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300237 - IE-MP4 - Electrical Installations

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2014
Degree: BACHELOR'S DEGREE IN AIRPORT ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan, English

Teaching staff

Coordinator: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

Prior skills

Basic knowledge of electricity and electronics

Degree competences to which the subject contributes

Specific:

1. CE 17 AERO. Conocimiento adecuado y aplicado a la ingeniería de: Los elementos fundamentales de los diversos tipos de aeronaves ; los elementos funcionales del sistema de navegación aérea y las instalaciones eléctricas y electrónicas asociadas; los fundamentos del diseño y construcción de aeropuertos y sus diversos elementos. (CIN/308/2009, BOE 18.2.2009)

Transversal:

2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
3. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
5. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

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Teaching methodology

Theory sessions
Theoretical material is presented in lectures, combining PowerPoint slides (which are delivered prior the class through to the digital campus) and board. Also problem examples are proposed and solved.
Laboratory Sessions
The practical sessions consist of simulations, computer aided design and experimental practices. For all cases, a report justifying the objectives achieved in each practice should be delivered.
Project sessions
During the project sessions, each team will organize to plan and structure the project conveniently. The project will be carried out by student teams. In the evaluation sessions, each group will present their work while the rest will make a summary for own learning while doing the assessment, both of the work and the presentation.
Self study
Autonomous learning is planned for:
· Understanding the concepts presented in lecture sessions. (Individual).
· Prepare the next session.
· Meet and discuss the issues raised in each session. (In Group).
· Perform the previous studies of practices (in groups).
· Perform practical reports (in groups).
· Perform work on electrical installations.

It will enhance the use of the consultation sessions to achieve the goals of independent learning.

Learning objectives of the subject

The course provides an introduction to electrical installations that allow the operation of airports. It includes wiring, generators and continuity, batteries, automation, interlocks and operating sequences. The facilities are presented as to design, plan and implement the necessary control and maintenance for smooth operation.

Power lines characteristics are studied to decide and choose the most appropriate for every situation and in different configurations, both overhead and underground. Further, safety systems and protective relays to avoid the effects of short circuits or other disturbances are deeply investigated. Current control elements, breakers and switches are also introduced.

Complementary to electrical systems, lighting systems are also studied. In particular, light quantification and formal equations to analyze the interior and platform lighting are presented. The electrical circuits and protections are also taken into account, along with track beacon lamps, cables and brightness sliders.

Goals of the course also include applicable electrical codes and international airport regulations. A project for the execution of works and maintenance of buoys is also proposed.

After completing the course of Electrical Installations, the student should be able:
- To know the operation of electrical installations airport.
- To know how to calculate and design a lighting system.
- To know how protect and maintain electrical installations against external shocks by point relays, circuit and breakers.

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Study load

Total learning time: 150h	Hours large group:	36h	24.00%
	Hours medium group:	0h	0.00%
	Hours small group:	24h	16.00%
	Guided activities:	6h	4.00%
	Self study:	84h	56.00%

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Content

Topic 1: Introduction. Introduction to Electricity

Learning time: 10h

Theory classes: 3h
Laboratory classes: 2h
Self study : 5h

Description:
This chapter reviews the basics of electricity (voltage, current, apparent power, active and reactive), transformers, converters, AC / DC and DC / AC. Phase systems are particularized to balanced, unbalanced and how to ensure a good quality power factor. Problem resolution is carried out in phasor space.

Related activities:
Classroom activities: solving examples that clarify theoretical presentations.
Collection problems.
Practical work: Lab 1

Specific objectives:
a) To know the basic electrical values (voltage, current, power)
b) To know transformers troubleshoot
c) To know balanced three-phase systems troubleshoot .
d) To know how to solve unbalanced three-phase systems.
e) To know the best possible power factor from technical and budgetary availability.

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Topic 2: Lighting and Marking	Learning time: 27h Theory classes: 6h Laboratory classes: 6h Self study : 15h

Description:
This chapter describes the features of light, its characterization and significant laws. The effects of the eye on the physical interpretation of light are also considered. Moreover, a brief description of commercial lighting systems for indoor and airport platform is presented. The design, planning and organization of a beacon system is studied, taking into account the features required by international standards, the system of runway approach lights and electrical equipment necessary for the proper functioning.

Related activities:
Classroom activities: solving examples that clarify the theoretical presentations.
Consolidation activities: resolution of problems
Labs works 2 and 3.

Project 1 - Airside facilities project.
The work includes a research literature and a part of the technical analysis.

Specific objectives:
a) To know the typical characteristics of light (flux, luminous intensity, illuminance and luminance), the solar spectrum and the spectrum of commercial sources.
b) To know how to quantify light (lux lumen¿)
c) To understand and apply the laws that govern the lighting: cosine law, law of Bouguer and Allard, Koshcmieder law.
d) To understand the operation of beacons and commercial sources (incandescent, fluorescent, electric arc, mercury vapor, sodium vapor, halide
e) To know computing the elements necessary to illuminate an indoor and outdoor space.
f) To meet international standards that set the characteristics of the beacons of approach, runway, taxi ...
g) To plan the installation of a commercial airport beacon.

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Topic 3: Power lines	Learning time: 23h Theory classes: 6h Laboratory classes: 4h Self study : 13h

Description:
This topic explores the different electricity transmission systems and what are the characteristic parameters of a line from the electrical standpoint. Analyses on electrical and mechanical calculation to design installations tailored to the needs and regulations.

Related activities:
Classroom activities: solving examples that clarify the theoretical presentations.
Consolidation activities: resolution of problems
Labs works 3 and 4.

Project 1 - Airside facilities project.
The work includes a research literature and a part of the technical analysis.

Specific objectives:
a) To know the different systems of power transmission.
b) To know how to design and secure the transmission bars and cables.
c) To know the possible types of connections between wires and rods.
d) To know the classifications of power lines.
e) To model power lines to determine losses.
f) To choose the most suitable wire for each line, depending on the electrical parameters and boundary (temperature, humidity ...).

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Topic 4: Short-circuit currents. Security and protections.	Learning time: 33h Theory classes: 9h Laboratory classes: 6h Self study : 18h

Description:
This chapter discusses disturbances in electrical systems, especially short-circuit currents. We present the elements of protection devices (protection relays), describing their general features, ratings. The performance of typical different of relays (fuses, overload relays, electromagnetic relays, differential relays (intensity), relays induction and electronic relays) are presented. The connecting and disconnecting (ECD) system is also studied: circuit breakers, switches and disconnectors. Emphasis on safety will be highlighted, both in terms of the protection of people and the same facilities, lines, transformers, motors and loads.

Related activities:
Classroom activities theory: solving examples that clarify the theoretical presentations.
Building activities: Troubleshooting the March issue of the collection of the subject.

Project 2 - Landside facilities.
Labs 5 and 6.

Specific objectives:
a) To understand the possible malfunctions of an electrical system to prevent overloads and short circuits.
b) To define and describe the different types of relays.
c) To choose the best protection for each electrical system.
d) To understand the operation of switches.
e) To understand the different power distribution systems: centralized and distributed.
f) To know the different signaling possibilities to choose the most appropriate in terms of the signal to be transmitted.
g) To know the effects of current on the human body depending on its intensity.
h) To know how to predict the possible types of accidents.

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Topic 5: Installations of an airport

Learning time: 48h

Theory classes: 12h
Laboratory classes: 6h
Guided activities: 2h
Self study : 28h

Description:
This chapter is divided into three main sections:
- High voltage, which describes the typical characteristics of electricity reaching the airport from power plants.
- Medium voltage, which describes internal transport systems of the airport. Here, we take into account the secondary generation facilities, generators, systems continuity.
- Low voltage, which describes all the facilities associated with consumption, both for the operation of the airport and aeronautical commercial facilities present.

Related activities:
Classroom activities theory: solving examples that clarify the theoretical presentations.
Building activities: Troubleshooting the March issue of the collection of the subject.

Project 2 - Landside facilities.
Labs 7

Specific objectives:
a) To know the sources of supply of airport facilities.
b) To know how to transform electric energy to the power and voltage levels appropriate.
c) To know how to solve problems with transformers, single and three phase.
d) To know how to calculate the electrical needs of an airport to size the electrical system.
e) To understand and design a backup power system.
f) To know how to deploy units for brief interruption of continuity (SAI).
g) To know how to design and electronics line diagrams.
h) To know the electrical installations for aircraft support.

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Topic 6: Generation and Efficiency	Learning time: 9h Theory classes: 0h Guided activities: 4h Self study : 5h

Description:
This chapter discusses the characteristics of airport facilities for good efficiency while ensuring their safety. Also presents generation systems and internal management to cut down the cost of energy consumption from the airport.

Related activities:
Project 2 - Landside facilities.

Specific objectives:
a) To design power systems using renewable energy in airports.
b) To outline the operation of a photovoltaic system and solar thermal.
c) To outline the operation of a wind power plant and its components.
d) To know what sources of energy loss.
e) To dimension installation to maximize performance, compliance with regulations.

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Planning of activities

PROJECT 1 - AIRSIDE FACILITIES	Hours: 36h Theory classes: 10h Laboratory classes: 6h Self study: 20h

Description:
Project in English summarizing the characteristics of the airside airport facilities.

Support materials:
Course notes and problems resolved during the course.
National and international electrical regulations.
Texts of the literature

Descriptions of the assignments due and their relation to the assessment:
Report
Oral presentation

Specific objectives:
Evaluation of the achievement of the competencies described in Chapters 2 and 3

MIDTERM EXAM	Hours: 6h 30m Theory classes: 1h 30m Self study: 5h

Description:
Midterm exam 1.5 h duration

Support materials:
Course notes and problems solved during the course.

Descriptions of the assignments due and their relation to the assessment:
Solved test.
Weight rating: 20%.

Specific objectives:
Evaluation of the achievement of the competencies described in chapters 1, 2 and 3

PROJECT 2 - LANDSIDE FACILITIES	Hours: 36h Theory classes: 10h Laboratory classes: 6h Self study: 20h

Description:
Project in English summarizing the characteristics of the landside airport facilities.

Support materials:
Course notes and problems resolved during the course.
National and international electrical regulations.
Texts of the literature

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Descriptions of the assignments due and their relation to the assessment:
Report
Oral presentation

Specific objectives:
Evaluation of the achievement of work-related skills on airport facilities, specifically on efficiency and alternative generation. This include the aims of chapters 4, 5 and 6.

FINAL EXAM	Hours: 6h 30m Theory classes: 1h 30m Self study: 5h

Description:
Final exam focused on chapters 3, 4, 5 and 6, but need to have attained knowledge of chapters 1 and 2.

Support materials:
Course notes and problems solved during the course.

Descriptions of the assignments due and their relation to the assessment:
Solved test.
Weight rating: 20%

Specific objectives:
Evaluation of the achievement of the competencies associated with chapters 3, 4, 5 and 6 as well as verification of knowledge on chapters 1 and 2.

PORTFOLIO	Hours: 72h Theory classes: 10h Laboratory classes: 26h Self study: 36h

Description:
Collect all the products developed during the practice sessions and assessments of others workd and projects. At least, it must include:
- Lab reports
- Assessments of the others' works
- Notes
- Class Problems

Support materials:
Reports, works assessments, notes, problems ...

Descriptions of the assignments due and their relation to the assessment:
Group Portfolio

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Specific objectives:

With this portfolio the student should be able to:

· Perform and plan experimental measurements.
· Know how to design programs and electronics with computer-aided design.
· Knowing simulate electrical installations of low, medium and high voltage.

General skills:

· To know how elaborate English summaries.
· To know how to evaluate the work of others.
· To know how to use laboratory instruments properly.
· To know the specifications of the measuring instruments and how these specifications affect the measurements.

Qualification system

Tests: 40%.
- Half-semester exam: 20%.
- Final exam: 20%.

Projects: 45%
Two projects will be assessed.
- Reports: 25%
- Presentations: 20%

Portfolio: 15%
It is divided into two parts: all the material up to half semester (7.5%) and the full portfolio at end of semester (7.5%).
- Reporting practices.
- Evaluations of others' work.
- Sketches.
- Class problems.

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Regulations for carrying out activities

Tests and controls
Exams and tests are individual. They will last an hour and a half. Only pen and calculator can allowed. Any mobile communication system (phones, laptops, PDAs ...) is allowed. They consist of solving problems related to the issues discussed in the course.

Projects
Projects will be done in groups and will include a study of literature on a topic related to electrical installations, together with an experimental design or component depending on the case. The job description will be given through the Digital Campus. Project sessions during theoretical sessions will be scheduled.

Problems
A problem collection will be proposed, to be solved in groups, both at class and outside class. They will be corrected during the course.
Practical
Practices are mandatory and will be developed in the laboratory. In case of no attendance the session is evaluated as zero. Work will be performed in groups. It will be necessary to have a logbook, which will also cover the objectives of the session, commented and discussed preliminary studies and the experimental results obtained during the session.

Portfolio
All documentation generated should be organized in the portfolio of the subject. Portfolio must contain at least:
- Lab reports.
- Reports of the work done.
- Summaries of others' projects.
- Assessments of other groups.

Bibliography

Basic:

Sanjurjo Navarro, R. Sistemas eléctricos en aeropuertos. Madrid: Ed. Centro de Documentación y Publicaciones de Aena, 2004. ISBN 8495135914.

"Annex 14 Aerodromes". ICAO [on line]. Available on: <www.icao.int>.

"Part 5 - Electrical Systems". Aerodrome design manual. DOC 9157-AN/901.

Organización de Aviación Civil Internacional. Manual de proyecto de aeródromos. 2a ed. Montreal: Ed. OACI, 1983.

Complementary:

García Galludo, M.; Sanjurjo Navarro, R. Sistemas energéticos en aeropuertos. 2ª ed. Madrid: Ed. Fundación AENA, 2000. ISBN 8495567377.

Sanjurjo Navarro, R. Sistemas eléctricos en aeropuertos. Madrid: Ed. Centro de Documentación y Publicaciones de Aena, 2004. ISBN 8495135914.

Seip, Günter G.; Sturm, Werner. Instalaciones eléctricas (o.c.). 2a ed. Berlin: Ed. Siemens Aktiengesellschaft, 1989. ISBN 3800915448.

Others resources: