Syllabus for TU STEM Summer Program (TSSP):

Exploring the Frontier of Science and Technology

June 20-July 15, 2022 at Tohoku University, Sendai, Japan

(Tentative)

PROGRAM DESCRIPTION

Japan continues to be a world leader in science, technology, and innovation. **Tohoku University STEM Summer Program (TSSP): Exploring the Frontier of Science and Technology** provides a unique opportunity for freshmen and sophomores to learn about the originality and state of advanced science and technology in Japan. Students will also get hands-on experience learning about creative science and engineering at one of Japan's premier universities, Tohoku University, in Sendai City.

In TSSP, students will be introduced to fundamental and innovative science and engineering concepts through lectures, laboratory work, and lab visits. Students then work on project teams with Tohoku University science and engineering students to use these concepts to solve problems. In addition, several special seminars and lectures are given by experts to develop knowledge about more advanced science and engineering principles.

During this four-week program, students also will learn how Japanese culture and society influenced science and engineering in Japan. The program provides Japanese language training and opportunities for exposure to traditional and local culture through workshops and field trips. The destinations of field trips include J-PARC, a series of world-class proton accelerators, a next generation synchrotron radiation center, experimental facilities at Tohoku University, a Japanese automotive manufacturer's production plant, the historic castle in Shiroishi, and coastal areas around Sendai that were affected by the 2011 tsunami.

LEARNING OBJECTIVES

This course has been designed to provide students with the contextual science and engineering background to apply critical thinking skills to modern science and engineering problems in an international context. Through this course, they will be able to:

1) Understand key information about advanced science and engineering concepts and their application in professional science and engineering practice
2) Demonstrate knowledge (?) of science and engineering culture and practice in Japan
3) Utilize technical design skills
4) Work effectively in diverse teams
5) Articulate their own academic and professional goals related to science and engineering
6) Communicate at an introductory level in Japanese and apply the language in real-world contexts
7) Experience Japanese traditional culture

ATTENDANCE POLICIES

Attendance is mandatory at all academic activities, including instructor/guest lectures, laboratory sessions, laboratory visits, Japanese language & culture sessions, field trips, group discussions, course meetings, etc. All academic activities are scheduled on weekdays. Excessive tardiness or absence may be grounds for dismissal from the program. Optional activities will be advertised as such and may include trips to sightseeing, shopping, or social gatherings.
Each student will submit a 250-word summary in MS Word format of what they learned from each activity. Should they have any questions/concerns, they should contact Prof. Kasukabe and/or other relevant professors.

PROGRAM SCHEDULE

The program schedule is shown below. This Program has been designed to require 200 hours of work, equivalent to an 8-ECTS, 4-week long course. The outline below is provided to help students guide use of their time.

A. Students pre-program work and homework during the program

Pre-program work before the program and homework during the program (equivalent of 40 educational hours):

- 12 hours: pre-program work (including self-study about Japan)
- 28 hours: homework during the program

B. June-July Program Time:

160 educational hours over the 4-week term distributed approximately as follows

- 2 hours of orientation and guidance
- 38 hours of lectures and lab-visits, including reading preparation
- 44 hours of group laboratory projects, including reading and report preparation
- 44 hours of field trips, including reading preparation
- 12 hours of culture learning
- 8 hours of language learning, including exercises
- 6 hours of group discussion
- 6 hours of individual and group presentation, including PPT preparation

A reading list will be posted on this program site to allow advance preparation. Readings are designed to provide context for instructor/guest lectures, laboratory visits, group laboratory projects and field trips. Final details and assignment schedules will also be posted.

TEACHING APPROACH

This course will focus on learning from "hands-on" projects, field trips, expert topical lectures, targeted scholarly readings, culture and language experience, group discussion, and student presentations.

STUDENT WORK AND ASSIGNMENTS

Student work outside of lectures, lab visits, lab work and field trips will consist of the TSSP 2022.

Study log and reflection: Students will keep a log recording notes, thoughts, and questions that arise during the program. Designated time will be set aside in the schedule for reflection on technical and cultural topics. In some cases, these individual thoughts will form the basis of small group discussion.

GRADING/SCORING

Students receive a numeric grade for their work. Students should expect grades to be comparable to those awarded for on-campus study.

Learning will be assessed in the following ways:

20% Participation in lectures, project lab work, lab visits, and field trips

Because of the unique nature of this study abroad program, engaged participation in all program activities is critical to allow for learning. Therefore, students are expected to attend all program activities and actively participate. As a general rule, please note that being present is not the same as participating.

30% Study log

You will be given a dedicated logbook. Keep a record of all your experiences in the logbook during the program. You should include lecture notes, lab results, field trip notes, data from readings, cultural observations, opinions on the engineering topics, and reflections on experiences. This information will be used for your final report and presentation preparation. At certain points during the program, you may be asked to include specific information in your study log (e.g., response to a question posed by the program director). **Your logbook will be collected and graded for completion before the final presentation.** Students should plan to fill 5-10 pages of their notebook each week to receive full points.

20% Reports from three hands-on-laboratories

Lab report format and other details: TBA

30% Project report and presentation

Each student will make a presentation, covering what they learned from this program and what they found interesting in regards to their potential career. The presentation will be made on the last day of the program.

FINAL ORAL PRESENTATION AND REPORT

Final oral presentation: XXX min. individual presentation in the TSSP presentation session

Final report: 4 pages in A4 format (TBA).
Contents: Students will discuss either the frontier of science and technology or the science and technology of disasters and damage reduction. Based on insights through the study of Japanese language and experience of Japanese culture and traditions, they will discuss how uniquely Japanese ways of thinking and approaches affect and influence the program's themes, their thoughts on basic and cutting-edge science and technologies, and how this program relates to their future careers.

Tip for your presentation
The TU STEM Summer Program (TSSP) has given you opportunities to challenge yourself in multiple ways over the four weeks of the program. Before departing from Sendai, we want you to think about your experiences and consider the skills, knowledge, and awareness you will take away from this program as a result. To help you with this, you will give a final presentation reflecting on what you have learned.

In your presentation, you will identify critical incidents you experienced in the program. A critical incident is "an event which made you stop and think, or one that raised questions for you" (Monash University, 2017). You should address at least one critical incident in each of three areas related to the learning objectives for the course: 1) scientific and engineering learning in lectures and labs, 2) Japanese culture and language, and 3) your personal and academic development. For each incident, reflect on why it was important to you and what knowledge you will take from it. You can refer to steps of the **DEAL** Model of Critical Reflection (Ash & Clayton, 2009) to help with this:

1. **D**escribe the incident you experienced in an objective and detailed way (What happened? How did you feel and react?)
2. **E**xamine the incident beyond just summarizing it to understand why it was important (What did you learn? Why does it matter?)
3. **A**rticulate your **L**earning from that incident and how you will apply what you learned in the future (What will you do now? How has this experience affected your future goals and plans?)

Lectures and labs	**Culture and language**	**Personal and academic development**
1.What occurred in this incident? What was your initial reaction to it? 2. What was engaging or challenging about this incident, and why? What other questions do you have a result of this incident that you would like to answer? How did the lecture style used by the Japanese professors affect the way you learned in the lectures and labs? 3. How might your academic and professional careers be affected as a result of what you learned?	1. What occurred in this incident? What was your initial reaction to it? 2. Why did you find this incident engaging or challenging? How did it improve your understanding of Japanese language and culture? What other elements of Japanese language and culture might provide context for this incident? 3. What did this experience make you realize about how you interact with new cultures? How might you be able to generalize what you learned from this experience and apply it to your encounters with other cultures in the future?	1. What occurred in this incident? What was your initial reaction to it? 2. What assumptions and expectations did you bring to this incident? How do you interpret the thoughts and behaviors of the other people involved? 3. How did this incident reinforce or challenge your values, beliefs, or priorities? How did this incident impact your sense of personal or academic identity, or your identity as a future engineering/scientist? How has this experience prepared you to respond to similar situations in the future?

You should address at least one incident related to each focus area, but you can provide more details on a given area if you have more to say about what you learned in that area. Also, a single incident may correlate to several focus areas; for instance, an incident that occurred during a lab session may have had an impact on your view of your own academic identity and development. In that case, you can present that incident as an example of one of the relevant areas, but you should still provide 2 additional incidents. While this is an academic presentation, we hope it will also serve you after this program as a record of your thoughts, observations, and experiences in Japan as well as a guide to help you put into practice some of your new skills, knowledge, and awareness. So feel free to have fun with it; photos, memes, etc. are encouraged if they will help make it a better reference point for you in the future.

Presentations will be graded on the following criteria:

- Address at least one critical incident from the three focus areas
- Demonstrate deep engagement with the process of examining each incident to understand the context surrounding it and why it is important
- Show how reflecting on the incidents leads to a set of realistic, achievable, and productive goals for the future
- Offer a high level of substantive reflection that will allow it to be useful as a guide for future practice

Summary of TU STEM Summer Program Assignments

(1) Group Lab reports: Lab session schedule is subject to change. Hence, the report due dates may change accordingly.

1. **Challenging Experiments for Quantum Theory** on 6/22(W).
   Report due: **noon on Monday June 27**

2. **Paper Aircraft Competition** on 6/23(Th) and 6/24(F).
   Report due: **noon on Monday July 4**

3. **Fastest Clip Motor Competition** on 7/12(Tu)
   Report due: **noon on Thursday July 14**

Report length: Single spaced A4/US Letter 3 pages max. including figures and tables
12-point Times New Roman font

(2) Lectures: The lecture schedule is subject to change.

1.	June 21 (T)-M	Tohoku Earthquake (Prof. Matsuzawa)
2.	June 23 (Th)-M	Intro to Aircraft Design (Prof. Nakamura)
S1.	June 27 (M)-M	Mat. Sci. of Japanese Sword Making (Prof. Ohuchi)
3.	June 29 (W)-A	Symmetry Breaking Creates Nature (Prof. Tanaka)
4.	July 1 (F)-M	Structural Metallic Materials (Prof. Yoshimi)
5.	July 1 (F)-A	Robotics for Space Exploration (Prof. Yoshida)
6.	July 4 (M)-M	Historical and Social Approaches to Disasters (Profs. Ebina and Boret)
7.	July 5 (T)-M	Origin of Life (Prof. Kakegawa)
8.	July 5 (T)-A	Japanese Second Sample Return Mission: Hayabusa 2 (Prof. Nakamura)
9.	July 7 (Th)-M	Interactive "Content" Design (Prof. Kitamura)
10.	July 7 (Th)-A	Advanced Research with Accelerators (Prof. Koike)
11.	July 11 (M)-M	Spintronics (President, Prof. Ohno)
12.	July 13 (W)-M	Renewable Energy Systems (Dr. Warzecha and Ms. Mehta)

Summary of what you learned in 250 words.
Google Classroom will be used. Each student will submit a MS Word file
File name: lecture number _your last name
(e.g., **3_smith.docx** = summary of lecture **3** written by **smith**)

(3) Final report due by 8:00 am on Friday, July 15. Final presentation on Friday, July 15.

See the details on the previous pages.
Final report: Single spaced 4 pages, including figures and tables (Times New Roman, 12-point font)
Final presentation: 10 min. (not more than 10 PPT slides)

QR code for Google Classroom (This code should be updated.)

GENERAL OUTLINE OF A <u>LABORATORY REPORT</u>

Scientific writing is just as important as scientific investigation or experimenting. Although the major part of scientific investigation takes place in the laboratory—setting up and repairing equipment, obtaining supplies and samples, checking each apparatus for consistency, calibration, and finally data collection by running the experiment—a great deal of time is spent presenting the results in a concise, objective, critical and conclusive format called a laboratory report (similar to a research paper). Therefore, a well-organized laboratory report is much more effective and influential than one without a structure. There is no short list of instructions for writing a good laboratory report. You may have only one chance to influence your reader. While ineffective writing can turn off the readers, a well-written laboratory report can have an impact on your reputation, chance of employment or promotion. You may also draw the attention of the scientific community to your work and retain them as your readers.

Sections of a laboratory report:
A laboratory report usually has several sections identified by titles. A typical report would include such sections as TITLE, INTRODUCTION, PROCEDURE, RESULTS, and DISCUSSION/CONCLUSION. If you are using a computer to type your work, section headings should be in boldface.

Title:
A good title can usually draw the attention of the reader to your work. It should clearly represent the work presented. If the purpose of the experiment is to measure the gravitational acceleration of the earth using a pendulum as the experimental apparatus, the title should be something like "*Measurement of Gravitational Acceleration Using Simple Pendulum*." Avoid "The" as the first word in the title as it will lead to misleading database search results.

Introduction:
State the purpose of the experiment in general terms. For example, "It is possible to measure gravitational acceleration using the oscillations of a simple pendulum."
Review the existing information or theory. Readers will look for some reminder of the basic information relating to this particular area. This can be done by giving them a brief summary of the existing state of knowledge. We can also include a summary of earlier work with proper references.
Supply a paragraph or two about how the basic information, such as an equation representing the behavior of a model (theory), can be used to make measurements.

Procedure:
Indicate the parameters or properties of the system you are measuring. Usually, you change a parameter of the system (such as changing the temperature, *independent variable*), and measure its effect (such as the length of a metal rod, *dependent variable*). Specify such measurement details as the type of standard or instrument used to make the measurement (for example, meter stick or Vernier caliper, etc.). Give the instrument uncertainties. For example, if we are using a meter stick, we can say, "The length of the rod is measured using a laboratory meter stick accurate to within 1 cm." You may also provide an apparatus diagram if necessary.

Results:
- Provide at least 3 scientific observations

- Scientific observations are things like “the solution turned blue upon adding a component,” not “we turned on the gas tank.”
- Provide tables showing your measurement with units.
- Describe the uncertainties: standard, instrument, random errors.
- Provide graphs. Graphs should be neat, clear, and include axis labels and units.
- Computation of the final answer: slope calculation, averages, and standard deviations all in proper significant figures.

Discussion/Conclusion:

- Present your findings from the experiment.
- Evaluate the outcome objectively, taking a candid and unbiased point of view. Suppose that the outcome is not close to what you expected. Even then, after checking your results, give reasons why you believe that outcome is not consistent with the expected. Make it plain and simple. Make factual statements such as “graph 1 shows a linear variation of velocity with time.”
- State the discrepancies between the experimental results and the model (theory), and discuss the sources of the differences in terms of errors by offering logical inferences.
- Suggest improvements

Although these do not make an exhaustive list of do’s or don'ts, they nevertheless offer a framework around which one can write an effective report. In our experiment, some of the items indicated under each section may not be needed. We will give you more feedback in class. We expect that, the lab reports, whether typed or handwritten, should be neat, clear, and organized. Points will be deducted for these, as well as for missing units and failing to follow the outline (i.e., title, introduction, procedure, results, discussion/conclusion) given above.

GENERAL OUTLINE OF NOTEBOOK (LOGBOOK) INSTRUCTIONS

Keeping a notebook that’s organized and legible is very important in science and engineering as you always want to be able to return to an experiment or situation simply by reading your notes. To do this, your notes should be thorough and comprehensive. Instructions have been provided below as to how you can start working towards a great notebook:

Title, Date, and Page number should be at the top of EVERY page.

On days with a lab, a pre-lab should be completed

- Pre-labs should have a definite beginning and end. Put PRE-LAB at the top of the first page and END at the bottom of the last page. Your in-group discussion/notes from lectures should go with the pre-lab section
- For the actual lab create the following sections:
    - Purpose & actual procedures
    - Drawings & calculations
    - Observations (include problems encountered and solved)
    - Results
    - Comparison to published values or results
    - Conclusion

On days without a lab, treat this like a notebook.

- At the end, include a summary of what you have learned.

The LOGBOOK will be collected before the final presentation.