Doctor of Philosophy Program in Science and Technology Education (International Program)
Revised Volume A.D. 2012
Institute for Innovative Learning, Mahidol University

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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. **Number of required credits**

    3.1 Plan 1

    (1) For students with a master's degree: dissertation 48 credits and non-credit courses according to the recommendation of an academic advisor

    3.2 Plan 2

    (1) For students with a master's degree: no less than 12 credits of coursework and dissertation 36 credits, and a total credit for the program no less than 48 credits

    (2) For students with a bachelor's degree: no less than 24 credits of coursework and dissertation 48 credits, and a total credit for the program no less than 72 credits

4. **Philosophy and Justification**

    To produce 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 should be able to research and develope educational innovations, to manage learning in appropriate way and corresponds to social context, and to effectively and efficiently transfer knowledge in science and technology.

5. **Objectives**

    5.1 Plan 1

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

    (1) behave morally and ethically, have a code of ethics in academic research and profession, have social responsibility, and solve problems morally with interest consideration for public;

    (2) inquire knowledge by themselves, pay attention to the development of science and technology education, and suggest appropriate ways to solve academic, profession, and social problems by integrating interdisciplinary and multidisciplinary to improve education in an effective and efficient manner;

    (3) master academic and professional knowledge, and apply principles and theories to develop innovations and learning processes in an ethical and appropriate manner compatible with the society and the educational needs;

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(4)   analyze both quantitative and qualitative information to synthesize the issues, and evaluate, translate and select information technology to communicate effectively and appropriately, both orally and in writing, to different target groups;

(5)   self control, have good leadership and followership, have good relationship with others, and help solve problems within and between groups;

(6)   master science and technology education to create innovations and develop learning process, effectively analyze facts from various resources in order to solve problems and conduct research to construct new knowledge for various levels of education.

5.2 Plan 2

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

(1)   behave morally, ethically, have a code of ethics in academic research and profession, and have social responsibility;

(2)   think, perform, inquire knowledge by themselves, pay attention to searching information, and suggest practical ways to solve academic, profession, and social problems;

(3)   master science and technology education knowledge, and apply principles and theories to create educational innovations and develop learning processes which are suitable for educational and social context;

(4)   analyze, evaluate, translate, and select information technology to effectively communicate and transfer academic knowledge;

(5)   be an amenable person, be an expert in learning management, and be an effective collaborator;

(6)   be a moral and ethical person in producing and publishing academic works, and be a leader in managing appropriate media or learning processes.

6.   Qualifications of Prospective Students

6.1 Plan 1

(1) Hold a master's degree in any field of basic science, education, art (science, mathematics, and technology major), or health science with cumulative GPA of at least 3.50, have research experiences in relating fields, and have article published in international academic journal.

(2)   Have good English skills in listening, speaking, reading and writing.

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

6.2 Plan 2

(1) Hold a bachelor's degree in any field of basic science, education, art (science, mathematics, and technology major), or health science with cumulative GPA of at least 3.50, and have research experiences in relating fields or

Hold a master's degree in any field of basic science, education, art (science, mathematics, and technology major), or health science with cumulative GPA of at least 3.50.

(2)   Have good English skills in listening, speaking, reading and writing.

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

7. **Curriculum Structure**

    Plan 1

Remedial Course	No credit
Dissertation	48 credits

    Take non-credit courses according to the recommendation of an academic advisor

Total (at least)	**48 credits**

    Plan 2 (for students with bachelor's degree)

Remedial Course	No credit
Required Courses	13 credits
Elective Courses (at least)	11 credits
Dissertation	48 credits
Total (at least)	**72 credits**

    Plan 2 (for students with master's degree)

Remedial Course	No credit
Required Courses	8 credits
Elective Courses (at least)	4 credits
Dissertation	36 credits
Total (at least)	**48 credits**

8. **Courses**

    <u>Plan 1</u>

    credits (lecture-lab-self study)

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

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

    (2) **Dissertation**

ILSE 699	Dissertation	48 (0-192-0)

    <u>Plan 2 (for students with bachelor's degree)</u>

    credits (lecture-lab-self study)

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

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

    (2) **Required Courses**

ILSE 601	Science Teaching	2 (2-0-4)
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 656	Innovations in Science and Technology for Development of Learning Process	3 (3-0-6)

| ILSE 657 | Research Seminar in Science and Technology Education | 1 (1-0-2) |
| ILSE 658 | Research Seminar in Innovative Learning | 1 (1-0-2) |

(3) Elective Courses

ILSE 604	Computers and Other Technologies in Science Teaching	3 (3-2-5)
ILSE 606	Mini Project Research in Science, Mathematics and Technology Education	4 (0-12-24)
ILSE 614	Scientific Attitude for Science Educators	2 (2-0-4)
ILSE 625	Chemistry Education	2 (2-0-4)
ILSE 631	Biology Education	2 (2-0-4)
ILSE 642	Physics Education	2 (2-0-4)
ILSE 652	Mathematics Education	2 (2-0-4)
ILSE 653	Computer Science Education	2 (2-0-4)
ILSE 654	Technology Education	2 (2-0-4)
ILSE 655	Measurement and Evaluation in 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) Dissertation

| ILSE 699 | Dissertation | 48 (0-192-0) |

Plan 2 (for students with master's degree)

credits (lecture-lab-self study)

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

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

(2) Required Courses

ILSE 609	Nature, History, and Philosophy of Science	3 (3-0-6)
ILSE 656	Innovations in Science and Technology for Development of Learning Process	3 (3-0-6)
ILSE 657	Research Seminar in Science and Technology Education	1 (1-0-2)
ILSE 658	Research Seminar in Innovative Learning	1 (1-0-2)

(3) Elective Courses

ILSE 601	Science Teaching	2 (2-0-4)
ILSE 604	Computers and Other Technologies in Science Teaching	3 (3-2-5)
ILSE 606	Mini Project Research in Science, Mathematics and Technology Education	4 (0-12-24)
ILSE 614	Scientific Attitude for Science Educators	2 (2-0-4)
ILSE 616	Research in Science and Technology Education	3 (3-0-6)
ILSE 625	Chemistry Education	2 (2-0-4)
ILSE 631	Biology Education	2 (2-0-4)
ILSE 642	Physics Education	2 (2-0-4)
ILSE 652	Mathematics Education	2 (2-0-4)
ILSE 653	Computer Science Education	2 (2-0-4)
ILSE 654	Technology Education	2 (2-0-4)
ILSE 655	Measurement and Evaluation in 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) Dissertation

ILSE 699   Dissertation   36 (0-144-0)

9. Emphasis of research projects

Research on innovations and development of learning processes with emphasis on knowledge creation or extension and development of learning approaches which are appropriate and practical by integrating content and pedagogical knowledge. The scope of research projects are as follows;

(1) Development of knowledge in science and technology education by constructing new knowledge or extension from the previous knowledge for the benefits in educational management.

(2) Development of innovations in science and technology education for the enhancement of learning in various situations.

(3) Development of learning packages in science and technology education which integrate content knowledge and learning approaches to improve the higher-order thinking skills.

10. Study Plan

Plan 1

Year	Summer Semester	Semester 1		Semester 2	
1	Remedial Course*	Take non-credit courses according to the recommendation of an academic advisor *Proposal Examination* ILSE 699 Dissertation	12 (0-48-0)	ILSE 699 Dissertation	12 (0-48-0)
		Total 12 credits		**Total 12 credits**	
2		ILSE 699 Dissertation	12 (0-48-0)	ILSE 699 Dissertation	12 (0-48-0)
		Total 12 credits		**Total 12 credits** Thesis Examination and Graduation	

* For students who have no basic of education only

Plan 2 (for students with bachelor's degree)

Year	Summer Semester	Semester 1		Semester 2	
1	Remedial Course*	ILSE 601 Science Teaching ILSE 609 Nature, History, and Philosophy of Science ILSE 616 Research in Science and Technology Education Elective Courses	2 (2-0-4) 3 (3-0-6) 3 (3-0-6) 2 credits	ILSE 656 Innovations in Science and Technology for Development of Learning Process ILSE 657 Research Seminar in Science and Technology Education Elective Courses *Preparation for Qualifying Examination*	3 (3-0-6) 1 (1-0-2) 8 credits
		Total 10 credits		**Total 12 credits**	

Year	Summer Semester	Semester 1		Semester 2	
2		ILSE 699 Dissertation	6 (0-24-0)	ILSE 699 Dissertation	6 (0-24-0)
		ILSE 658 Research Seminar in Innovative Learning	1 (1-0-2)	*Proposal Examination*	
		Elective Courses	2 credits		
		Qualifying Examination			
		Total 9 credits		**Total 6 credits**	
3		ILSE 699 Dissertation	9 (0-36-0)	ILSE 699 Dissertation	9 (0-36-0)
		Total 9 credits		**Total 9 credits**	
4		ILSE 699 Dissertation	9 (0-36-0)	ILSE 699 Dissertation	9 (0-36-0)
		Total 9 credits		**Total 9 credits**	
				Thesis Examination and Graduation	

* For students who have no basic of education only

Plan 2 (for students with master's degree)

Year	Summer Semester	Semester 1		Semester 2	
1	Remedial Course*	ILSE 609 Nature, History, and Philosophy of Science	3 (3-0-6)	ILSE 656 Innovations in Science and Technology for Development of Learning Process	3 (3-0-6)
		Elective Courses	4 credits	ILSE 657 Research Seminar in Science and Technology Education	1 (1-0-2)
				Preparation for Qualifying Examination	
		Total 7 credits		**Total 4 credits**	
2		ILSE 699 Dissertation	9 (0-36-0)	ILSE 699 Dissertation	9 (0-36-0)
		ILSE 658 Research Seminar in Innovative Learning	1 (1-0-2)	*Proposal Examination*	
		Qualifying Examination			
		Total 10 credits		**Total 9 credits**	
3		ILSE 699 Dissertation	9 (0-36-0)	ILSE 699 Dissertation	9 (0-36-0)
		Total 9 credits		**Total 9 credits**	
				Thesis Examination and Graduation	

* For students who have no basic of education only

11. Requirements for Graduation

11.1 Plan 1

(1) Complete the study within 6 academic years.

(2) Complete all courses in the curriculum (dissertation 48 credits and take non-credit courses according to the recommendation of an academic advisor) and obtain an achievement according to the curriculum requirement.

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

(4) Pass the 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) Submit at least 2 documents showing 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

11.2 Plan 2

(1) Complete the study within:
- 8 academic years for students holding a bachelor's degree
- 6 academic years for students holding a master's degree

(2) Complete all courses in the curriculum:
- For students with a bachelor's degree: no less than 24 credits of coursework and dissertation 48 credits, and a total credit for the program no less than 72 credits
- For students with a master's degree: no less than 12 credits of coursework and dissertation 36 credits, and a total credit for the program no less than 48 credits

(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 the 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) Submit documents showing 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 documents for dissertation 48 credits
- at least 1 document for dissertation 36 credits

12. Course Description

credits (lecture-lab-self study)

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

Educational components; education psychology; concepts, theories, and philosophy of education; educational reform; curriculum; learning theories; learning-teaching approaches; ethics for teacher; measurement and evaluation in education

ILSE 601 Science Teaching 2 (2-0-4)

Reform in learning and science teaching; science curricula; learning theories; principles in science teaching; ethics for science teaching; content knowledge and teaching pedagogy; science teaching methods; exploring student perception; learning assessment; teaching plans; micro-teaching

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

Nature and role of science; scientific method; origin of scientific laws, theories, and scientific knowledge; important discovery in physical and biological sciences; conceptual and philosophical changes in scientific discoveries; interaction between science and society; philosophical issues and personalities in science; Thai scientific heritage; moral and ethical issues concerning the progression of science and technology

credits (lecture-lab-self study)

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

Research paradigms; quantitative research; qualitative research; research question; research framework; research methodology; data collection; data analysis; ethics for research in science and technology education; evaluation of research in science and technology education; writing research proposal in science and technology education

ILSE 656   Innovations in Science and Technology for Development of Learning Process

3 (3-0-6)

Creativity and innovation; Innovations for development of learning process; key databases of educational innovations in science, mathematics and technology; morals and ethics in the development of innovations in science and technology education; morals and ethics in using innovations to develop learning processes in science and mathematics; designing innovations to enhance learning; evaluation of the effectiveness of innovations in science and technology education on learning achievement

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

Seminar concerning the direction of research on science and technology education; selecting research topic on science and technology education; special topics in science and technology education; ethical issue concerning research in science and technology education; current topics in science and technology education; progress report on research in science and technology education

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

Seminar concerning the direction of research and development of innovative learning; special topics on innovative learning and country development; ethical issue concerning the development of innovations for learning; selected topics concerning innovative instructional learning media in science, mathematics, and technology; selecting research topic on innovative learning; progress report on research on innovative learning

Elective Courses

credits (lecture-lab-self study)

ILSE 604   Computers and Other Technologies in Science Teaching   3 (2-2-5)

Fundamental information technology; information technologies in learning and teaching; virtual reality systems; models in science classrooms; computer simulation; games to enhance science learning, instructional teaching design; storyboard writing; application programs for authoring instructional media; implementation instructional media in science classrooms; evaluation of the effectiveness of instructional teaching media

credits (lecture-lab-self study)

ILSE 606   **Mini Project Research in Science, Mathematics, and Technology Education**

     4 (0-12-4)

         Designing of mini project research in science, mathematics and technology education; integration of scientific, mathematics, and technological knowledge with learning process; components in research development; tools for data collection and analysis; ethics for educational research; classroom management; writing and presenting research work

ILSE 614   **Scientific Attitude for Science Educators**   **2 (2-0-4)**

         Definition of scientific attitude; types of scientific attitudes; components of scientific attitude; characteristics of persons with proper scientific attitude; scientific attitude and objectives of science teaching; scientific attitude and science and technology education

ILSE 625   **Chemistry Education**   **2 (2-0-4)**

         Nature of learning chemistry; misconceptions in learning chemistry; the particle concept of matter; structure-property relationships in matter; acid-base reactions; special topics in chemistry education

ILSE 631   **Biology Education**   **2 (2-0-4)**

         Transformation of biology education as a result of the educational reform; development of biology curricula; application of learning theories for learning and teaching biology subject; development of teachers' pedagogical content knowledge for effective life science teaching; exploring students misconceptions in biology; teaching approaches in biology subject; measurement and evaluation of students learning achievement; writing of teaching plan in biology subject; micro-teaching

credits (lecture-lab-self study)

ILSE 642   **Physics Education**   **2 (2-0-4)**

         Nature and protocol of physics educational research; research of well known physics educational researchers; development of physics educational research based on local context

ILSE 652   **Mathematics Education**   **2 (2-0-4)**

         Educational reform that effects the teaching and learning of mathematics; mathematics curricula; synthesis of learning theories and teaching approaches in promoting the learning of number and operation, geometry, statistics and probability, and algebra; the use of technology in the learning-teaching of mathematics; instruments selection for measurement and evaluation; constructing of teaching-learning plans in mathematics; micro-teaching of a mathematics subject

credits (lecture-lab-self study)

ILSE 653   **Computer Science Education**   **2 (2-0-4)**

Educational reform that effects the learning and teaching of computer science; computer science curricula; synthesis of learning theories and teaching-learning approaches in promoting the learning of programming, data structure, and algorithm; the use of technology in learning and teaching of computer science; instrument selection for measurement and evaluation; constructing learning and teaching plans in computer science; micro-teaching of a computer-science subject

ILSE 654   **Technology Education**   **2 (2-0-4)**

Relationships between technology and educational reform; roles of technology in the development of learning process; using technology in learning and teaching; ethics in using educational technologies for learning; technology for measurement and evaluation in education; relationships among technology, science, and society

ILSE 655   **Measurement and Evaluation in Education**   **2 (2-0-4)**

Roles of measurement and evaluation in education; approached for measurement and evaluation during learning; approaches for measurement and evaluation at the end of learning; approaches for authentic measurement and evaluation; instruments for measurement and evaluation in cognitive domain; instruments for measurement and evaluation in affective domain; instruments for measurement and evaluation in psychomotor domain; morals and ethics in measurement and evaluation

Dissertation

credits (lecture-lab-self study)

ILSE 699   **Dissertation**   **48/36 (0-192/144-0)**

Research projects on science and technology education with emphasis on content, yielding instructional multimedia, apparatus, or process; an international publication whose work is useful for learning and teaching in the nation; research that aligns with national priorities concerning science and technology education; research in chemistry, biology, physics, mathematics, or computer science

Faculty

Program Committee

Item	Name –Surname	Degree (field of study) Institution: Year of Graduation
1.	Lect.Dr. Namkang Sriwattanarothai	Ph.D. (Science and Technology Education) Mahidol University: 2009 M.Sc. (Biochemistry) Mahidol University: 2006 B.Sc. (Biology) Chiang Mai University: 2003
2.	Lect.Dr. Parames Laosinchai	Ph.D. (Science and Technology Education) Mahidol University: 2011 M.S. (Finance) Washington University in Saint Louis: 1998 M.B.A. (Finance and Investment) Baruch College, CUNY: 1993 B.Eng. (Computer) Chulalongkorn University: 1986
3.	Assist.Prof.Dr. Piyachat Jittam	Ph.D. (Science and Technology Education) Mahidol University: 2008 M.Sc. (Biochemistry) Mahidol University: 2005 B.Sc. (General Science) Prince of Songkla University: 1996
4.	Assist.Prof.Dr. Suchai Nopparatjamjomras	Ph.D. (Science and Technology Education) Mahidol University: 2008 M.Sc. (Physics) Mahidol University: 2003 B.Sc. (Electronics Physics) Thammasat University: 1998
5.	Assist.Prof.Dr.Thasaneeya R. Nopparatjamjomras	Ph.D. (Science Education) Kasetsart University: 2006 Diploma (Professional in Science Teaching) Kasetsart University: 1998 B.Sc. (Biology) Kasetsart University: 1997
6.	Lect.Dr.Wararat Wongkia	Ph.D. (Science and Technology Education) Mahidol University: 2012 Diploma (Teaching Profession) Mahidol University: 2006 B.Sc. (Mathematics) Mahidol University: 2005

Lecturers

Item	Name –Surname	Degree (field of study) Institution: Year of Graduation
1.	Assoc.Prof.Dr. Khajornsak Buarapan	Ph.D. (Science Education) Kasetsart University: 2006 B.Ed. (Physics) Rajabhat Institute Chiang Rai: 1997
2.	Assist.Prof.Dr. Patcharin Panjaburee	Ph.D. (Science and Technology Education) Mahidol University: 2010 Diploma (Teaching Profession) Chiang Mai Rajabhat University: 2006 B.Sc. (Computer) Chiang Mai University: 2005
3.	Assist.Prof.Dr. Watcharee Ketpichainarong	Ph.D. (Science and Technology Education) Mahidol University: 2009 Diploma (Teaching Profession) Mahidol University: 2004 B.Sc. (Biology) Mahidol University: 2003
4.	Lect.Dr.Artorn Nokkaew	Ph.D. (Science and Technology Education) Mahidol University: 2013 Diploma (Teaching Profession) Rajabhat Mahasarakham University: 2005 B.Sc. (Computer Science) Rajabhat Mahasarakham University: 2004
5.	Lect.Dr. Monamorn Precharattana	Ph.D. (Physics) Mahidol University: 2011 Diploma (Teaching Science Profession) Kasetsart University: 2007 B.Sc. (Physics) Kasetsart University: 2006
6.	Lect.Dr.Pratchayapong Yasri	Ph.D. (Education) University of Glasgow: 2014 M.Sc. (Science Education and Communication) University of Glasgow: 2009 M.Sc. (Molecular Genetics and Genetic Engineering) Mahidol University: 2008 B.Sc. (Biology) Chulalongkorn University: 2006
7.	Lect.Dr. Pirom Chenprakhon	Ph.D. (Science and Technology Education) Mahidol University: 2011 Diploma (Science Teaching Profession) Silpakorn University: 2005 B.Sc. (Chemistry) Ubon Ratchathani University: 2004
8.	Lect.Dr. Supan Yodyindyong	Ph.D. (Science and Technology Education) Mahidol University: 2010 Diploma (Teaching Profession) Rajabhat Mahasarakham University: 2005 B.Sc. (Chemistry) Rajabhat Mahasarakham University: 2004