HYDRAULIC AND PNEUMATIC SYSTEMS

ENAM 353

Lecture	**: 3**	**Year : III**
Tutorial	**: 1**	**Part : II**
Practical	**: 3/2**	

Course Objectives:

The objective of this course is to introduce the fundamental principles of hydraulic and pneumatic systems and their applications in modern vehicles. It focuses on developing practical understanding of fluid power in automotive braking, steering, and suspension systems. Upon completion, students will be able to apply these systems in automotive design and perform basic troubleshooting and maintenance of hydraulic and pneumatic components.

1 Hydraulic System (12 hours)

- 1.1 Review of principles and laws of fluids and hydraulics
- 1.2 Functions of hydraulic system
- 1.3 Applications and components
- 1.4 Types of hydraulic system and their working principle: Open and closed center system
- 1.5 Hydraulic pumps
  - 1.5.1 Types, construction and working principle
  - 1.5.2 Selection of pumps
  - 1.5.3 Characteristics of pumps
- 1.6 Accumulator and its types
- 1.7 Filters and its types
- 1.8 Hydraulic accessories and components
  - 1.8.1 Oil seals and its types
  - 1.8.2 Pipes and hoses and their types
  - 1.8.3 Hydraulic connectors and couplings

2 Pneumatic System (8 hours)

- 2.1 Basic principle of pneumatics
- 2.2 Preparation of compressed air, its properties and functions
- 2.3 Applications of pneumatic system
- 2.4 Components of pneumatic system and their functions
- 2.5 Air compressor: Types, function, construction
- 2.6 Filter, regulator, lubricator (FRL) unit

3 Actuators and Valves (6 hours)

3.1 Actuators: Purpose and classification
3.2 Working principle of linear actuators and rotary actuators
3.3 Selection criteria of actuators
3.4 Valve: Purpose and classification
3.5 Direction, flow and pressure control valves
3.6 Selection criteria of valves

4 Hydraulic and Pneumatic Circuits (8 hours)

4.1 Hydraulic and pneumatic component symbols
4.2 Series and parallel circuits
4.3 Reciprocating circuits
4.4 Accumulator circuit
4.5 Speed control circuit
4.6 Sequencing circuit
4.7 Time delay circuit
4.8 Logical units of pneumatic system (OR, AND, Memory)
4.9 Troubleshooting

5 Electrical and Electronic Control (6 hours)

5.1 Limit switches
5.2 Solenoids and relays
5.3 Temperature switches
5.4 Electro-hydraulic system
5.5 Logic Control: AND, OR, NOT and memory functions
5.6 Sensors in hydraulic and pneumatic systems

6 Automotive Applications (5 hours)

6.1 Hydraulic braking system
6.2 Power steering system
6.3 Hydraulic and pneumatic suspension
6.4 Air braking systems (Heavy vehicles)
6.5 Hydro-static transmission: Function, construction and working

Tutorial (15 hours)

1. Solving numerical problems related to the principles and properties of hydraulic systems
2. Performance of analysis and selection for hydraulic system components
3. Identification of actuators and control valves in hydraulic systems
4. Identification of actuators and control valves in pneumatic systems
5. Implementation of electrical control and automotive applications for hydraulic and pneumatic systems

Practical **(22.5 hours)**

1. Demonstration and operation of hydraulic pumps
2. Observation and operation of hydraulic valves
3. Observation and operation of pneumatic valves
4. Design and simulation of hydraulic circuits
5. Design and simulation of pneumatic circuits
6. Demonstration of automotive hydraulic and pneumatic systems

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	12	16
2	8	10
3	6	8
4	8	10
5	6	8
6	5	8
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Esposito, A. (2014). Fluid power with applications. Pearson.
2. Parr, A. (2011). Hydraulics and pneumatics: A technician's and engineer's guide. Elsevier.
3. Hicks, T. G., Pippenger, J. J. (1979). Industrial hydraulics (Latest Edition). McGraw-Hill Education.
4. Ilango, S., Soundararajan, V. (2011). Introduction to hydraulics and pneumatics. PHI Learning.