| Tsuyama College | Year | 2020 | Course Title | Mathematical Engineering |
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## Course Information

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| Course Code | 0157 | Course Category | Specialized / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Department of Integrated Science and Technology Communication and Informations System Program | Student Grade | 5th |
| Term | First Semester | Classes per Week | 2 |
| Textbook and/or Teaching Materials | Textbooks : Matsubara Ryota et al.,"Discrete Mathematics(Japanese)"(Ohmusha), Material on BlacBoard(LMS), Reference books : Seymour Lipschutz etal., "Schaum's outline of Theory and Problems of Discrete mathematics, 3rd Ed." (McGraw-Hill) , Ibaraki Toshihida, "Discrete Mathematics for Informatics(Japanese)"(Shokodo) | | |
| Instructor | KIKUCHI Yosuke | | |

## Course Objectives

Learning purposes :
The purposes of this course are understanding the basic notion of sets, functions, properties of integers, logic, graph theory, automata, and formal language as the theoretical basis of information engineering.

Course Objectives :
1. To understand the basic concept of a set and can execute operations of a set.
2. To be able to explain basic concept of a function.
3. To be able to explain basic concept of information theory.
4. To be able to explain basic concept of logical algebra and predicate logic.
5. To be able to explain basic concept of graph theory.
6. To be able to explain basic concept of automata and formal language.

## Rubric

| | Excellent | Good | Acceptable | Not acceptable |
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| Achievement 1 | The students understand basic concept of set, and can execute set operation and calculate cardinality of set using inclusion-exclusion | The students understand basic concept of set, and can execute set operation and calculate cardinality of set. | The students understand basic concept of set and can execute set operation. | The students do not understand basic concept of set, nor can execute set operation. |
| Achievement 2 | The students can explain correspondence and basic concept of function and prove some theorems using these concepts. | The students can explain correspondence and basic concept of function and prove bijection of set using these notion. | For given function, the students can judge whether the function is surjective or injective or neither. | For given function, the students cannot judge whether the function is surjective or injective or neither. |
| Achievement 3 | The students can explain basic notion of information theory and prove simple theorems. | The students can explain basic notion of information theory. | The students can explain entropy. | The students can not explain entropy. |
| Achievement 4 | The student can explain basic notion of logical algebra and predicate logic and use them daily life. | The student can explain basic notion of logical algebra and predicate logic. | The student can explain basic notion of logical algebra. | The student can not explain basic notion of logical algebra. |
| Achievement 5 | The student can explain basic notion of graph theory and prove simple theorem. They can also model problem on graph. | The student can explain basic notion of graph theory and prove simple theorem. | The student can explain basic notion of graph theory. | The student can not explain basic notion of graph theory. |
| Achievement 6 | The student can explain basic notion of automata and formal language and prove simple theorem. | The student can explain basic notion of automata and formal language and make state transition diagram. | The student can explain basic notion of automata and formal language. | The student can not explain basic notion of automata and formal language |

## Assigned Department Objectives

## Teaching Method

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| Outline | ※Relationship with practice: This course is provided by a teacher who worked at another institute (IMAI Quantum Computation and Information Project and Quantum Computation and Information Project Solution Oriented Research for Science and Technology. The purpose of this course is to use teacher's experience in understanding the basic idea of information theory as the basis of information engineering. This course is given in lecture format.<br><br>General or Specialized : Specialized<br>Required, Elective, etc. : Elective must complete subjects<br>Foundational academic disciplines : Integrated Disciplines/Informatics/Principles of Informatics<br>Field of learning : Infromation system・Programming・Network<br>Relationship with Educational Objectives :This class is equivalent to "(3) Acquire deep foundation knowledge of the major subject area".<br><br>MCC Goals(Based on the guidelie 4/28/2017 version, number in brackets is MCC level) : V-D-7 Information mathematics・Information theory/Discrete mathematics(4), Applied discrete mathematics(4), Information theory(4).<br><br>Relationship with JABEE programs :<br>The main goal of learning / education in this class are "A A-1" also "A-2" is involved.<br><br>Course outline :<br>This course provides understanding theoretical basis of information engeering, through leraningbasic mathematics concerned with information engineering. This course deal with discrete mathematics mainly. |

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| Style | Course method :<br>The class is held on the presupposition that all students will check the materials on Blackboard(LMS). The class occurs in a flipped classroom. The class is held mainly in English.<br><br>Grade evaluation method :<br>Exams (100%).<br>Examinations will be conducted a total of 2 times, and the evaluation ratios will be weighted. As a general, retaking exams can not performed. Bringing textbook and notebook at examination is not permitted but depending on the situation. Examinations are based on the rubric but there is no guarantee that the examinations cover achievements in rubric. |
| Notice | Precautions on the enrollment : English is used in classrooom mainly.<br><br>Course advice : Information concerned with classes will appear on Blackboard(LMS).<br><br>Foundational subjects : Mathematical Information(4th year)<br><br>Attendance advice : If you are late for the roll call, you will be treated as absent 1 period.<br>If you are 50 minutes late, you will be treated as 2 absence.<br>Most of the contents are basic and many exercises appear on textbook. All exercise may not solve in classroom from a temporal restriction. However almost exercises are basic, then the students can solve them by themselves. You can consult with BlackBoard(LMS). |

## Course Plan

| | | | Theme | Goals |
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| 1st Semester | 1st Quarter | 1st | Guidance | |
| | | 2nd | Set | The students understand basic notion of set, execute set operation. |
| | | 3rd | Logic and inference | The students judge proposition is whether true or false using truth table. The students can explain the basic notion of boolean algebra.The student can explain basic notion of logical algebra and predicate logic. |
| | | 4th | Relation | The student can prove the equivalence relation. The students can explain basic notion of correspondence or function between sets. |
| | | 5th | Function and algorithms | The student can explain the property of bijective function. The students can explain basic notion of correspondence or function between sets. |
| | | 6th | Information theory1 | The student can explain entropy and data compression. |
| | | 7th | Information theory2 | The student can explain encoding of communication channel. |
| | | 8th | 1st semester mid-term exam | |
| | 2nd Quarter | 9th | Return and commentary of exam answers | |
| | | 10th | Graph theory | The students can explain graphs. The students understand that knowledge of discrete mathematics can be used to design algorithms. |
| | | 11th | directed graphs | The students can explain difference of graphs and digraphs. The students understand that knowledge of discrete mathematics can be used to design algorithms. |
| | | 12th | binary trees | The students can explain an algorithm using binary trees. The students understand that knowledge of discrete mathematics can be used to design algorithms. |
| | | 13th | Formal language and automata | The students can pumping lemma. The students understand that knowledge of discrete mathematics can be used to design algorithms. |
| | | 14th | Turing machine | The students can draw state transition diagram. The students understand that knowledge of discrete mathematics can be used to design algorithms. |
| | | 15th | (1st semester final exam) | |
| | | 16th | Return and commentary of exam answers | |

## Evaluation Method and Weight (%)

| | Examination | Presentation | Mutual Evaluations between students | Behavior | Portfolio | Other | Total |
|---|---|---|---|---|---|---|---|
| Subtotal | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| Basic Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Specialized Proficiency | 100 | 0 | 0 | 0 | 0 | 0 | 100 |
| Cross Area Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |