Course Title	Hydraulics and Pneumatics				
Course Code	ME 310				
Course Type	Compulsory				
Level	BSc Level				
Year / Semester	3rd year / 5th semester				
Teacher's Name	Dr.-Ing. Paris A. Fokaides				
ECTS	6	Lectures / week	3	Laboratories/week	1
Course Purpose	This course examines the construction, principles of operation, and calculation of hydraulic and pneumatic power systems. Special attention is paid to building a solid theoretical background in the subject, which should enable the students to go on to further study and analysis of the static and dynamic performance of the different fluid power elements and systems. In addition to theory, the course includes case studies of typical construction elements of hydraulic and pneumatic power systems. These elements are categorized, and the special features of their design and performance are discussed.				
Learning Outcomes	1. Classify power systems into mechanical, electrical, pneumatic, hydrodynamic and hydrostatic. 2. Recognize and outline the main components of a hydraulic and a pneumatic system. 3. Interpret the main properties of hydraulic oils and classify hydraulic fluids. 4. Calculate the appropriate internal and external diameter of hydraulic transmission lines as well as the pressure and power losses in hydraulic conduits 5. Perform ideal and real pump analysis 6. Classify hydraulic pumps into bent axis, swash plate, axial piston, radial piston, external gear, internal gear and screw pumps. 7. Outline hydraulic control valves (pressure control, directional control, check and flow control valves). 8. Analyze hydraulic actuators, including hydraulic cylinders, hydraulic rotary actuators and hydraulic motors. 9. Explain the peculiarities of pneumatic systems and the effects of air compressibility, air density and air viscosity 10. Calculate the properties and the performance of basic pneumatic circuits. 11. Set-up, regulate and operate a hydraulic circuit in lab by connecting all hydraulic elements in a proper way 12. Set-up and operate meter-in, meter-out and by-pass flow control circuits. 13. Demonstrate pressure intensification in a cylinders-in-series circuit				

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<tr><td></td><td colspan="3">14. To calculate the torque and speed of a hydraulic motor and a hydraulic pump and determine the effect a change in flow rate or pressure has on motor operation.</td></tr>
<tr><td>Prerequisites</td><td>ME 200 Thermodynamics I
ME 202 Fluid Mechanics I</td><td>Corequisites</td><td></td></tr>
<tr><td>Course Content</td><td colspan="3">1.Introduction to Hydraulic Power Systems
- The Classification of Power Systems
- Pneumatic Power Systems
- Basic Hydraulic Power Systems
- Comparison of Power Systems
2.Hydraulic Oils and Theoretical Background
- Basic Properties of Hydraulic Oils
- Classification of Hydraulic Fluids
- Typically Used Hydraulic Fluids
- Requirements Imposed on the Hydraulic Liquid
3.Hydraulic Transmission Lines
- Hydraulic Tubing
- Rigid Pipes and Hoses
- Pressure and Power Losses in Hydraulic Conduits
- Minor Losses
- Friction Losses
4.Hydraulic Pumps
- Ideal Pump Analysis
- Real Pump Analysis
- Classification of Pumps
- Variable Displacement Pumps
- Rotodynamic Pumps
5.Hydraulic Control Valves
- Pressure-Control Valves
- Directional Control Valves
- Check Valves
- Flow Control Valves
6.Hydraulic Actuators
- Hydraulic Cylinders
- Hydraulic Rotary Actuators
- Hydraulic Motors
7.Introduction to Pneumatic Systems
- Peculiarities of Pneumatic Systems
- Advantages and Disadvantages of Pneumatic Systems
- Basic Elements of Pneumatic Systems
- Basic Pneumatic Circuits
Laboratory Exercises:
1. Lab Exercise 1: Hydraulic Power Transmission Systems
2. Lab Exercise 2: Flow Rate and Velocity
3. Lab Exercise 3: Cylinders in Series
4. Lab Exercise 4: Hydraulic Motor Circuits
5. Lab Exercise 5: Pneumatic Power Transmission Systems</td></tr>
<tr><td>Teaching</td><td colspan="3">The teaching methodology of this course will be based on lecturing,</td></tr>
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Methodology	demonstrating and collaborating. - Lecture notes, comprising of the fundamentals of each module of the course will be prepared and presented in class on a weekly basis. The notes will introduce the major concepts and will focus on specific learning outcomes of the course. - Demonstration activities including the solution of worked examples in class on a weekly basis, as well as laboratorial work will also be employed. For each fundamental concept, at least one worked example will be solved during lectures. The laboratory work will cover all major topics of the course, allowing the students to personally relate to the presented knowledge. - Collaborating teaching through classroom discussion and debriefing will also be encouraged during lectures. Besides from the notes taken by students in class, all of the course material will be made available through the class website and also through the eLearning platform. The instructor will also be available to students during office hours or by appointment in order to provide any necessary tutoring.
Bibliography	Textbook: Rabie, M. G. (2009). Hydraulic Power Engineering. McGraw-Hill Education. References: - Esposito, A. (2003). „Fluid Power with Applications", Fourth Edition, Prentice Hall. - Evett, J.B., Liu, C. (1989): 2500 solved problems in Fluid Mechanics and Hydraulics. McGraw Hill.
Assessment	Students will be assessed through: - Biweekly quiz concerning the laboratory exercises - A midterm test at the 7th week of the course, examining the fundamentals of hydraulic oils, hydraulic transmission lines and hydraulic pumps - A final test at the end of the semester, in which all material will be examined. The weights of the course assessment are as follows: Lab Quiz: 20% Midterm Exams: 20% Final Exams: 60%
Language	English