Doctor of Philosophy Programme in Science and Technology Education (International Programme)
Revised Volume A.D. 2018
Institute for Innovative Learning, Mahidol University

1. **Program Title :** Doctor of Philosophy Program in Science and Technology Education (International Program)
2. **Name of Degree**

   Full Name : Doctor of Philosophy (Science and Technology Education)
   Abbreviation : Ph.D. (Science and Technology Education)

3. **Philosophy and Justification**

To produce the Doctor of Philosophy graduates in science and technology education who have knowledge, moral, ethics, and a code of ethics in academic research and profession. The graduates are able to research and apply educational innovations to manage student-centered learning in appropriate ways and corresponds to social context, and to effectively and efficiently transfer knowledge in science and technology.

4. **Learning Outcomes**

Upon completion of this curriculum, the graduates will be able to

(1) display moral and ethical behavior for science and technology educators both academically and professionally;
(2) apply principle in science and technology education to design and implement learning innovations in science and/or technology class appropriately;
(3) synthesis solutions to learning problems;
(4) conduct science and technology education research by integrating knowledge in the field of study;
(5) create innovations in science and technology education consistent to knowledge in the field of study and social context;
(6) enhance knowledge of oneself;
(7) display the ability to control and improve oneself;
(8) display leadership quality and ability to effectively collaborate with others.

The revised curriculum volume A.D. 2018 has been approved by Mahidol University council on February 21st, 2018.

5. Qualifications of Prospective Students

Plan 1 Research track

(๑) Hold a master's degree in any field of basic science, engineering, education, art (science, mathematics, and technology major), or health science from the program certified by office of the higher education commission, Thailand.

(๒) Have a cumulative GPA of at least 3.50.

(๓) Have research experience and publication published in academic international journals

(๔) Have qualified English skills in listening, speaking, reading and writing according admission criteria

(๕) Exceptions to the above items may be considered for enrollment by the program director and the dean of the faculty of graduate studies.

Plan 2

(๑) Hold a bachelor's degree or master's degree in any field of basic science, engineering, education, art (science, mathematics, and technology major), or health science from the program certified by office of the higher education commission, Thailand.

(๒) Have a cumulative GPA of at least 3.50.

(๓) Have qualified English skills in listening, speaking, reading and writing according admission criteria

(๔) Exceptions to the above items may be considered for enrollment by the program director and the dean of the faculty of graduate studies.

6. Total Credits :

Program	Credits
Plan 1	48
Plan 2	
Master graduates in Science and technology education	48
Master graduates	51
Bachelor graduates	72

7. Curriculum Structure

	Plan 1	Plan 2 Master graduates in Science and technology education	Plan 2 Master graduates	Plan 2 Bachelor graduates
Remedial Course	-	-	-	-
Required Courses	-	8	11	16
Elective Courses (at least)	-	4	4	8
Thesis	48	36	36	48
Total (at least)	48	48	51	72

8. Courses

credits (lecture-lab-self study)

(1) Remedial Course (for students who have no basic of education only)

SCID 500	Cell and Molecular Biology	3 (3-0-6)
ILSE 603	Basic Knowledge in Education	2 (2-0-4)
ILSE 607	Basic Knowledge for Educational Research	2 (2-0-4)

(2) Required Course

Plan 2 Master graduates for all majors

ILSE 600	Instructional Science	3 (3-0-6)
ILSE 609	Nature, History, and Philosophy of Science	3 (3-0-6)
ILSE 657	Research Seminar in Science and Technology Education	1 (1-0-2)
ILSE 658	Research Seminar in Learning Innovation	1 (1-0-2)
ILSE 659	Innovation in Science and Technology to Improve Learning	3 (1-4-4)

Plan 2 Bachelor graduates

ILSE 600	Instructional Science	3 (3-0-6)
ILSE 609	Nature, History, and Philosophy of Science	3 (3-0-6)
ILSE 616	Research in Science and Technology Education	3 (3-0-6)
ILSE 655	Measurement and Evaluation in Education	2 (1-2-3)
ILSE 657	Research Seminar in Science and Technology Education	1 (1-0-2)
ILSE 658	Research Seminar in Learning Innovation	1 (1-0-2)
ILSE 659	Innovation in Science and Technology to Improve Learning	3 (1-4-4)

(3) Elective Course

ILSE 606	Mini Project Research in Science, Mathematics and Technology Education	3 (1-4-4)

ILSE 615	Developing Learning Media Using Modern Information Technology	3 (2-2-5)
ILSE 617	Emerging Technology for Learning	2 (2-0-4)
ILSE 625	Chemistry Education	3 (3-0-6)
ILSE 631	Biology Education	3 (3-0-6)
ILSE 642	Physics Education	3 (3-0-6)
ILSE 652	Mathematics Education	3 (3-0-6)
ILSE 653	Computer Science Education	3 (3-0-6)
ILSE 660	Psychology and Philosophy for Education	2 (2-0-4)

Students can select other elective graduate courses from other faculties/universities with the approval of the program director or academic advisor.

(4) Thesis

Plan 1

ILSE 898	Thesis	48 (0-192-0)

Plan 2 Master graduates for all majors

ILSE 699	Thesis	36 (0-144-0)

Plan 2 Bachelor graduates for all majors

ILSE 799	Thesis	48 (0-192-0)

9. Emphasis of research projects

The scope of research projects are as follows;

(1) Development of e-learning for personalized learming.
(2) Development of models in science and mathematics.
(3) Development of learning packages, games and simulations.
(4) Development of learning activity for science laboratory.
(5) Development of learning-teaching approaches based on knowledge construction in science and mathematics.
(6) Development of professional development model.
(7) Other projects approved by the thesis advisory committee.

10. Study plan

Plan 1

<table>
<tr><td colspan="3">Summer Semester</td></tr>
<tr><td colspan="3">Remedial Course *
SCID 500 Cell and Molecular Biology 3 (3-0-6)
ILSE 603 Basic Knowledge in Education 2 (2-0-4)
ILSE 607 Basic Knowledge for Educational Research 2 (2-0-4)
Qualifiying Examination</td></tr>
<tr><td>Year</td><td>Semester 1</td><td>Semester 2</td></tr>
<tr><td>1</td><td>ILSE 898 Dessertation 8 (0-32-0)
Proposal examination
Total 8 credits</td><td>ILSE 898 Dessertation 8 (0-32-0)
Proposal examination
Total 8 credits</td></tr>
<tr><td>2</td><td>ILSE 898 Dessertation 8 (0-32-0)
Total 8 credits</td><td>ILSE 898 Dessertation 8 (0-32-0)
Total 8 credits</td></tr>
<tr><td>3</td><td>ILSE 898 Dessertation 8 (0-32-0)
Total 8 credits</td><td>ILSE 898 Dessertation 8 (0-32-0)
Total 8 credits
Thesis examination and Graduation</td></tr>
</table>

***** For students who have basic principle less than the program requirement

Plan 2

Plan 2 Master graduates in Science and technology education

Year	Semester 1	Semester 2
1	ILSE 609 Nature, History, and Philosophy of Science 3 (3-0-6) ILSE 657 Research Seminar in Science and Technology Education 1 (1-0-2) Elective course 2 Credits **Total 6 credits**	ILSE 658 Research Seminar in Innovative Learning 1 (1-0-2) ILSE 659 Innovations in Science and Technology to Improve Learning 3 (1-4-4) Elective course 2 Credits Qualifying Examination **Total 6 credits**
2	ILSE 699 Dessertation 9 (0-36-0) Qualifying Examination **Total 9 credits**	ILSE 699 Dessertation 9 (0-36-0) *Proposal examination* **Total 8 credits**
3	ILSE 699 Dessertation 9 (0-36-0) **Total 9 credits**	ILSE 699 Dessertation 9 (0-36-0) **Total 9 credits**

Plan 2 Master graduates in other majors

Summer Semester		
Remedial Course * SCID 500 Cell and Molecular Biology 3 (3-0-6) ILSE 603 Basic Knowledge in Education 2 (2-0-4) ILSE 607 Basic Knowledge for Educational Research 2 (2-0-4) Qualifiying Examination		
Year	**Semester 1**	**Semester 2**
1	ILSE 600 Instructional Science 3 (3-0-6) ILSE 609 Nature, History, and Philosophy of Science 3 (3-0-6) ILSE 657 Research Seminar in Science and Technology Education 1 (1-0-2) Elective course 2 Credits **Total 9 credits**	ILSE 658 Research Seminar in Innovative Learning 1 (1-0-2) ILSE 659 Innovations in Science and Technology to Improve Learning 3 (1-4-4) Elective course 2 Credits Qualifying Examination **Total 6 credits**
2	ILSE 699 Dessertation 9 (0-36-0) Qualifying Examination **Total 9 credits**	ILSE 699 Dessertation 9 (0-36-0) *Proposal examination* **Total 8 credits**
3	ILSE 699 Dessertation 9 (0-36-0) **Total 9 credits**	ILSE 699 Dessertation 9 (0-36-0) **Total 9 credits** **Thesis examination and Graduation**

***** For students who have basic principle less than the program requirement

Plan 2 Bachelor graduates

Summer Semester		
Remedial Course * SCID 500 Cell and Molecular Biology 3 (3-0-6) ILSE 603 Basic Knowledge in Education 2 (2-0-4) ILSE 607 Basic Knowledge for Educational Research 2 (2-0-4) Qualifiying Examination		
Year	**Semester 1**	**Semester 2**
1	ILSE 600 Instructional Science 3 (3-0-6) ILSE 609 Nature, History, and Philosophy of Science 3 (3-0-6) ILSE 616 Research in Science and Technology Education 3 (3-0-6) ILSE 657 Research Seminar in Science and Technology Education 1 (1-0-2) Elective course 3 Credits **Total 13 credits**	ILSE 655 Measurement and Evaluation in Education 2 (1-2-3) ILSE 658 Research Seminar in Innovative Learning 1 (1-0-2) ILSE 659 Innovations in Science and Technology to Improve Learning 3 (1-4-4) Elective course 5 Credits Qualifying Examination **Total 11 credits**
2	ILSE 799 Dessertation 6 (0-24-0) **Total 6 credits**	ILSE 799 Dessertation 6 (0-24-0) **Total 6 credits**
3	ILSE 799 Dessertation 6 (0-24-0) **Total 6 credits**	ILSE 799 Dessertation 6 (0-24-0) **Total 6 credits**
4	ILSE 799 Dessertation 6 (0-24-0) **Total 6 credits**	ILSE 799 Dessertation 6 (0-24-0) **Total 6 credits**
5	ILSE 799 Dessertation 6 (0-24-0) **Total 6 credits**	ILSE 799 Dessertation 6 (0-24-0) **Total 6 credits** **Thesis examination and Graduation**

***** For students who have basic principle less than the program requirement

11. Requirements for Graduation

Plan 1

(1) Complete the study within the plan.

(2) Complete all courses in the curriculum.

(3) Pass the English proficiency requirement announced by the Faculty of Graduate Studies, Mahidol University.

(4) Pass qualifying examination

(5) Pass the thesis examination and submit the complete thesis and other requirements announced by the Faculty of Graduate Studies, Mahidol University.

(6) Participate work and life skills courses requirements announced by the Faculty of Graduate Studies, Mahidol University.

(7) Submit a document that shows that the thesis or a part of the thesis is published or accepted for publication in a journal or an academic printed matter which has a peer review at least 2 articles.

Plan 2

(1) Complete the study within the plan.

(2) Complete all courses in the curriculum

	Plan 1	Plan 2 Master graduates in Science and technology education	Plan 2 Master graduates	Plan 2 Bachelor graduates
Total (at least)	**48**	**48**	**51**	**72**

(3) Obtain the overall GPA of at least 3.00.

(4) Pass the English proficiency requirement announced by the Faculty of Graduate Studies, Mahidol University.

(5) Pass qualifying examination

(6) Pass the thesis examination and submit the complete thesis and other requirements announced by the Faculty of Graduate Studies, Mahidol University.

(7) Participate work and life skills courses requirements announced by the Faculty of Graduate Studies, Mahidol University.

(8) Submit a document that shows that the thesis or a part of the thesis is published or accepted for publication in a journal or an academic printed matter which has a peer review at least 1 article.

12. Course Description

(1) Remedial Course

credits (lecture-lab-self study)

SCID 500 Cell and Molecular Biology 3 (3-0-6)

Cell structure and function; life and information flow in cell, energy flow in biosystem; cell signaling; cell division; cellular differentiation; cell death and development

ILSE 603 Basic Knowledge in Education 2 (2-0-4)

National Education Act; National Education Plan; educational curriculum; educational system; learning standards; content; learning in the 21st century; transformative education; contemplative education; extra-curricular activity; educational technology; learning community

ILSE 607 Basic Knowledge for Educational Research 2 (2-0-4)

Components of educational research; database for educational research; information retrieval for research; literature review; basic statistics for educational research; citation and reference

(2) Required Course

credits (lecture-lab-self study)

ILSE 600 Instructional Science 3 (3-0-6)

How students learn; learning theory; pedagogical content knowledge; effective teaching and learning approaches; instructional design theory and model; learner analysis; learning level and assessment; classroom management; principle, concept, and guidelines for constructing lesson plan; ethics in teaching and professional ethics; micro-teaching

ILSE 609 Nature, History, and Philosophy of Science 3 (3-0-6)

Nature, role, relationship, and methodology of science, mathematics, and technology; origin and philosophy of knowledge in science, mathematics, and technology; scientific reasoning, law, and theory; relationship between nature of science and learning science; self-enhancement of in-depth understanding in science, mathematics, and technology; morals and ethics in the construction of knowledge in science, mathematics, and technology

ILSE 616 Research in Science and Technology Education 3 (3-0-6)

Research paradigms and methodology; quantitative research; qualitative research; mixed methods research; research question; research design; research instruments; data analysis; ethics in science and technology education research; analysis of science and technology education research; classroom action research

credits (lecture-lab-self study)

ILSE 655 Measurement and Evaluation in Education 2 (1-2-3)

Principle of measurement and evaluation for improving learner; formative assessment; summative assessment; authentic assessment; principle and practice in measurement and evaluation of cognitive, affective, and psychomotor domains; quality of measurement and evaluation tool; ethics in measurement and evaluation

ILSE 657 Research Seminar in Science and Technology Education 1 (1-0-2)

Current issue concerning research in science and technology education; selected interdisciplinary topics; ethics in using and publishing academic work

ILSE 658 Research Seminar in Innovative Learning 1 (1-0-2)

Current issue concerning research in learning innovation; presentation of selected learning innovation; ethics in using and publishing leaning innovation; organizing academic seminar

ILSE 659 Innovations in Science and Technology to Improve Learning 3 (1-4-4)

Principle, concept, design, application, and development of innovation for improving science, mathematics, and technology learning; morals and ethics in the development of innovation in science and technology education; morals and ethics in using innovation to improve learning; quality of innovation in science and technology education

(3) Elective Course

credits (lecture-lab-self study)

ILSE 606 Mini Project Research in Science, Mathematics and Technology Education 3(1-4-4)

Analysis of research in science and technology education; designing of mini research project in science and technology education; components in research development; data collection and analysis; ethics in educational research; writing and presenting research work; teaching an interdisciplinary project

ILSE 615 Developing Learning Media Using Modern Information Technology 3 (2-2-5)

Information and communication technology and learning in the 21st century; concept of using modern information technology (IT) in learning and teaching; analysis of case study on using modern IT in learning activity; learning media design; application for authoring learning media; learning media development and evaluation

ILSE 617 Emerging Technology for Learning 2 (2-0-4)

Relationship between technology and educational reform; relationship between technology, specific content, and pedagogy; role of technology in the development of learning process; using emerging technology in learning and teaching; technology for context-aware learning; ethics in using educational technology for learning; technology for measurement and evaluation in education

ILSE 625 Chemistry Education 3 (3-0-6)

Nature of learning chemistry; misconceptions in learning chemistry; pedagogical content knowledge for teaching chemical bonding, chemical reactions and stoichiometry, chemical thermodynamics, chemical kinetics, chemical equilibrium, electrochemistry, nanochemistry, green chemistry, biocatalyst, solar cell, spectroscopy techniques

credits (lecture-lab-self study)

ILSE 631 Biology Education 3 (3-0-6)

Nature of learning biology; misconception in biology; pedagogical content knowledge for teaching cell biology, biodiversity, evolution, biochemistry, modern genetics, bionanotechnology, biomass and bioenergy, plant biology, and biomedicine; emerging fields of biological sciences; professional ethics and ethics in biology teaching

ILSE 642 Physics Education 3 (3-0-6)

Nature of learning physics; misconceptions in physics; pedagogical content knowledge for teaching mathematics for physics, mechanics, thermodynamics, electricity and magnetism, light and optics, nuclear physics, relativity

ILSE 652 Mathematics Education 3 (3-0-6)

Nature of learning mathematics; misconceptions in mathematics; pedagogical content knowledge for teaching probability and statistics, logic and mathematical proof, real and complex numbers, geometry, algebra, calculus

ILSE 653 Computer Science Education 3 (3-0-6)

Nature of learning computer science education; misconceptions in computer science; pedagogical content knowledge for teaching algorithm, programming, data structure, simulation, artificial intelligence, microcontroller

ILSE 660 Psychology and Philosophy for Education 2 (2-0-4)

Fundamental psychology; developmental psychology; educational psychology; cognitive psychology; individual differences; inclusive education; multiple intelligences, educational guidance; counselling; philosophy, concept and theory in education, religion, economy, society and culture; educational concept and strategy for sustainable development

(4) Thesis

credits (lecture-lab-self study)

Plan 1

ILSE 898 Dissertation 48 (0-192-0)

Learning innovation evaluation and presentation within a research group; research project on creating learning innovation in science, mathematics, and technology yielding publication in international academic journal

Plan 2

ILSE 699 Dissertation 36 (0-144-0)

Research project on creating learning innovation in science, mathematics, and technology yielding publication in international academic journal

ILSE 799 Dissertation 48 (0-192-0)

Research project on creating learning innovation in science, mathematics, and technology yielding publication in international academic journal

13. Faculty

(1) Program Committee

1. Assoc. Prof. Dr.Khajornsak Buarapan
2. Asst. Prof. Dr.Patcharin Panjaburee
3. Asst. Prof. Dr.Suchai Nopparatjamjomras
4. Asst. Prof. Dr.Watcharee Ketpichainarong
5. Lect. Dr.Artorn Nokkaew
6. Lect. Dr.Monamorn Precharattana
7. Lect. Dr.Parames Laosinchai
8. Lect. Dr.Pirom Chenprakhon
9. Lect. Dr.Pratchayapong Yasri

(2) Lecturers

1. Asst. Prof. Dr.Namkang Sriwattanarothai
2. Asst. Prof. Dr.Thasaneeya R. Nopparatjamjomras
3. Lect. Dr.Supan Yodyingyong