

Academic Year/course: 2021/22

30166 - Maintenance Management

Syllabus Information

Academic Year: 2021/22

Subject: 30166 - Maintenance Management

Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia

Degree: 425 - Bachelor's Degree in Industrial Organisational Engineering

ECTS: 6.0

Year: 4

Semester: First semester

Subject Type: Optional

Module:

1. General information

1.1. Aims of the course

The general objective of the subject is to convey the need for continuous improvement in the Maintenance Departments, of all types of organizations and / or companies, both productive and services, integrating the multiple techniques that the market and the state of science offer for such improvement.

This requires the correct use of terminology, the application of regulations of official bodies, the study of the most common computer applications for maintenance management and also correctly interpreting the technical documentation of the implemented management systems.

Indicators that the objectives have been achieved will be: the ability to analyze typical cases of maintenance in companies, covering their machinery and facilities, cost analysis, productivity improvements and proposals for maintenance plans that improve services., L, C, etc.; These types of problems also serve to support the design process.

These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (<https://www.un.org/sustainabledevelopment/es/>), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree:

- **4.4** By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.
- **4.7** By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development.
- **9.1** Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
- **9.4** By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.
- **12.2** By 2030, achieve the sustainable management and efficient use of natural resources.
- **12.5** By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

1.2. Context and importance of this course in the degree

The Maintenance Management course is part of the Industrial Organization Engineering Degree taught by EUPLA, framed within the group of subjects that make up the Company profile. This is a fourth-year subject located in the seventh semester and optional (OP), with a teaching load of 6 ECTS credits.

The specific training in Maintenance Management, should help (as many authors claim) that maintenance systems mature as a discipline, which should be researched and practiced within the industry, as one more field of engineering and industrial management.

1.3. Recommendations to take this course

The development of Maintenance Management requires the putting into play knowledge and strategies, coming from subjects corresponding to the previous semesters of the Industrial Organization Engineering Degree, related to:

Mathematics, Physics, Graphic Expression, Computer Science, Environmental Engineering, Quality, Business Economics and Logistics.

However, it is not a legal requirement to have passed them in order to take this subject.

2. Learning goals

2.1. Competences

- (C2): Ability to plan, budget, organize, direct and control tasks, people and resources.
- (C22): Basic knowledge and application of environmental technologies and sustainability.
- (C23): Applied knowledge of business organization.
- (C30): Knowledge and capabilities for the implementation and management of information systems in organizations.
- (C46): Knowledge and skills for management and maintenance techniques.

2.2. Learning goals

- To identify maintenance as an integrated system which requires planning, design, engineering and control by employing statistical and optimization techniques.
- To use quantitative techniques for the operation, control and improvement of maintenance systems.
- To select and interpret adequate information to propose and assess solutions to common technical needs and problems in the field of maintenance, with a level of precision consistent with that of the several variables involved in them.
- To establish criteria that determine the most suitable conditions for outsourcing maintenance services.
- To know how to use the general methodology and the appropriate software tools to work in maintenance management.

2.3. Importance of learning goals

Maintenance, as a system, plays a key role in achieving the company's goals and objectives. Maintenance management is an essential tool in modern production systems, based mainly on inventory reduction, assured quality and productive maintenance, coinciding with the criteria of reliability and total quality, fundamental in current maintenance models.

Students, future maintenance managers, receive through this course, the necessary training to

understand the role of maintenance in the industry and the techniques available for its control and organization. As highlighted by several authors (whose texts are included in the bibliography):

"A technical approach to maintenance is essential, if those responsible for it want to control the industrial plant and not that the plant controls them".

3. Assessment (1st and 2nd call)

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

The evaluation of the subject contemplates the continuous evaluation system, as the most appropriate to be in line with the guidelines of the EHEA (Bologna agreements), regarding the degree of involvement and continued work of the student throughout the course.

In order to benefit from this assessment system, students must submit at least 80% of the tasks (problems, jobs, practices) assigned by the teacher. The continuous assessment system will culminate, with the weighted sum of the grade obtained in each of the four blocks, which form the content structure of the subject:

$$\text{FINAL NOTE} = 20\% \text{ Block 1} + 20\% \text{ Block 2} + 20\% \text{ Block 3} + 40\% \text{ Block 4}$$

The course will be passed when in this weighted evaluation, a score equal to or greater than 5.0 points is obtained, taking into account that the minimum mark for each block, to be included in the previous formula, will be 3.0 points in blocks 1 to 4. A grade lower than 3.0 in a block assumes that the student must pass the content in the final exam. The teacher will notify each student whether or not they have passed the subject based on the level demonstrated in the continuous assessment system.

In case of not passing in this way, the student will have two additional opportunities (final exams) to do so (global assessment test), on the other hand, the student who has passed the course through this dynamic, may also choose the global assessment test, in first call, to upload note. The subject of the blocks that have not exceeded the minimum score will be compulsory, and the subject with the highest score is always optional under the responsibility of the student.

For each of the indicated content blocks (unless expressly indicated), the types of activities described below will be controlled, applying the assessment criteria indicated:

- **Exercises, theoretical questions and proposed works:** Their approach and correct development, the writing and coherence of the treated will be valued, as well as the achievement of results and the final conclusions obtained. The active participation of the student will be taken into account, answering the questions promptly posed by the teacher in the daily course of the class, and the qualification of the theoretical-practical exercises that may be proposed.
- **Practices:** In each one of the practices the dynamics followed for its correct execution and operation will be valued, as well as the problems raised in its development. The score of each practice will be from 0 to 10 points.
- **Oral assessment test (for Blocks 1 to 3):** It will consist of public defense of a work (individual or group) that covers the different topics covered in each block. Depending on the content, such work may include solving case studies or problems. As indicated in other points of this Guide, Block 4 has no written evaluation test.
- **Individual activities in Moodle Forums (for Blocks 1 to 3):** The active participation of the student will be taken into account, responding to the possible proposals made by the teacher in the corresponding forums.
- **Group activities in class (for Block 4):** In this block the defense and public exposition of the part of matter that has been assigned to each group of students will be evaluated. These are more real and broader cases than those contained in blocks 1 to 3, and the depth of knowledge of the PGMwin software and other tools will be valued.

The weighting of the qualification process, of the different activities, in which the continuous evaluation process of the subject has been structured will be as follows:

BLOCKS 1, 2 and 3:

- Class activities, exercises and proposed works, Moodle activities: maximum 20%.
- Laboratory practices: maximum 20%.

- Defense of works: 60% -100%.

BLOCK 4

- Activity memory: 30%.
- Public defense of activity: 70%.
- Mutual evaluation (compulsory): in case of not being present in the defenses of the other students, the teacher can apply a correction factor of up to 50% of the mark obtained in the previous activities.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

If classroom teaching were not possible due to health reasons, it would be carried out on-line.

This Maintenance Management course is designed as a set of contents, but distributed in four blocks. The first block, brings together basic concepts, which perhaps students in many cases have already acquired. The second and third blocks form the core of the subject that the subject must contribute to its training. The final block, brings together complementary knowledge to complete the training in Maintenance.

The first three blocks will be dealt with under three fundamental and complementary ways: the theoretical concepts of each didactic unit, the resolution of problems or questions and practices, supported in turn by another series of activities such as tutorials and seminars and will be tested individually, regardless of the blocks.

The fourth block will have a different treatment, because the students will work in groups only previously assigned sections, they will be able to express their preferences but all the subjects will have to be assigned to some group. They will prepare presentation materials and defend their work with a public presentation, which will be valued by the rest of the students and the teacher.

The teacher / student interaction is carried out in this way, through a distribution of work and responsibilities between students and teachers. However, it must be taken into account that, to a certain extent, students can set the pace of learning according to their needs and availability, following the guidelines set by the teacher.

The organization of teaching involves the active participation of the student, and will be carried out following the following guidelines:

- Lectures: Theoretical activities imparted in a fundamentally expositive way by the teacher, in such a way as to expose the theoretical supports of the subject, highlighting the fundamental, structuring the concepts and relating them to each other.
- Practice Sessions: The teacher solves problems or practical cases for illustrative purposes. This type of teaching complements the theory explained in the lectures with practical aspects.
- Seminars: The total group of lectures or practical lessons may or may not be divided into smaller groups, as appropriate. They will be used to analyze cases, solve problems, etc. Unlike what happens with the practical lessons, the teacher is not a protagonist, simply listening, counseling, clarifying, evaluating, assessing. It seeks to encourage student participation, as well as making the continuous assessment of students possible and to learn about the performance of learning.
- Practice tasks: Practice tasks are carried out in groups of two students (or three students at the most), although for the report of the activities (according to the teacher) homonymous groups of different shifts can be associated to encourage teamwork.
- Group tutorials: Programmed activities of learning follow-up in which the teacher meets with a group of students to guide their work of autonomous learning and supervision of works directed or requiring a high degree of advice by the teacher.
- Individual tutorials: These are the ones made through the individual attention of the teacher in the department. They aim to help solve the doubts that students come across, particularly those who for various reasons cannot attend group tutorials or need more personalized attention. These tutorials can be classroom or virtual.

4.2. Learning tasks

Generic on-site activities:

? Lectures: The theoretical concepts of the subject will be explained and illustrative practical examples will be developed as a support for the theory when it is deemed necessary.

? Practice Sessions: Problems and practical cases will be made as a complement to the theoretical concepts studied.

? Practical tasks: Students will be divided into several groups of no more than 20 students, being guided by the tutorial action of the teacher.

?Defense and presentation of topics: on the particular contents that are assigned to each group of students, corresponding to Block 4.

Generic off-site activities:

? Study and assimilation of the theory explained in the lectures.

- ? Understanding and assimilation of solved cases in practical lessons.
- ? Preparation of seminars, solving suggested problems, etc.
- ? Participation in Forums of the subject via Moodle, to provide links of information on the Internet.
- ? Preparation and development of scripts and corresponding reports.
- ? Preparation of written continuous assessment tests, and global assessment tests.

Autonomous tutored activities: Although they will be done on-site, they have been taken into account separately because of their particular features, they will be focused mainly on seminars and tutorials under the supervision of the teacher.

Reinforcement activities: Off-site activities preferably, via the virtual portal of teaching (Moodle), will be designed to reinforce the basic contents of the subject. These activities can be personalized or not.

4.3. Syllabus

The theoretical contents are divided into four Topics (numbers 1 to 4) preceded by an introduction to Maintenance. The choice of the content of the Topics has been made looking for the express clarification of the final objective, so that with the union of incidental knowledge, the student obtains a structured knowledge, easily assimilated for the Management Engineers.

Each of the Topics is composed of subjects, with a temporary assignment of one or two weeks of the course, these topics collect the contents necessary for the acquisition of predetermined learning outcomes.

The course will address the following topics:

Topic 0: INTRODUCTION

1. Maintenance Overview.
2. Reliability, Historical Management, Machines, Installations.

Topic 1: OVERVIEW OF MAINTENANCE TECHNIQUES

1-. Evolution and structure of maintenance

- ? Function, objectives, types.
- ? Maintenance companies.
- ? Industries with their own maintenance.
- ? Breakdowns, management, and treatment. Organization of the intervention.
- ? The contrast between corrective and preventive maintenance.
- ? Technical documentation: installations, systems, machines, elements.
- ? History data bank.

2-. Management software

- ? Databases.
- ? History of Data Management.
- ? Storage and purchasing management.
- ? Expert systems.

Topic 2: OPTIMIZATION OF MAINTENANCE MANAGEMENT

3-. Reliability and Quality

- ? Reliability. "Maintainability". RCM.
- ? Availability of facilities.
- ? Quality. Typology of breakdowns in machines.
- ? The Japanese Maintenance Method: TPM.

4-. Warehouse and maintenance material

- ? Supplies. Supplier approval.
- ? Organization and control of the warehouse.
- ? Spare parts catalog.
- ? Inventory control and orders.
- ? Tools and tool management.

5-. Optimization of economic management

- ? The cost of integral maintenance.
- ? Cost analysis.
- ? Maintenance Productivity
- ? Maintenance Outsourcing.

Topic 3: MAINTENANCE PLANNING AND PROCESSES

- 6-. Organization of preventive maintenance.
- ? Concepts and types.

- ? Human resources (HR) and materials.
- ? Optimization of the maintenance workshop.
- ? Periodic inspections and controls.

7-. Predictive Maintenance

- ? Based on vibration analysis.
- ? Based on oil analysis.
- ? Based on temperature. Thermography.
- ? Other analysis and application examples.

8-. Energy and environmental maintenance

- ? Energy processes in production.
- ? Consumption Control.
- ? Comprehensive use of a facility.
- ? Environmental maintenance.

Topic 4: CASE STUDY IN MACHINES AND FACILITIES

9-. Case studies in machines

- ? Maintenance of mechanical elements.
- ? Maintenance of electrical and electronic elements.
- ? Maintenance of pneumatic and hydraulic elements.
- ? Maintenance of computer equipment.

10-. Practical cases in facilities

- ? Ventilation and air conditioning installations.
- ? Heating and domestic hot water installations.
- ? Flexible production lines.
- ? Facilities in hospitals and large buildings.

Practical contents

Each Topic presented in the previous section has associated practices, through assumptions and/or simulations, leading to the obtaining of results and their analysis and interpretation. As the topics are developed, these Practices will be proposed, preferably in the classroom and also via the Moodle platform. They will be carried out by the students in weekly one-hour sessions.

Practice 1: MAINTENANCE TECHNIQUE OVERVIEW

- ? Making a historical map on the evolution of Industrial Maintenance.
- ? Identification of the UNE Regulation on Maintenance Management.
- ? Introduction to the use of the PGM-Win management program.

Practice 2: MAINTENANCE MANAGEMENT OPTIMIZATION

- ? The contrast between RCM and TPM methods.
- ? Warehouse control operations using GMAO.

Practice 3: MAINTENANCE PLANNING AND PROCESSES

- ? Analysis of the integral use of a facility.
- ? Description of actual predictive maintenance cases.

Practice 4: CASE STUDY IN MACHINES AND INSTALLATIONS

Documentation of one of the applications of units 9 and 10, depending on what is assigned for theoretical defense.

4.4. Course planning and calendar

Temporary distribution of a school week:

The subject is defined in the Verification Report of the Degree with a low experimental level, that's why the 10 weekly hours are distributed as follows:

- ? Lectures-practical lessons: 3 hours per week (blocks 1, 2 and 3). 5 hours per week (block 4).
- ? Practice tasks: 1 hour per week.
- ? Other activities: 6 hours per week (blocks 1, 2 and 3). 4 hours per week (block 4).

Test Calendar

For assessment tests, described in the continuous assessment process, the following timetable is suggested:

- ? Week 3: Test 1 (Topics 1 and 2).
- ? Week 7: Test 2 (Topics 3, 4 and 5).
- ? Week 12: Test 3 (Topics 6, 7 and 8).

Essay Presentation-Defense

Those belonging to Block 4 (Case Studies in Machines and Installations), will be tested orally during the three final weeks of the course, organized according to the number of students and the specific development of the preparatory tasks.

4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30166>