



Course Syllabus

HEMR 1304 – Natural Gas Compression

Revision Date: 01/11/2017

Catalog Description: An introductory course to the principles of operation for gas compressors and natural gas engines.

Lecture hours = 2, Lab hours = 4

Prerequisites: None

Semester Credit Hours: 3

Lecture Hours per Week: 2

Lab Hours per Week: 4

Contact Hours per Semester: 96

State Approval Code: 47.0605

Instructional Goals and Purposes: The purpose of this course is to employ safety in handling natural gas, use specialty tools to adjust and repair engines and compressors, analyze and repair failure using specialty tools and visual and other inspection and repair procedures.

Learning Outcomes:

1. Compressor Package and Components
2. Basic Compression Theory
3. Compressor Valves
4. Capacity Control Devices and Systems
5. Coupling Alignment
6. Compressor Vibration
7. Lubrication Systems: Frames and Cylinders

Specific Course Objectives (includes SCANS):

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

1. **Compressor Package and Components.** 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. List and describe the primary components of a compressor package.
 - b. List and describe the key components of a reciprocating compressor.
 - c. Describe the operation of a double acting cylinder and the difference between it and tandem cylinders.

- d. Describe the purpose of a separator/scrubber and its placement within the package.
 - e. Describe the stages of compression.
- 2. Basic Compression Theory.** 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. List the properties of a gas.
 - b. Define natural gas and list its major components.
 - c. List and describe the gas laws used in the development of the Ideal Gas Law.
 - d. List and define gas properties including specific gravity, specific heat and compressibility.
 - e. List and define gas conditions.
 - f. List and discuss the sequence of events represented in a compressor cylinder PT diagram.
 - g. List possible compressor issues that a PT diagram can be used to evaluate.
- 3. Compressor Valves.** 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. Discuss the basic theory of operation for compressor valves.
 - b. Discuss the importance of the PV diagram, an essential part to understanding valve operation.
 - c. Explain valve lift and how it relates to compressor efficiency and durability of the valve.
 - d. Discuss the function of the valve springs.
 - e. List and discuss valve problems.
- 4. Capacity Control Devices 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. Discuss the factors that affect cylinder capacity.
 - b. Define clearance volume and explain how it affects compressor capacity.
 - c. Define normal clearance.
 - d. Describe the relationship between cylinder capacity and volumetric efficiency using the PV diagram.
 - e. List equipment and methods for changing clearance volume to control capacity.
- 5. Coupling Alignment.** 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. Know and follow appropriate safety procedures prior to beginning any work.
 - b. List coupling functions.
 - c. List the types of couplings.
 - d. Describe the installation of a coupling hub.
 - e. List alignment methods and discuss the reasons for controlling misalignment.
- 6. Compressor Vibration.** 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. Define Unbalanced Forces and Couples.
 - b. Define Mechanical Balance.
 - c. Define Torque Reaction.
 - d. Define Torsional Analysis.
 - e. Define Pulsation.
 - f. Define Resonance.
 - g. Define Vibration.
- 7. Lubrication Systems: Frame and Cylinder.** 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 each component used in the Frame Lubrication System.
- b. Track the flow of oil through the Frame Lubrication System.
- c. Describe the Cylinder Lubrication system and the function of each component used in this system.
- d. Describe the Packing lubrication.
- e. Discuss Distribution Block cycle times and flow rates.

Course Content:

A general description of lecture/discussion topics included in this course are 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 any scheduled lab assignments or class projects. 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 and lab 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/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 exercises.

Attendance is based on the student missing no more than 10% out of the semester without a valid excuse, at which point, the instructor may withdraw the student at their discretion. Any student thirty or more minutes late may be counted absent. Students that leave before class is dismissed will be counted absent. The Instructor reserves the right to dock points on any makeup work resulting from an unexcused absence.

Lab Exercises

Students will complete lab assignments designed to teach them how to apply knowledge gained from studying course material.

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. Instructor is not required to makeup work for an unexcused class absence. The Instructor also reserves the right to give full or partial credit for any makeup work that is allowed and that resulted from an unexcused absence.

Attendance is based on the student missing no more than 10% out of the semester without a valid excuse, at which point, the instructor may withdraw the student at their discretion. Any student thirty or more minutes late may be counted absent. Students that leave before class is dismissed will be counted absent. The Instructor reserves the right to dock points for any missed class without a legitimate excuse.

Scholastic dishonesty is treated with the utmost seriousness by the Instructor and Panola College. Academic dishonesty includes, but is not limited to, the willful attempt to misrepresent one's work, cheat, plagiarize, or impede other students' scholastic progress.

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

1. Reading Assignment 1: Compressor Package and Components
2. Reading Assignment 2: Basic Compression
3. Reading Assignment 3: Compressor Valves
4. Reading Assignment 4: Capacity Control Devices and Systems
5. Reading Assignment 5: Coupling Alignment
6. Reading Assignment 6: Vibration
7. Reading Assignment 7: Lubrication Systems: Frames, Cylinders
8. Research Paper 1: Types of metal used in Ariel Compressors
9. Research Paper 2: Screw Compression versus Reciprocating
10. Research Paper 3: Vibration
11. Compressor teardown and rebuild
12. Lab 1: Internal mechanical parts list for Ariel Compressor
13. Lab 2: Ariel Compressor parts test
14. Student Presentations

Assessment(s):

1. Quiz 1: Compressor Package and Components
2. Quiz 2: Basic Compression Theory
3. Quiz 3: Valves
4. Quiz 4: Capacity Control Devices and Systems
5. Quiz 5: Coupling Alignment
6. Quiz 6: Vibration
7. Quiz 7: Lubrication Systems: Frames, Cylinders
8. Research Paper 1: Types of Metal used in Ariel Compressors
9. Research Paper 2: Screw Compression versus Reciprocating
10. Research Paper 3: Vibration
11. Lab 1: Internal mechanical parts list for Ariel Compressor
12. Lab 2: Parts Test
13. Midterm Exam
14. Student Presentations
15. Final Exam

Course Grade:

The grading scale for this course is as follows:

- Attendance – 10%
- Labs – 20%
- Quizzes – 30%
- Exams – 40%

Texts, Materials, and Supplies:

- *All course materials will be offered through Canvas as downloadable PDF files or Videos.*
- *Appropriate PPE required in Lab; refer to **School of Energy Safety Contract***
- *Calculator, notepad and pen or pencil*

Required Readings:

- None

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 flowcharts.
 - 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 on-line computer data bases 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.