# Technological University of Panama
# College of Industrial Engineering
# Master of Science in Supply Chain Engineering
# Course Syllabus

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| **Course** | : | Operations Research 1 | **e-mail** | : | humberto.alvarez@utp.ac.pa |
| **Professor** | : | Ing. Humberto R. Álvarez A., Ph. D. | **Tel/fax** | : | 290-8400 |
| **Campus** | : | Victor Levi Sasso Postgraduate Building | **Cel.** | : | 6673-1119 |
| **Course Number** | : | 0503 | **Credit hours** | : | 3 |
| **Group code** | : | 1ZM103 | **Professor Webpage** | : | http://www.academia.utp.ac.pa/humberto-alvarez |

**A. Course Description**

Linear programming, network flows, integer programming, unconstrained optimization, nonlinear optimization.

**B. Objectives**

Operations Research is the scientific approach to decision-making. By the use of mathematical models, the science of Operations Research seeks to design, improve and operate complex systems in the best possible way. Mathematical models are either deterministic or stochastic, depending on the nature and requirements of the system under study. This course is an introduction to deterministic modeling and optimization. The goal is to learn methods of formulating a wide variety of engineering problems and understanding solution strategies. These strategies are used today by hundreds of companies successfully.

At the end of the course you should be:

- Able to formulate underlying deterministic mathematical programs in various practical systems
- To know what standard techniques are out there to solve them
- Able to interpret the results of a model and present the insights
- To know the limitations of different solution methodologies.

You will be expected to have basic familiarity with modeling real life optimization applications as linear and integer programming, some concepts on undergraduate level linear algebra, basic calculus, basic statistics and programming skills. The use of application software, such as AMPL, MPL, Solver, WinQSB and GAMS (http://www.gams.com/) will be strongly supported.

**C. Methodology:**

To reach the proposed objectives the course will be taught through different methodologies and tools.

- Through lectures and presentations from the instructor to provide the basic knowledge and information about the different topics.
- Through case studies and field projects to develop abilities of analysis and application to participants
- Through presentations from the participants, to present the findings in the case studies and field projects and to discuss the findings with the group, developing team work skills.

- Through a final project, consisting on defining and proposing solutions to a real life situation oriented towards logistic, supply chain management or design, among others.

**D. Course Content**

I. Introduction to Operations Research and Optimization
   - Concepts, definitions and applications
   - Modeling
   - Types of Optimization Problems

II. Linear Programming
   - Modeling
   - Geometry
   - The Simplex method
   - Duality and Sensitivity
   - Large-scale LP algorithms.

III. Special problems in LP
   - Measuring Efficiency in Decision Units
     - Data Envelopment Analysis
   - Network Flow Problems
   - Introduction and Modeling
   - Minimum Spanning Tree
   - Minimum Cost Flow Problems
     - Assignment Problem
     - Transportation Problem
     - Maximum Flow Problem
     - Traveling Salesperson Problem
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IV. Integer Programming
   - Modeling
   - Linear Programming Relaxation
   - Lagrangian Relaxation
   - Solution Strategies:
     - Branch and Bound
     - Cutting Planes

**E. Course Evaluation**

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| Midterms (2) | 30% |
| Assignments | 10% |
| Projects | 25% |
| Final examination | 35% |
| Total | 100% |

**F. References**

References for this course will be upon availability of books and documents in English at the University's Bookstore. Otherwise, the instructor will provide notes, documents and other sources of information to complement this class. Some of the information will be taken from the following references:

**Recommended textbook:**

Hillier, Frederick S., and Gerald J. Lieberman (2009) *Introduction to Operations Research*, McGraw Hill, United States.

**Additional references:**

Pike, R. (1986), *Optimization for Engineering Systems*, Van Nostrand Reinhold Co., Nueva York.

Ragsdale, Cliff (2006) Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Management Science, South Western Publishers, United States.

Rardin, Ronald (1997) *Optimization in Operations Research*, Prentice Hall – United States.

Shapiro, Jeremy (2001) *Modeling the Supply Chain*, Duxbury, Thomson Learning

Taha, Hamdy (2004) *Operations Research, An Introduction*, Prentice Hall – United States.

Course Webpage: http://www.academia.utp.ac.pa/humberto-alvarez/operations-research-1

Other references, articles and journals can be found at:
www.doaj.org
www.informs.org

**G. General information**

Several aspects are important to mention for this course:

**Grading:**
The grading will be composed of several elements as mentioned above, including written exams, in-class and at-home assignments, field projects and a final exam consisting of an applied project.

Aspects to be considered in the grading include, but are not limited to: in-class participation, peer evaluation, instructor evaluation of written exams, in-class presentation and written projects. In addition aspects such as quality of work, written style and format of the written assignments are considered in the grading.

Since most of the projects are group assignment, the evaluation will consist of two aspects: group evaluation and peer evaluation, thus, the entire group will evaluate aspects such as participation, cooperation and delivery for each member of the group.

For written assignment the IEEE Journal and Article Format will be used as reference. This document will be provided the first day of classes.

We believe that trust is an integral part of the learning process and that self-discipline is necessary in this pursuit. We also believe that any instance of dishonesty hurts the entire community. The University's bylaws have considerations regarding academic dishonesty actions such as, but limited to: plagiarism, copy, using no authorized material during tests, etc.

**Rubric:**

| Grade | Individual work | Group evaluation (if applicable, 35%) |
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| Type A Student 91 – 100 | The student fully understands the content, concepts and theoretical and practical approach of the course.<br>The student solves the written tests with complete knowledge of the responses.<br>The student fully participates in all the class discussions and contributes with opinions and examples of high quality.<br>The student is fully confident and responsible of his/her opinions during in-class presentations and project analysis and solutions | The group, in consensus, considers that the contributions and participation of the student are significant for the group understanding of the topic.<br>The group, in consensus, considers that the contribution of the student has been excellent in the level of quality and grade of the group projects.<br>The group, in consensus, considered that the academic skills, leadership and motivation influence the rest of the group. |
| Type B Student 81 – 900 | The student understands the majority of the content, concepts and theoretical and practical approach of the course.<br>The student solves the written tests with good knowledge of the responses.<br>The student participates in most of the class discussions and contributes with opinions and examples of good quality.<br>The student is confident and responsible of his/her opinions during in-class presentations and project analysis and solutions | The group, in the average, considers that the contributions and participation of the student are important for the group understanding of the topic.<br>The group, in the average, considers that the contribution of the student has been important in the level of quality and grade of the group projects.<br>The group, in the average, considered that the academic skills, leadership and motivation influence the rest of the group. |
| Type C Student 71 – 100 | The student, in the average, understands the content, concepts and theoretical and practical approach of the course.<br>The student solves the written tests with average knowledge of the responses.<br>The student partially participates in class discussions and contributes with some opinions and examples.<br>The student has confidence during in-class presentations and project analysis and solutions | The group, in the average, considers that the contributions and participation of the student are of some help for the group understanding of the topic.<br>The group, in the average, considers that the contribution of the student has been in the average in defining the grade of the group projects.<br>The group, in the average, considered that the student has certain level of academic skills and motivation with respect to the rest of the group. |
| Type D Student 61-70 | The student barely understands the content, concepts and theoretical and practical approach of the course.<br>The student solves the written tests with partial knowledge of the responses.<br>The student does not participate in all the class discussions nor contributes | The group considers that the contributions and participation of the student are of no significance for the group understanding of the topic.<br>The group considers that the contribution of the student has been poor in the level of quality and grade of the group project. |

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| | with opinions and examples to the class.<br>The student has no level of confidence or quality during presentations, project analysis and solutions | The group considers that the academic skills, leadership and motivation have barely or no influence for the rest of the group. |
| Type F Student 60 or bellow | The student does not understand the content, concepts and theoretical and practical approach of the course.<br>The student can not solve the written tests or case study analysis.<br>The student does not participate in any of the class discussions.<br>The student is not confident nor responsible of his/her opinions during in-class presentations and project analysis and solutions<br>The student has cheated of committed plagiarism in any of the tests, projects or academic work. | The group has a poor opinion of the contributions and participation of the student and his/her influence on the grades, quality or results of the group work.<br>The group convinced that the student has cheated of committed plagiarism in any of the tests, projects or academic work. |

**Attendance:**
Although attendance is not formally evaluated, the student is responsible for attending class, on time and with full cooperation, especially during the application of a written test or presentation and evaluation of a project. Students will be fully responsible of presenting their assignments and tests on time.

**Communication:**
All the communication will be conducted through email, thus all the students should activate their University's email address (nombre.apellido@utp.ac.pa) or provide a valid email address. Since the communication will be sent weekly, normally with attachments, all the students should have enough space in their mailboxes and to set up their fire walls and junk mail filters to receive the mail without inconveniences.

## H. The Instructor

Professor Humberto Alvarez has a B. S. in Industrial and Mechanical Engineering from the Technological University of Panama, and M. Sc. and Ph. D. degrees at the University of Missouri – Columbia, U. S. A. He is a professor of Industrial Engineering and currently is the private advisor and secretary for the University's President. Dr. Alvarez is member of the Institute of Industrial Engineers, Institute for Operation Research and Management Science, Tau Beta Pi Engineering Society, the American Society of Engineering Education and the Hispanic Society of Professional Engineers, all in the United States. Additionally is member of the Innovation Commission at the National Secretary of Science, Technology and Innovation in Panama, and of the Panamanian Academy for the Advancement of the Sciences.

Students can expect fully cooperation and help of the instructor accordingly. In other words, you can call or email Dr. Alvarez any time (except early morning or late night calls and missed calls) to ask questions about assignments or tests. In addition, you can make an appointment by email or telephone.