

The Second Summer School and The First National Conference of the Industrial Engineering Department

"Empowering Students in Research and Business Skills"

**Executive Secretary: Dr. Roya Soltani**

**Scientific Secretary: Dr. Neda Mawanizadeh**



Participants in each of the modules or courses will be awarded a certificate of attendance and completion of the course by Khatam University

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**Introduction**

In order to empower students to carry out scientific and applied research and master's theses, the department of Industrial Engineering of Khatam University organizes practical courses along with related software training in the form of a summer school in August and September 2023, which has also been registered in the Islamic World Science Citation Database (ISC) as a national conference.

**Objectives of the conference**

* Improving the quality of research and theses;
* Increasing students' skills in conducting scientific and business research;
* Increasing students' skills in using tools, methods and software required for research;
* Introduction of related research and business fields by the professors of the course.

**Conference benefits**

* Having mentoring services (students receiving a guide or scientific support during the course);
* Exchanging experience with renowned professors in the fields of research and business;
* Providing a certificate of successful completion of the course subject to attendance in all classes at Khatam University;
* As students are busy, most of the classes are scheduled from 14:00 onwards;
* The mode of the course is virtual in the LMS system of Khatam University.

**Mathematical modeling and programming**

One of the specialties of industrial engineers is analyzing systems and making appropriate decisions to improve or optimize systems. Since real problems are complex and many controllable and uncontrollable factors affect them, they are modeled under a series of assumptions. In this course, the structure of a mathematical model is introduced and a number of widely used industrial engineering problems are modeled and coded in GAMS software. Additionally, single-objective and multi-objective methods of mathematical programming are taught.

**Table of contents**

* Mathematical modeling (modeling of various applied problems in industrial engineering);
* Mathematical programming (linear programming, integer programming, non-linear programming, etc.) in GAMS software;
* Linearization methods of non-linear models;
* Lagrange release method;
* Multi-objective programming in GAMS software (ideal programming, comprehensive criterion method, epsilon limit method, performance measurement methods of multi-objective algorithms).

**Instructors of the course: Dr. Roya Soltani (a faculty member of the university) and Dr. Saeed Alaei (a faculty member of the university)**

**Course duration: 20 hours**

**Single-objective and multi-objective meta-heuristic methods along with coding in MATLAB**

Many of the problems raised in industrial engineering are NP-Hard, which means that with the increase in the dimensions of the problem, the time to obtain a definitive answer increases exponentially. Therefore, on a large scale, these problems cannot be solved with exact methods and it is necessary to use innovative or meta-heuristic methods to solve the problems. In this course, single-objective and multi-objective meta-heuristic methods are introduced to solve practical industrial engineering problems, and different ways to code and implement them in MATLAB software is taught afterwards.

**The instructor of the course: Dr. Shahla Paslar (a faculty member of the university)**

**Course duration: 20 hours**

**Table of contents**

* Optimization problems and their types;
* Methods of solving optimization problems;
* The main concepts of meta-heuristic algorithms;
* Classification of meta-heuristic algorithms;
* Introduction of genetic algorithm;
* Practical implementation of genetic algorithm in MATLAB;
* Introduction of hybrid meta-heuristic algorithms;
* Practical implementation of a sample hybrid meta-heuristic algorithm in MATLAB;
* Introduction of NSGAII algorithm;
* Practical implementation of NSGAII algorithm in MATLAB.

**Non-deterministic programming along with coding in GAMS**

This course provides an introduction to the principles of stochastic programming and nondeterministic optimization. First, we will start with a short introduction to optimization and stochastic programming. Then, we will explore different types of uncertainty in optimization problems and recursive function and multiperiod stochastic programming. The L-Shaped method for stochastic two-stage problems, Benders Decomposition and its formulation, Chance Constrained and Robust Optimization will be discussed as well.

In addition to the mentioned topics, you will learn the utilization of these tools. This course emphasizes on both the basics and the applications, and helps students have the necessary tools to formulate and solve stochastic optimization problems under conditions of uncertainty. Besides, during the course, GAMS software and its CPLEX solution tool will be discussed, so that students learn how to code mathematical models in non-deterministic programming.

**Table of contents**

*Week 1 (Introduction to Uncertainty and Stochastic Planning)*

• An introduction to uncertainty and its effect on optimization;

• Definitions and concepts in stochastic programming;

• An overview of stochastic programming models;

• Basic familiarity with GAMS.

*Week 2 (one-stage random programming)*

• Formulation of one-step stochastic programming problems;

• Approaches to solving one-step stochastic programming problems;

• One-step stochastic programming applications;

• Working with GAMS and solving an example in a one-step stochastic program.

*Week 3 (two-stage randomized planning)*

• Formulation of two-stage stochastic programming problems;

• Recourse function and its role in two-stage stochastic programming;

• Approaches to solving two-stage stochastic programming problems;

• Two-stage stochastic programming applications;

• Working with GAMS and solving an example in a two-stage stochastic program.

*Week 4 (multistage random programming and L-Shaped method)*

• Formulations and approaches to solve multistage stochastic programming problems;

• Introducing the method and its implementation;

• Applications of multi-stage stochastic programming and L-Shaped method;

• Working with GAMS and solving an example in a multistage stochastic program.

*Week 5 (steady optimization)*

• An introduction to robust optimization and its comparison with random programming;

• Formulation of robust optimization problems;

• Robust optimization problem solving approaches;

• Working with GAMS and solving an example in robust optimization.

**The instructor of the course: Dr. Hossein Karimi (a faculty member of the university)**

**Course duration: 15 hours**

**Game theory**

When the result of choosing and making a decision is not clear or when in a game, the results of the opponent's game are not known in advance, the use of game theory and decision rules can be considered as a tool to achieve a suitable strategy. Meanwhile, the use of mathematical models and optimization and the theory of statistics and probability will be the basis for making the right decisions. In this course, important game theory models will be presented along with practical examples in industrial engineering.

**Table of contents**

* The theory of games and its concepts and its differences with decision making;
* Types of games and their classification;
* Static games with complete discrete and continuous information;
* Two-player games;
* Popular games and static game applications with complete information in the real world;
* Zero sum games;
* Specific and mixed equilibrium points;
* Sequential games with perfect information;
* Applications of sequential games in the real world;
* Games with complete and incomplete information;
* Games with incomplete information;
* Bargaining;

**The instructor of the course: Dr. Maryam Esmaeili (a faculty member of the university)**

**Course duration: 12 hours**

* Repetitive games;
* Evolutionary games.

**Data Envelopment Analysis (DEA) and its applications**

Data envelopment analysis (DEA) is a linear programming technique whose main purpose is to compare and evaluate the efficiency of a number of similar decision-making units that have different consumption inputs and production outputs. DEA models utilized to evaluate the efficiency of the unit under review can use two separate approaches: 1) reducing the number of inputs without changing the number of outputs (input-oriented approach) 2) increasing the number of outputs without changing the number of inputs (output-oriented approach). In this course, the main data envelopment analysis models are introduced along with their application in industrial engineering problems.

**Table of contents**

* Data covering analysis;
* An introduction to performance evaluation;
* Economic basics of data coverage analysis;
* Basic (radial) models of data coverage analysis;
* Basic (non-radial) models of data envelopment analysis;
* Interpretation of results;
* Network models of data envelopment analysis;
* Dynamic models (multi-period);
* Uncertainty in data coverage analysis;
* Familiarity with commercial data analysis software.

**The instructor of the course: Dr. Seyyed Hossein Razavi (a faculty member of the university)**

**Course duration: 15 hours**

**Dynamics system with VENSIM**

System Dynamics is a modeling and simulation tool used to analyze and predict the behavior of complex systems. This tool can be used in various fields including management, economics, social sciences, environment and health. By using the dynamics system, it is possible to get a better understanding of the effective factors in a system and their effect on the evolution process of that system. Moreover, this tool can be used to design and optimize different solutions in facing different problems and challenges. The purpose of the system dynamics course is to familiarize students, experts and managers with the concept of system thinking and system dynamics, its modeling approaches and its implementation.

**Table of contents**

* Familiarity with the concept of systemic thinking;
* System modeling and simulation based on Sterman's approach;
* System diagrams and how to draw them;
* Types of common behaviors in systems;
* Familiarity with Dynamics system software;
* Solving an example in the software;
* Sensitivity analysis of dynamics system models;
* Checking the validity of the dynamics system models.

**The instructor of the course: Dr. Mojtaba Hajian (a faculty member of the university)**

**Course duration: 16 hours**

**Simulation with ARENA**

ARENA is a simulation software used to model and analyze complex systems and business processes. By using ARENA, it is possible to get a better understanding of the effective factors in a system and their impact on the evolution process of that system. Besides, this tool can be used to design and optimize business processes, improve performance and reduce costs. ARENA can be used in various industries such as production, services, transportation, finance, and health. The purpose of this course is to familiarize students, experts and managers with the concept of simulation, its modeling approaches and its implementation. The major part of the class is to solve various examples in the software.

**Table of contents**

* Familiarity with the concept of simulation and its components;
* Monte Carlo method;
* The concept of simulation modeling and its application in various examples;
* Simulation diagrams;
* Computer simulation methods;
* Familiarity with simulation software;
* Solving various examples in the software;
* Simulation generalizations including simulation optimization;
* Checking the validity of simulation models.

**The instructor of the course: Dr. Mojtaba Hajian (a faculty member of the university)**

**Course duration: 20 hours**

**Statistical analysis with Minitab software**

In order to analyze the results obtained from scientific research, it is very useful to use a variety of statistical analysis tests to measure the level of confidence for conclusions and inferences. In this course, we try to teach the required analysis of the results presented in the fourth chapter of theses along with the Minitab software.

**Table of contents**

* Introduction to Minitab software (Introduction of modules, types of data, introduction of some commonly used statistical charts);
* Parametric tests (An introduction on how to perform statistical tests and distance estimations, tests related to averages/variance of a population, tests related to the difference of averages/ratio of variances of two populations, tests related to ratios);
* Other tests of applied assumptions (A reference to some probability distributions and fit tests, outlier data identification tests, normality tests);
* Analysis of variance and design of experiments (Introduction of variance analysis and the study of variance analysis table, one-way and two-way variance analysis);
* Regression (Introduction of the concepts of correlation and linear regression, obtaining correlation between two or more variables, calculating regression parameters, analyzing linear regression, checking regression assumptions, drawing the residual graph and analyzing it, multiple linear regression);
* A reference to some non-parametric tests (Wilcoxon test, sign test, Mann-Whitney test, Kruskal-Wallis test, etc.)

**The instructor of the course: Dr. Paria Soleimani (a faculty member of the university)**

**Course duration: 16 hours**

**Data mining with WEKA software**

In this course, an attempt will be made to explain statistical learning approaches such as: Supervised and Unsupervised Learning. Afterwards, the statistical foundations of conventional classification methods such as parametric and non-parametric algorithms will be discussed. Next, students will get acquainted with the WEKA software environment and will try to use the applied data set. The learned classification algorithms will be implemented and analyzed in the software environment. WEKA software can be considered an advanced data mining tool. This software includes a set of visualization tools, data analysis methods and prediction models and machine learning algorithms that are gathered in a graphical interface so that the user has the best way to execute commands.

**Table of contents**

* Familiarity with the concept of statistical learning;
* Getting to know the concepts of predictor, classifier, and classification (Prediction, Classifier, Classification);
* Estimation strategies;
* Familiarity with some parametric classification methods (Parametric Classification Methods);
* Familiarity with Weka software;
* Data preparation including filters, missing data, feature selection and etc.;
* Implementation of parametric methods described in the software;
* Familiarity with some non-parametric classification methods (Non-Parametric Classification Methods);
* Implementation of non-parametric methods described in the software;
* Description of performance evaluation indicators in classification methods.

**The instructor of the course: Dr. Ahmad Ebrahimi (a faculty member of the university)**

**Course duration: 16 hours**

**Project-oriented machine learning with Python**

Today, machine learning is used in many fields, including process optimization, financial fields, social network analysis, etc. In this course, students try to familiarize themselves with the basic concepts of data and examine the applications of machine learning in different fields. Different algorithms are introduced and coding of all cases is taught in Python. During the semester, each student will carry out a complete machine learning project in Python and will face the challenges of this field in a practical way.

**The instructor of the course: Mohammadreza Ghaderi, M.Eng (M.Eng in Industrial Engineering, Tarbiat Modarres)**

**Course duration: 20 hours**

**Table of contents**

* General data analysis;
* Python and data analysis tools;
* Prerequisite libraries;
* Data analysis and discovery (EDA) and visualization + practice;
* Examining exercises and solving problems;
* Data preprocessing and preparation;
* Classification algorithms + training;
* Important concepts in data analysis;
* Performance evaluation criteria;
* Other classification algorithms;
* Project presentation by volunteer students;
* Clustering;
* Dimension reduction and feature selection + practice;
* Association rules;
* Investigation of intelligent machine learning (Automated Machine Learning).

**Basics of machine learning and data analysis**

Machine learning is one of the branches of artificial intelligence, which uses algorithms and statistical models and allows the computer to learn from data. In this process, the machine extracts patterns and rules from data that are not easily recognizable by humans. This can help people in forecasting and making decisions. In today's world, data has become very important and is being collected and stored at every moment. Machine learning makes it possible to discover useful patterns automatically and at high speed.

The current course deals with teaching data analysis with supervised and unsupervised approaches based on conventional methods used in machine learning.

**Table of contents**

* Basics of machine learning;
* Problem recognition and data recognition;
* Evaluation and improvement of data quality and data mining;
* Familiarity with supervised learning models, assessment criteria for supervised models;
* Familiarity with unsupervised learning models and their evaluation;
* Being involved with a real project from zero to hundred.

**The instructor of the course: Dr. Toktam Khatibi (A faculty member of the university)**

**Course duration: 20 hours**

**Financial intelligence and ways to earn from financial markets (digital currency, metaverse, NFT)**

Financial IQ is a person's ability to solve their and others' financial problems. The more financially intelligent you are, the easier it is to earn more and live with fewer financial problems. By increasing your financial intelligence and knowing different financial markets, you can identify investment opportunities and ways to preserve the value of money and increase wealth, especially in the country's inflationary conditions.

**The instructor of the course: Dr. Eydan Torkzadeh (A university instructor & investment consultant)**

**Course duration: 20 hours**

**Table of contents**

* What is financial intelligence;
* The relationship between financial intelligence and getting rich;
* How to increase your financial intelligence;
* Familiarity with financial markets;
* Digital currency;
* What is Web 3.0;
* Familiarity with blockchain technology;
* Familiarity with digital currency and tokens of the digital currency market;
* How to enter the digital currency market and identify investment opportunities;
* Familiarity with Metaverse;
* Identification of opportunities in the field of metaverse;
* Introduction of Metaverse projects;
* Familiarity with Metaverse and NFT sites;
* How to make and trade NFTs.

**New ideas for start-ups**

The importance of entrepreneurship and education in starting a business for economic development and creating jobs in human societies shows the vital role of this element in growth and progress. Entrepreneurship not only acts as a main engine for initiative and innovation in the economic structure, but also provides possibilities for creating job opportunities. Training in the field of entrepreneurship is necessary to increase the power of creativity, business skills and the information necessary for the development and management of start-up businesses. This training allows people to implement their ideas and turn innovative plans into independent businesses by encouraging and nurturing an entrepreneurial mindset. Therefore, focusing on entrepreneurship education and creating supportive environments for new entrepreneurs, including students and young people, can lead to creating favorable conditions for economic growth and development in communities.

**Table of contents**

* Principles of finding new ideas for businesses;
* Business canvas design;
* Examining the experiences of successful entrepreneurs.

**The instructor of the course: Dr. Alireza Goli (A faculty member of the university)**

**Course duration: 9 hours**

**Elaboration and basics of Business Plans**

A business plan is a written, descriptive and comprehensive document about the business of an institution that describes the implementation method of the desired idea from the beginning to the end and provides a comprehensive and documented study to evaluate the business plan. This plan contains a detailed report about the company's products or services, production methods, market and customers, marketing strategies, human resources, organizations, the need for infrastructure and financing needs, financing resources and ways of utilizing them. To summarize, the plan for managing and implementing a new economic opportunity is called a business plan. Most of the people who intend to start a business always emphasize that: "The product or service offered by us is offered for the first time" or "The quality of my product and service presentation is better than the similar works". However, before any action, the validity of these claims must be measured and evaluated in reliable and scientific ways. One of these widely used and valid methods and guidelines for evaluating the feasibility of a business is writing a business plan. Therefore, the aim of this course is to familiarize scholars with the concept and components of various types of business plan and create the necessary ability to write this plan as accurately as possible. On the other hand, the detailed writing of this plan can help entrepreneurs who seek to finance the plan and get the support of their partners, venture capitalists, financial institutions, etc. and show the goals and prospects of the desired acquisition and provide useful help in attracting their support.

**Table of contents**

* Getting to know the business plan;
* Introduction and types of business plans;
* Difference between business model and technical plan - justification with business plan;
* Favorite plans of all kinds of investors;
* Structure of a standard business plan;
* Introduction page;
* Management summary;
* Review of the industry;
* Business description;
* Production schedule;
* Marketing plan;
* Organizational structure and operational plan;
* Risk assessment;
* Financial plan;
* Appendices of the plan;
* Other proposals and explanations related to the business plan;
* One page business plan components;
* Vision;

**The instructor of the course: Dr. Amirreza Keighobadi (A faculty member of the university)**

**Course duration: 16 hours**

* Mission;
* Objectives;
* Strategies;
* Action Plans;
* Various ways of presenting business plans;
* Dos and don'ts in developing a business plan;
* Misconceptions and essential points in developing a business plan;
* Examples and practice of writing each component of the business plan.

**Reference management with Endnote**

EndNote reference management software is a powerful tool for managing references in scientific research. This software helps researchers, students, and authors easily manage their references, update their references, and use their resources simply and quickly.

**Table of contents**

* Citation methods in research;
* Creating a library and categorizing articles;
* Getting to know how to insert references in the text and at the end of the article;
* Getting to know how to manually and automatically enter articles into separate libraries;
* The possibility of searching articles from different databases.

**The instructor of the course: Mahnaz Shabani (A PhD candidate of Industrial Engineering, Alzahra University)**

**Course duration: 6 hours**

**Weekly Plans**

|  |  |  |
| --- | --- | --- |
| Day/Time | 14-17 | 17-20 |
| Saturday | Metaheuristic methods with MATLAB(20 hours) | Game theory(From 17:00 to 19:00)(12 hours) | Financial intelligence and ways to make money from financial markets (first group)(From 19:00 to 21:00) |
| Sunday | Project-oriented machine learning with Python (20 hours)(First session of the week from 14:00 to 15:30) | Reference management with Endnote(6 hours)(From 15:30 to 17) | Data covering analysis(15 hours)(From 17:00 to 19:00) | Financial intelligence and ways to earn money from financial markets (second group)(From 19:00 to 21:00) |
| Monday | Statistical analysis with MINITAB(14:00 to 16:00)(16 hours) | Data mining with WEKA(16:00 to 18:00)(16 hours) | Compilation of business plans and basics of business plans(18:00 to 20:00) |
| Tuesday | Mathematical programming with GAMS(20 hours) | Indeterminate planning(15 hours) |
| Wednesday | Dynamics system with VENSIM(16 hours) | Basics of machine learning and data analysis (20 hours) |

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| --- | --- | --- | --- |
| Day/Time | 11-12:30 | 14-17 | 17-20 |
| Thursday | Project-oriented machine learning with Python (20 hours)(The second meeting of the week from 11 to 12:30) | Simulation with ARENA(20 hours) | Introduction to starting a new business (3 sessions of 3 hours) |

**Courses offered and registration fee**

Since conducting scientific research based on the type of research requires related tools and methods, the four courses are defined as follows.

|  |  |
| --- | --- |
| Courses names | Relevant courses |
| Optimization and decision making | Mathematical programming with GAMS, meta-heuristic methods with MATLAB, non-deterministic programming, game theory, data envelopment analysis, reference management with Endnote |
| Data analysis | Basics of machine learning and data analysis, statistical analysis with MINITAB, data mining with WEKA, reference management with Endnote |
| Data optimization and analysis | Mathematical programming with GAMS, machine learning with Python, system dynamics with VENSIM, simulation with ARENA, reference management with Endnote |
| Business Development | Ideas for starting a new business, developing a business plan (business plan), financial intelligence and ways to earn money from financial markets (digital currency, metaverse, NFT) |

|  |
| --- |
| * With the support of the president of Khatam University, the registration fees of Khatam University students in each of the modules are considered with a 50% discount;
* Students of other universities have a 25% discount to register in each of the courses.
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| --- | --- | --- |
| Lesson’s name | Hours | Fee (Tomans) |
| Metaheuristic methods with MATLAB | 20 | 400,000 |
| Mathematical programming with GAMS | 20 | 400,000 |
| Indeterminate planning | 15 | 300,000 |
| Dynamics system with VENSIM | 16 | 320,000 |
| Simulation with ARENA | 20 | 400,000 |
| Game theory | 12 | 240,000 |
| Data covering analysis | 15 | 300,000 |
| Statistical analysis with MINITAB | 16 | 320,000 |
| Data mining with WEKA | 16 | 320,000 |
| Machine learning with Python | 20 | 400,000 |
| Basics of machine learning and data analysis | 20 | 400,000 |
| New business startup ideas | 9 | 180,000 |
| Compilation of business plan and basics of business plan | 16 | 320,000 |
| Financial intelligence and ways to make money from financial markets (digital currency, metaverse, NFT) | 20 | 400,000 |
| Reference management with Endnote | 6 | 120,000 |
| Total | 241 | 4,820,000 |

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| --- | --- | --- | --- | --- |
| Lesson’s Name | Offered hours | Registration fee for students of Khatam University with a 50% discount (in Tomans) | Registration fee for students of other universities with a 25% discount (in Tomans) | Registration fee for independent scholars (in Tomans) |
| 88,000 | 880,000 | 1,320,000 | 1,760,000 | 88,000 |
| 58,000 | 580,000 | 870,000 | 1,160,000 | 58,000 |
| 82,000 | 820,000 | 1,230,000 | 1,640,000 | 82,000 |
| 45,000 | 450,000 | 675,000 | 900,000 | 45,000 |
| 241,000 | 2,410,000 | 3,615,000 | 4,820,000 | 241,000 |

* It is possible to register a module, single course, and combined and comprehensive courses by the applicant's choice.

**How to register**

* The registration will be done according to the flowchart from July 1st to July 11th. Classes will start on August 1st.
* Due to the limited capacity of the classes, priority is given to those who have completed and submitted the pre-registration form within the above-mentioned period.
* Other notifications are made through the Telegram channel. <https://t.me/Summerschoolkhatamuni>
* To get more information, contact Dr. Soltani via the following email or Telegram ID.

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