

## COURSE SYLLABUS

ILSE 609 Nature, History, and Philosophy of Science

Semester A (2022), 3 (3-0-6) credit hours

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### Course Description

ธรรมชาติ บทบาท ความสัมพันธ์ และวิธีการทางวิทยาศาสตร์ คณิตศาสตร์ และเทคโนโลยี ที่มาและปรัชญาของความรู้ทางวิทยาศาสตร์ คณิตศาสตร์ และเทคโนโลยี การให้เหตุผล กฎ และทฤษฎีทางวิทยาศาสตร์ ความสัมพันธ์ระหว่างธรรมชาติของวิทยาศาสตร์กับการเรียนรู้วิทยาศาสตร์ การยกระดับความเข้าใจเชิงลึกของตนเองทางวิทยาศาสตร์ คณิตศาสตร์ และเทคโนโลยี คุณธรรมและจริยธรรมในการสร้างความรู้ทางวิทยาศาสตร์ คณิตศาสตร์ และเทคโนโลยี

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

### 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. Synthesize 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. Enhance 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.

Thompson, M. (2003). *Teach Yourself Philosophy of Science*. McGraw-Hill.

Class handouts.

- **Supplementary readings**

*Big History Project*—An excellent starting point for the understanding of Earth history in a scientific way. [www.bighistoryproject.com](http://www.bighistoryproject.com).

*Nobelprize.org*—The official website of the Nobel prize. [www.nobelprize.org](http://www.nobelprize.org).

Course Outline (Tuesday, 9.00–12.00): <https://mahidol.webex.com/mahidol/j.php?MTID=m004d64237a8375659326bdd75c891190>

Meeting number: 2644 944 8063, Password: ILSE609, Host key: 636840

| Week | Date      | Topic  | Teaching Approach          | CLO | Instructor |
|------|-----------|--|----------------------------|-----|------------|
| 1    | 9 Aug 22  | Introduction to the nature of science I  | Modeling instruction       | 2   | PL         |
| 2    | 16 Aug 22 | Introduction to the nature of science II                                       | Modeling instruction       | 2   | PL PS      |
| 3    | 23 Aug 22 | Nature of science and scientific method (10%)                                  | Active lecture, discussion | 2   | PL KB PS   |
| 4    | 30 Aug 22 | Scientific reasoning   | Discussion, analogy        | 2   | PL SY      |
| 5    | 6 Sep 22  | Philosophy of science I  | Active lecture, discussion | 2   | PL NS      |
| 6    | 13 Sep 22 | Philosophy of science II (10%)   | Active lecture, Discussion | 2   | PL NS      |
| 7    | 20 Sep 22 | Relationship between nature of science and science learning                    | Discussion                 | 2   | PL KB PS   |
| 8    | 27 Sep 22 | Enhancing in-depth understanding in science, mathematics, and technology (10%) | Discussion, reflection     | 5   | PL PJ      |
| 9    | 4 Oct 22  | Social issues in scientific discoveries  | Case study, discussion     | 1   | PL NS      |
| 10   | 11 Oct 22 | Morals and ethics in scientific progress (10%)                                 | Case study, discussion     | 1   | PL NS      |
| 11   | 25 Oct 22 | Nature of and discoveries in mathematics*                                      | Presentation               | 2–4 | PL WW      |
| 12   | 1 Nov 22  | Nature of and discoveries in physics*  | Presentation               | 2–4 | PL MP SN   |
| 13   | 8 Nov 22  | Nature of and discoveries in chemistry*  | Presentation               | 2–4 | PL PC SY   |
| 14   | 15 Nov 22 | Nature of and discoveries in biology*  | Presentation               | 2–4 | PL NS WK   |
| 15   | 22 Nov 22 | Nature of and discoveries in computer science*                                 | Presentation               | 2–4 | 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.

|                     | <b>Present (1)</b>                               | <b>Attentive (2)</b>   | <b>Engaging (3)</b>   | <b>Satisfactory (4)</b>  | <b>Exemplary (5)</b>   |
|---------------------|--|--|---|--|--|
| 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 30 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 20 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 4 October 2022)**

Each student will be required to reflect on his/her experience of enhancing 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%, CLOs 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%, CLOs 2, 3, and 5, due 29 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 by the following guidelines:

|                 |         |
|-----------------|---------|
| ≥ 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/>).