Ministry of Science Research and Technology

DANESHPAJOOHAN PISHRO
Higher Education Institute

MSc in Industrial Eng. Systems Optimization

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- **COURSE CHART**
- **SYLLABUS**

MSc. Industrial Engineering – Systems Optimization Course Chart

Systems Optimization Courses - I

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051011	Multivariate Statistical Analysis	3	3	0	-----	-----
3051012	Industrial Systems Planning	3	3	0	-----	-----
3051013	Design of Experiments	3	3	0	-----	-----
3051014	Stochastic Processes	3	3	0	-----	-----
3051015	Queuing Theory	3	3	0	-----	-----
Total Credits		15	Note: students have to pass 9 credits from these courses			

Systems Optimization Courses - II

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051016	Linear Programming	3	3	0	-----	-----
3051017	Integer Programming	3	3	0	-----	-----
3051018	Nonlinear Programming	3	3	0	-----	-----
3051019	Dynamic Programming	3	3	0	-----	-----
Total Credits		12	Note: students have to pass 3 credits from these courses			

Systems Optimization Courses - III

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051020	Seminar	2	2	0	-----	-----
3051021	Thesis	6	0	6	-----	Seminar
Total Credits		8				

Elective Courses (not complete)

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051031	Design of Automated Manufacturing Systems	3	3	0	-----	-----
3051034	Decision Theory	3	3	0	-----	-----
3051035	Game Theory	3	3	0	-----	-----
3051033	Combinatorial Optimization	3	3	0	-----	-----
Total Credits		-	Note: students have to pass 12 credits from these courses			

Multivariate Statistical Analysis

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051011	Multivariate Statistical Analysis	3	3	0	-----	-----

- Review of basic matrix operations and random vectors
- Numerical and graphical summaries of multivariate data
- Multivariate normal distribution
- Inference for multivariate mean
- Comparison of two or more mean vectors
- Multivariate Linear Regression
- Principal Components
- Factor Analysis
- Discrimination and Classification
- Cluster Analysis
- Canonical Correlation

Design of Experiments

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051013	Design of Experiments	3	3	0	-----	-----

This course covers the statistical design of experiments for systematically examining how a system functions. Topics covered will include: introduction to experiments, completely randomized designs, blocking designs, full factorial designs with two levels, fractional designs with two levels and response surface designs.

Stochastic Processes

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051014	Stochastic Processes	3	3	0	-----	-----

Many systems evolve over time with an inherent amount of randomness. The purpose of this course is to develop and analyze probability models that capture the salient features of the system under study to predict the short and long term effects that this randomness will have on the systems under consideration. The study of probability models for stochastic processes involves a broad range of mathematical and computational tools. This course will strike a balance between the mathematics and the applications.

Linear Programming

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051016	Linear Programming	3	3	0	-----	-----

A linear program is an optimization problem that seeks to minimize or maximize a linear function subject to a system of linear inequality and/or equality constraints. Applications of linear programs include transportation problems, flight scheduling, corporate planning, linear and nonlinear curve fitting, product mix, load balancing, production scheduling, inventory control, and many others. There are two major classes of algorithms for solving linear programs: simplex methods and interior point methods. Simplex methods stem from a basic operation, called pivot algebra, whereas interior point methods are based on the use of penalty functions. This course will cover the simplex method in detail, emphasizing both mathematical foundations as well as computational considerations for effective computer implementations. A brief introduction to interior point methods will also be given. In addition to covering these two algorithms, the course will discuss theoretical aspects of linear programming, such as polyhedral theory, duality theory, optimality conditions, convexity, degeneracy, and convergence theory, as well as sensitivity analysis. Additional topics include network flows problems and large scale optimization.

Seminar

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051020	Seminar	2	2	0	-----	-----

In this course students, with the help and supervision of their instructor, will choose a topic (usually the same as their thesis), and study and investigate all the previous and modern researches and facts about it. Subsequently they have to prepare and present their results and conclusions for the whole class, in the form of a seminar.

Thesis

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051021	Thesis	6	0	6	-----	Seminar

In this project students will choose and study a specific subject or problem and find its answer or solution, through practical analyzing, experiencing, and experimenting. Eventually, students will compile their theses and present them as their final project.

Design of Automated Manufacturing Systems

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051031	Design of Automated Manufacturing Systems	3	3	0	-----	-----

- Basic manufacturing concepts
- Fundamentals of manufacturing automation
- Automated flow lines
- Automated assembly systems
- Numerical control
- Computer numerical control
- Industrial robots: technology and applications.
- Group technology
- Computer aided process planning
- Flexible manufacturing systems
- Material handing and storage systems
- Computer integrated manufacturing: CAD/CAM and CIM

Decision Theory

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051034	Decision Theory	3	3	0	-----	-----

- Utility and Probability
- Utility theory in medical problems
- Wald and Decision Functions
- Decision Functions for Testing and Estimation
- Completeness and Sufficiency
- Admissibility
- Stein and Shrinkage Estimators
- Scoring Rules
- The value of information
- Optimal Sample Size
- Dynamic Programming

Game Theory

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051035	Game Theory	3	3	0	-----	-----

Game theory models conflict and cooperation between rational decision-making agents. It has applications in a wide variety of areas, including statistical decision theory, artificial intelligence (online learning, multi-agent systems), economics and business (auctions, pricing, bargaining), biology (evolution, signaling behavior, fighting behavior), political science (stability of government, military strategy), and philosophy (ethics, morality and social norms).

Combinatorial Optimization

Course Code	Course Title	Credits	Theoretical	Practical	Pre-requisite	Co-requisite
3051033	Combinatorial Optimization	3	3	0	-----	-----

The course will present a thorough introduction to the fundamental algorithmic techniques of Discrete Mathematics - Linear and Convex Programming, Flow & Matching Theory, Randomization, and Approximation. We will tackle a variety of optimization problems by applying these techniques to find efficient algorithms. Topics include:

- How fast can a maximum matching be found in a graph?
- Why is the maximum flow equal to the minimum cut?
- What is duality and how to make use of it?
- Is optimization reducible to random sampling?
- Is there a strongly polynomial-time algorithm for linear programming?
- How to find a short traveling salesman tour?
- How to find disjoint flow paths?