

Course guide

300323 - CIASA-OA - Air Conditioning and Installations in Aircraft and Airport Systems

Last modified: 22/01/2024

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 717 - DEGD - Department of Engineering Graphics and Design.

Degree: BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Definit a la infoweb de l'assignatura

Others: Definit a la infoweb de l'assignatura

PRIOR SKILLS

Sufficient knowledge of Physics and Thermodynamics.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:

CG1. (ENG) CG1 - Capacidad para el diseño, desarrollo y gestión en el ámbito de la ingeniería aeronáutica que tengan por objeto, de acuerdo con los conocimientos adquiridos, los vehículos aeroespaciales, los sistemas de propulsión aeroespacial, los materiales aeroespaciales, las infraestructuras aeroportuarias, las infraestructuras de aeronavegación y cualquier sistema de gestión del espacio, del tráfico y del transporte aéreo.

CG2. (ENG) CG2 - Planificación, redacción, dirección y gestión de proyectos, cálculo y fabricación en el ámbito de la ingeniería aeronáutica que tengan por objeto, de acuerdo con los conocimientos adquiridos, los vehículos aeroespaciales, los sistemas de propulsión aeroespacial, los materiales aeroespaciales, las infraestructuras aeroportuarias, las infraestructuras de aeronavegación y cualquier sistema de gestión del espacio, del tráfico y del transporte aéreo.

CG8. (ENG) CG8 - Conocimiento, comprensión y capacidad para aplicar la legislación necesaria en el ejercicio de la profesión de Ingeniero Técnico Aeronáutico.

CG5. (ENG) CG5 - Capacidad para llevar a cabo actividades de proyección, de dirección técnica, de peritación, de redacción de informes, de dictámenes, y de asesoramiento técnico en tareas relativas a la Ingeniería Técnica Aeronáutica, de ejercicio de las funciones y de cargos técnicos genuinamente aeroespaciales.

01 UEQ N1. EFFICIENT USE OF EQUIPMENT AND INSTRUMENTS - Level 1: Using instruments, equipment and software from the laboratories of general or basic use. Realising experiments and proposed practices and analyzing obtained results.

Transversal:

01 EIN N1. ENTREPRENEURSHIP AND INNOVATION - Level 1. Showing enterprise, acquiring basic knowledge about organizations and becoming familiar with the tools and techniques for generating ideas and managing organizations that make it possible to solve known problems and create opportunities.

05 TEQ N3. 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.

07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

06 URI N2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

Basic:

CB2. (ENG) CB2 - Que los estudiantes sepan aplicar sus conocimientos a su trabajo o vocación de una forma profesional y posean las competencias que suelen demostrarse por medio de la elaboración y defensa de argumentos y la resolución de problemas dentro de su área de estudio

TEACHING METHODOLOGY

Combine lectures which Professor exposes the contents of the field. These explanations are combined with exercises posed to students in order to complete the theoretical explanations.

The subject is taught from the outset with a practical orientation so that students can reinforce their training in the subject through the elaboration of projects.

From the first day will attend individually each student for to begin a project that must be paid at the end of the semester.

Will be held with reasoning inductive and deductive using Blackboard and technologies ICT

activities for the design and calculation of elements of air conditioning or refrigeration plants to solve in class will be raised. The student will see through the use of CAD software 3D SolidWorks FloXpress simulation of the flow of coolant through models that will prepare students of parts or assemblies in your project, so you will find problem areas calculated analytically.

Will also perform the analysis and study of the transmission of heat from one object to another refrigerant.

In the laboratory sessions will combine slate with ICT technologies and each student will have a computer with appropriate software to perform the exercises, when necessary, they will be proposed in class.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course of air conditioning and facilities in aircraft and airport systems, the student has to be capable of:

- identify elements of the facilities of refrigeration and air conditioning systems airport.
- Identify the elements of refrigeration and air conditioning of aircraft in general in flight.
- Identify the elements of refrigeration and air conditioning of aircraft in general on Earth.
- Design and calculation facilities of refrigeration and air conditioning of the airport systems.
- Designing and calculating facilities for spaces in airports to store goods that they cannot break the cold chain.
- Explain the principle of utilization of air from the engines of the aircraft and the techniques that exist for winterizing the cabin air (heating, cooling, humidification, dehumidification, ventilation and pressurization of the cabin of flight and passenger air)
- Design and in general calculate the components of refrigeration and air conditioning of the aircraft in flight.
- To design and calculate the components of refrigeration and air conditioning of aircraft in general on Earth.
- Use an advanced CAD program to draw, develop or redesign elements calculated analytically.
- Project, design and calculate an installation air conditioning (cooling or heating) in general, and in particular of the aircraft, taking into account other facilities necessary to its operation (a project multidisciplinary)

STUDY LOAD

| Type | Hours | Percentage |
|-------------------|-------|------------|
| Hours large group | 36,0 | 24.00 |
| Hours small group | 24,0 | 16.00 |
| Guided activities | 6,0 | 4.00 |
| Self study | 84,0 | 56.00 |

Total learning time: 150 h

CONTENTS

Air conditioning and refrigeration. Introduction.

Description:

- Presentation, field of application of the subject and explanation of the objectives to be achieved.
- Concept of cold and air conditioning. Refrigeration.
- Types of installations. Fixed systems. Mobile systems.
- Presentation of projects proposed by the teacher. Assignment of the projects to be carried out by the student (individual project) or groups (multidisciplinary project)

Related activities:

- Proposals of the project to be carried out.

Full-or-part-time: 7h 30m

Theory classes: 3h

Guided activities: 3h 30m

Self study : 1h

Air conditioning in airplanes and airports

Description:

- Classification of refrigeration systems and heating systems.
- Air and steam cycle cooling systems in airplanes
- Distribution of air conditioning in airplanes.
- Pressurizing.
- Air conditioning. Cold systems. Refrigeration.

Related activities:

- Selection and assignment of the project to be carried out. Individual assistance of the teacher to the students.

Full-or-part-time: 18h

Theory classes: 6h

Laboratory classes: 2h

Self study : 10h

Refrigeration fluids

Description:

- Historical evolution. Environmental influence. Kyoto Protocol. Montreal Protocol. Concept of regulated substances. Evaluation reports prepared by IPCC.
- Refrigerating fluids. Types and classification. Nomenclature. ASHRAE.
- Refrigerating fluids and refrigerating fluids.
- Mixtures of refrigerants: zeotropic and azeotropic.
- Refrigerants. Thermodynamic properties. Freezing point, specific heat, specific volume, density, temperature.
- Refrigerating fluids for primary and secondary circuits.
- Use of refrigerant fluids in air-conditioning applications in aircraft and airport systems. Refrigeration of the mechanical parts of an aircraft.

Full-or-part-time: 6h

Theory classes: 3h

Self study : 3h



Diagram of Mollier and psicrometry.

Description:

- Types of Diagrams for resolution of air conditioning and refrigeration systems.
- Refrigeration cycles in the Mollier diagram. Carrier Diagram. Application for cold rooms and air conditioning.
- The psychrometric chart. Ashrae psychrometric diagrams. Comfort. Air quality in cabin. Application for comfort in airports and in airplanes. Application for products to be preserved.

Related activities:

- Problems.
- Application to the project being carried out.

Full-or-part-time: 19h

Theory classes: 6h

Laboratory classes: 2h

Guided activities: 1h

Self study : 10h

Compressors

Description:

- Compression.
- Field of application in airplanes.
- Engines and compressors. Classification and types according to the applications.
- Calculation of compressor.

Related activities:

- Problems.
- Application to the project being carried out.

Full-or-part-time: 17h

Theory classes: 3h

Laboratory classes: 4h

Self study : 10h

Lubricants

Description:

- Definition and Types.
- Characteristics.
- Lubricants and refrigerants. Compatibilities.
- Components of lubrication systems. Seals of sealing. Bearings.

Related activities:

- Problems.
- Application to the project being carried out.

Full-or-part-time: 5h

Laboratory classes: 2h

Self study : 3h



Heat exchanger for refrigeration and air-conditioning installations.

Description:

- Types of heat exchanger and refrigeration.
- The condenser. Concept. Types and classification.
- Design and calculation of heat exchangers to condense.
- Manufacture of capacitors.
- The evaporator. Concept. Types and classification.
- Defrosting. Types.
- Design and calculation of heat exchangers to evaporate.
- Manufacture of evaporators.
- Applications at airports.

Related activities:

- Application to the project being carried out.

Full-or-part-time: 17h

Theory classes: 3h

Laboratory classes: 4h

Self study : 10h

Accessories, containers, regulation, control and safety

Description:

- Pressure vessels. Types. Design and calculation. Type record. Manufacturing.
- Valves, Distributors, Filters, Pressure switches, Thermostats, Safety valves.
- Isolation.
- Automations.
- Electric panels.

Related activities:

- Application to the project being carried out.
- Problems

Full-or-part-time: 15h

Theory classes: 3h

Laboratory classes: 2h

Self study : 10h



Welding in air conditioning and refrigeration

Description:

- Types of welding for air conditioning and refrigeration.
- Approval of welders.
- Approval of the procedure. Automation for series production.
- Authorized inspection bodies. Inspections.

Related activities:

- Application to the project being carried out.
- Problems

Full-or-part-time: 5h

Theory classes: 3h

Self study : 2h

CAD FloXpress SW Design

Description:

- Knowledge and use of the SolidWorks CAD software FloXpress module

Related activities:

- Application to the project being carried out.

Full-or-part-time: 10h

Laboratory classes: 2h

Self study : 8h

Engineering projects in air conditioning and refrigeration

Description:

- Architecture of air conditioning and refrigeration systems in airports and airplanes.
- Calculation of ducts. Moody's Abacus.
- Design, layout and interpretation of diagrams and schemes of air conditioning and refrigeration. Symbology.
- Legislation and regulations.

Full-or-part-time: 30h 30m

Theory classes: 6h

Laboratory classes: 6h

Guided activities: 1h 30m

Self study : 17h



ACTIVITIES

Exam #1: ExMQ

Description:

Problems

Specific objectives:

Demonstrate that you have mastery of the knowledge you have seen so far

Material:

Student's notes

Delivery:

Written

Full-or-part-time: 1h 30m

Guided activities: 1h 30m

Exam #2: ExFQ

Description:

Problemes

Specific objectives:

Demonstrate that you have mastery of the knowledge you have seen so far

Material:

Student's notes

Delivery:

Demostrar que se tiene dominio de los conocimientos vistos hasta ese momento

Full-or-part-time: 1h 30m

Guided activities: 1h 30m

Basic test: CQ

Description:

Test

Specific objectives:

It is a question of proving by means of a test type test, that are being acquired the minimum competences essential to be able to follow the subject.

Class attendance and understanding of the explanations should be sufficient to overcome this test.

Material:

Without reference material.

Delivery:

Writing

Full-or-part-time: 1h

Guided activities: 1h



Project: ADPR

Description:

It is about doing a project related to the subject from the first day.
It will be supervised by the teacher

Delivery:

End of the term.
The final date will be agreed with the teacher.

Full-or-part-time: 2h

Guided activities: 2h

GRADING SYSTEM

Defined in the infoweb of the subject

EXAMINATION RULES.

All proposed activities are mandatory.

BIBLIOGRAPHY

Basic:

- García Pérez, Alberto. Diseño de motores de aviación comercial. Madrid: Centro de Documentación y Publicaciones de Aena, 2008. ISBN 9788492499090.
- Kerrebrock, Jack L. Aircraft engines and gas turbines [on line]. 2nd ed. Cambridge, Mass.: MIT Press, 1992 [Consultation: 05/10/2023]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=6243327>. ISBN 0262111624.
- Miranda, Ángel Luis. Manual técnico de refrigerantes : [incluye contenidos técnicos para el estudio y práctica de refrigerantes, principalmente fluorados ...]. Barcelona: Marcombo, 2012. ISBN 9788426717696.
- Esteban Oñate, Antonio. Conocimientos del avión. 6ª ed. Madrid: Thomson-Paraninfo, cop. 2007. ISBN 9788428329514.
- Rapin, Pierre J. Instalaciones frigoríficas. Barcelona: Marcombo. Boixareu, 1978-1979. ISBN 8426703488.
- Sanjurjo Navarro, Rafael. Sistemas eléctricos en aeropuertos. [Madrid]: Centro de Documentación y Publicaciones de Aena, 2004. ISBN 8495135914.
- Silberstein, Eugene. Refrigeration & air conditioning technology. Ninth edition. Boston: Cengage, [2021]. ISBN 9780357122273.
- Sapali, S.N. Refrigeration and air conditioning. Second edition. New Delhi: PHI Learning, 2014. ISBN 9788120348721.
- Desmons, Jean; Le Roy, Léoric. Régulation en génie climatique: froid-Climatisation-Chauffage. 4e édition. Malakoff: Dunod, [2020]. ISBN 9782100809233.
- Jacquard, Patrick; Sandre, Serge. La Pratique du froid. 6e edition. Paris: Dunod : Pyc Média, 2019. ISBN 9782100801558.
- Egg, Jay; Cunniff, Greg; Orio, Carl D.. Modern geothermal HVAC : engineering and control applications. New York: McGraw Hill Education, [2013]. ISBN 9780071792684.
- Kleinert, Eric. HVAC and refrigeration preventive maintenance. New York: McGraw Hill Education, [2015]. ISBN 9780071825658.
- Rapin, Pierre; Sandre, Serge. Formulaire du froid : technologie des matériels frigorifiques, automatismes et régulation, applications sectorielles, maintenance et sécurité. 15a ed.. Paris: Dunod : La RPF, [2014]. ISBN 9782100708963.
- Porges, F.. HVAC engineer's handbook. 11a ed.. Oxon ; New York: Routledge, 2020. ISBN 9780367578886.

Complementary:

- Desmons, Jean. Aide-mémoire Froid industriel. 4e édition. Paris: RPF: Dunod, [2018]. ISBN 9782100782796.
- Therville, Robert. L'Abc du froid : je monte ... j'entretiens ... je dépanne 3a ed.. Paris: PYC Livres, 2013. ISBN 9782862431086.

RESOURCES



Other resources:

Room computers

SolidWorks Program