



Course Syllabus

DEMR 1316 - Basic Hydraulics

Catalog Description: This course teaches the fundamentals of hydraulics including components and related systems.

Lecture hours = 2, Lab hours = 3

Prerequisites: None

Semester Credit Hours: 3

Lecture Hours per Week: 2

Lab Hours per Week: 3

Extended hours:

Contact Hours per Semester: 80

State Approval Code: 47.0605

Class section meeting time:

Instructional Goals and Purposes: The purpose of this course is to identify various components used in hydraulic systems; evaluate hydraulic components by inspection and testing; and explain the theory, circuits, and application of hydraulics.

Learning Outcomes:

1. **Fluid Power Systems:** *The Basic System*
2. **Fluid Power Standards and Symbols:** *Language of the Industry*
3. **Hydraulic Fluid:** *Energy Transmitting Medium*
4. **Source of Hydraulic Power:** *Power Units and Pumps*
5. **Fluid Storage and Distribution:** *Reservoirs, Conductors, and Connectors*
6. **Actuators:** *Workhorses of the System*
7. **Controlling The System:** *Pressure, Direction, and Flow*
8. **Accumulators:** *Pressure, Flow, and Shock Control Assistance*
9. **Conditioning System Fluid:** *Filtration and Temperature Control*
10. **Applying Hydraulic Power:** *Typical Circuits and Systems*

Specific Course Objectives (includes SCANS):

After studying all materials and resources presented in the course, the student will be able to:

1. **Fluid Power Systems:** *The Basic System.* SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Explain the functions of fluid power systems.
 - b. Identify the basic structure of fluid power systems.

- c. List the basic component groups involved in the structure of fluid power systems.
 - d. Describe the function of the components involved in basic fluid power systems.
 - e. Describe the similarities and differences of hydraulic and pneumatic systems.
 - f. Explain the operation of basic hydraulic and pneumatic systems.
- 2. Fluid Power Standards and Symbols: *Language of the Industry.*** SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
- a. Describe the meaning of a standard and the importance of standardization in an industry.
 - b. Identify the primary groups that provide standards for the fluid power industry and describe the standards information maintained by each group.
 - c. Provide specific examples of standards from standardizing groups involved in the fluid power industry.
 - d. Explain the symbols used to designate components in fluid power circuit diagrams.
 - e. Identify and explain the parts of circuit diagrams typically used with fluid power equipment.
- 3. Hydraulic Fluid: *Energy Transmitting Medium.*** SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
- a. Describe the various functions a hydraulic fluid performs in a fluid power system.
 - b. Identify and explain the general properties of a liquid that would make it suitable as a hydraulic fluid.
 - c. Name and describe the general categories of materials that are commonly used as hydraulic fluids.
 - d. Explain the terms used to describe the basic characteristics of hydraulic fluids.
 - e. Explain procedures to follow for the selection and performance monitoring of hydraulic fluids.
 - f. Describe appropriate procedures for handling, storage, and disposal of hydraulic fluid.
- 4. Source of Hydraulic Power: *Power Units and Pumps.*** SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
- a. Describe the function of a hydraulic power unit and identify its primary components.
 - b. Explain the purpose of a pump in a hydraulic system.
 - c. Explain the operation of a basic hydraulic pump.
 - d. Compare the operating characteristics of positive-displacement and non-positive-displacement hydraulic pumps.
 - e. Compare the operating characteristics of rotary and reciprocating hydraulic pumps.
 - f. Compare the operating characteristics of constant-volume and variable-volume hydraulic pumps.
 - g. Explain the principles involved in the operation of a pressure-compensated hydraulic pump.
 - h. Describe general construction for each of the various hydraulic pump designs.
 - i. Explain cavitation and its effect on pump performance and service life.
 - j. Interpret performance data supplied by a pump manufacturer.
- 5. Fluid Storage and Distribution: *Reservoirs, Conductors, and Connectors.*** SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
- a. Describe the function of the hydraulic system reservoir and identify the primary design features involved in its construction.
 - b. Explain the factors that must be considered when establishing the size of a reservoir for use in a system.
 - c. Describe the factors that are basic to the design and structure of fluid conductors used in hydraulic systems.
 - d. Compare and contrast the various types of pipe, tubing, and hose used in hydraulic systems and explain the ratings for each conductor.
 - e. Identify and explain the factors that must be considered when selecting a conductor for use in a hydraulic system.

- f. Explain the information typically found on data sheets provided by the manufacturers of hydraulic system pipe, tubing, and hose.
- 6. Actuators: Workhorses of the System.** SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
- Describe the construction and operation of basic hydraulic cylinders, limited-rotation actuators, and motors.
 - Compare the design and operation of various types of hydraulic cylinders.
 - Select appropriate cylinder design options available for mounting hydraulic cylinders and reducing hydraulic shock.
 - Compare the design and operation of various types of hydraulic motors.
 - Contrast the operation of fixed- and variable-speed hydraulic motors.
 - Describe the construction and operation of a basic hydrostatic transmission.
 - Size hydraulic cylinders and motors to correctly meet system force and speed requirements.
 - Interpret manufacturer specifications for hydraulic cylinders.
- 7. Controlling The System: Pressure, Direction, and Flow.** SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
- Explain the function of each of the three general types of control valves used in hydraulic systems.
 - Compare the design and operation of direct-acting and pilot-operated pressure control valves.
 - Describe the function of the various types of pressure control valves used in hydraulic systems.
 - Compare the design and operation of two-way, three-way, and four-way directional control valves.
 - Compare the design and operation of non-compensated and compensated flow control valves.
 - Explain the effect fluid temperature and pressure variations have on the operation of flow control valves.
- 8. Accumulators: Pressure, Flow, and Shock Control Assistance.** SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
- Explain the four basic functions of accumulators in hydraulic systems.
 - Describe the design of weight-, spring- and gas-loaded accumulators.
 - Compare the basic operating principles of weight-, spring-, and gas-loaded accumulators.
 - Compare the construction and performance of piston-, diaphragm-, and bladder-type gas-loaded accumulators.
 - List and describe the typical uses of accumulators in hydraulic systems.
 - Select the proper type and size of an accumulator for a circuit.
 - List the safety factors that must be considered when working with accumulators.
- 9. Conditioning System Fluid: Filtration and Temperature Control.** SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
- Identify the typical contaminants found in hydraulic system fluid and describe the source of each.
 - Explain the source of the energy responsible for increasing fluid temperature during hydraulic system operation
 - Describe how reservoir design can be used to reduce fluid contamination.
 - List and compare the various filter media used for hydraulic fluid filtration.
 - Describe the filtration rating methods used with hydraulic filters and strainers.
 - Compare the characteristics of the various filter locations and circuits that may be used in hydraulic systems.
 - Explain the function of heat exchangers in hydraulic systems.
 - Describe the design and structure of heat exchangers commonly used in hydraulic systems.

- i. Identify the factors that must be considered when determining the need for a heat exchanger in a hydraulic system.

10. Applying Hydraulic Power: *Typical Circuits and Systems*. SCANS (1 A-I, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-I, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C- ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)

- a. Name common, basic subsystems that compose complex hydraulic systems and describe their function.
- b. Compare the design and operation of basic pressure control circuits.
- c. Contrast the operating characteristics of meter-in, meter-out, and bleed-off flow control circuits.
- d. Compare the design and operation of several typical flow control circuits.
- e. Compare the design and operation of basic motion control circuits.
- f. Describe the design and operation of rapid-advance-to-work circuits.
- g. Describe various hydraulic circuits designed to provide for operator safety and the protection of system components.

Course Content:

A general description of lecture/discussion topics included in this course is listed in the Learning Objectives / Specific Course Objectives sections of this syllabus.

Students in all sections of this course will be required to do the following:

1. Attend scheduled classes regularly and be on time for every class period. Students can be dropped from a class due to excessive absences. More than **two (2)** unexcused absences are considered to be excessive.
2. Study the assigned materials, complete and submit homework assignments on time, complete quizzes and exams to assess understanding and comprehension of the material presented.
3. Complete scheduled lab assignments. Personal Protective Equipment (PPE) is required to be worn in lab.

Methods of Instruction/Course Format/Delivery:

Students will have access to this course in Canvas and will meet regularly for class each week. Classes will consist of lecture, lab, and online exercises as appropriate. Quizzes and exams may be administered by the Instructor or by an approved testing facility.

Students in traditional, hybrid and Internet classes will have access to courses via Canvas. Students in the traditional class will meet regularly for lecture. Students in the Internet class will be required to take quizzes and exams at an approved testing facility or, they may also be administered by the instructor. Students in hybrid classes will have both in class and online assignments. Hybrid classes are required to read assigned material, take quizzes and exams as assigned by the instructor, and complete assigned homework prior to meeting for the face to face lecture or lab.

The following will be used to calculate the student's final grade:

Attendance and Participation

Students are expected to attend face to face classes and be on time. Students are required to participate in class discussions and work with other students during class lab exercises.

Attendance is based on the student missing no more than 10% of class periods in the semester without a valid excuse (10% equals two class periods). Any student thirty minutes late will be counted absent. Students that leave before being dismissed will be counted absent.

Lab Exercises

Students will complete lab assignments designed to teach them how to apply the knowledge gained from the textbook to actual hydraulic circuits.

Quizzes

Upon completion of each major assignment, students will take online quizzes over the material covered. Quizzes will generally contain true/false, multiple choice, matching or fill In-the-blank questions.

Midterm and Final Exams

There will be two major exams consisting of a Midterm Exam and a Final Exam. The Final Exam will be cumulative.

Grading Notes

Missed quizzes or exams due to legitimate reasons should be taken prior to the reporting of mid-term or final grades as applicable. It is the responsibility of the student to reschedule the makeup with the instructor, who reserves the right to change the test format of any makeup quiz or exam. **No makeup work will be allowed for an unexcused absence.**

Scholastic Dishonesty includes, but is not limited to, the willful attempt to misrepresent one's work, cheat, plagiarize, or impede other students' scholastic progress. It is a serious offence and will be dealt with as such by the Instructor and Panola College. The penalty for **Scholastic Dishonesty** is an F in the course.

Grading Scale: A=90-100, B=80-89, C=70-79, D=60-69, F=59 and below

Major Assignments / Assessments:

The following items will be assigned and assessed during the semester and used to calculate the student's final grade.

Assignments: Textbook

Chapter 2: **Fluid Power Systems:** *The Basic System*

Chapter 4: **Fluid Power Standards and Symbols:** *Language of the Industry*

Chapter 6: **Hydraulic Fluid:** *Energy Transmitting Medium*

Chapter 7: **Source of Hydraulic Power:** *Power Units and Pumps*

Chapter 8: **Fluid Storage and Distribution:** *Reservoirs, Conductors, and Connectors*

Chapter 9: **Actuators:** *Workhorses of the System*

Chapter 10: **Controlling The System:** *Pressure, Direction, and Flow*

Chapter 11: **Accumulators:** *Pressure, Flow, and Shock Control Assistance*

Chapter 12: **Conditioning System Fluid:** *Filtration and Temperature Control*

Chapter 13: **Applying Hydraulic Power: Typical Circuits and Systems**

Lab Exercises: (Lab-Volt Hydraulics Trainers)

Introduction to Hydraulics: Exercise 1-1 and Exercise 1-2

Fundamentals: Exercise 2-1, Exercise 2-2, Exercise 2-3, and Exercise 2-4

Basic Circuits: Exercise 3-1, Exercise 3-2, Exercise 3-3, and Exercise 3-4

Functional Circuits: Exercise 4-1, Exercise 4-2, Exercise 4-3, and Exercise 4-4

Assessment (Textbook)

Chapter 2 Quiz

Chapter 4 Quiz

Chapter 6 Quiz

Chapter 7 Quiz

Chapter 8 Quiz

Chapter 9 Quiz

Chapter 10 Quiz

Chapter 11 Quiz

Chapter 12 Quiz

Chapter 13 Quiz

Assessment (Labs)

Exercise 1-1

Exercise 2-4

Exercise 4-1

Exercise 1-2

Exercise 3-1

Exercise 4-2

Exercise 2-1

Exercise 3-2

Exercise 4-3

Exercise 2-2

Exercise 3-3

Exercise 4-4

Exercise 2-3

Exercise 3-4

Course Grade:

The grading scale for this course is as follows:

- Attendance – 10%
- Lab Exercises – 20%
- Quizzes – 30%
- Exams – 40%

Texts, Materials, and Supplies:

- *Fluid Power Hydraulics and Pneumatics*
- ISBN 9781605259314
Author: James R. Daines
Publisher: The Goodheart-Willcox Company, Inc.
Tinley Park, IL, www.g-w.com
- Calculator (**Do not use your Phone; it is NOT a calculator!!**)
- Notepad and pen or pencil
- **Safety Glasses (Do not come to class without them!!)**

Required Reading

- *Lab Exercises*

Recommended Readings:

- None

Other:

- For current texts and materials, use the following link to access bookstore listings:
<http://www.panolacollegestore.com>
- For testing services, use the following link: <http://www.panola.edu/elearning/testing.html>
- If any student in this class has special classroom or testing needs because of a physical learning or emotional condition, please contact the ADA Student Coordinator in Support Services located in the Administration Building or go to <http://www.panola.edu/student-success/disability-support-services/> for more information.
- Withdrawing from a course is the student's responsibility. Students who do not attend class and who do not withdraw will receive the grade earned for the course.
- Student Handbook, *The Pathfinder*:
<http://www.panola.edu/student-success/documents/pathfinder.pdf>

SCANS CRITERIA

- 1) **Foundation skills are defined in three areas: basic skills, thinking skills, and personal qualities.**
 - a) **Basic Skills:** A worker must read, write, perform arithmetic and mathematical operations, listen, and speak effectively. These skills include:
 - i) Reading: locate, understand, and interpret written information in prose and in documents such as manuals, graphs, and schedules.
 - ii) Writing: communicate thoughts, ideas, information, and messages in writing, and create documents such as letters, directions, manuals, reports, graphs, and flow charts.
 - iii) Arithmetic and Mathematical Operations: perform basic computations and approach practical problems by choosing appropriately from a variety of mathematical techniques.
 - iv) Listening: receive, attend to, interpret, and respond to verbal messages and other cues.
 - v) Speaking: Organize ideas and communicate orally.
 - b) **Thinking Skills:** A worker must think creatively, make decisions, solve problems, visualize, know how to learn, and reason effectively. These skills include:
 - i) Creative Thinking: generate new ideas.
 - ii) Decision Making: Specify goals and constraints, generate alternatives, consider risks, and evaluate and choose the best alternative.
 - iii) Problem Solving: recognize problems and devise and implement plan of action.
 - iv) Visualize ("Seeing Things in the Mind's Eye"): organize and process symbols, pictures, graphs, objects, and other information.
 - v) Knowing How to Learn: use efficient learning techniques to acquire and apply new knowledge and skills.
 - vi) Reasoning: discover a rule or principle underlying the relationship between two or more objects and apply it when solving a problem.
 - c) **Personal Qualities:** A worker must display responsibility, self-esteem, sociability, self-management, integrity, and honesty.
 - i) Responsibility: exert a high level of effort and persevere toward goal attainment.
 - ii) Self-Esteem: believe in one's own self-worth and maintain a positive view of oneself.
 - iii) Sociability: demonstrate understanding, friendliness, adaptability, empathy, and politeness in group settings.
 - iv) Self-Management: assess oneself accurately, set personal goals, monitor progress, and exhibit self-control.
 - v) Integrity and Honesty: choose ethical courses of action.
- 2) **Workplace competencies are defined in five areas: resources, interpersonal skills, information, systems, and technology.**
 - a) **Resources:** A worker must identify, organize, plan, and allocate resources effectively.
 - i) Time: select goal-relevant activities, rank them, allocate time, and prepare and follow schedules.
 - ii) Money: Use or prepare budgets, make forecasts, keep records, and make adjustments to meet objectives.
 - iii) Material and Facilities: Acquire, store, allocate, and use materials or space efficiently.
Examples: construct a decision time line chart; use computer software to plan a project; prepare a budget; conduct a cost/benefits analysis; design an RFP process; write a job description; develop a staffing plan.
 - b) **Interpersonal Skills:** A worker must work with others effectively.

- i) Participate as a Member of a Team: contribute to group effort.
 - ii) Teach Others New Skills.
 - iii) Serve Clients/Customers: work to satisfy customer's expectations.
 - iv) Exercise Leadership: communicate ideas to justify position, persuade and convince others, responsibly challenge existing procedures and policies.
 - v) Negotiate: work toward agreements involving exchange of resources, resolve divergent interests.
 - vi) Work with Diversity: work well with men and women from diverse backgrounds.
- Examples: collaborate with a group member to solve a problem; work through a group conflict situation, train a colleague; deal with a dissatisfied customer in person; select and use appropriate leadership styles; use effective delegation techniques; conduct an individual or team negotiation; demonstrate an understanding of how people from different cultural backgrounds might behave in various situations.

c) **Information:** A worker must be able to acquire and use information.

- i) Acquire and Evaluate Information.
- ii) Organize and Maintain Information.
- iii) Interpret and Communicate Information.
- iv) Use Computers to Process Information.

Examples: research and collect data from various sources; develop a form to collect data; develop an inventory record-keeping system; produce a report using graphics; make an oral presentation using various media; use online computer databases to research a report; use a computer spreadsheet to develop a budget.

d) **Systems:** A worker must understand complex interrelationships.

- i) Understand Systems: know how social, organizational, and technological systems work and operate effectively with them.
- ii) Monitor and Correct Performance: distinguish trends, predict impacts on system operations, diagnose deviations in systems' performance and correct malfunctions.
- iii) Improve or Design Systems: suggest modifications to existing systems and develop new or alternative systems to improve performance.

Examples: draw and interpret an organizational chart; develop a monitoring process; choose a situation needing improvement, break it down, examine it, propose an improvement, and implement it.

e) **Technology:** A worker must be able to work with a variety of technologies.

- i) Select Technology: choose procedures, tools or equipment including computers and related technologies.
- ii) Apply Technologies to Task: understand overall intent and proper procedures for setup and operation of equipment.
- iii) Maintain and Troubleshoot Equipment: Prevent, identify, or solve problems with equipment, including computers and other technologies.

Examples: read equipment descriptions and technical specifications to select equipment to meet needs; set up and assemble appropriate equipment from instructions; read and follow directions for troubleshooting and repairing equipment.