# ÇANKAYA UNIVERSITY
# Faculty of Engineering and Architecture
## Course Definition Form

This form should be used for both a new elective or compulsory course being proposed and curricula development processes for an undergraduate curriculum at Çankaya University.

Please fill in the form completely and submit the printed copy containing the approval of the Department Chair to the Dean's Office, and mail its electronic copy to sercing@cankaya.edu.tr. Upon the arrival of *both copies*, the printed copy will be forwarded to the Faculty Academic Board for approval. Incomplete forms will be returned back to the Department. The approved form is finally sent to the President's office for Senate's approval.

### Part I. Basic Course Information

| | | | |
|---|---|---|---|
| Department Name *Use capital letters only* | INDUSTRIAL ENGINEERING | Dept. Numeric Code | 12 |
| Course Code (Dept. Code+Course No) | IE454 | Number of weekly lecture hours: 3 / Number of weekly lab/ tutorial hours: 0 / Number of Credit Hours: 3 | |
| Course Web Site *Use capital letters only* | HTTP://IE454.CANKAYA.EDU.TR/ | ECTS Credit | 05 |

**Course Name**
*This information will appear in the printed catalogs and on the web online catalog.*

English Name *maximum 40 characters*
AN INTRODUCTION TO COMBINATORIAL ANALYSIS

Abbreviated English Name *maximum 15 characters*
COMB. ANLYS.

Turkish Name *maximum 40 characters*
KOMBİNATORYEL ANALİZE GİRİŞ

Abbreviated Turkish Name *maximum 15 characters*
KOMBİN. ANALİZ

| | 1st | 2nd | 3rd | 4th |
|---|---|---|---|---|
| **Prerequisites** (if any) *Give course codes and check all that are applicable.* | | | | |
| **Co-requisites** (if any) | | | | |

[X] Consent of the Instructor
[ ] Senior Standing
[ ] Give others, if any.

**Course Type**
*Check all that are applicable*

[ ] Must course for Dept. [ ] Must course for other dept(s) [X] Elective course for Dept. [X] Elective course for other dept(s)

| Is the new course **replacing** a former course in the curriculum**?** | | | |
|---|---|---|---|
| Former Course's Code | Dept. Code+Course No | Former Course's Name | |
| Is there any similar course which has content **overlap** with other courses offered by the university**?** | | | ☐ Yes ☒ No |
| Most Similar Course | Dept. Code+Course No | Course Name | |

| **Frequency** of Offerings<br>*Check all semesters that the course is planned to be offered.* | ☒ Fall | ☒ Spring | ☐ Summer |
|---|---|---|---|

| **First** Offering | | | | | |
|---|---|---|---|---|---|
| Academic Year | 20 03 / 20 04 | Semester | ☒ Spring | ☐ Fall | |
| Maximum **Class Size** Proposed | 30 | Student **Quota** for Other Departments | 5 | Approximate **Number of Students** Expected to Take the Course | 25 |

## Part II. Detailed Course Information

**Justification for the proposal** *Maximum 80 words*

Combinatorial analysis problems are often faced with in operations research and management science. Besides, many practical problems exist in real life cases. Therefore, formulating and building related models has upmost attention. Industrial engineering students can have sufficient level of theoretical side of mathematical modeling and solution algorithms by the department's specific courses. Formulating and building combinatorial models require study real life cases, work on practical applications, use solver packages, etc., which are actually not covered by current department courses. This course is expected to fill this gap.

**Course Description**
*Provide a brief overview of what is covered during the semester. This information will appear in the printed catalogs and on the web online catalog. Maximum 60 words.*

The aim of this course is to develop better skills in understanding, formulating and building combinatorial models. Real life cases are studied. Software packages are used for solution and analysis of models.

**Course Objectives**
*Explain the aims of the course. Maximum 100 words.*

This course is designed to equip students understanding of discreteness of nature, and the related counting process in OR/IE/MS problems

**Learning Outcomes**
*Explain the learning outcomes of the course. Maximum 10 items.*

The student will

- be able to count properly
- have an understanding of combinatorial modeling in problem solving
- have skills in combinatorial analysis
- be able to solve basic combinatorial optimization problems

**Course Classification**
*Give the appropriate percentages for each category.*

| Category | Percentage |
|---|---|
| Mathematics & Natural Sciences | 75 |
| Engineering Sciences | 5 |
| Engineering & Architectural Design | 10 |
| Engineering & Architectural Technology | 10 |
| Architectural Sciences | 0 |
| Administrative Sciences | 0 |
| Humanities & Law | 0 |
| Arts | 0 |

**Course Outline**
*List the topics covered within each week.*

| Week | Topic(s) |
|---|---|
| 1 | Introduction: What is combinatorics? |
| 2 | Basic counting rules: The Sum Rule and The Product Rule |
| 3 | Basic counting rules: Pigeonhole Principle, Permutation, Combination |
| 4 | Basic counting rules: Occupancy Problems |
| 5 | Recurrence relations |
| 6 | Generating Functions |
| 7 | Introduction to Graph Theory |
| 8 | Searches |
| 9 | Optimization methods: Dynamic Programming |
| 10 | Famous problems: Eulerian and Hamiltonian Paths and Circuits |
| 11 | Famous problems: Chinese Postman and Street Sweeping Problems |
| 12 | Famous Problems and Heuristic techniques: Traveling Salesman Problem |
| 13 | Famous Problems and Heuristic techniques: Steiner Tree |
| 14 | Famous Problems and Heuristic techniques: Assembly Line Balancing |

**Textbook**(s)
*List the textbook(s), if any, and other related main course materials.*

| Author(s) | Title | Publisher | Publication Year | ISBN |
|---|---|---|---|---|
| | | | | |

**Reference Book**s
*List the reference books as supplementary materials, if any.*

| Author(s) | Title | Publisher | Publication Year | ISBN |
|---|---|---|---|---|
| Rosen, K.H. | Discrete Mathematics and Its Applications, 4th ed. | McGraw-Hill | 1999 | 0-07-289905-0 |

**Teaching Policy**
*Explain how you will organize the course (lectures, laboratories, tutorials, studio work, seminars, etc.)*

All contact with the students will be by lectures. Lecture notes to be uploaded.

**Laboratory/Studio Work**
*Give the number of laboratory/studio hours required per week, if any, to do supervised laboratory/studio work, and list the names of the laboratories/studios in which these sessions will be conducted.*

No weekly applications are required.

**Computer Usage**
*Briefly describe the computer usage and the hardware/software requirements in the course.*

No computer usage is necessary except MS excel.

**Grading Policy**
*List the assessment tools and their percentages that may give an idea about their relative importance to the end-of-semester grade.*

| Assessment Tool | Quantity | Percentage | Assessment Tool | Quantity | Percentage | Assessment Tool | Quantity | Percentage |
|---|---|---|---|---|---|---|---|---|
| Homework | 5 | 10 | Case Study | | | Attendance | | |
| Quiz | 5 | 25 | Lab Work | | | Field Study | | |
| Midterm Exam | 1 | 25 | Class Participation | | | | | |
| Term Paper | | | Oral Presentation | | | | | |
| Project | | | Final Exam | 1 | 40 | | | |

**ECTS Workload**
*List all the activities considered under the ECTS.*

| Activity | Quantity | Duration (hours) | Total Workload (hours) |
|---|---|---|---|
| Attending Lectures (*weekly basis*) | 14 | 3 | 42 |
| Attending Labs/Recitations (*weekly basis*) | | | |
| Preparation beforehand and finalizing of notes (*weekly basis*) | 2 | 14 | 28 |
| Collection and selection of relevant material (*once*) | 1 | 2 | 2 |
| Self study of relevant material (*weekly basis*) | 14 | 1 | 14 |
| Homework assignments | 5 | 4 | 10 |
| Preparation for Quizzes | 5 | 2 | 10 |
| Preparation for Midterm Exams (*including the duration of the exams*) | 1 | 10 | 10 |
| Preparation of Term Paper/Case Study Report (*including oral presentation*) | | | |
| Preparation of Term Project/Field Study Report (*including oral presentation*) | | | |
| Preparation for Final Exam (*including the duration of the exam*) | 1 | 10 | 10 |
| | | TOTAL WORKLOAD | 136 |
| | | TOTAL WORKLOAD / 30 | 4.57 |
| | | **ECTS Credit** | **5** |

**Program Qualifications vs. Course's Learning Outcomes**

*Consider the below program qualifications determined in terms of learning outcomes of all the courses in the curriculum and capabilities. Look at the learning outcomes of this course given above. Relate these two using the Likert Scale by marking with X in one of the five choices at the right..*

| No | Program Qualifications | Contribution | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| IE-01 | Adequate knowledge in mathematics, science and engineering subjects pertaining to Industrial Engineering; ability to use theoretical and applied information in these areas to model and solve Industrial Engineering problems. | | | | | X |
| IE-02 | Ability to identify and define complex Industrial Engineering problems involving human, material, machinery, money, information, time and energy elements; ability to select and apply proper analysis tools and operations research methods and modeling techniques for formulating and solving such problems. | | | | | X |
| IE-03 | Ability to analyze a complex system and/or a subsystem or a process involving human, material, machinery, money, information, time and energy elements and ability to design it under realistic constraints and conditions, in such a way as to meet the desired improvement; ability to apply modern systems design methods for this purpose. | | | X | | |
| IE-04 | Ability to devise, select, and use modern techniques and computing tools needed for Industrial Engineering practice of integrated systems; ability to employ and make use of information technologies effectively with the knowledge of state-of-the art hardware but mostly software capabilities related to Industrial Engineering. | | | X | | |
| IE-05 | Ability to design and conduct experiments, gather data, analyze and interpret results for investigating industrial engineering problems in general and for integrated systems analysis, design, implementation and continuous improvement from Industrial Engineering perspective in particular. | X | | | | |
| IE-06 | Ability to search data bases and other information sources efficiently; ability to identify and extract effectively the required information and knowledge from literature and other sources. | | X | | | |
| IE-07 | Ability to work efficiently in teams; ability to collaborate effectively in intra-disciplinary and multidisciplinary teams; ability to take responsibility within teams. | X | | | | |
| IE-08 | Ability to work individually, to take independent initiatives, and to create original inferences. | | | | X | |
| IE-09 | Ability to communicate effectively in Turkish, both orally and in writing. | X | | | | |
| IE-10 | Knowledge of a minimum of one foreign (English in particular) at a fluency level enough to follow easily Industrial Engineering knowledge presented in that language and enough to communicate effectively with collogues. | | X | | | |
| IE-11 | Ability to report the findings, conclusions and interpretations related to a project work, ability to write technical reports, to prepare and conduct effective presentations. | | X | | | |
| IE-12 | Ability to identify self learning needs; ability to access information, to follow developments in science and technology, and to keep continuously self improved. | | | X | | |
| IE-13 | Awareness of professional and ethical responsibility issues and their legal consequences; ability to address potential social responsibility activities and apply them. | X | | | | |
| IE-14 | Capability to grasp business life practices such as project management, risk management, change management and strategic management; awareness of international standards, policies, rules and regulations, and practices. | | | X | | |
| IE-15 | Awareness of environmental issues, occupational safety and health, and their legal consequences; ability to identify contemporary issues and the global and social effects of engineering practices; awareness of the legal consequences of engineering solutions. | X | | | | |
| IE-16 | Awareness of entrepreneurship, innovation, and sustainable development. | X | | | | |

Contribution Scale to a Qualification: **0**-None, **1**-Little, **2**-Medium, **3**-Considerable, **4**-Largest

**Other** Relevant Information

## Part III. Approval Process

| Names of other **faculty** members who may be interested in **teaching** this course<br>*Give the Academic Title first.* | | **Proposed by** | Faculty Member<br>*Give the Academic Title first.* | Signature |
|---|---|---|---|---|
| All faculty with IE/OR background | | | Prof. Dr. Levent Kandiller | |
| | | | Inst. Benhür Satır | |
| Date | 28.01.2010 | | Prof. Dr. Ümit Yüceer | |

| | | | | | |
|---|---|---|---|---|---|
| Departmental Board Meeting Date | | Meeting Number | | Decision Number | |
| Department Chair | Prof. Dr. Levent Kandiller | Signature | | Date | |

| | | | | | |
|---|---|---|---|---|---|
| Faculty Academic Board Meeting Date | | Meeting Number | | Decision Number | |
| Dean | Prof. Dr. Levent Kandiller | Signature | | Date | |

| | | | | | |
|---|---|---|---|---|---|
| Senate Meeting Date | | Meeting Number | | Decision Number | |