	Overview of space astrophysics (6 credits)
STAT6016	Spatial data analysis (6 credits)
STAT7102	Advanced statistical modelling (6 credits)
ELEC6008	Pattern recognition and machine learning (6 credits)
ELEC6026	Digital signal processing (6 credits)
ELEC6065	Data compression (6 credits)
ELEC6100	Digital communications (6 credits)
Capstone Project	
SPSC7031	Space science final project (6 credits)

** Timetabling of courses may limit availability of some electives. The actual offering of such electives will be based on student demand.*

B. COURSE CONTENTS

Core Courses

SPSC7002 Introduction to space weather (6 credits)

Our modern lifestyles rely on satellite technology which can be severely affected by the Earth's local particle environment. Much of this is due to the influence of the Sun, which emits large quantities of radiation and charged particles that interact with the Earth's magnetic field. This course covers the fundamentals of space weather, from its origins, to its effects, and forecasting.

Assessment: coursework (50%); written examination (50%)

SPSC7003 Remote sensing in space science (6 credits)

This course introduces the theory behind, and the many practical applications of remote sensing, focusing on applications of satellite-based detectors to monitor the Earth's environment. The course covers the physical principles of remote sensing, including the various spectral signatures in the different parts of the electromagnetic spectrum. Students will learn about the different sensor technologies, and how to characterize and quantify their performance.

Assessment: coursework (50%); written examination (50%)

SPSC7004 Radiation detection and measurement (6 credits)

This course provides an overview of various ways we detect radiation to make physical measurements in space science. It covers the fundamentals of radiation interactions and properties of radiation detectors, including some of the most commonly used ones in contemporary science missions.

Assessment: coursework (50%); written examination (50%)

SPSC7005 Space science entrepreneurship (6 credits)

No longer driven entirely by governmental institutions, developments in frontier space science in modern times also receive boosts from academia, corporations and entrepreneurs alike. Businesses like SpaceX, Blue Origin, or Virgin Galactic are not only capturing people's imagination, but also proving that space provides big business opportunities. This course will cover the basics of designing, launching, and running a business, with a special emphasis on how ventures can be started for the burgeoning space industry.

Assessment: coursework (60%); final case study and presentation (40%)

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%); written examination (50%)

SPSC7015 Introduction to planetary science (6 credits)

We live in a golden age of planetary science, with new missions being proposed at an unprecedented rate by all the major space agencies. This course provides a modern understanding of the properties of our Solar System and planetary systems around other stars and of the physical, chemical, and geological processes that govern their motion and properties. Special attention will be paid to how our knowledge has been enriched by recent discoveries from space missions such as Cassini and Kepler.

Assessment: coursework (50%); written examination (50%)

Elective Courses

SPSC7006 Small satellite design (6 credits)

Small satellites (sometimes referred to as microsatellites, CubeSats, etc.) are becoming increasingly popular. Once proposed mainly for educational purposes, due to their low cost and shorter development time scales, these days many such satellites are being proposed and launched with a range of cutting-edge scientific goals. Microsatellites make full use of the latest achievements in basic technologies such as modern microelectronics, micro mechanics, and advanced materials. This course covers the practical aspects of designing a small satellite, based on the principle of purchasing "off-the-shelf" components, and benefitting from "open source" solutions to many of the technical challenges. Topics include: science instruments and payloads, satellite subsystems, ground networks, space science data and software, ground networks, launchers, and operations.

Assessment: coursework (50%); written examination (50%)

SPSC7011 Introduction to space plasma physics (6 credits)

Most of space is filled with plasma, the fourth state of matter where freely moving charges from ionized gas interact with (and generate) electric and magnetic fields, leading to a complicated set of phenomena. This course will provide an introduction to the field, covering such topics as plasma characteristics, electromagnetic waves in cold plasmas, collision theory, magnetohydrodynamics (MHD), force-free magnetic-field configurations, stochastic processes, and interaction of particles and waves. The course will emphasize some of the applications of plasma physics in the fields of geophysics and astrophysics.

Assessment: coursework (50%); written 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 analyzing 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 (AI). 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 contemporary research in 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%); written examination (50%)

SPSC7016 Overview of space astrophysics (6 credits)

While astrophysics from space was historically proposed to cover those parts of the electromagnetic spectrum not visible from earth such as X-rays and gamma rays, almost every part of the spectrum can benefit from space observations, removing the obstacles posed by our atmosphere. Some of the most iconic astrophysical images have been produced by the Hubble Space telescope, a relatively modest (in size) instrument which has made some stunning discoveries over the course of its 30-year lifetime. This course provides an overview of past, present, and future astrophysical space missions, including their major science goals and achievements, and the technologies that made them possible.

Assessment: coursework (50%); written examination (50%)

STAT6016 Spatial data analysis (6 credits)

This course covers statistical concepts and tools involved in modelling data which are correlated in space. Applications can be found in many fields including epidemiology and public health, environmental sciences and ecology, economics and others. Covered topics include: (1) Outline of three types of spatial data: point-level (geostatistical), areal (lattice), and spatial point process. (2) Model-based geostatistics: covariance functions and the variogram; spatial trends and directional effects; intrinsic models; estimation by curve fitting or by maximum likelihood; spatial prediction by least squares, by simple and ordinary kriging, by trans-Gaussian kriging. (3) Areal data models: introduction to Markov random fields; conditional, intrinsic, and simultaneous autoregressive (CAR, IAR, and SAR) models. (4) Hierarchical modelling for univariate spatial response data, including Bayesian kriging and lattice modelling. (5) Introduction to simple spatial point processes and spatio-temporal models. Real data analysis examples will be provided with dedicated R packages such as geoR.

Assessment: coursework (50%); written examination (50%)

STAT7102 Advanced statistical modelling (6 credits)

This course introduces modern methods for constructing and evaluating statistical models and their implementation using popular computing software, such as R or Python. It will cover both the underlying principles of each modelling approach and the model estimation procedures. Topics from: (i) Linear regression models; (ii) Generalized linear models; (iii) Model selection and regularization; (iv) Kernel and local polynomial regression; selection of smoothing parameters; (v) Generalized additive models; (vi) Hidden Markov models and Bayesian networks.

Assessment: coursework (50%); written examination (50%)

ELEC6008 Pattern recognition and machine learning (6 credits)

This course aims at providing fundamental knowledge on the principles and techniques of pattern recognition and machine learning.

Specifically, the course covers the following topics: Bayes decision theory; parametric and non-parametric methods; linear discriminant functions; unsupervised learning and clustering; feature extraction; neural networks; context-dependent classification; case studies.

Pre-requisite: A good background in linear algebra, programming experience.
Mutually exclusive with: COMP7504 Pattern recognition and applications

Assessment: coursework (25%); written examination (75%)

ELEC6026 Digital signal processing (6 credits)

This course provides an introduction to the fundamental concepts of digital signal processing (DSP) including a wide variety of topics such as discrete-time linear time invariant systems, sampling theorem, z-transform, discrete-time/discrete Fourier transform, and digital filter design. Furthermore, the course will also discuss in detail about other advanced topics in digital signal processing such as multidimensional signals and systems, random processes and applications, and adaptive signal processing.

Assessment: coursework (30%); written examination (70%)

ELEC6065 Data compression (6 credits)

This course provides an introduction to the state-of-the-art compression techniques for typical media including files, digital images, videos and audios. Specifically, the course will discuss in detail about the coding and quantization techniques commonly used for images, videos and audios. Finally, the course will cover basic concept and terminologies of common image, video and audio standards.

Assessment: coursework (30%); written examination (70%)

ELEC6100 Digital communications (6 credits)

This course aims at enabling the fundamental understanding of the digital communication systems. After an overview on basic probability and random processes, the course will cover the modulation and demodulation. Then, performance analyses under additive white Gaussian noise channel and fading channel are examined. This is followed by topics on spatial diversity and channel equalization.

Mutually exclusive with: ELEC6014 and ELEC6045

Assessment: coursework (40%); written examination (60%)

Capstone Project

SPSC7031 Space science final project (6 credits)

Students must carry out a research project in any aspect of space science under the guidance of a faculty member from the MSc in Space Science program. Students are encouraged to approach faculty members in their areas of interest as soon as possible, in order to choose an appropriate project. Students may either propose a topic of interest, participate in any existing projects of the faculty member, or else they will be assigned a project after consultation with the course coordinator. An oral presentation is required and a written report must be submitted.

Assessment: oral presentation (25%); written report (75%)

SYLLABUSES FOR THE DEGREE OF MASTER OF SCIENCE IN THE FIELD OF PHYSICS
(for students admitted in 2021-22 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 Electromagnetism (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)
PHYS8750	Nanophysics (6 credits)
PHYS8751	Device Physics (6 credits)
PHYS8850	Topics in Particle Physics (6 credits)
PHYS8852	Photonics (6 credits)
Capstone requirement (9 credits)	
PHYS8971	Capstone Project (9 credits)

B. COURSE CONTENTS

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 time in actual programming. Topics include: introduction to computational physics, introduction to data analysis, 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, AI and machine learning related topics such as regression (multivariate linear and logistic), feature extraction (principal component analysis, recommender systems, clustering) and neural networks (biological neural networks, mathematical representation, feed-forward neural networks, convolutional neural networks).

Assessment: coursework (60%) and examination (40%)

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 introduces 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%)

PHYS8351 Graduate Quantum Mechanics (6 credits)

This course covers the theory and advanced techniques in quantum mechanics, and their applications to select topics in condensed matter physics. Topics include: 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 (40%) and examination (60%)

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 (30%) and examination (70%)

PHYS8450 Graduate Electromagnetism (6 credits)

This course covers advanced topics in equilibrium statistical physics. Topics include: boundary-value problems in electrostatics and Green Function method; electrostatics of media; magnetostatics; Maxwell's equations and conservation laws; gauge transformations; electromagnetic waves and wave guides.

Assessment: coursework (40%) and examination (60%)

PHYS8550 Graduate Statistical Mechanics (6 credits)

This course covers the theory of classical electromagnetic field, enabling them to master key analytical tools for solving real physics problems. Topics include: ensemble theory—the micro-canonical ensemble, the canonical ensemble, and the grand canonical ensemble; quantum mechanical ensemble theory; theory of simple gases, ideal Bose systems, ideal Fermi systems; statistical mechanics of interacting systems; some topics in the theory of phase transition may be selected.

Assessment: coursework (40%) and examination (60%)

PHYS8551 Topics in Solid State Physics (6 credits)

This course covers a broad introduction to modern theory of the solid state physics. 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 model; electronic and optical properties; semi-classical model of electron dynamics; if time permits, topics of semiconductor physics, quantum Hall effect, superconductivity, two-dimensional materials will also be covered.

Assessment: coursework (40%) and examination (60%)

PHYS8552 Condensed Matter Physics (6 credits)

The collective behavior of systems consisting of many particles (bosons or fermions) gives rise to new states of matter, which emerge at low temperatures where interactions are important. This course aims to introduce the students to those novel quantum states, emphasizing the general themes such as elementary excitations, broken symmetry, hydrodynamic description, and topological properties of condensed matter. Theoretical language useful in the interpretation of experiments, such as response functions, will be discussed. The emphasis will be on a selected few examples that illustrate the above concepts and techniques. This course is intended for both experimentalists and theorists. It will concentrate on the phenomena of emergent many-body states that require not only the effects of quantum mechanics, but also that of quantum statistics to its proper explanation. Examples include: Fermi liquid, superfluidity, superconductivity, and the quantum Hall states. We will emphasize on the interaction effects and discuss the primary feature brought about by the interaction. Some general themes related to these quantum states, such as elementary excitation, Ginzburg-Landau description and symmetry breaking will be discussed.

Assessment: coursework (40%) and examination (60%)

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 matter tensor; the Einstein gravitational field equations; the Schwarzschild solution; black holes; gravitational waves detected by LIGO; special topics such as bending of light calculation and Kerr black holes and their causal structures will be discussed if time permits.

Assessment: coursework (40%) and examination (60%)

PHYS8656 Topics in Astrophysics (6 credits)

This course covers radiation mechanism and high energy processes, basic theory of stellar structure and evolution, and introduction to compact objects. It follows a vigorous mathematical treatment that stresses on 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; if time permits, additional selected topics in high-energy and particle astrophysics will be covered.

Assessment: coursework (40%) and examination (60%)

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 knowhow, and the strength and limitations of the techniques. It will discuss and train students of the following techniques:

1. Noise, Data Analysis, and Computer Grid
2. Vacuum technology and deposition techniques
3. Raman spectroscopy and photoluminescence (PL)
4. Electrical Characterizations
5. Scanning Probe Microscopy (STM and AFM)
6. Electron and X-Ray Diffraction (LEED/RHEED/XRD)
7. Photoemission Spectroscopy (PES)
8. Scanning Electron Microscopy (SEM)
9. Transmission Electron Microscopy (TEM)
10. Low-temperature electrical measurements
11. Radiation Detection and Measurements in Nuclear Physics
12. Particle Detection in Space and Microwave Measurement with Superconducting Detector.

Assessment: coursework (100%)

PHYS8750 Nanophysics (6 credits)

This course is designed to deliver fundamental concepts and principles of nano physics to fresh postgraduate students, mostly focusing on the transport properties of the low-dimensional electronic systems under external electric and/or magnetic fields. The course will cover various topics in nano physics, such as zero-, one-, and two-dimensional electronic gas systems, quantum dots, graphene and 2D materials, semiconductor heterostructures, quantum Hall effects, Coulomb blockade effects, single electron effects, field effect transistors, and phase-coherent interference effects. While the most discussions will be made based on experimental findings, the basics of the relevant theories will also be covered using the tight-binding model, basic quantum mechanics, and Landauer-Büttiker formula. The principles and applications of nano fabrication and low-temperature measurement techniques will be discussed if the time allows.

Assessment: coursework (40%) and examination (60%)

PHYS8751 Device Physics (6 credits)

This course introduces the working principle and the processing technology of microelectronic and photonic devices. Topics include: introductory semiconductor physics, fundamental and practical aspects of semiconductor devices, including rectifying diodes, photodiodes, photodetector and laser, bipolar and field-effect transistors, integrated circuits.

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

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, gauge theory, particle accelerator and detector.

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

PHYS8852 Photonics (6 credits)

The discovery of the quantum nature of light and the invention of laser has deeply impacted our fundamental understanding of both light and matter, and led to the birth and rapid development of whole new branches of physics, such as quantum optics, laser physics and nonlinear optics etc. This course aims at providing a fundamental but coherent text starting from the physical nature of light, and then giving a self-contained and straightforward access to the quantum nature of light. In particular, this course deals with the coherence properties of light, its seemly conflicting wave and particle aspects and its interaction with matter. The course text is primarily designed for senior undergraduate students and requires no much knowledge of quantum mechanics. On the other hand, it will also be of interest to graduate students and even research workers since it includes some most recent results in quantum beats such as Rabi oscillations. This course will begin at the physical nature of light, emphasizing quantization and coherence of light. Then it handles the interaction between light and matter. The interaction topics include the interaction representation, the dipole approximation, spontaneous and stimulated emission and absorption. In addition, damping and linewidth broadening will be also discussed. In the final part of this course, quantum coherence and quantum beats of light will be treated, including examples of the evaluation of quantum mechanical coherence functions and Rabi oscillations.

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

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 are required to attend and take part in a specified number of seminars organized by Department of Physics to expose themselves to various topics of contemporary physics research and to learn the technique of professional physics presentation. Students are also required to submit a written paper, to give an oral presentation of about 15 minutes normally on the background materials related to their Capstone Project and to orally answer questions related to the oral presentation.

Assessment: seminar participation (20%), written paper (30%), oral presentation (50%) including the ability to answer questions related to the presentation

---

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. The student 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. The student 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: coursework (100%)
