30113 - Operative Research

Información del Plan Docente

Academic Year	2018/19
Subject	30113 - Operative Research
Faculty / School	175 - Escuela Universitaria Politécnica de La Almunia 179 - Centro Universitario de la Defensa - Zaragoza
Degree	457 - Bachelor's Degree in Industrial Organisational Engineering 563 - Bachelor's Degree in Industrial Organisational Engineering 425 - Bachelor's Degree in Industrial Organisational Engineering
ECTS	6.0
Year	2
Semester	Half-yearly
Subject Type	Compulsory
Module	---

1.General information

1.1.Aims of the course

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

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Specific evaluation activities

Written tests:

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Throughout the course two main written tests will be conducted. They are focused on theoretical and / or practical aspects of the subject. Its weight in the rating is 65%. Learning results which are related are the 1, 2, 3 and 4.

In the written tests will be evaluated:

- The understanding of mathematical concepts used to solve problems
- The use of strategies and efficient procedures in its resolution
- Clear and detailed explanations
- The absence of mathematical errors in the development and solutions
- Correct use of terminology and notation
- Orderly, clear and organized exhibition

Individual work:

The student must submit an individual work. The teacher may require oral defense of the work by the student. Its weight in the final grade will be 15%. Learning results which are related are 1,2, 3, 4 and 5.

In individual work will be evaluated:

- The correct domain and use of mathematical software commands needed to solve problems
- The proper resolution of the problem and mathematical methods and strategies employed
- Detail the code used in solving problems
- The correct interpretation of the results
- The ability to select the most appropriate method
- Explanations and / or clear reasoning and detailed to questions
- The final outcome and quality of work
- The quality and coordination in the exhibition of the same
- The mathematical language used
- The quality of bibliographical sources

Participatory controls:

Throughout the course, students will perform four participatory valued each of them at 5% of the final grade, which consist of conducting practical exercises or evaluative questionnaires scheduled through the virtual platform moodle. Learning results which are related are the 1, 2, 3 and 4.

In participatory controls will be evaluated:

- The understanding of mathematical concepts used to solve problems
- The use of strategies and efficient procedures in its resolution
- Clear and detailed explanations
- The absence of mathematical errors in the development and solutions
- Correct use of terminology and notation
- Orderly, clear and organized exhibition

Overall evaluation.

Students who have not passed the subject with the system of continuous rating, must pass a written equivalent exam to controls described in paragraph 1 and 3, whose weight in the final grade is 85%, it will also be present the individual work which he has awarded throughout the course weight being 15% of the final grade.

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4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

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The learning process that is designed for this subject is based on the following:

The course is designed as an introduction to optimization theory and decision making. It is included in the credits of basic training of an engineer. The essential contents of operational research as linear programming, network flow models or multi-criteria decision techniques are collected.

The methodology includes theoretical sessions where main concepts are provided, also reinforced with practical sessions in the computer room. The practical sessions include the use of software R language programming and the libraries lpSolve, igraph.

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The learning process that is designed for this subject is based on the following:

- The presentation of the contents of the subject in master classes.
- Solving problems in class. As far as possible this activity will be performed by the students.
- Individual of the contents by students.
- Practical work undertaken by the students. During these practical activities the theoretical knowledge is complemented. These activities can be individual or group activities.

4.2.Learning tasks

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The program that the student is offered to help you achieve the expected results includes the following activities ...

The course is organized with 4 hours of class a week for the 15 weeks of the semester. All classes are taught in the computer room, where theoretical concepts are reinforced with practical work using the R programming language.

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There are two kinds of activities.

- Classroom activities: Master classes, discussion of practical problems and resolution of problems with computer software.
- Non-contact activities: Guided assignments. This activity includes individual and group tasks. Individual study by the students.

4.3.Syllabus

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- Introduction to Optimization: Phases of an optimization study: analysis and problem definition, development and validation of the model solution, implementation of the solution. Features of an optimization problem: Objective, variables, constraints, data, solution.
- Linear Programming: Formulation of linear programming problem (PPL), PPL graphical solution, canonical form and standard form. Basic matrix, optimal basic program. Simplex algorithm. Method of penalties, the two phases method. The dual problem: formulation, production scheduling and shadow price. Sensitivity analysis: vector availability, cost vector, introducing a new activity, introduction of a new restriction.
- Flow networks: Networks. Cost and adjacency matrix. The problem of the shortest route. Dijkstra algorithm. The problem of peak flow. Ford and Fulkerson algorithm. The problem of minimum spanning tree. Kruskal algorithm. The flow problem minimum cost. The problem of transportation. The allocation problem.
- Decision theory with uncertainty or risk: States of nature. Alternatives or decisions. Decision table. Expected value criterion, minimax or maximin, Hurwicz, Savage or opportunity costs. Decision trees: random nodes and decision nodes
- Multicriteria decision: Attribute, objective, level of aspiration, goal, criteria. Pareto optimal or efficient alternative solution. Payoff matrix. Methods of resolution. Method of weights. Method of epsilon restrictions. Goal programming.
- Game Theory: Strategies and payments. Cooperative and noncooperative games. Nash equilibrium. Mixed Strategies. Dominated strategies

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1. Methodology of Operations Research.
2. Linear programming.
   - Modelling.
   - Solving LP problems: graphical method, Simplex method, artificial variables, Simplex dual method, etc.
   - Duality.
   - Sensitivity analysis.
3. Multicriteria optimization
   - Modelling
   - Solving methods: lexicographical, weights, goal programming, etc.
   - Interpretation of results.
4. Integer programming.
5. Graph theory.
   - Introduction to graph theory.
   - Shortest path problem.
   - Minimun spanning tree.
   - Maximun flow in networks.
   - Task assignment.
   - Modelling graph problems using LP.
6. Game theory
   - Classification and representation of games.
   - Strategies. Domination and saddle points.
7. Dynamic programming.

4.4.Course planning and calendar

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The contents will be developed over 15 weeks teaching with the following weights:

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1. Methodology of Operational Research. 0.5-1.5 credits
2. Linear optimization problems 2.5-3.5 credits
3. Techniques of multicriteria decision 0.5-1.5 credits
4. Analysis of decisions in the presence of uncertainty 1-2 credits

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Before the start of the semester, the calendar of activities will be published on the Moodle platform (http://moodle2.unizar.es).

4.5.Bibliography and recommended resources