ME3360 Fluid Power Systems

Jan-term Syllabus

Instructor: Dr. Edmond Richer, Embrey 301D, x8-3059, richer@lyle.smu.edu

Course Description:

Fluid power plays an important role in many sectors of the economy: aerospace, machine tools, agricultural, industrial, processing equipment, transportation vehicles, etc. This course builds on the Fluid Mechanics and Dynamics courses and provides students with a theoretical framework as well as practical knowledge of fluid power systems.

Principles of operation, mathematical models, design criteria, performance characteristics, operation, and maintenance of fluid power systems are discussed. Advantages and limitations of fluid power, the prevailing industrial standards, the ANSI/ISO graphic symbols used for circuit representation, and performance of standard fluid power components such as pumps, motors, valves, cylinders, etc. are studied. Circuits for directional, speed, pressure, and flow control are discussed relative to system performance goals.

Through practical/demo lectures and design project students will gain familiarity with the actual components and fluid power circuits found in common industrial applications.

Instructor Bio:

Prof. Richer has degrees in Mechanical Engineering (EngDeg and PhD) from the University of Craiova, Romania, and Southern Methodist University respectively. He has been teaching fluid power systems and dynamics and control classes at SMU since 2008. Outside of the classroom, Prof. Richer has an active research program investigating high performance fluid power actuators, advanced manufacturing techniques, and their applications to bio-instrumentation, medical robotics, and soft robots. Prof. Richer frequently uses in class demonstrations based on two state of the art pneumatic and hydraulic trainers.

Course Benefits:

This course will introduce the basic theoretical principles, design techniques, analysis tools for industry prevalent hydraulics and pneumatics systems. Upon successful completion of this course, the student will:

- Have an understanding of the fundamental theoretical concepts governing fluid power
- Have the ability to formulate and analyze mathematical models of hydraulic and pneumatic circuits;
- Be familiar with common hydraulic and pneumatic components (pumps, actuators, motors, valves, etc.), their use, symbols, and their performance characteristics;
- Have the ability to design and implement simple fluid power systems common in industrial applications using commercial components: circuits for directional, speed, pressure, force, and flow control.
- Through practical/demo lectures and design project students will gain familiarity with the actual components and fluid power circuits found in common industrial applications.

Lectures: Location TBD

Website: Canvas

Pre-requisites: ME2342 Fluid Mechanics, ME2320 Dynamics or equivalent.

Required Textbook :

"Fluid Power with Applications", A. Esposito, Prentice Hall, 7th ed., 2008;

Grading:

- Assignments 33%
- Midterm exams (2) 33%
- Final Exam 34%
- Design Project (extra credit) 10%

Homework and Exam Policies:

Six homework assignments will be posted throughout the term. The homework is provided as an exercise for the students, but will not be graded. Homework and additional exercises will be discussed in class. Participation in the demo lectures will be weighted heavily in the class participation grade. Two midterm exams will be given during the Jan-term (Jan 9 - 19) and the final exam on Jan 19th.

Lecture Policies:

Class attendance is mandatory. The class time will be divided between lecture, homework/exercise, demo lectures, and exams. A typical daily schedule will be as follows:

9:00 – 12:00	Lecture
12:00 – 1:00	Break
1:00 – 4:00	Lecture, demo, or Exam.

Lecture topics:

No	Topic
1	Introduction to fluid power; History, applications, advantages and limitations; General components of fluid power systems
2	Introduction to hydraulic systems design; Energy and power in hydraulic systems; Physical properties of hydraulic fluids; frictional losses in hydraulic pipelines
3	Hydraulic Pumps; pumping theory, gear, vane, and piston pumps; pump specifications, performance and selection;
4	Hydraulic Cylinders, Motors, and Rotary Actuators
	Hands-on lectures on the hydraulic trainer

	Exam I
5	Control Components: directional control valves, pressure control valves, flow control valves, servo valves, proportional valves
6	Other circuit components: reservoirs, accumulators, conductors and fittings; Hydraulic fluids, contamination and filtration
7	Hydraulic circuit design and analysis
	Hands-on lectures on the hydraulic trainer
	Exam II
9	Pneumatics theory: mathematical modeling; air preparation and components
10	Pneumatic compressors, cylinders, motors, and rotary actuators
11	Pneumatics: circuits and applications, design considerations
12	Directional, force, and speed control of air cylinders;
13	Pressure Intensifiers; Air-Over-Oil Applications;
14	Hands-on lectures on the pneumatic trainer
16	Research topics / Challenges in fluid power systems design
	Final Exam

Disclaimer: The lecture schedule is tentative and subject to change.

Note: It is highly recommended that students purchase the text book and read at least the first three (3) chapters BEFORE class begins.

Curriculum Professional Component Allocation

Engineering Science and Design: 3 Semester Credit Hours or 100 percent of the course content.

Student Learning Outcomes:

This course fulfills the following Mechanical Engineering Program outcomes:

a. an ability to apply knowledge of mathematics, science, and engineering

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

University Policies:

- Disability Accommodations: Students needing academic accommodations for a disability must first be registered with Disability Accommodations & Success Strategies (DASS) to verify the disability and to establish eligibility for accommodations. Students may call 214-768-1470 or visit http://www.smu.edu/alec/dass to begin the process. Once registered, students should then schedule an appointment with the professor to make appropriate arrangements.

- Religious Observance: Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the

semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (See University Policy No. 1.9.)

- Excused Absences for University Extracurricular Activities: Students participating in an officially sanctioned, scheduled University extracurricular activity should be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (University Undergraduate Catalogue)