Master of Science Program in Physics

(International Program)

Curriculum Last Revised in 2018

Program Structure and Specification

1. Program Title Master of Science Program in Physics (International Program)

2. Name of Degree

Full Name : Master of Science (Physics)

Abbreviation : M.Sc. (Physics)

3. Responsible Units

3.1 Department of Physics, Faculty of Science, Mahidol University

3.2 Faculty of Graduate Studies, Mahidol University

4. Philosophy and Expected Learning Outcomes of the Program

4.1 Philosophy of the Program

To produce a graduate who is knowledgeable and expertise in advanced physics, who ethically conducts research in accordance to the global scientific community, who is passionate in pursuing life-long learning, and who has competent skills in independently conducting physics research for solving physics problems in at least one subfield of physics as well as being able to keep up with advanced research from around the world in that subfield

4.2 Expected Learning Outcomes of the Program

Upon graduating, the graduates are expected to possess the following qualities.

4.2.1. Graduates adhere to ethics in accordance to the global scientific community.

4.2.2. Graduates are able to understand in-depth knowledge in fundamental physics, which includes (1) classical mechanics, (2) quantum mechanics, (3) thermodynamics and statistical physics, (4) electromagnetism, and related mathematical methods.

4.2.3. Graduates demonstrated competent skills in independently conducting physics research for solving physics problems in at least one subfield of physics and are able to keep up with advanced research from around the world in that subfield.

4.2.4. Graduates are able to analyze physics research problems based on scientific processes.

4.2.5. Graduates have international-level skills to independently evaluate up-to-date scientific literatures, formulate new scientific hypotheses, and develop suitable techniques or experiments to verify them.

4.2.6. Graduates possess leadership, teamwork, and 21st century skills.

4.2.7. Graduates are able to apply their statistical and mathematical knowledge to investigate physics research problems and to efficiently present their finding.

4.2.8. Graduates are able to use information technology to search, collect, and communicate, both orally and in written, their acquired knowledge and research outputs to the international scientific community.

5. Admission Requirements

5.1 Applicants must received a B.Sc. degree in physics, mathematics, chemistry, geology, general science, engineering, or related fields from a university that the Office of the Higher Education Commission has certified

5.2 Applicants must have GPA of at least 2.50.

5.3 Applicants must pass the English proficiency examination according to the regulation of the Graduate School, Mahidol University.

5.4 Applicants who lack the required criteria above may be accepted to the program upon an approval of a committee.

6. Selection Method

Applicants are selected according to rules and regulation of the Faculty of Graduate Studies, Mahidol University.

7. Academic System

7.1 Semester System 2 semester/academic year

7.2 Credit Assignment

7.2.1 Lecture or discussion consuming 15 hours per semester is equal to 1 credit hour.

7.2.2 Laboratory or practice consuming 30 hours per semester is equal to 1 credit hour.

7.2.3 Thesis consuming 45 hours per semester is equal to 1 credit hour.

8. Language

English is used in teaching and learning as well as in the assessment processes.

9. Registration

9.1 Students must register as full time students.

9.2 Students must register for no less than 9 credits and no more than 15 credits per regular semester, or according to program study plan.

10 Evaluation and Graduation Requirements

10.1 Evaluation

Student evaluation is in accordance with the rules and regulations of Mahidol University. (See details at http://www.grad.mahidol.ac.th)

10.2 Graduation Requirements

10.2.1 Students register for at least 26 credits of coursework and 12 credits of thesis. Total credits acquired must be at least 38 credits. A cumulative GPA must be 3.00 or more.

10.2.2 Students pass the English Proficiency Examination offered by the Faculty of Graduate Studies, Mahidol University or equivalent.

10.2.3 Students present thesis and pass the oral thesis defense examination according to the rules and regulations of the Faculty of Graduate Studies, Mahidol University.

10.2.4 Students obtain at least one publication or a manuscript that has been accepted for publication as a journal article or a conference proceeding at the national or international level.

11. Library

The Stang Mongkolsuk Library possesses more than 10,000 books. Many journals can be accessed online. Besides, a lot of text books and journals (in both electronic and printed formats) are available at other libraries within Mahidol University.

12. Program Structure

12.1 The number of credits required for the program

Number of credits required for the program is at least 38 credits

12.2 Curriculum Structure

The program is set according to the Ministry of Education Announcement titled "Standard Criteria for Graduate Studies 2005", with specified plan A (2) curriculum.

12.2.1	Required Courses		14	credits
12.2.2	Elective Courses	at least	12	credits
12.2.3	Thesis		12	credits
	Total	no less than	38	credits

12.3 Course Requirements

12.3.1 Required Courses (14 credits)

		Credits (lecture-lab-self study)
SCPY 502	Classical Mechanics	3 (3-0-6)
SCPY 503	Quantum Mechanics	3 (3-0-6)
SCPY 504	Thermodynamics and Statistical Physics	3 (3-0-6)
SCPY 507	Classical Electrodynamics	3 (3-0-6)
SCPY 596	Seminar in Physics I	1 (1-0-2)
SCPY 597	Seminar in Physics II	1 (1-0-2)

12.3.2 Elective Courses (at least 12 credits)

		Credits (lecture-lab-self study)
Subjects in mathematics and computer science		
SCPY 505	Mathematical Methods for Physicists	3 (3-0-6)
*SCPY 510	Advanced Mathematical Methods for Physicists	3 (3-0-6)
SCPY 570	Signal and Image Processing	3 (3-0-6)
SCPY 571	Parallel Programming	3 (3-0-6)
SCPY 574	Numerical Methods for Differential Equations	3 (3-0-6)
SCPY 576	Scientific Visualization	3 (3-0-6)
SCPY 612	Computational Physics I	3 (3-0-6)
*SCPY 613	Computational Physics II	3 (3-0-6)

Subject in classical physics and nonlinear physics

SCPY 517	Fluid Mechanics	3 (3-0-6)
SCPY 523	Classical Field Theory	3 (3-0-6)
SCPY 575	Computational Fluid Dynamics	3 (3-0-6)
*SCPY 614	Advanced Fluid Mechanics	3 (3-0-6)
SCPY 646	Fractals and Chaos	3 (3-0-6)
SCPY 647	Nonlinear Waves	3 (3-0-6)
SCPY 648	Computational Nonlinear Phenomena	3 (3-0-6)
SCPY 655	Complex Systems	3 (3-0-6)
*SCPY 686	Selected topics in Nonlinear Phenomena	3 (3-0-6)

Subjects in quantum mechanics and applications

SCPY 511	Atomic and Molecular Physics	3 (3-0-6)
SCPY 519	Nuclear Physics	3 (3-0-6)
*SCPY 522	Advanced Quantum Mechanics	3 (3-0-6)
*SCPY 611	Advanced Atomic Physics	3 (3-0-6)
SCPY 620	Non-Perturbative Methods in Quantum Field Theory	3 (3-0-6)
SCPY 621	Supersymmetry in Field Theory and String	3 (3-0-6)
SCPY 637	Molecular Simulation	3 (3-0-6)
SCPY 638	Molecular Quantum Mechanics	3 (3-0-6)
SCPY 639	Quantum Field Theory	3 (3-0-6)
SCPY 640	Theory of Many-Particle Systems	3 (3-0-6)

Subject in condensed matter physics and material science

SCPY 515	Electrical Materials	3 (3-0-6)
SCPY 516	Electronic Devices and Circuits	3 (3-0-6)
SCPY 521	Physics of Semiconductor	3 (3-0-6)
SCPY 543	Surface and Interface Physics	3 (3-0-6)
SCPY 642	Diffraction Techniques	3 (3-0-6)
SCPY 643	Thin Film Physics and Technology	3 (3-0-6)
SCPY 650	Plasma Technologies and Applications	3 (3-0-6)
SCPY 651	Semiconductor Devices	3 (3-0-6)
SCPY 652	Superconductivity	3 (3-0-6)
*SCPY 653	Special Methods in Theoretical Superconductivity	3 (3-0-6)
*SCPY 657	Advanced Condensed Matter Physics	3 (3-0-6)
*SCPY 683	Selected Topics in Thin Film and Surface Physics	3 (3-0-6)

Subjects in optics

SCPY 524	Fourier Optics	3 (3-0-6)
SCPY 525	Photonics	3 (3-0-6)
SCPY 636	Optoelectronics	3 (3-0-6)
SCPY 645	Laser Theory	3 (3-0-6)
*SCPY 685	Selected Topics in Laser Applications	3 (3-0-6)

Subjects in quantum optics and quantum information

SCPY 526	Quantum Optics	3 (3-0-6)
SCPY 527	Mathematics for Quantum Information	3 (3-0-6)
SCPY 528	Quantum Information	3 (3-0-6)
SCPY 529	Topics in Quantum Information	3 (3-0-6)

Subjects in astronomy and astrophysics

SCPY 531	Cosmic Rays	3 (3-0-6)
SCPY 532	Galactic Astronomy	3 (3-0-6)
SCPY 533	Astronomy and Astrophysics	3 (3-0-6)
SCPY 534	Solar Physics	3 (3-0-6)
SCPY 535	General Relativity	3 (3-0-6)
SCPY 649	Plasma Physics	3 (3-0-6)
*SCPY 680	Selected Topics in Astrophysics	3 (3-0-6)
*SCPY 681	Selected Topics in Astronomy	3 (3-0-6)

Subjects in biophysics

SCPY 561	Fundamentals of Biophysics	3 (3-0-6)
SCPY 562	Modeling and Simulation in Biophysics	3 (3-0-6)
SCPY 668	Contemporary Biophysics	3 (3-0-6)

Subjects in geophysics

SCPY 581	Geophysical Prospecting: Potential Field Methods	3 (3-0-6)
SCPY 582	Geophysical Prospecting: Electromagnetic Methods	3 (3-0-6)
SCPY 583	Geophysical Prospecting: Seismic Methods	3 (3-0-6)
*SCPY 584	Advanced Seismic Exploration	3 (3-0-6)
SCPY 585	Introductory Seismology	3 (3-0-6)
SCPY 586	Applied Modern Seismology	3 (3-0-6)
SCPY 587	Earthquake Source Theory	3 (3-0-6)
SCPY 630	Physics of the Solid Earth	3 (3-0-6)
SCPY 670	Inverse Theory and Applications	3 (3-0-6)
*SCPY 684	Selected Topics in Geophysics	3 (3-0-6)

Subjects in physics education

SCPY 626	Physics Education	3 (3-0-6)
SCPY 627	Data Analysis in Physics Education	3 (3-0-6)
SCPY 628	Physics Concepts and Misconception	3 (3-0-6)
*SCPY 682	Selected Topics in Physics Education	3 (3-0-6)

Subjects in selected topics and applied physics

*SCPY 687	Selected Topics in Physics	3 (3-0-6)
*SCPY 688	Selected Topics in Applied Physics	3 (3-0-6)

* denotes the courses that are in the Ph.D. program but not in the M.Sc. program. However, students in the M.Sc. program can register in these courses upon the approval of the graduate program committee.

Besides the above elective courses, students can enroll in other courses offered by graduate programs of Mahidol University and/or in international programs in other universities with approval from the program director, major advisor, or program administrative committee.

12.3.3 Thesis (12 credits) **Credits (lecture-lab-self study)**

SCPY 698 Thesis 12 (0-36-0)

12.3.4 Research Projects of the Program

Research projects in the Department of Physics include those in the following subfields of physics:

(1) **Applied optics**
(2) **Biophysics**
(3) **Condensed matter physics**
(4) **Geophysics**
(5) **Nanophysics**
(6) **Nonlinear physics**
(7) **Quantum optics and quantum information**
(8) **Physics education**
(9) **Astronomy and astrophysics**
(10) **Computational science**
(11) **Atomic physics**

12.4 Course Code Explanation

Two first letters represent the abbreviated name of Faculty

SC = Faculty of Science

GR = Faculty of Graduate Studies

The third and fourth letters represent the abbreviated name of responsible units

PY = Department of Physics

The first numbers (5XX and 6XX) represent postgraduate program level.

12.5 Study Plan

Year	1st semester		2nd semester	
1	SCPY 502 Classical Mechanics	3 (3-0-6)	SCPY 504 Thermodynamics and Statistical Physics	3 (3-0-6)
	SCPY 503 Quantum Mechanics	3 (3-0-6)	SCPY 507 Classical Electrodynamics	3 (3-0-6)
	Selective courses	3 credits	SCPY 596 Seminar I	1 (1-0-2)
			Selective courses	3 credits
	Total 9 credits		**Total 10 credits**	
	SCPY 596 Seminar I	1 (1-0-2)	SCPY 698 Thesis	9 (0-27-0)
	SCPY 698 Thesis	3 (0-9-0)		
	Selective courses	6 credits		
	Total 10 credits		**Total 9 credits**	

13. Requirement for Thesis

13.1 Brief description

The thesis must be a research project that produces new knowledge in physics, or leads to the application of knowledge in physics or related subfields. The thesis must show innovation or new knowledge, and must be submitted in the required form and within the timeframe of the program.

13.2 Expected Learning Outcomes

13.2.1. Graduates adhere to ethics in accordance to the global scientific community.

13.2.2. Graduates demonstrated competent skills in independently conducting physics research for solving physics problems in at least one subfield of physics and are able to keep up with advanced research from around the world in that subfield.

13.2.3. Graduates are able to analyze physics research problems based on scientific processes.

13.2.4 Graduates have international-level skills to independently evaluate up-to-date scientific literatures, formulate new scientific hypotheses, and develop suitable techniques or experiments to verify them.

13.2.5. Graduates are able to apply their statistical and mathematical knowledge to investigate physics research problems and to efficiently present their finding.

13.2.6. Graduates are able to use information technology to search, collect, and communicate, both orally and in written, their acquired knowledge and research outputs to the international scientific community.

13.3 Timeframe

From the 1st semester of the second year

13.4 Number of Credits 12 credits

13.5 Preparation

The program arranges the orientation to introduce the students into the program, research groups in the department, and all requirements for graduation. The orientation will give the students an opportunity to choose a research-project topic. After the students register in the thesis, the committee will be formed to track the progress of the research project. The student must submit the progress report and present the progress to the committee every semester.

13.6 Evaluation process

13.6.1 Evaluate the scope of the thesis research by the proposal committee.

13.6.2 Evaluate the progress of the thesis by the research-advisory committee.

13.6.3 Evaluate the final result of the thesis by the thesis committee.

The students must present the thesis and publish their work in a peer-review international journal or a conference proceeding at the national or international level. The work can be either published or accepted to be published upon graduation in accordance with the regulation of the Faculty of Graduate Studies.

14. Students Job Opportunities

The following list demonstrates some of the career options that our graduates have chosen after they graduated from the program.

14.1 Scientists, scholars, researchers in private, government, and international institutes.

14.2 Academic careers in a university.

14.3 An entrepreneur using applied physics.