COURSE SYLLABUS

ILSE 608 Evolution of Science, Mathematics, and Technology

Semester A (2020), 2 (2-0-4) credit hours

Course Coordinator

Parames Laosinchai, Ph.D. (PL)	parames.lao@mahidol.edu

Instructors

Khajornsak Buaraphan, Ph.D. (KB)	khajornsak.bua@mahidol.ac.th
Monamorn Precharattana, Ph.D. (MP)	monamorn.pre@mahidol.edu
Parames Laosinchai, Ph.D. (PL)	parames.lao@mahidol.edu
Patcharapan Siriwat, Ph.D. (PS)	patcharapan.sir@mahidol.edu
Pirom Chenprakhon, Ph.D. (PC)	pirom.che@mahidol.edu
Piyachat Jittam, Ph.D. (PJ)	pjittam@gmail.com
Suchai Nopparatjamjomras, Ph.D. (SN)	suchai.nop@mahidol.edu
Supan Yodyingyong, Ph.D. (SY)	supan.yod@mahidol.edu
Wararat Wongkia, Ph.D. (WW)	wararat.won@mahidol.ac.th

Office: Room IL2009, Institute for Innovative Learning, Mahidol University

Tel: 02-441-9723 # 2011

Course Description

ธรรมชาติ บทบาท ความสัมพันธ์ และวิธีการทางวิทยาศาสตร์ คณิตศาสตร์ และเทคโนโลยี ที่มาและวิวัฒนาการของความรู้ทางวิทยาศาสตร์ คณิตศาสตร์ และเทคโนโลยี ความสัมพันธ์ระหว่างธรรมชาติของวิทยาศาสตร์กับการเรียนรู้วิทยาศาสตร์ การประเมินระดับความเข้าใจเชิงลึกของตนเองทางวิทยาศาสตร์ คณิตศาสตร์ และเทคโนโลยี คุณธรรมและจริยธรรมในการสร้างความรู้ทางวิทยาศาสตร์ คณิตศาสตร์ และเทคโนโลยี ธรรมชาติของคณิตศาสตร์ ฟิสิกส์ เคมี ชีววิทยา และวิทยาการคอมพิวเตอร์

Nature, role, relationship, and methodology of science, mathematics, and technology; origin and evolution of knowledge in science, mathematics, and technology; relationship

between nature of science and learning science; self-evaluation of in-depth understanding in science, mathematics, and technology; morals and ethics in the construction of knowledge in science, mathematics, and technology; nature of mathematics, physics, chemistry, biology, and computer science

Course Learning Outcomes (CLO)

At the end of the course, students should be able to:

Learning outcomes	PLO	Sub-PLO
1. Discuss the moral and ethical consequences of scientific/technological inventions.	1	1.2
2. Analyze the nature of scientific/mathematics-related conceptual knowledge.	2	2.2
3. Acquire scientific/mathematics-related conceptual knowledge in a way that is appropriate to its nature.	2	2.2
4. Communicate such knowledge/understanding to others with different levels of knowledge in the topic in an effective way.	2	2.3
5. Evaluate your in-depth conceptual understanding of scientific/mathematics-related topics.	6	6.1–6.4
6. Display self-control in class and in doing assignments	7	7.1
7. Respect others' opinions	8	8.2

Readings

- **Required readings**

  Gribbin, J. (2009). *Science: A History*. Penguin Books Limited.

- **Supplementary readings**

  Big History Project—An excellent starting point for the understanding of Earth history in a scientific way. www.bighistoryproject.com.

  Nobelprize.org—The official website of the Nobel prize. www.nobelprize.org.

Course Outline (Wednesday, 10.00–12.00): https://mahidol.webex.com/mahidol/j.php?MTID=mfe455d79806827fa0806d5d4301687a1

Meeting number: 2641 479 1978, Password: ILSE608, Host key:538517

Week	Date	Topic	Teaching Approach	CLO	Instructor
1	10 Aug 22	Introduction to the evolution of science and technology I	Modeling instruction	2	PL
2	17 Aug 22	Introduction to the evolution of science and technology II	Modeling instruction	2	PL
3	24 Aug 22	Nature of science and scientific method (10%)	Active lecture, discussion	2	PL KB PS
4	31 Aug 22	Scientific reasoning	Discussion, analogy	2	PL SY
5	7 Sep 22	Scientific evidence	Active lecture, discussion	2	PL SY
6	14 Sep 22	Scientific laws and theories (10%)	Active lecture, Discussion	2	PL KB
7	21 Sep 22	Relationship between nature of science and science learning	Discussion	2	PL KB PS
8	28 Sep 22	Self-evaluation of in-depth understanding in science, mathematics, and technology (10%)	Discussion, reflection	5	PL PJ
9	5 Oct 22	Social issues in scientific discoveries	Case study, discussion	1	PL
10	12 Oct 22	Morals and ethics in scientific progress (10%)	Case study, discussion	1	PL
11	26 Oct 22	Nature of and discoveries in physics*	Presentation	3	PL MP SN
12	2 Nov 22	Nature of and discoveries in mathematics*	Presentation	3	PL WW
13	9 Nov 22	Nature of and discoveries in chemistry*	Presentation	3	PL PC SY
14	16 Nov 22	Nature of and discoveries in biology*	Presentation	3	PL PS
15	23 Nov 22	Nature of and discoveries in computer science*	Presentation	3	PL WW

Course Requirements

- **Class participation (20 points, CLOs 6 and 7)**

  The class will be held online. Active and thoughtful participation is vital to learning and will be counted toward the final grade. Rubric and marking scheme for class participation are provided below.

	Present (1)	**Attentive (2)**	**Engaging (3)**	**Satisfactory (4)**	**Exemplary (5)**
Active contribution	Show up but never contribute to class discussion	Seldom contribute to class discussion, unless asked	Occasionally contribute to class discussion	Regularly contribute to class discussion	Proactively and regularly contribute to class discussion
Active listening	Lack of attention to the discussed topic	Listen when others discuss and occasionally respond to the discussed topic	Listen when others discuss and sometimes respond to the discussed topic	Appropriately listen when others discuss and consistently respond to the discussed topic	Appropriately listen when others discuss and usefully respond to the discussed topic

- **Assignments (40 points)**

  The numbers in the parentheses after some of the sessions indicate the contributions of the assignments on those and preceding topics toward the final grade.

  - **Assignment 1 (10 points, CLOs 2 and 3, due 31 August 2022)**

    Each student will be required to explain a natural phenomenon using a scientific model.

    Criteria

    – The model is relevant to the phenomenon—2 points.

- The model is sufficient to explain the phenomenon—2 points.
- The explanation is coherent, accurate, and complete—4 points.
- Proper citations and references—2 points.

- **Assignment 2 (10 points, CLOs 2 and 3, due 21 September 2022)**

  Each student will be required to analyze how scientific reasoning gives rise to a pair of related scientific law and theory.

  Criteria

  - The selected law and theory are related—2 points.
  - The scientific reasoning behind the law is accurately and completely analyzed—3 points.
  - The scientific reasoning behind the theory is accurately and completely analyzed—3 points.
  - Proper citations and references—2 points.

- **Assignment 3 (10 points, CLO 5, due 5 October 2022)**

  Each student will be required to reflect on his/her experience of evaluating in-depth understanding of a topic.

  Criteria

  - The topic is clearly specified—1 point.
  - The reflection is sufficiently detailed (what did you do?)—4 points.
  - The reflection includes the expected and realized outcomes—3 points.
  - The reflection suggests a plan to do it better—2 points.

- **Assignment 4 (10 points, CLO 1)**

  Each student will be required to prepare for and contribute to in-class discussion about social issue and/or morals and ethics in science.

  Criteria

  - The arguments are clear and relevant—3 points.
  - The arguments are logical—3 points.
  - The arguments are insightful—2 points.

- The arguments are concise—2 points.

- **Scoring for concept presentation and in-depth report**

  The final scores will be the product of two components, difficulty (4 points) and performance (5 points, see below). For example, the difficulty score of 3 points and the performance score of 4 points will result in the final score of 12 points. A fact-based presentation/report will earn low scores for both components. The difficulty score of the presentation will be more lenient than that of the report. Roughly, the university-level concept should earn a full difficulty score for the presentation but the same concept should be dealt with in more depth in the report to earn the same difficulty score.

- **Concept presentation (20%, CLO 2–4)**

  Each student is required to present a selected topic on one of the days marked by an asterisk.

  Performance criteria

  - Encourage concept construction—2 points.
  - Active rather than passive—1 point.
  - Comprehensible by nonmajors—1 point.
  - Well organized and accurate—1 point.

- **In-depth report (20%, CLO 2, 3, and 5, due 30 November 2022)**

  A report on the same topic but emphasizing in-depth understanding.

  Performance criteria

  - Deeper than the presentation—1 point.
  - Well structured—1 point.
  - Accurate and complete—1 point.
  - Make references to knowledge gained from weeks 1–6—1 point.
  - Proper citations and references—1 point.

- **Remarks**
  - All written assignments will be checked for plagiarism by Turnitin and will be accepted for grading only if they contain less than 25% similarity.
  - Those who take the course for credit will be evaluated if attend at least 12 sessions.
  - Those who audit the course will get a passing grade if attend at least 12 sessions, do the concept presentation, submit the in-depth report, and get at least 60% of the available marks.

Grading

The final grade will be determined as follows:

≥ 84%	A,
≥ 76% and < 84%	B+,
≥ 68% and < 76%	B,
≥ 60% and < 68%	C+, and
≥ 50% and < 60%	C.

In addition, a student's final grade may be higher than the suggested guideline if the student's score is close enough (< 1% gap) to the next higher score. That is, close scores will likely earn the same final grade.

Please note that any formal appeal made to raise concerns about the course regarding learning, teaching, and assessment, as well as the facilities and infrastructures can be made through the IL Education website (https://il.mahidol.ac.th/eng/education/).