240AR016 - Industrial Scheduling

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 732 - OE - Department of Management
Academic year: 2019
Degree: MASTER'S DEGREE IN AUTOMATIC CONTROL AND ROBOTICS (Syllabus 2012). (Teaching unit Compulsory)
ECTS credits: 4,5
Teaching languages: English

Teaching staff

Coordinator: Doménech Léga, Bruno
Others: Doménech Léga, Bruno
Garrido Godes, Ernesto

Opening hours

Timetable: Bruno Domenech: to be arranged by email (bruno.domenech@upc.edu), office H-11.16

Prior skills

- Numerical ability.
- Reflective, analytical and synthesis attitudes.
- Proactivity and responsibility.
- Basic and applied statistics (probability, distribution laws and forecasting techniques).
- Calculus and algebra.
- Concepts of engineering.

Requirements

Fundamentals of Operations Management, at undergraduate level, is advisable.

Degree competences to which the subject contributes

Specific:

CEAR4. The student will be able to use analysis tools and computer-aided design of control systems in the tasks usual analysis, simulation and controller design.

CEAR8. The student will acquire a set of knowledge and skills to basic and advanced level of mobile robotics, putting special emphasis on probabilistic models applied to mobile robotics.

CEAR14. The student will be able to direct and organize enterprises and production systems and services, applying knowledge and skills in industrial organization, business strategy, planning and logistics, commercial and labor law, financial and cost accounting.

CEAR15. The student will be able to lead and manage the organization of work and human resources applying criteria of industrial safety, quality management, risk prevention, sustainability, and environmental management

Transversal:

2. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
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Teaching methodology

Lectures: a lecturer presents the contents of the subject but the active participation of students is requested.
Practical sessions: Students solve problems related to the theoretical contents of the course and work on their projects.
Projects: students have to solve several practical situations related to the contents of industrial organization within a business plan. Projects are undertaken in groups. Groups are expected to solve each step of the project and make a final public presentation.

Learning objectives of the subject

At the end of the course, students must know several concepts and they must be able of using several procedures about productive and logistic systems. They are going to provide the students with a broad conceptual view with some instrumental aspects, which is going to allow them undertake design tasks and managing tasks as well.

Study load

<table>
<thead>
<tr>
<th>Total learning time</th>
<th>Hours large group:</th>
<th>Hours small group:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td>112h 30m</td>
<td>27h</td>
<td>13h 30m</td>
<td>72h</td>
</tr>
<tr>
<td></td>
<td>24.00%</td>
<td>12.00%</td>
<td>64.00%</td>
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</tbody>
</table>
### Content

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Description</th>
<th>Related activities</th>
<th>Specific objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction.</strong></td>
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<tr>
<td><strong>Lesson 1: Introduction to production systems and decisions in operations management</strong></td>
<td>Definiciones de Producto, proceso y sistema productivo. Clasificación de sistemas productivos. Decisiones en entornos productivos. Sistemas de gestión.</td>
<td>Students have to make groups inorder to solve the exricies in this course and they have to decide the subject of their project or Business Case.</td>
<td>Students should know the requirements of this course.</td>
</tr>
<tr>
<td><strong>Lesson 2: Facilities location.</strong></td>
<td>Location: (1) Concepts. (2) Examples. (3) Decision criteria. (4) Distances and costo. (5) one-dimensional location. (6) Two-dimensional location. (7) Isocost lines. (8) Locating several facilities. (9) Product placement. (10) Coverage.</td>
<td>These concepts are going to be used by the students in their Business Case.</td>
<td>Students must be able to define the studied concepts, use them correctly and identify them in a given situation.</td>
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<table>
<thead>
<tr>
<th>Learning time: 4h 30m</th>
<th>Learning time: 5h</th>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 1h 30m</td>
<td>Theory classes: 1h 30m</td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>Practical classes: 1h 30m</td>
<td>Practical classes: 1h 30m</td>
<td>Practical classes: 3h</td>
</tr>
<tr>
<td>Self study : 1h 30m</td>
<td>Self study : 2h</td>
<td>Self study : 2h</td>
</tr>
</tbody>
</table>
# Lesson 3: Investments and costs.

**Learning time:** 5h  
Theory classes: 1h 30m  
Practical classes: 1h 30m  
Self study: 2h

**Description:**  
Investments and costs linked to the capacity of a project or productive system:  
1. Cost definition.  
2. Classification of manufacturing costs.  
3. Break-even point.  
4. Investments.  
5. Cash flows.  
6. Size of the investment and payback period.  
7. Assessment criteria.  
8. Capitalization and discounting.  
9. NPV & IRR.  
10. Risk management.

**Related activities:**  
Problems.  
Students include these elements in their Business Cases.

**Specific objectives:**  
Students can compute the cash flows associated to an investment project and they can compare different projects using several assessment criteria.

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# Lesson 4: Project management (I).

**Learning time:** 8h  
Theory classes: 3h  
Practical classes: 3h  
Self study: 2h

**Description:**  
1. Definition and examples of projects. Its life cycle.  
2. Task scheduling: a historic view.  
3. Tasks: Attributes.  
5. Solutions: Terminology.  
6. Problems: Types.  
7. Problems with potential bondings.  
8. Representing problems with potential bondings: Roy Chart, PERT/CPM chart, Gantt chart.  
9. Load curves.  
 Execution costs calendar.

**Related activities:**  
Problems.  
An element of the Business Case.

**Specific objectives:**  
Students can draw, understand and compute the different types of charts.
### Lesson 5: project management (II).

**Learning time:** 8h  
Theory classes: 3h  
Practical classes: 3h  
Self study: 2h

**Description:**  
(1) Cumulative problems.  
(2) Lower bounds.  
(3) Resource balancing and compatibility.  
Greedy algorithms.  
(4) Problems with disjunctive conditions.

**Related activities:**  
Problems.  
Part of the Business Case.

**Specific objectives:**  
Students can solve cases when the situations described in this lesson appear (specially the lack of productive resources).

### Lesson 6: Aggregate production planning (I).

**Learning time:** 5h  
Theory classes: 1h 30m  
Practical classes: 1h 30m  
Self study: 2h

**Description:**  
(1) El proceso de planificación.  
(2) Plan Maestro de producción.  
(3) Planificación agregada.

**Related activities:**  
Problems.  
An element of the Business Case.

**Specific objectives:**  
The student understands the planning process. The student can prepare a production plan.
### Lesson 7: Aggregate production planning (II).

**Description:**
(1) Linear programming with production, inventories and backorders (2) Bowman's transportation table. (3) Linear programming - transportation problem. (4) Detailed planning.

**Related activities:**
Problems.
An element of the Business Case.

**Specific objectives:**
The student can outline a production plan by means of linear programming. The student can solve a Bowman's transportation table.

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<tr>
<td>Self study: 2h</td>
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### Lesson 8: Material Requirements Planning (MRP) (I).

**Description:**
(1) Bill of materials (BOM). (2) Gozinto matrix (3) Explosion and gross requirements. (4) Detailed planning (LP). Implosion.

**Related activities:**
Problems.
Part of the Business Case.

**Specific objectives:**
To make a bill of materials. Students can explain the process that leads to the gross requirements and compute them.

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<tbody>
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<tr>
<td>Practical classes: 1h 30m</td>
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<tr>
<td>Self study: 2h</td>
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</table>
### Lesson 9: MRP (II).

**Description:**
1. Definition.
2. BOM & Master schedule
3. Input data and MRP software execution. Output.
4. MRP II.

**Related activities:**
- Problems.
- Element of the Business Case.

**Specific objectives:**
- To understand the logic behind the MRP software and to be able to reproduce it.
- To understand the output of the software.

**Learning time:** 5h
- Theory classes: 1h 30m
- Practical classes: 1h 30m
- Self study: 2h

### Lesson 10: Inventory management (I).

**Description:**
1. Introduction to inventory management.
2. ABC chart.
3. Inventory management costs.
4. The economic order quantity (EOQ) model.
5. Reorder point.

**Related activities:**
- Problems.
- An element of the Business Case.

**Specific objectives:**
- Students abide by the fundamentals of inventory management.
- They can prepare an ABC chart.
- They can compute the EOQ and the reorder point.

**Learning time:** 5h
- Theory classes: 1h 30m
- Practical classes: 1h 30m
- Self study: 2h
**Lesson 11: Inventory management (II).**

<table>
<thead>
<tr>
<th>Learning time: 5h</th>
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<tbody>
<tr>
<td>Theory classes: 1h 30m</td>
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<tr>
<td>Practical classes: 1h 30m</td>
</tr>
<tr>
<td>Self study: 2h</td>
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</tbody>
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**Description:**
- (1) Quantity discounts.
- (2) Generalized EOQ model.
- (3) Problems with constraints.
- (4) Multiple product manufacturing.

**Related activities:**
- Problems.
- Part of the Business Case.

**Specific objectives:**
- Students can compute different situations in inventory management.

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**Qualification system**

Method 1) Continuous assessment

\[ \text{Final grade} = 0.3 \times \text{Midterm} + 0.5 \times \text{Project} + 0.2 \times \text{Exercises} \]

Grading the Project takes into account the solutions, oral presentations, and final public presentation.

Grading exercises takes into account the solutions and the oral presentations.

Method 2) The old way assessment

\[ \text{Final grade} = 0.3 \times \text{Midterm} + 0.7 \times \text{End of term examination} (*) \]

\( (*) \) Not attending the end of term examination results in a final grade of NA

Students can freely opt between method 1 and method 2

Students who do not pass method 1 are expected to attend the end of term examination (method 2).

**Regulations for carrying out activities**

Both the exercises and the project will be carried out in groups of 4 or more students. The group members will have to show their involvement in the development of the activities, actively participating in them.

Written examinations will be carried out individually; lecture notes and books are acceptable, but not computers. Cell phones are strictly prohibited.
Bibliography

Basic:


Shapiro, Jeremy F. Modeling the supply chain. 2nd ed. Belmont [etc.]: Thomson Brooks/Cole, cop. 2007. ISBN 049512611X.


Others resources:

These resources are available in Spanish only.

Hyperlink

http://ocw.upc.edu/curs/59740/Apunts
  Resource

http://www.prothius.com/docencia/?filtre=apunt&filtre2=Ol&lang=es
  Resource