Ethics Across the Curriculum

The implementation of full-scale university-wide engineering ethics education

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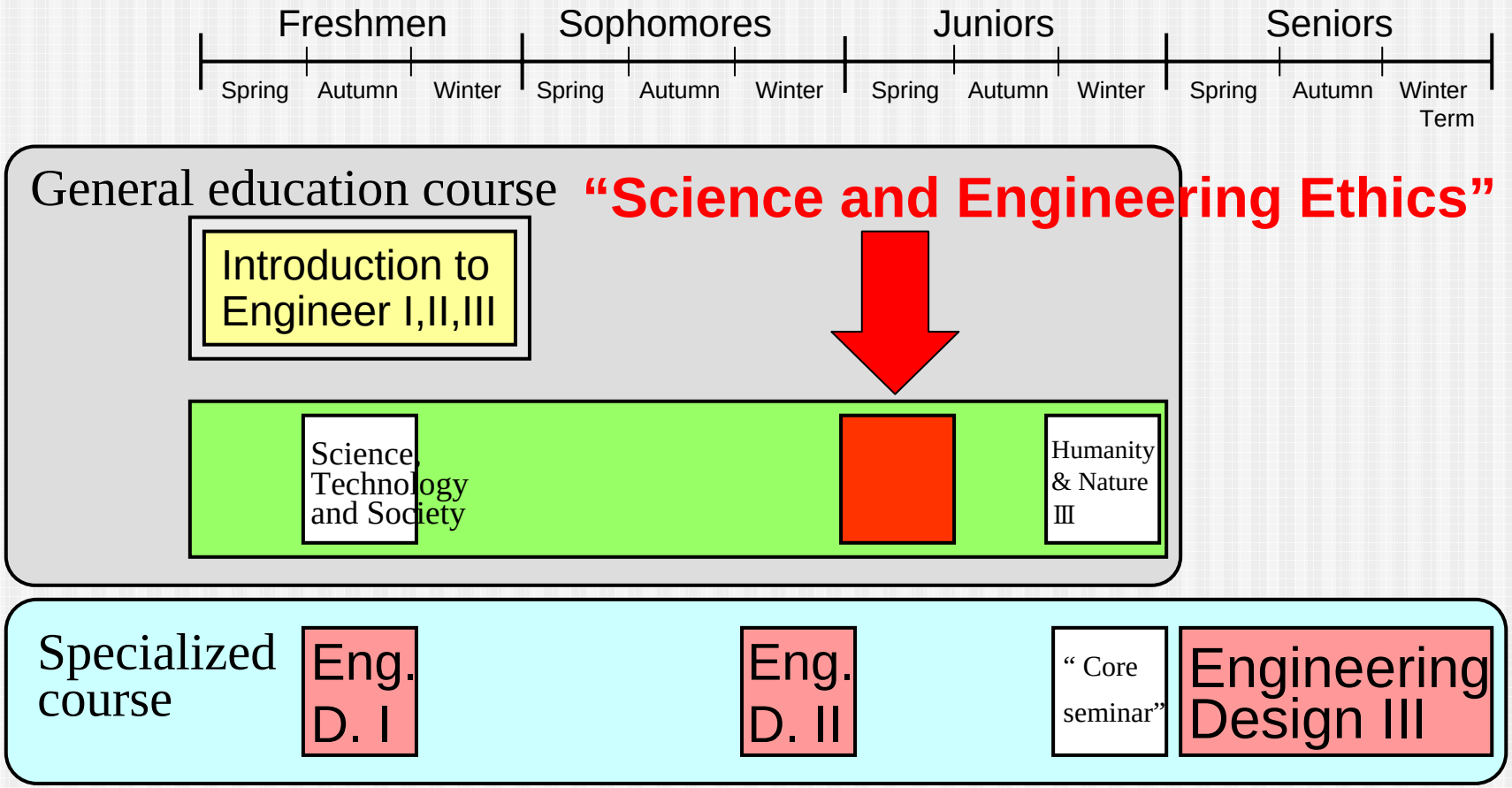
Introduction

- The realization of EAC, Ethics Across the Curriculum, at KIT
  - Capstone subject, “Science and Engineering Ethics”
  - General education subjects
  - Each specialized subject
- EAC Taskforce Committee
- EAC Workshop and “Micro-Insertion”

What's EAC?

- EAC：Ethics Across the Curriculum
  - Let students examine ethical elements at every possible opportunity through whole curriculum
- Benefits brought about to students by EAC
  - Understanding of the social and environmental impact of science and technology
  - Understanding of ethical and social responsibility as a professional

Ethics Across the Curriculum at KIT



Sequentially implemented since AY 2004. Limited to directly related subjects.

“Science and Engineering Ethics”

“Science and Engineering Ethics”

- Capstone subject of engineering ethics education at KIT
- Compulsory for juniors
  - 2 credit course
  - 60 min x 2 lectures/wk x 11 wks
  - 1,600 students (all juniors) by 5/6 instructors
  - Divided into 30 classes (50-70 students per class)
  - 10 classes per term = 2-3 classes per instructor
  - Employing case method

“Science and Engineering Ethics”

- Educational Goals
  - Understanding of the tremendous social and environmental impact of science and technology
  - Understanding of ethical and social responsibility as a professional
  - Improvement in the ability to solve an ethical problem that engineers may face with

Course contents

1	General Introduction
2	What's Value?
3	What's Ethics? What's Technology? What's Engineering Ethics?
4	Outline of Environmental Ethics, Bioethics and Information Ethics. Special Responsibility of Engineer.
5	What's Ethics Code?
6	Case Study 1 (Space Shuttle Challenger Accident)
7	The Method for making good judgment (Ethics Test, Seven-Step Guide etc.)

Course contents

8	Explanation of some cases (Ford's Pint, Hyatt Regency, Citicorp Tower, Honda's CVCC Engine, etc.)
9	Midterm Examination
10	"Science and Technology" and Risk
11	Research Ethics (Fabrication, Falsification, Plagiarism)
12	Group Discussion about Research Ethics
13	Laws, Engineering Ethics and Business Ethics
14	Case Study 2 ("Gilbane Gold")

Course contents

15	Case Study 2 (cont.), Group Discussion about Whistle-blowing
16	Business Ethics
17	Engineering Ethics and Transnational Enterprise
18	Add-up of this course
19	Final Examination
20	Checking the score

Textbook: Caroline Whitbeck (1998), *Ethics in Engineering Practice and Research*, England: Cambridge University Press.

“Science and Engineering Ethics”

- Examinations and Assignments
  - Midterm and final examinations
  - A quiz
  - A case study report
  - Reports on 3 times of group discussions
  - 7 assignments

“Science and Engineering Ethics”

- Cases with discussion
  - Space Shuttle Challenger Accident
    - Unstructured discussion
  - Research Ethics
  - “Gilbane Gold”
    - Structured discussion based on “Seven-Step Guide ”

EAC Task Force Committee

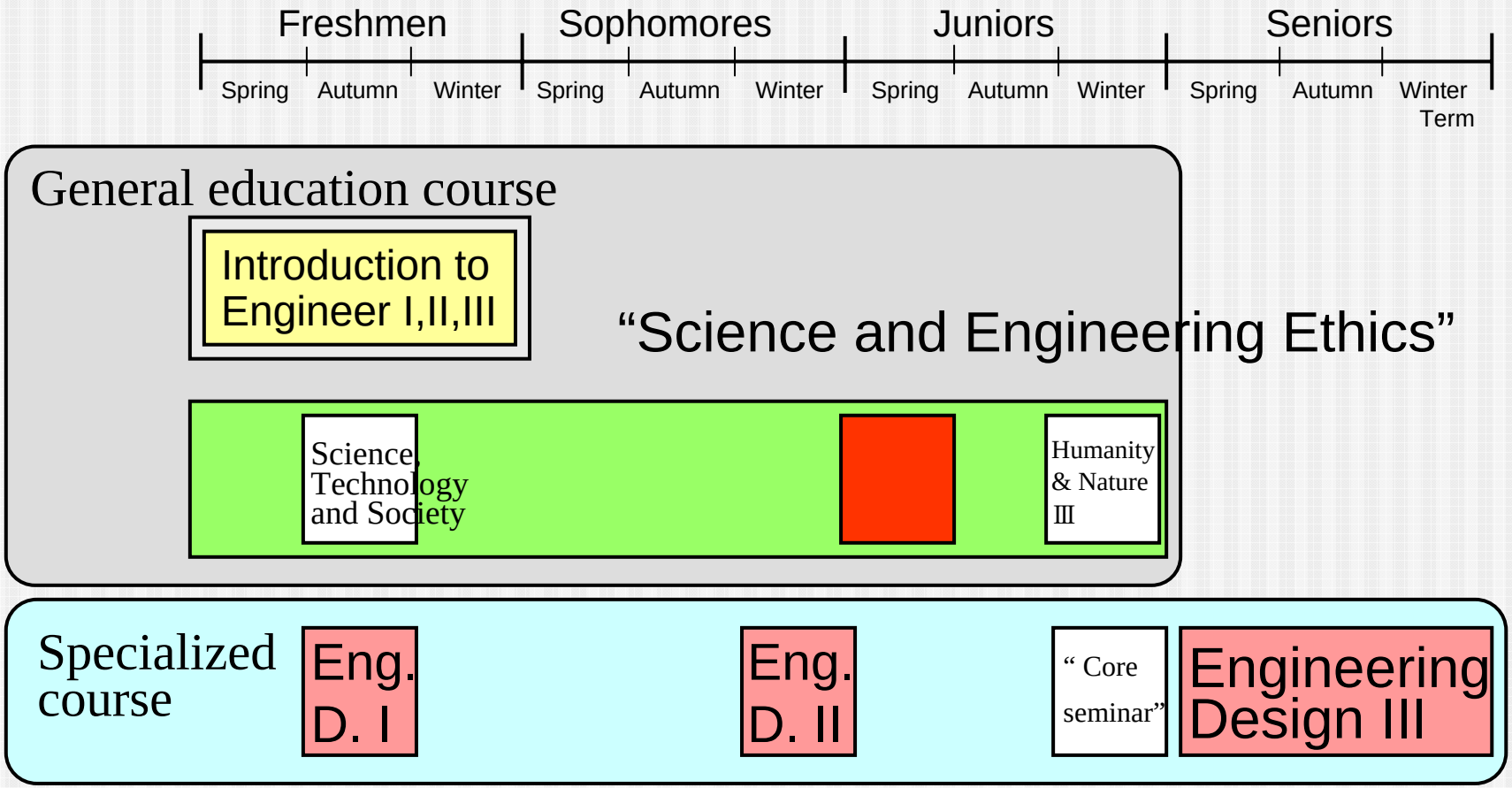
EAC Task Force Committee

- System
  - Session: Several times a year
  - Chairperson: Dean of academic affairs
  - Committee members: Selected from each department
- Missions
  - Provide engineering ethics information to the specialized subject instructors
  - Encourage the specialized subject instructors to provide the ethics subject instructors with cases in line with actual situations in their specialized field
  - Master the “Micro-Insertion” technique through participation to the EAC-Workshop

EAC Task Force Committee

- Future challenges
  - Strengthen linkage between specialized subjects and general education subjects.
    - “Engineering Design I, II & III”
    - “Introduction to Engineer I, II & III”
    - “Japanology (Japan and Japanese)”
  - Form working groups.
  - Solve difficulty in gaining understanding and cooperation from the specialized subject instructors.

Ethics Across the Curriculum at KIT



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EAC Workshop

EAC Workshop (Japanese version)

- Intended participants: Specialized subject instructors and ethics officers of entities
- Aims
  - Deepen understanding on science and engineering ethics.
  - Master the “Micro-Insertion” technique.
- Three Japanese-version EAC Workshops up to now
  - 1st Workshop（2005）
  - 2nd Workshop (2006）
  - 3rd Workshop（2007）

“Micro-Insertion”

“Micro-Insertion”

- A technique of incorporating ethical elements in quiz and assignments of normal specialized subjects
- The engineering ethics education in line with the actual situations of the specialized subjects can be given by the specialized subject instructors during their specialized subject course, with low burden.

Good example of Micro-Insertion

Created by Ph.D Yoshio Katakura,
Graduate School of Engineering, Osaka University

Q1. In the process of growing a microorganism in a liquid culture, the change in the cell concentration is given as $\frac{dX}{dt} = \mu X$, where X is cell concentration (cells·ml^{-1}) and μ is the specific growth rate (h^{-1}). Introduce the equation that gives the cell concentration at time t (h). Suppose that the initial cell concentration is X_0 (cells·ml^{-1}).

Q2. Table 1 shows the specific growth rates of a bacterium at various conditions. Calculate the cell concentration after 24, 48 and 72 h at 20°C and pH 5. Suppose that the initial cell concentration is 10^2 cells·ml^{-1}.

Q3 When the initial cell concentration is 10^2 cells·ml^{-1}, calculate the time required for the cells to propagate to the concentration of 10^8 cells·ml^{-1} at 35°C and pH 7.

Good example of Micro-Insertion

Created by Ph.D Yoshio Katakura,
Graduate School of Engineering, Osaka University

Q4. A microorganism can produce useful or toxic material (defined as a product) in the culture. The change in the product concentration is given as $\frac{dP}{dt} = \rho X$, where P is the product concentration ($g \cdot l^{-1}$) and ρ is the specific production rate ($g\text{-product} \cdot g\text{-cell}^{-1} \cdot h^{-1}$). Introduce the equation that gives the product concentration at time t (h). Suppose that the initial product concentration is P_0 ($g \cdot l^{-1}$).

Q5. The specific production rates of a product at various growth conditions are shown in Table 1(abbr.). When the microorganism is grown under a condition at 20°C and pH 7, and under a condition at 35°C and pH 5, compare the product concentrations after 12 h of incubation.

Good example of Micro-Insertion

Created by Ph.D Yoshio Katakura,
Graduate School of Engineering, Osaka University

Homework

You work for Y Corporation and are developing a new kind of soft drink. Your boss orders you to define the expiration date of the drink on a commercial basis. Assuming that:

the drink contains 10^2 cells·ml^{-1} of a bacterium which produces enterotoxin A.

the specific growth and production rates given in Table 1 (abbr.) can be applied for the bacterium.

the pH of the drink is 5.

Investigate the poisonous properties of enterotoxin A, and define the expiration date by yourself.

Good example of Micro-Insertion

Created by Ph.D Yoshio Katakura,
Graduate School of Engineering, Osaka University

Points for grading

Did the student investigate the poisonous properties (the amount of enterotoxin that develops poisoning)?

There are many reports about the toxicity and there are various values about the toxicity. If the student compares a number of the values and adopts the most safety value, add extra point.

Are the data obtained from reliable source(s)?

Is the source of the data described in her/his report?

How did the student assume the intake of the drink?

Did she/he consider unexpected intake, for example, drink 1 L at a time?

Did the student give consideration to weak people?

Babies and aged persons are more sensitive to the toxin.

Good example of Micro-Insertion

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Graduate School of Engineering, Osaka University

Points for grading（Cont.）

Did the student consider the temperature management at store and marketing distribution channel?

If the student defines the expiration date in summer and winter individually, add extra point.

If the student takes refrigeration into consideration, add extra point in the following cases:

The student considers the possibility that the drink is kept at room temperature by mistake.

The student defines expiration date based on the datum at 5°C as promises for the distribution at dependable stores such as manufacturer's retail store.

Add-up

Add-up

- The realization of EAC, Ethics Across the Curriculum at KIT
  - Capstone subject, “Science and Engineering Ethics”
    - Realized the engineering ethics education targeting at approximately 1,600 students
    - Introduced an educational approach utilizing the case method
    - Established the learning/educational objectives, educational materials (case examples, presentation/distribution materials, issues) and measurement/assessment methods that are structurally defined and that can easily be improved
    - In preparation for a drastic revision in the next fiscal year
  - General education subjects
  - Each specialized subject

Add-up

- EAC Taskforce Committee
- EAC-Workshop and “Micro-Insertion”

- Issues
  - We still have difficulty gaining understanding and cooperation from the specialized subject instructors.
  - We need to devise ways to realize a true sense of EAC.