Aircraft Engines I

Code: MK3REH1J08JL20-EN
ECTS Credit Points: 8
Evaluation: mid-semester grade
Semester: 5th semester
Its prerequisite(s): Thermodynamics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 4+4

Topics:

Historical overview, classification, basic operation and fields of application. Basic parameters of jet engines, intermittent and ramjet engines, gas turbine jet engines, turbojet and turbofan engines, turboshaft engines: turboprop and propfan engines. Gas dynamics, similarity theory. Intake ducts, combustion chambers, compressor instabilities. Axial compressors and turbines. Dimensionless numbers. Characteristics. Speed triangles. Euler turbine equation. Stage characteristics and T-s diagram, possibilities of increasing the stage pressure ratio. Degree of reaction, 3D flow - blade twist and its laws. Centrifugal

compressors. General structural design of gas turbine aircraft engines. Design of discs. Structure and design of suction ducts (diffusers).

Literature:

Compulsory:

- Cohen H, Rogers G, Saravanamutto H: Gas Turbine Theory. Longman. New York. 1998.
- Gordon C. Oates: Aerothermodynamics of Gas Turbine and Rocket Propulsion. AIAA Education Series. 1988.
- Ahmed F. El-Sayed: Aircraft Propulsion and Gas Turbine Engine. ISBN 978-0-8493-9196-5. Taylor & Francis. 2006.
- Treager I. E.: Aircraft Gas Turbine Engine Technology. McGraw-Hill. 2000.

Schedule

1st week Registration week	
2nd week: **Lecture:** Historical overview, classification, basic operation and fields of application. Basic parameters of jet engines, intermittent and ramjet engines, gas turbine jet engines, turbojet and turbofan engines, turboshaft engines: turboprop and propfan engines. **Practice:** Solving and practicing the numerical examples necessary for mastering the theoretical part of the curriculum; discussion of related issues.	**3rd week:** **Lecture:** Gas dynamics, similarity theory. Intake ducts, combustion chambers, compressor instabilities. **Practice:** Solving and practicing the numerical examples necessary for mastering the theoretical part of the curriculum; discussion of related issues.
4th week: **Lecture:** Axial compressors and turbines: introduction, classification, application and basic operation. Dimensionless numbers. **Practice:** Solving and practicing the numerical examples necessary for mastering the theoretical part of the curriculum; discussion of related issues.	**5th week:** **Lecture:** Characteristics. Speed triangles. Euler turbine equation. Stage characteristics and T-s diagram, possibilities of increasing the stage pressure ratio. **Practice:** Solving and practicing the numerical examples necessary for mastering the theoretical part of the curriculum; discussion of related issues.
6th week: **Lecture:** Degree of reaction, 3D flow - blade twist and its laws.	**7th week:** **Lecture:** Centrifugal compressors, radial turbines: thermodynamic and flow

Practice: Solving and practicing the numerical examples necessary for mastering the theoretical part of the curriculum; discussion of related issues.	characteristics. Speed triangles. Centrifugal compressors pre-spin: backward-bending, radial and forward-bending vanes. **Practice:** Solving and practicing the numerical examples necessary for mastering the theoretical part of the curriculum; discussion of related issues.
8th week: 1st drawing week	1st Mid-term test
9th week: **Lecture:** Mass, momentum and energy conservation, spin shrinkage factor, losses, real characteristics. Determination of the main dimensions of centrifugal compressors and radial turbines. **Practice:** Disassembly and assembly practice of gas turbine engines.	10th week: **Lecture:** General structural design of gas turbine aircraft engines. Power systems of engines, forces acting on rotating and stationary parts. Attaching the engine to the aircraft. **Practice:** Disassembly and assembly practice of gas turbine engines.
11th week: **Lecture:** Structural design of centrifugal and axial compressors. Bearings, requirements, clearances. Axial and radial gaps. Structural design and main types of axial turbines. Rotating and stationary blade designs, blade connections. **Practice:** Disassembly and assembly practice of gas turbine engines.	12th week: **Lecture:** Design of discs. Strength calculation of rotating blades. Calculation of blade connections. **Practice:** Disassembly and assembly practice of gas turbine engines.
13th week: **Lecture:** Structural design and structural materials of combustion chambers and afterburners. Construction and structural design of nozzles. Structure and design of suction ducts (diffusers). **Practice:** Disassembly and assembly practice of gas turbine engines.	14th week: **Lecture:** Additional options for increasing the temperature before the turbine. Development perspectives of the construction and structural solutions of engines. **Practice:** Disassembly and assembly practice of gas turbine engines.
15th week: End-term test	

Requirements

A, for a signature:

The criterion for the signature is the successful completion of the two written examinations during the semester and successful completion of each of the laboratory practices. In case of insufficient written examination, it is possible to make up for it.

B, for a grade:

The mid-term grade is the arithmetic average of the results of the two written examinations rounded up.