

Industrial Engineering

Academic Programme (Course Structure)

Course Name	Course Code	Year	Semester	Hour (T+U)	Local Credit	ECTS Credit
Multiple Criteria Decision Making	IE 404	-	-	3 + 0	3	5

Course Information

Language of Instruction:	English
Level of Course Unit:	Bachelor's Degree
Type of Course Unit:	Elective
Mode of Delivery:	Face to Face

Learning Outcomes of Course:

- Ability to identify decision making problems with multiple criteria
- An understanding of utility theory
- Ability to formulate and resolve multi-attribute decision making problems under certainty and uncertainty
- Practice and skills to use computer tools to solve decision making problems.
- Involved in team work
- Aware of ethical issues

Prerequisites and/or co-requisites of the course:-

Recommended optional programme components:-

Course Definition:

This course is designed to cover quantitative decision analysis. The course is mainly divided into three parts, general introduction to decision analysis, multicriteria decision analysis, and multi-objective optimization. In the first part, how people make decisions and decision-making traps are covered. The merits of a structured rational decision-making process are emphasized. In the second part, the structuring of decision elements (values, objectives, alternatives, measures, tradeoffs, and uncertainty), multi-attribute utility theory (MAUT) and analytic hierarchy process (AHP) for decision under certainty, and decision trees for decisions under uncertainty are introduced. Value-added risk management is also discussed. Finally, in the third part, optimization and goal programming are discussed.

Use of Generative Artificial Intelligence:

No

Weekly Course Content

#	Subject
1	Variety of decision-making situations. Historical relevance to Operations Research. Sample cases.
2	Background and formal definitions of decision making. Multiple and contradicting objectives. Decision trees. Overview of problems under certainty and uncertainty.
3	Defining objectives and sub-objectives. Comprehensive and measurable attributes. Domination and efficient frontier solutions.
4	Single objective approach to multiple objective problems. Trade-off, weighted average functions, satisficing.
5	Goal programming approach for problems under certainty.
6	The Analytical Hierarchy Process for problems under certainty.
7	Extensions of the Analytical Hierarchy Process.
8	Problems under uncertainty. The Expected Monetary Value approach to multiple objective decision making. Utility Theory. Utility functions for single-attribute problems. Assessment of utility functions. Risk aversion.
9	Problems under uncertainty and the Utility Theory. Utility functions for single-attribute problems. Assessment of utility functions. Risk aversion.
10	Utility functions for single-attribute problems. Assessment of utility functions. Risk aversion.
11	Multi-attribute problems under uncertainty and utility independence.
12	Assessment of multi-attribute utility functions. Examples with hierarchical attributes.
13	Overview of applications of decision making.
14	Advanced topics in decision making.

Required Reading:

W.L. Winston, Operations Research: Applications and Algorithms (4th ed.), Thomson-Brooks/Cole, 2004. H. Raiffa, Decision Analysis: Introductory Lectures on Choices under Uncertainty, Addison-Wesley, 1968.

Recommended Reading:

R.L. Keeney and H. Raiffa, Decisions with Multiple Objectives: Preferences and Value Tradeoffs, Cambridge University Press, 1993. R.L. Keeney, Value Focused Thinking: A Path to Creative Decision Making, Harvard University Press, 1996.

Planned Learning Activities and Teaching Methods:

Each week, 3 hours of lecturing

Assesment Methods and Criteria:

Type of Assessment	Number of Assessment	Contribution (%)
Midterm Exam	1	%30
Final Exam	1	%40
Homework	2	%15
Project	1	%15

Does the course require workplacement(s)?

Do not Require

Course ECTS Work Load:

#	Activity	Quantity	Duration (Hour)	Work Load
1	Attending Lectures (weekly basis)	14	3	42
2	Attending Labs/Recitations (weekly basis)	0	0	0
3	Preparation beforehand and finalizing of notes (weekly basis)	14	0.5	7
4	Collection and selection of relevant material (once)	0	0	0
5	Self study of relevant material (weekly basis)	14	3	42
6	Homework assignments	2	3	6
7	Preparation for Quizzes	0	0	0
8	Preparation for Midterm Exams (including the duration of the exams)	1	9	9

#	Activity	Quantity	Duration (Hour)	Work Load
9	Preparation of Term Paper/Case Study Report (including oral presentation)	0	0	0
10	Preparation of Term Project/Field Study Report (including oral presentation)	1	8	8
11	Preparation for Final Exam (including the duration of the exam)	1	12	12

Program Qualifications vs. Learning Outcomes

#	Program Qualification	Contribution Level (0-4)
1	Knowledge of mathematics, science, basic engineering, computer computing and subjects specific to the Industrial Engineering discipline.	4
2	Ability to use this information in solving complex Industrial Engineering problems.	4
3	Ability to define complex Industrial Engineering problems involving components such as human, material, machine, money, information, time, technology and energy, using basic science, mathematics and engineering knowledge and taking into account the UN Sustainable Development Goals related to the problem addressed, and to formulate and analyze using appropriate operations research methods and modeling techniques.	4
4	Ability to design creative solutions to complex Industrial Engineering problems involving components such as people, materials, machines, money, information, time, technology and energy.	1
5	Ability to design a complex system and/or sub-system or process to meet current and future requirements, taking into account realistic constraints and conditions.	1
6	Ability to select and use Industrial Engineering-related software tools and appropriate techniques, resources, modern engineering and informatics tools, while being aware of their limitations, for the analysis and solution of complex engineering problems encountered in Industrial Engineering applications, including estimation and modeling.	1
7	Ability to use research methods to examine complex Industrial	0

#	Program Qualification	Contribution Level (0-4)
	Engineering problems, including researching literature, designing experiments, conducting experiments, collecting data, analyzing and interpreting results.	
8	Knowledge about the effects of engineering practices on society, health and safety, economy, sustainability and environment within the scope of the UN Sustainable Development Goals.	0
9	Awareness of the legal consequences of engineering solutions.	0
10	Knowledge on behavior in accordance with engineering professional principles and ethical responsibility.	2
11	Awareness of acting impartially, without discrimination on any issue, and being inclusive of diversity.	2
12	Ability to work effectively individually and as a team member or leader in intradisciplinary and multidisciplinary teams (face-to-face, remote or hybrid).	1
13	Ability to communicate effectively verbally and in writing on technical issues, taking into account the various differences of the target audience (such as education, language, profession).	1
14	Ability to use visual tools such as technical drawings and flow diagrams.	1
15	Knowledge of business practices such as project management and economic feasibility analysis.	0
16	Awareness about entrepreneurship and innovation.	0
17	Lifelong learning ability that includes being able to learn independently and continuously, adapting to new and developing technologies, and thinking inquisitively about technological changes.	0