Unit 29: Electro, Pneumatic and Hydraulic Systems

Unit code	**L/615/1498**
Unit level	**4**
Credit value	**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 explain applications of hydraulic and pneumatic systems in the production industry, determine the fundamental principles and practical techniques for obtaining solutions to problems, appreciate real-life applications of pneumatic and hydraulic systems, and investigate the importance of structured maintenance techniques.

Learning Outcomes

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

1. Calculate the parameters of pneumatic and hydraulic systems.
2. Identify the notation and symbols of pneumatic and hydraulic components.
3. Examine the applications of pneumatic and hydraulic systems.
4. 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 **Identify 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

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

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Calculate the parameters of pneumatic and hydraulic systems</td><td rowspan="2">D1 Produce a presentation analysing fluid viscosity using Stokes' Law and validate how this relates to Navier–Stokes equations</td></tr>
<tr><td>P1 Determine the change in volume and pressure in pneumatic systems

P2 Determine the change in volume and pressure in hydraulic systems</td><td>M1 Using Bernoulli's Equation, calculate values at stationary incompressible flow</td></tr>
<tr><td colspan="2">LO2 Identify the notation and symbols of pneumatic and hydraulic components</td><td rowspan="2">D2 Stating any assumptions, compare the applications of practical hydraulic and pneumatic systems</td></tr>
<tr><td>P3 Identify 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</td><td>M2 Assess the different factors that impact on actuator choice for a given application</td></tr>
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Pass	Merit	Distinction
LO3 Examine the applications of pneumatic and hydraulic systems		**D3** Evaluate the design modifications that can be introduced to improve the functionality and maintenance of pneumatic and hydraulic systems without creating reliability issues
P6 Investigate and analyse the design and function of a simple hydraulic or pneumatic system in a 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	
LO4 Investigate the maintenance of pneumatic and hydraulic systems		**D4** Evaluate the importance of maintenance, inspection, testing and fault finding in respect of improved system performance
P8 Recognise system faults and potential hazards in pneumatic and hydraulic systems **P9** Determine regular testing procedures to ensure efficient maintenance of pneumatic and hydraulic systems	**M4** Compare construction and operation of hydraulic and pneumatic systems with regards to legislation and safety issues	

Recommended Resources

Textbooks

PARR, A. (1999) *Hydraulics and Pneumatics: A Technician's Guide*. 2nd Ed. Butterworth-Heinemann.

ROHNER, R. (1995) *Industrial Hydraulic Control*. John Wiley & Sons.

STACEY, C. (1997) *Practical Pneumatics*. Elsevier.

TURNER, I. (1996) *Engineering Applications of Pneumatics and Hydraulics*. Butterworth-Heinemann.

Links

This unit links to the following related units:

Unit 11: Fluid Mechanics

Unit 64: Thermofluids