King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 436: Fluid Power Systems

Catalogue Description: (3-0-3)
Study of fluid power systems as used in industrial applications to transmit power by the flow of hydraulic fluids. Fluid power circuit diagrams including components, such as, valves, pumps, actuators, filters, intensifiers, reservoirs and accumulators. Design of positive displacement pumps. Analysis of fluid leakage, hydrostatic transmissions, hydraulic stiffness, and performance of positive displacement pumps and actuators.
Status in Curriculum (Required or Elective): Elective

Prerequisites:*ME 311*

Co-requisites: None

Prerequisites by Topics:
1) Basic fluid mechanics definitions asliquid compressibility, bulk modulus, viscosity, head, hydraulic power, etc. (ME 311)
2) Hydrostatics, Pascal's Law, conservation of mass, and conservation of energy. (ME 203, ME 311)
3) Basics of laminar and turbulent flows in pipes including frictional losses in valves and fittings. (ME 311)
4) Flow and pressure measurements. (ME 203 and ME 311)
5) Ideal Gas Systems (ME 203)

Textbook: Anthony Esposito, FLUID POWER WITH APPLICATIONS, 7th edition, Prentice Hall Inc., 2009.

References:

1. Michael J. Pinches and John G.Ashby, Power Hydraulics Prentice Hall Inc., 1988.
2. *Walter Ernst, Oil Hydraulic Power and Its Industrial Applications,* 2nd edition, McGraw-Hill Book Co., *1960.*

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Goals:(general objectives)
1. Introduce students to fundamentals required to understand, analyze and design components used in fluid power systems.
2. Make students familiar with graphical symbols of fluid-power components conforming to international standards.
3. Provide students with a working knowledge of components forming hydraulic circuits.
4. Introduce students to some safety considerations in hydraulic systems.
5. Introduce students to modeling of leakage problem in fluid-power components and computer-aided calculations of leakage in pumps and motors.

Course Outline (Lecture Topics):
1. Introduction, applications of fluid power, standard symbols and some basic circuits, directional, pressure and flow control valves. (7 Classes)
2. Efficiencies of pumps and motors, compressibility, hydraulic stiffness, natural frequency of fluid-power systems, and other important definitions. (7 Classes)
3. Analysis of positive displacement pumps and their ideal and actual performance. (5 Classes)
4. Design procedure for positive displacement pumps. (6 Classes)
5. Hydrostatic transmissions analysis and design. (3 Classes)
6. Cylinders: types, cushioning, usage and control, design and related applied circuits. (6 Classes)
7. Leakage analysis and modeling. (5 Classes)
8. Accumulators and intensifiers analysis and design and some related circuits. (2 Classes)
9. Some applied circuits. (2 Classes)
10. Tests. (2 Classes)

Design Activities/Projects:
A major project on positive displacement-pump design will be assigned. In this project the student will be given only two figures (the pump discharge and pressure rise) and he is requested to design the pump from A to Z. Problems containing design elements include design of hydraulic cylinders and selection of suitable hydrostatic transmissions and accumulators

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Computer Usage:

Students model leakage in fluid-power components and use computer-aided calculations for leakage in pumps and motors.

Laboratory: None

Assessment Tools:

i- Two Major Examinations
ii- Homework Assignments and Term Project
iii- Quizzes
iv- Final Exam (comprehensive)

Course Learning Outcomes:

1. Recognize different components of fluid power and their operation together in a fluid-power system.
2. Read hydraulic diagrams in accordance with ISO or ANSI standards.
3. Recognize different types of pumps and actuators, their use in real life, their theoretical performance and their actual performance.
4. Design positive-displacement pumps for given discharge and pressure rise.
5. Recognize different types of valves and their use in fluid power systems to control direction of flow, pressure (system load) and flow rate (operation speed).
6. Compute the leakage from cylinders, motors and pumps.
7. Demonstrate an understanding of analysis and design of hydraulic circuits and some safety precautions in such circuits.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
Course-to-Student outcome mapping	3	1, 3; 5	2, 4, 5	2, 4	6	7	2	7			2, 6
Emphasis*	**S**	L; M	**S**	S	**S**	M	S	S			S

* **L**: Little/None **M**: Moderate **S**: Strong

Status of Continuous Improvement review of this Course:

Date reviewed: ----------
Reviewed by: Design Dynamics Group
Prepared by: Dr. Maged El-Shaarawi
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