



# STARK STATE COLLEGE

## GENERAL SYLLABUS

### Course Information

**Course Name:** Industrial Applications, Customer & Products  
**Course Number:** ARL233

### Required Materials

**Textbook(s):** Industrial Applications, Customers and products Handbook Ariel Corp.  
**Required Readings:** None  
**Additional Materials:** Scientific Calculator, Laptops, Note Pads, Writing Utensils, Web Links, Handouts and related items as provided in class.

### Course Outline/Calendar

The date of coverage and order of coverage may be modified based on the faculty member and events beyond the control of faculty members that interfere with class times and teaching.

Week	Chapter/Topic/Lab
1: Introduction to Large Industrial Compressors	<ul style="list-style-type: none"> <li>• Module 1: Fundamental Principles: Review the basic laws of thermodynamics and fluid dynamics as they apply to gas compression.</li> <li>• Module 2: Compressor Types and Classification: Differentiate between positive displacement (reciprocating, rotary screw) and dynamic (centrifugal, axial) compressors, with a focus on large-scale industrial units.</li> <li>• Module 3: Terminology and Performance Metrics: Define key terms like pressure ratio, flow rate (CFM), horsepower (HP), and efficiency ratings (SEER, EER).</li> </ul>
2: Reciprocating Compressors	<ul style="list-style-type: none"> <li>• Module 1: Design and Operation: Explore the construction and working principles of double-acting, multi-stage reciprocating compressors.</li> <li>• Module 2: Maintenance and Operation: Discuss key components like pistons, valves, lubrication systems, and the principles of capacity control via intake unloading and clearance pockets.</li> <li>• Module 3: Applications and Limitations: Analyze the use of large reciprocating compressors in high-pressure applications for oil and gas and industrial gases.</li> </ul>
3: Dynamic Compressors (Centrifugal and Axial)	<ul style="list-style-type: none"> <li>• Module 1: Centrifugal Compressors: Explain the principle of converting kinetic energy to pressure using impellers. Cover key components like impellers, diffusers, and volutes.</li> <li>• Module 2: Axial Compressors: Examine axial flow technology, focusing on the high flow rates achieved with bladed rotors and stators. Compare and contrast axial and centrifugal performance.</li> <li>• Module 3: Performance and Control: Review compressor curves and control mechanisms like variable inlet guide vanes, speed control, and anti-surge control systems.</li> </ul>

Week	Chapter/Topic/Lab
4: Rotary Screw and Vane Compressors	<ul style="list-style-type: none"> <li>Module 1: Rotary Screw Technology: Focus on the operation of large, industrial-grade rotary screw compressors. Cover oil-injected and oil-free designs, rotors, and air-end technology.</li> <li>Module 2: Rotary Vane and Scroll Compressors: Introduce the principles of rotary vane and scroll compressors, highlighting their specific niche markets, such as laboratories and wastewater aeration.</li> <li>Module 3: System Components: Discuss the associated components for all compressor types, including drivers (electric motors, gas turbines), cooling systems, filters, and dryers.</li> </ul>
5: Oil and Gas Industry	<ul style="list-style-type: none"> <li>Module 1: Upstream Applications: Explore compressors used for natural gas gathering, pipeline boosting, and gas injection to enhance oil recovery.</li> <li>Module 2: Midstream and Downstream Applications: Analyze compressor use in liquefied natural gas (LNG) production, gas processing plants, and refineries.</li> <li>Module 3: Gas Turbine Integration: Cover the compressor section of large gas turbines used for power generation and pipeline compression.</li> </ul>
6: Petrochemical and Chemical Industry	<ul style="list-style-type: none"> <li>Module 1: Process Gas Compression: Discuss the compression of process gases like hydrogen, nitrogen, and synthesis gas for chemical manufacturing.</li> <li>Module 2: Catalyst and Reaction Processes: Examine how large compressors support processes that require high-pressure gas streams for chemical reactions.</li> <li>Module 3: Refrigeration and Cooling: Explore the use of compressors in industrial refrigeration systems for cooling and chilling processes.</li> </ul>
7: Energy and Power Generation	<ul style="list-style-type: none"> <li>Module 1: Power Plant Operations: Focus on the role of compressors in gas turbine power plants and energy storage systems.</li> <li>Module 2: Compressed Air Energy Storage (CAES): Examine how large compressors and expanders are used in CAES facilities for grid-scale energy storage.</li> <li>Module 3: Offshore and Marine: Discuss specialized compressor applications for offshore platforms, floating LNG facilities, and naval vessels.</li> </ul>
8: General Manufacturing and Other Industries	<ul style="list-style-type: none"> <li>Module 1: Industrial Air Systems: Provide an in-depth look at large compressed air systems for manufacturing, including system design, efficiency, and leak reduction.</li> <li>Module 2: Metallurgy and Mining: Review compressor applications in steel production, foundry operations, and mining.</li> <li>Module 3: Water Treatment and Food Processing: Cover the use of oil-free compressors in wastewater aeration, food and beverage processing, and pharmaceutical manufacturing.</li> </ul>
9: Customer Needs and Drivers	<ul style="list-style-type: none"> <li>Module 1: End-User Perspective: Understand customer priorities, including reliability, energy efficiency, lifecycle costs, and maintenance.</li> <li>Module 2: Original Equipment Manufacturer (OEM) vs. End-User: Analyze the different needs and purchasing drivers for OEMs versus the final equipment operators.</li> <li>Module 3: Sales and Procurement Process: Explore the typical sales cycle, key decision-makers, and technical evaluation criteria used by large industrial buyers.</li> </ul>
10: Competitive Landscape and Market Trends	<ul style="list-style-type: none"> <li>Module 1: Major Compressor Manufacturers: Review the key players in the large compressor market (e.g., Atlas Copco, Siemens Energy, Ariel, Ingersoll Rand).</li> <li>Module 2: Market Segmentation: Analyze market trends, size, and growth drivers segmented by application, compressor type, and geography.</li> <li>Module 3: Emerging Technologies and Sustainability: Discuss market shifts toward variable speed drives (VSDs), energy efficiency, and the role of compressors in the energy transition.</li> </ul>
11: Case Studies in Application and Selection	<ul style="list-style-type: none"> <li>Module 1: Reciprocating vs. Centrifugal Case Study: Use real-world examples to contrast the selection process for reciprocating vs. centrifugal compressors, considering factors like pressure, flow, and cost.</li> <li>Module 2: System Optimization Case Study: Analyze a case study on optimizing an existing compressed air system to reduce energy costs and improve reliability.</li> <li>Module 3: Complex Project Bidding: Role-play or analyze a complex, large-scale project proposal, from initial requirements gathering to final bid submission.</li> </ul>
12: financial and Commercial Considerations	<ul style="list-style-type: none"> <li>Module 1: Total Cost of Ownership (TCO): Evaluate the full lifecycle cost of large compressors, including initial capital expenditure, energy costs, and maintenance.</li> <li>Module 2: Pricing and Value Proposition: Understand how to price large compressor packages and articulate the value proposition to different customer types.</li> </ul>

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	<ul style="list-style-type: none"> <li>Module 3: Project Finance and Economics: Discuss the financial models used to justify large equipment purchases, including return on investment (ROI) and payback periods.</li> </ul>
13: Product Design and Configuration	<ul style="list-style-type: none"> <li>Module 1: Sizing and Selection Software: Get hands-on with proprietary software used to size and select compressors, such as Ariel Performance Software.</li> <li>Module 2: Component Customization: Explore how different customer requirements lead to variations in compressor packages, including drivers, controls, and ancillary equipment.</li> <li>Module 3: Standards and Certification: Review key industry standards and compliance requirements (e.g., ISO, API) that apply to large compressor products.</li> </ul>
14: System Control and Optimization	<ul style="list-style-type: none"> <li>Module 1: Control Systems: Deepen the understanding of advanced control strategies for large compressors, including sequencing, VSD control, and system automation.</li> <li>Module 2: Instrumentation and Monitoring: Review the types of sensors, diagnostics, and monitoring systems used to ensure optimal compressor performance and reliability.</li> <li>Module 3: Energy Efficiency Audits: Learn how to conduct energy audits of compressed air systems to identify savings opportunities.</li> </ul>
15: Service, Maintenance, and Troubleshooting	<ul style="list-style-type: none"> <li>Module 1: Reliability and Maintenance Planning: Cover best practices for preventive, predictive, and condition-based maintenance for large compressors.</li> <li>Module 2: Troubleshooting and Diagnostics: Train on common failure modes, diagnostic procedures, and troubleshooting techniques for various compressor types.</li> <li>Module 3: Field Service and Support: Understand the role of field technicians, repair procedures, and the logistics of servicing large, complex equipment.</li> </ul>
16: Course Review and Final Project	<ul style="list-style-type: none"> <li>Module 1: Comprehensive Review: Recap the entire course, connecting the technical aspects to market applications and customer solutions.</li> <li>Module 2: Final Project / Capstone: Work on a real-world case study or a hypothetical project, requiring the selection, justification, and presentation of a large compressor system for a specific industrial application.</li> </ul>