Northeast Wisconsin Technical College

10-620-101 054703 Fluids 2: Basic Hydraulics

Course Outcome Summary

Course Information

Description	10-620-101 FLUIDS 2: BASIC HYDRAULICS ...hydraulic pumps, basic hydraulics actuator circuits, hydraulic schematics, apply Pascal's Law, summarize the effects of fluids friction, define properties of hydraulic energy, design hydraulic circuits with directional control valves. (Corequisite: 10-620-100, Fluids 1: Basic Pneumatics)
Total Credits	1
Total Hours	36

Course History

Last Revision Date	12/14/2017

Employability Skills

1. Communicate Effectively
2. Demonstrate Personal Accountability
3. Solve Problems Effectively
4. Think Critically and Creatively
5. Value Individual Differences and Abilities
6. Work Cooperatively and Professionally

Program Outcomes

1. TSA1 - Perform work safely
2. TSA2 - Troubleshoot electrical and mechanical systems and devices
3. TSA4 - Communicate Technical Information
4. Understand and apply knowledge of electricity, electronics, hydraulics, and electric motors and mechanics.
5. Read technical drawings, schematics, and diagrams.
6. Document technical information through descriptive writing, sketches/diagrams, mathematical expression, computation, and graphs.

7. Perform electrical, mechanical, and fluid measurements by properly selecting tools and test equipment.
8. Perform electrical/mechanical assembly/disassembly, repair, or calibrate components by properly selecting tools and equipment and following procedures.
9. Understand the overall operation and control of machines.
10. Apply critical thinking skills to solving problems.
11. Perform safe work practices.

Course Competencies

1. Explain Hydraulic Components, Schematics and Applications

Assessment Strategies

Homework will be checked for accuracy and completion by Instructor
Lab Activity Packet Quiz given by Instructor
LAP Skill Accomplishment points evaluated on lab station by Instructor
Skill accomplishment test evaluated by Instructor on lab station
Examinations will be taken in a classroom environment and evaluated by Instructor.

Learning Objectives

1.a. Explain Hydraulic Pumps and Applications
1.b. Explain hydraulic flow
1.c. Implement Basic Hydraulic Actuator Circuits
1.d. Utilize Hydraulic Schematics

Criteria

Your performance will be successful when:

1.1. Describe the operation of a fixed-displacement pump and give its schematic symbol.
1.2. Describe the operation of three types of fixed displacement pumps and give an application of each.
1.3. Distinguish between positive displacement and nonpositive displacement pumps.
1.4. Describe the pumping action of pumps.
1.5. Explain the operation of gear, vane, and piston pumps.
1.6. Understand the difference between fixed displacement and variable displacement pumps.
1.7. Explain the operation of pressure-compensated pumps.
1.8. Distinguish between bent-axis-type piston pumps and the swash plate design.
1.9. Differentiate between internal and external gear pumps.
1.10. Define flow rate and explain how it can be measured.
1.11. Describe the operation of two types of flowmeters and give their schematic symbol.
1.12. Connect and read a flow meter.
1.13. Describe the main function of a needle valve.
1.14. Describe the purpose, construction, and operation of various flow control valves.
1.15. Describe the operation of a needle valve and give its schematic symbol.
1.16. Connect and operate a needle valve to control the speed of an actuator.
1.17. Control the speed of an actuator using a manually-operated DCV.
1.18. Describe the function of a hydraulic motor and give an application.
1.19. Describe the operation of a hydraulic motor and give an application.
1.20. Describe the operation of a hydraulic motor and give its schematic symbol.
1.21. List three types of hydraulic motors and give an application.
1.22. Explain the operation of gear, vane, and piston hydraulic motors.
1.23. Connect and operate a bi-directional hydraulic motor using a 3-position, manually-operated DCV.
1.24. Describe eight basic rules for drawing hydraulic schematics.
1.25. Draw a hydraulic schematic from the actual circuit connections on a pictorial.
1.26. Draw a hydraulic circuit given a schematic.
1.27. Design a multiple actuator hydraulic circuit.
1.28. Describe the operation of a complete hydraulic circuit drawn with symbols for all components.
1.29. Homework check-off point worth 8pts. Must achieve 8/8 points.
1.30. LAP Skill Accomplishment points worth 5pts. (Observation and verbal evaluation). Must achieve at

least 5/5 points.
1.31. LAP Skill Accomplishment Test worth 14pts. (Problem solving sheet). Must achieve at least 9/14 points.
1.32. Quiz grade worth 10pts. (Questions: multiple-choice). Must achieve at least 6/10 points.
1.33. Achieve at least 60% on examination.

2. Apply Fundamental Laws to Hydraulic Systems

Assessment Strategies

Homework will be checked for accuracy and completion by Instructor
LAP Skill Accomplishment points evaluated on lab station by Instructor
Skill accomplishment test evaluated by Instructor on lab station
Lab Activity Packet Quiz given by Instructor
Examinations will be taken in a classroom environment and evaluated by Instructor.

Learning Objectives

2.a. Apply Fundamental Laws to Hydraulic Systems
2.b. Summarize the Effects of Fluid Friction
2.c. Define The Fundamental Physical Properties of Hydraulic Energy/Power and Pressure

Criteria

Your performance will be successful when:

2.1. Describe how to calculate the force output of an extending cylinder.
2.2. Describe how to calculate the force output of a hydraulic cylinder in retraction.
2.3. Calculate the extension force of a cylinder given its size and pressure.
2.4. Measure the force output of an extending cylinder.
2.5. Calculate the retraction force of a cylinder given its size and pressure.
2.6. Measure the force output of a retracting cylinder.
2.7. State Pascal's Law and explain its significance in hydraulics.
2.8. Explain how force is multiplied with Pascal's Law.
2.9. Apply Pascal's Law to a hydraulic system.
2.10. Describe two types of resistance in a hydraulic system.
2.11. Explain how Delta P describes hydraulic resistance.
2.12. Explain how pressure is distributed in a hydraulic system.
2.13. Measure Delta P across a hydraulic component.
2.14. Describe two methods of representing hydraulic pressure.
2.15. Describe how oil flows on the suction side of the pump.
2.16. Differentiate between gage pressures and absolute pressures.
2.17. Convert between absolute pressure and gage pressure.
2.18. Differentiate between hydraulic power and hydraulic energy.
2.19. Define the term efficiency.
2.20. Explain the conservation of energy law.
2.21. Calculate fluid flow rates and velocities using the continuity equation.
2.22. Describe the difference between elevation energy, pressure energy, and kinetic energy.
2.23. Homework check-off point worth 8pts. Must achieve 8/8 points.
2.24. LAP Skill Accomplishment points worth 5pts. (Observation and verbal evaluation). Must achieve at least 5/5 points.
2.25. LAP Skill Accomplishment Test worth 12pts. (Problem solving sheet). Must achieve at least 8/12 points.
2.26. Quiz grade worth 9pts. (Questions: multiple-choice). Must achieve at least 6/9 points.
2.27. Achieve at least 60% on examination.

3. Apply Control Components of Hydraulic Circuits

Assessment Strategies

Homework will be checked for accuracy and completion by Instructor
LAP Skill Accomplishment points evaluated on lab station by Instructor
Skill accomplishment test evaluated by Instructor on lab station
Lab Activity Packet Quiz given by Instructor
Examinations will be taken in a classroom environment and evaluated by Instructor.

Learning Objectives

3.a. Identify basic control components of circuits
3.b. Analyze Speed Control Circuits Using Flow Control Valves

Criteria

Your performance will be successful when:

3.1. Describe the function of a relief valve and give an application.
3.2. Describe the operation of a direct-acting relief valve and give its schematic symbol.
3.3. Describe how a relief valve is used for system protection.
3.4. Describe how a relief valve is used for speed control assistance.
3.5. Connect a relief valve in a circuit to limit pressure in the system.
3.6. Describe the function of a check valve and give an application.
3.7. Describe the operation of three types of check valves and give their schematic symbol.
3.8. Design a circuit to provide bypass flow.
3.9. Describe the function of the flow control valve and give an application.
3.10. Describe the operation of a flow control valve and give its schematic symbol.
3.11. Describe the effect of actuator load changes on flow control valve operation.
3.12. Describe the purpose, construction, and operation of various flow control valves.
3.13. Analyze how flow control valves can control the speed of hydraulic cylinders.
3.14. Differentiate between a non-compensated and a compensated flow control valve.
3.15. Connect and adjust a flow control valve to control speed of an actuator.
3.16. Describe the operation of a meter-in flow control circuit and give an application.
3.17. Describe the operation of a meter-out flow control circuit and give an application.
3.18. Connect and operate a meter-in flow control circuit.
3.19. Connect and operate a meter-out flow control circuit.
3.20. Define independent speed control and give an application.
3.21. Explain how speed control valves can be used to provide multiple speeds.
3.22. Design an independent speed control circuit.
3.23. Design a two-speed actuator circuit.
3.24. Describe how to calculate the extend speed of a hydraulic cylinder.
3.25. Describe how to calculate the retract speed of a hydraulic cylinder.
3.26. Describe how to calculate the stroke time of a cylinder.
3.27. Calculate the load-carrying capacity, speed, and power of hydraulic cylinders during the extending and retracting strokes.
3.28. Evaluate the power delivered to a hydraulic cylinder.
3.29. Determine speed of a hydraulic cylinder.
3.30. Calculate the extend speed of a hydraulic cylinder given its size and flow rate.
3.31. Calculate the retract speed of a hydraulic cylinder given its size and flow rate.
3.32. Calculate the cylinder stroke time given its size and a flow rate.
3.33. Homework check-off point worth 20pts. Must achieve 20/20 points.
3.34. LAP Skill Accomplishment points worth 5pts. (Observation and verbal evaluation). Must achieve at least 5/5 points.
3.35. LAP Skill Accomplishment Test worth 20pts. (Problem solving sheet). Must achieve at least 12/20 points.
3.36. Quiz grade worth 16pts. (Questions: multiple-choice). Must achieve at least 10/16 points.
3.37. Achieve at least 60% on examination.

4. Design Pressure Valve Circuits

Assessment Strategies

Homework will be checked for accuracy and completion by Instructor
LAP Skill Accomplishment points evaluated on lab station by Instructor
Skill accomplishment test evaluated by Instructor on lab station
Lab Activity Packet Quiz given by Instructor
Examinations will be taken in a classroom environment and evaluated by Instructor.

Learning Objectives

4.a. Summarize types of pressure valves
4.b. Summarize uses of check valves
4.c. Differentiate between a pressure relief valve, a pressure-reducing valve, a sequence valve, and an unloading valve.

Criteria

Your performance will be successful when:

4.1. Describe the function of a pressure sequence valve and give an application.
4.2. Describe the operation of a direct-acting sequence valve and give its schematic symbol.
4.3. Connect and adjust the pressure setting of a sequence valve.
4.4. Connect and operate a pressure sequence circuit.
4.5. Describe the function of a bypass check valve in a sequence valve circuit.
4.6. Describe the operation of an integral check valve and give its schematic symbol.
4.7. Describe the function of a PRV's bypass check valve.
4.8. Describe the function of a two-sequence valve control circuit.
4.9. Explain why a sequence valve is externally drained.
4.10. Design a pressure sequence circuit.
4.11. Design a two-sequence valve control circuit.
4.12. Describe the function of a pressure reducing valve and give an application.
4.13. Describe the operation of a direct-acting PRV and give its schematic symbol.
4.14. Describe the purpose, construction, and operation of various pressure control valves.
4.15. Connect and adjust a pressure setting of a PRV.
4.16. Connect and operate a reduced pressure circuit.
4.17. Explain why a PRV is externally drained.
4.18. Calculate the power loss in pressure relief and unloading valves.
4.19. Identify Counterbalance Valves
4.20. Identify the graphical symbols used for directional, pressure, and flow control valves.
4.21. Design a hydraulic circuit that uses a pressure reducing valve.
4.22. Homework check-off point worth 7pts. Must achieve 7/7 points.
4.23. LAP Skill Accomplishment points worth 5pts. (Observation and verbal evaluation). Must achieve at least 5/5 points.
4.24. LAP Skill Accomplishment Test worth 14pts. (Problem solving sheet). Must achieve at least 9/14 points.
4.25. Quiz grade worth 10pts. (Questions: multiple-choice). Must achieve at least 6/10 points.
4.26. Achieve at least 60% on examination.

5. Design Hydraulic Circuits with Directional Control Valves

Assessment Strategies

Homework will be checked for accuracy and completion by Instructor
LAP Skill Accomplishment points evaluated on lab station by Instructor
Skill accomplishment test evaluated by Instructor on lab station
Lab Activity Packet Quiz given by Instructor
Examinations will be taken in a classroom environment and evaluated by Instructor.

Learning Objectives

5.a. Describe and explain the terms used to specify DCVs.
5.b. Design a hydraulic circuit using a 2-position DCV.

Criteria

Your performance will be successful when:

5.1. Describe the purpose, construction, and operation of various directional control valves.
5.2. Differentiate between two-way, three-way, and four-way directional control valves.
5.3. Explain how valves are actuated using manual, mechanical, fluid pilot, and electric solenoid methods.
5.4. Connect and operate a hydraulic DCV with a tandem center.
5.5. Select the spool option for a hydraulic DCV based on the application information.
5.6. Describe the function of a hydraulic 4/2 DCV and name one application.
5.7. Describe the operation of a hydraulic 4/2 DCV and give its schematic symbol.
5.8. Describe the operation of a hydraulic 3/2 DCV and give its schematic symbol.
5.9. Connect and operate a hydraulic 4/2 DCV.
5.10. Connect and operate a 4/2 DCV to function as a 3/2 DCV.
5.11. Describe the function of a hydraulic pilot-operated DCV and name one application.
5.12. Describe the operation of a hydraulic pilot-operated DCV and give a schematic symbol.
5.13. Connect and operate a hydraulic pilot-operated DCV.
5.14. Describe the function of a hydraulic cam-operated valve and name one application.
5.15. List two types of hydraulic cam-operated valves and describe their application.
5.16. Describe the operation of a hydraulic 4/2 cam-operated valve and give its schematic symbol.
5.17. Connect, adjust and operate a cam-operated hydraulic valve.
5.18. Design a hydraulic sequence circuit using a cam-operated hydraulic valve.

5.19. Design a rapid traverse-slow feed hydraulic circuit using a cam-operated valve.
5.20. Homework check-off point worth 4pts. Must achieve 4/4 points.
5.21. LAP Skill Accomplishment points worth 5pts. (Observation and verbal evaluation). Must achieve at least 5/5 points.
5.22. LAP Skill Accomplishment Test worth 18pts. (Problem solving sheet). Must achieve at least 12/18 points.
5.23. Quiz grade worth 12pts. (Questions: multiple-choice). Must achieve at least 8/12 points.
5.24. Achieve at least 60% on examination.