Unit 4024: Electro, Pneumatic and Hydraulic Systems

Unit Code: F/651/0746

Level: 4

Credits: 15

Introduction

Hydraulics and pneumatics incorporate the importance of fluid power theory in modern industry. This is the technology that deals with the generation, control, and movement of mechanical elements or systems with the use of pressurised fluids in a confined system. In respect of hydraulics and pneumatics, both liquids and gases are considered fluids. Oil hydraulics employs pressurised liquid petroleum oils and synthetic oils, whilst pneumatic systems employ an everyday recognisable process of releasing compressed air to the atmosphere after performing the work.

The aim of this module is to develop students' knowledge and appreciation of the applications of fluid power systems in modern industry. Students will investigate and design pneumatic, hydraulic, electro-pneumatic and electro-hydraulic systems. This unit offers the opportunity for students to examine the characteristics of fluid power components and evaluate work-related practices and applications of these systems.

On successful completion of this unit students will be able to learn about applications of hydraulic and pneumatic systems in the production industry, fundamental principles and practical techniques for obtaining solutions to problems, real-life applications of pneumatic and hydraulic systems, and the importance of structured maintenance techniques.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Calculate the parameters of pneumatic and hydraulic systems

LO2 Illustrate the notation and symbols of pneumatic and hydraulic components

LO3 Examine the applications of pneumatic and hydraulic systems

LO4 Investigate the maintenance of pneumatic and hydraulic systems.

Essential Content

LO1 Calculate the parameters of pneumatic and hydraulic systems

Pneumatic and hydraulic theory:

Combined and ideal gas laws: Boyle's Law, Charles' Law and Gay-Lussac's Law

Fluid flow, calculation of pressure and velocity using Bernoulli's Equation for Newtonian fluids

System performance, volumetric operational and isothermal efficiency

Dynamic and Kinematic Viscosity

Methods of measuring viscosity including Stokes' Law

Navier Stokes Equations.

LO2 Illustrate the notation and symbols of pneumatic and hydraulic components

Performance of hydraulic and pneumatic components:

The use and importance of International Standards, including relative symbols and devices

Fluid power diagrams

Pneumatic and hydraulic critical equipment and their purpose

Circuit diagrams, component interaction and purpose

Dynamics of modern system use.

LO3 Examine the applications of pneumatic and hydraulic systems

System applications:

Calculation of appropriate capacities and specifications

Applied functions of control elements

Design and testing of hydraulic and pneumatic systems

Fluid power in real-life examples

Valued component choice

Alternative actuating systems.

LO4 **Investigate the maintenance of pneumatic and hydraulic systems**

Efficiency of systems:

Efficient maintenance: accurate records and procedures to ensure efficiency

Functional inspection, modern techniques to limit production problems, quality control

Testing, efficient procedures to enable component longevity, recommendations

Fault finding, diagnostic techniques, effects of malfunctions, rectification of faults

Use relevant problem-solving tools where applicable e.g root cause analysis (RCA), process failure modes effects analysis (PFMEA), fishbone, practical problem solving (PPS) and advanced product quality planning (APQP)

Job market and opportunities for efficiency and maintenance of pneumatic and hydraulic systems.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Calculate the parameters of pneumatic and hydraulic systems		
P1 Calculate the change in volume and pressure in pneumatic systems. **P2** Determine the change in volume and pressure in hydraulic systems.	**M1** Using Bernoulli's Equation, calculate values at stationary incompressible flow.	**D1** Develop a presentation analysing fluid viscosity using Stokes' law and validate how this relates to Navier–Stokes equations.
LO2 Illustrate the notation and symbols of pneumatic and hydraulic components		
P3 Show the purpose of components on a given diagram. **P4** Explain the use of logic functions used within circuits. **P5** Illustrate the use of advanced functions and their effect on circuit performance.	**M2** Assess the different factors that impact on actuator choice for a given application.	**D2** Stating any assumptions, compare the applications of practical hydraulic and pneumatic systems.

Pass	Merit	Distinction
LO3 Examine the applications of pneumatic and hydraulic systems		
P6 Examine the design and function of a hydraulic or pneumatic system employed in a modern production environment. **P7** Define the purpose and function of electrical control elements in a given hydraulic or pneumatic system.	**M3** Justify the measures taken to improve circuit design in respect of performance.	**D3** Propose the design modifications that can be introduced to improve the functionality and maintenance of pneumatic and hydraulic systems without creating reliability issues.
LO4 Investigate the maintenance of pneumatic and hydraulic systems		
P8 Recognise system faults and potential hazards in pneumatic and hydraulic systems. **P9** Investigate procedures to ensure efficient maintenance and operation of pneumatic and hydraulic systems.	**M4** Compare construction and operation of hydraulic and pneumatic systems with regards to legislation and safety issues.	**D4** Evaluate the importance of maintenance, inspection, testing and fault-finding in respect of improved system performance.

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Esposito A. (2013) *Fluid Power with Applications*, 7th Ed. Pearson

Parr E. A. (2011) *Hydraulics and Pneumatics – A Technician's and Engineer's Guide*. 3rd Ed. Oxford: Butterworth-Heinemann.

Mills D. (2015) *Pneumatic Conveying Design Guide*. 3rd Ed. Elsevier.

Turner I.C. (2021) *Engineering applications of pneumatics and hydraulic*s. Routledge.

Salam M.A. (2022) *Fundamentals of Pneumatics and Hydraulics*. Springer.

Vacca A. and Franzoni G. (2021) *Hydraulic fluid power: fundamentals, applications, and circuit design*. John Wiley & Sons.

Stryczek J. and Warzyńska U. (Editors) (2020) *Advances in Hydraulic and Pneumatic Drives and Control 2020*. Springer Nature.

Parambath J. (2020) *Electro-Pneumatics and Automation*.

Journals

Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.

Experiments in Fluids

International Journal of Fluid Power

Journal of Hydraulic Engineering

Journal of Hydraulic Research

Links

This unit links to the following related units:

Unit 4011: Fluid Mechanics

Unit 5023: Thermofluids.