OFFERING COURSE: **Thermo-fluid Dynamics Design of Fluid Machinery**			
ACADEMIC YEAR: **2017/18**			
TYPE OF EDUCATIONAL ACTIVITY: **Distinguishing**			
INSTRUCTOR: **Vinicio Magi, Full Professor**			
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Language: **Italian**			
ECTS: **9**	Course hours: **81**	Campus: **Potenza** Dept./School: **School of Engineering** Program: **Laurea Magistrale**	Semester: **Spring**

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

To educate mechanical engineering students in the fundamentals of thermo-fluid dynamics design of fluid machinery and their application to important practical problems using design, analysis, and synthesis of mechanical components, systems, and tools, and through basic and applied research.

The course will provide students with the necessary tools to evaluate the criteria of choice and design of the elements constituting the fluid machinery in order to influence the performance characteristics and efficiency of both the individual components of the fluid machinery and the machine as a whole.

PRE-REQUIREMENTS

To facilitate the study of this course it is suggested to take in advance the following exams: Applied Energy, Heat Transfer and Principles of Fluid Mechanics for Internal Combustion Engines and Turbomachinery. The knowledge of the fundamental concepts of Thermodynamics, Fluid Mechanics, Fluid Dynamics and Numerical Analysis are essential for a simple and quick learning of the topics covered in this course.

SYLLABUS

1. Elements of thermodynamics and fluid dynamics (8 hours).
   Energy conversion in fluid machinery with stationary flow. Entropy diagram. De Laval nozzles in series. Euler theorem. Politropic thermodynamic transformation.
2. Steam thermal power plants (20 hours).
   Diagrams and power plant components. Heat regenerators. Special problems at low pressure. Design challenges and their solutions: material stress, diaphragms, discs, shafts, drums, seals, housings, thrust and load bearings, turning low-rpm engine. Impulse and reaction steam turbines, choice of the number of revolutions, stages under fluid dynamic similarities, two-dimensional axisymmetric study. Regulation and safety performance outside design conditions, control systems, safety and control.
3. Rotary compressors (14 hours).
   Vane, Roots, gear and screw compressors. Work cycles. Losses, scavenging performance. Control of rotary compressors.
4. Centrifugal compressors (18 hours).
   Design elements and challenges. Operating conditions of centrifugal compressors. Pre-wheel. Characteristic curves. Control. Notes on axial compressors.
5. Hydraulic transmissions (9 hours).
   Volumetric rotary pumps and motors. Control of hydraulic transmissions. Fluid couplings. Torque converters polyphase and multistage.
6. Internal combustion engines (ICEs) (12 hours).
   Classification. Reciprocating and rotary engines. Notes on Wankel engine. Turbochargers. ICEs with compressor mechanical control and with turbocharger exhaust gas. Performance and efficiency of turbo engines. Types of fuels. Requirements of fuels. Automotive pollution and choice of techniques to reduce pollutants. Construction drawings of automotive engines.

TEACHING METHODS

The course includes 81 hours of teaching between lessons and practice. In particular, the course includes 48 hours of frontal theoretical lessons and 33 hours of laboratory tutorials. At the end of the course, technical visits to electricity power plants and fluid machinery laboratories of other universities and research centers will be organized.

EVALUATION METHODS

The aim of the exam is to test the level of achievement of the previously mentioned educational goals.
The exam consists of 3 parts:

- Written exam which provides the solution of numerical exercises on all topics covered in the course. This exam is intended to evaluate the understanding of the basic issues of the course and to provide a first selection (i.e., the student who does not show sufficient knowledge of the subjects is not admitted to the subsequent tests). The student must acquire at least 18 points out of 30 to pass this test. It is not allowed to consult texts or use PCs.
- Project exam with the aim of assessing whether the student has acquired the ability to set up and solve design problems for fluid machinery and energy systems. The student must acquire at least 18 points out of 30 to pass this test.
- Oral exam which will assess the ability to compare different aspects covered during the course. The student must acquire at least 18 points out of 30 to pass this test.

The final grade is the average of the 3 scores. If one of the 3 trials are lacking or if the total score is less than 18, the student must repeat all 3 tests.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Notes provided by the Instructor.
Specific topics can be explored on the following textbooks:

1. D. Giacosa, "Motori Endotermici", Hoepli, Milano.
2. S. Sandrolini, G. Naldi, "Macchine", Pitagora, Bologna.
3. O. Acton, C. Caputo, "Impianti Motori", UTET, Torino.
4. J. H. Horlock, "Axial Flow Compressor", Buttherwords, London.
5. J. H. Horlock, "Axial Flow Turbines", Buttherwords, London.
6. L. Vivier, "Turbines a` Vapeur et a` Gaz", Ed. Albin, Paris.

INTERACTION WITH STUDENTS

At the beginning of the course, after describing the objectives, program and methods of verification, the Instructor provides educational materials (shared folders, notes, website, useful links, etc.). At the same time, the Instructor collects the mailing list of the students who want to attend the course, together with their name, serial number and email for communications.
Office hours : Tuesdays 10:00am - 2:00pm and Wednesday 3:00pm - 7:00pm at Campus Macchia Romana, School of Engineering (Engineering Building, Fifth floor, Room n . 70).
In addition to weekly reception, the Instructor is available at all times for a contact with the students, through their e-mail or telephone contact .

EXAMINATION SESSIONS (FORECAST)[1]

Jan 22, 2018 – Mar 26, 2018 – May 21, 2018 – Jul 09, 2018 – Sep 17, 2018 – Nov 12, 2018

SEMINARS BY EXTERNAL EXPERTS YES X NO □

FURTHER INFORMATION

[1] Subject to possible changes: check the web site of the Instructor or the Department/School for updates.