Advanced Systems Engineering

General Engineer
Subjects Elective
2 credit

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1. Course Description

"System" means a whole set of interacting components. Ecological systems in natural world consist of interacting living creatures. Network-connected computer systems consist of computers communicating with each other. "Systems engineering" deals with investigation, analysis, planning, and operation of various systems.
This course consists of lectures in the classroom with exercises of practical problems, and laboratory works in the computer laboratory (CL).
Through this course, students are expected to acquire the knowledge and technical methods with respect to DP 1.

2. Course Objectives

In this course, students are expected to learn and understand the principles and important techniques of systems engineering. Lectures are given in such a way that even students without basic knowledge of systems engineering can understand the lectures.
The first objective is to learn and understand the basic knowledge and techniques of modelling-- how to express a system with mathematic equations and/or graphical diagrams, and to be able to make a model for a system of small size.
The second objective is to learn the concepts and techniques of computer simulation, and to be able to obtain system features and behaviors through simulations with various different settings or conditions.
The third objective is to learn and understand the concepts and techniques of system optimization, and to be able to optimize a well-defined system by running an optimization software.

3. Grading Policy

Grading policy is based on the results of exercise answers (50%) and reports on laboratory works (50%).

4. Textbook and Reference

Textbook
H. Tamura, et al.（田村 坦之, 他） Systems engineering（システム工学） Ohm publishing Co.（オーム社）, ISBN-13:978-4274131677
Reference
none

5. Requirements(Assignments)

Basic knowledge and understanding on mathematics is required, especially on differentials and integrals.
Students are required to spend at least 30 hours for preparation study, review, and reports to assignments and to laboratory works.

6. Note

As mentioned above, this course is intended to give lectures which are understandable to students without any knowledge beforehand in systems engineering. Students of various different technological fields are welcome to this course.
Systems engineering has become more important as economic developments and advancing technologies have more impact on natural environment and make artificial systems more complicated and influential.

7. Schedule

[1] Introduction to systems engineering
[2] Systems description—mathematical models 1: differential equation, transfer function
[3] Systems description—mathematical models 2: least squares method, multiple regression
[4] Laboratory work 1: multiple regression
[5] Systems description—graphical models: state transition, adjacency matrix
[6] Differential equation and simulation: Euler's method, Runge-Kutta method
[7] Laboratory work 2: simulation of differential equations
[8] Probability distribution 1: uniform/normal distribution, random number generation
[9] Probability distribution 2: Poison/exponential distribution
[10] Stochastic systems and simulation, queuing system
[11] Laboratory work 3: queuing system
[12] System optimization 1: linear programming (LP)
[13] System optimization 2: nonlinear programming (NLP)
[14] Laboratory work 4: linear and nonlinear programming
[15] Genetic algorithm, reviews and exercises