



# دبلوم تطبيقات التحكم الأوتوماتيكي في نظم القوى الميكانيكية

## MEP 562-Basics of Hydraulics

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**Mechanical Power Engineering Department**

**Contents:** Definition of Hydraulics- Hydrostatics (Pressure, Transportation & Magnification of Force & Moment)- Hydrodynamics (Continuity eqn., Bernoulli's eqn., Energy eqn., types of fluid flow)- Methods of Power transportation- Basic Components of Hydraulic Systems-Types of Positive Displacement Pumps (Gear, Vane, and piston pumps)- Types of Hydraulic Actuators (Cylinders, Engines, Semi-rotating Engines)- Pressure Valves – Directional Control Valves – Flow Control Valves- Non-return Valves – Conditioning of Hydraulic Oils (filters, Heat Exchangers, Tanks)- Oil Piping – Auxiliaries (Accumulators, Manifolds, Flow Meters, Pressure Gauges, Switches)- Hydraulic Symbols – Reading Hydraulic Schematics – Basic Hydraulic Circuits (Direction Control, Speed Control, Two-cylinders Control, Pumps Curves, Step-displacement diagram, Numbering of Hydraulic Elements).

**Course Objectives: to give participants skills & knowledge to:**

**1- Basic Components of Hydraulic Circuit and hydraulic system.**

**2- Fluid viscosity, Tanks and Hydraulic Fluids**

**3- Examination of Hydraulic Pumps (Types of PDP).**

**4- Types of Hydraulic Actuators (Motors & Cylinders)**

**5-Understand basic types of various control valves (pressure control, direction control, flow control). This include functions, materials, sizes, geometry considerations and essential flow characteristics .**

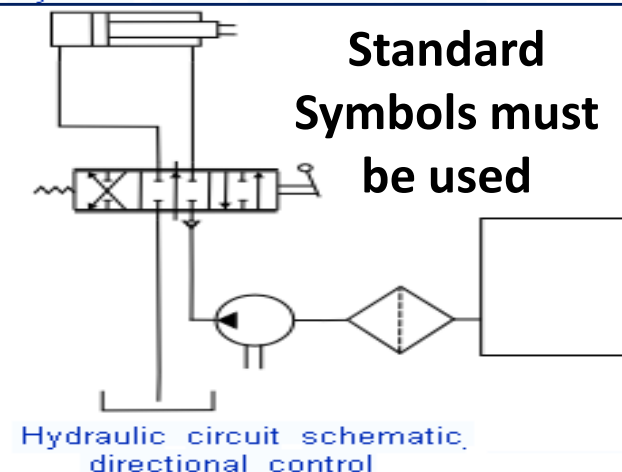
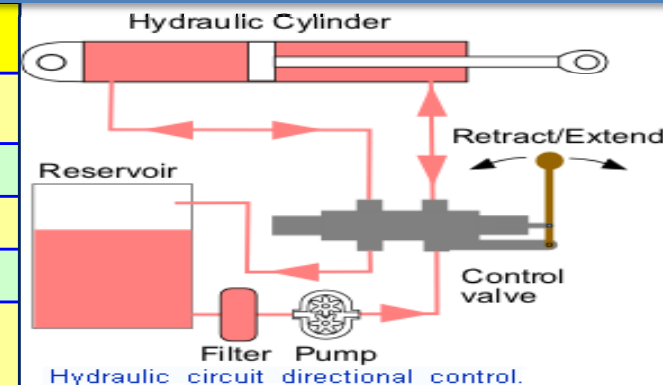
**6- Examine various types of Hydraulic Accessories.**

**7-Applications of Reading hydraulic Schematics.**

**8- Practical Training for Basic System Design.**

**9- Examination of Maintenance and Troubleshooting**

**Important Note:** Each lecture will be followed by a very comprehensive interactive and computer based virtual and multi-media training lab. Each lab will include also animations, 3-D models and on-line quizzes



## Course Specifications & Basic Information

<b>1. Title:</b>	<b>Using Hydraulic Circuits in Automatic Control Systems</b>			<b>Code:MEP562</b>
<b>2.Credit hrs per week</b>	<b>Lectures= 3 hours per week</b>	<b>Tutorial= 0.0</b>	<b>Practical= 0.0</b>	<b>Total=3 Cr.Hrs</b>

### B- Professional Information

#### 1. Course description: Overall Aims:

This is a mandatory course as one of the 6 mandatory core courses of the Diploma. It is designed to show the basic concepts and essentials of Hydraulic Circuits as it is applied in automatic control of mechanical power systems. The course uses the Virtual Lab method by a practical on-line interactive PC program. This control Virtual Lab is an E-self-learning type software. The course includes a large number of examples for hydraulic parts and circuits, 3-D animations, e-learning labs, quizzes..etc. This Virtual Lab program along with the course notes & sheets provide a typical example for modern self-learning education techniques for studying and analyzing various aspects related to applications of Hydraulic Circuits in automatic control of mechanical power systems. Course overall aims is s to introduce & study basic definitions of Hydrostatics (i.e., Pressure, work, transportation and magnification of force and moment). Hydraulic Power Transportation-Basic Components of Hydraulic Systems-Types of Positive Displacement Pumps(Gear, Vane, and piston pumps)-Types of Hydraulic Actuators (Cylinders, Engines, Semi-rotating Engines)- Pressure control Valves – Directional Control Valves- Flow Control Valves-Non-return Valves–Conditioning of Hydraulic Oils (filters, Heat Exchangers, Tanks)- Oil Piping – Auxiliaries (Accumulators, Manifolds, Flow Meters, Pressure Gauges, Switches)-Hydraulic Symbols –Reading Hydraulic Schematics– Basic Hydraulic Circuits(Direction and Speed Control, 2 cylinders Control, Pumps Curves, Step-displacement diagram, Numbering of Hydraulic Elements).

#### 2. Intended Learning Outcomes of Course (ILOs):

##### a) Knowledge and Understanding:

Having successfully completed this course, the post-graduate student should have knowledge and understanding of:

- Basics & various definitions & terminologies associated with Hydraulic control circuits/systems.
- Requirements of general interactive virtual lab program to study and analyze control systems.
- Basics of on-line interactive virtual lab to study and analyze Hydraulic control circuits/systems.
- Basic & essential components of Hydraulic circuits as types of control systems for producing mech. type outputs.
- Various types of positive displacement Pumps, hydraulic actuators, pressure control valves, directional control valves, flow control valves, check or non-return valves, fluid oil conditioning methods, oil conductors, and hydraulic circuit auxiliaries.
- Essential hydraulic symbols used for presentation of all types of hydraulic circuits & systems.
- Concepts of reading hydraulic circuits schematics for proper analysis of the hydraulic system function, performance and the type of the circuit output.

### **-b) Intellectual Skills:**

Having successfully completed this course, the student should have the ability to do:

- Select and apply appropriate technical and optimum method in doing engineering design and analysis of automatic control problems using Hydraulic systems.
- Searching for scientific information and adopting automatic control self-E-learning capabilities.
- Analyze and compare the component effects, performance, and efficiency of different types of automatic control Hydraulic circuits/systems.
- Apply the concept of software simulation of diagnostics & operation of various types of practical Hydraulic circuits/systems.
- Compare between various types of Hydraulic symbols, components, & complete circuits/systems.
- Select & apply appropriate Hydraulic symbols, components to design, model, analyze, and solve automatic Hydraulic control problems.

### **c) Professional and Practical Skills:**

Having successfully completed this course, the student should have the ability to do

- Identify several types of automatic Hydraulic control problems which are essential for design and operation of mechanical power systems and energy transfer processes.
- Perform professional design and modelling for different automatic Hydraulic control systems.
- Suggest possible alternative solutions for various types of Hydraulic components and parts.
- Diagnose efficiency and performance of different types of Hydraulic control circuits/systems.
- Analyze different types of Hydraulic symbols, schematics, and control circuits.

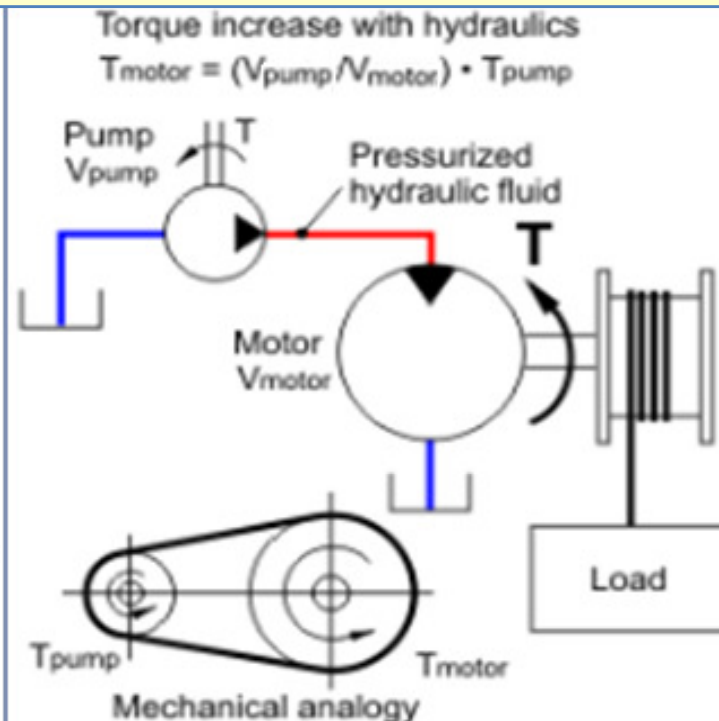
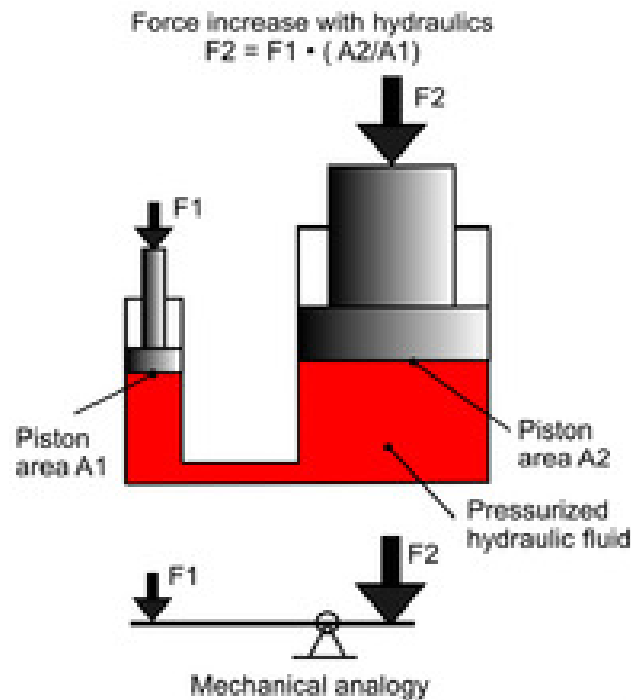
### **d) General and Transferable Skills:**

Having successfully completed this course, the student should have the ability to do:

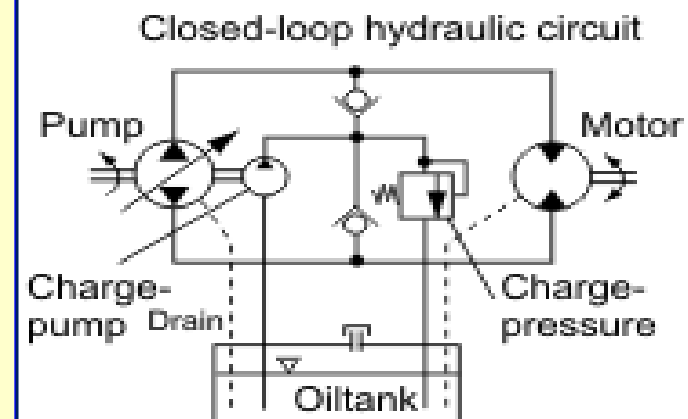
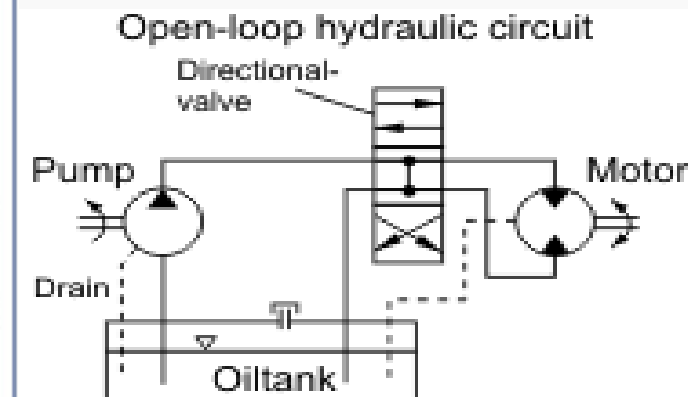
- Perform engineering calculations, draw feed-back control circuits, block diagrams, graphical presentation of experimental data, and perform data-regression analysis.
- Transfer knowledge, Work in group, & Communicate in written & oral forms, in English.
- Use IT& evolutionary technological tools& PC applications (Excel, Mat lab, Virtual labs, .etc).
- Prepare & write reports, Manipulate & sort data, Think logically, and continuous self-E-learning.
- Identify practical problems, compare between different technologies for measurement systems.
- Organise & manage time & resources effectively; for short-term and longer-term commitments.

## Overview

**Hydraulics** is a branch of science & engineering concerned with the use of fluids to perform mechanical tasks.



An excavator; main hydraulics: Boom cylinders, swingdrive, cooler fan and trackdrive



**Hydraulic systems** are essential parts of many industrial / practical engineering application. Designing of hydraulic circuits and their components & their operation & maintenance are one of the very important practices of many engineers & technicians. **Availability, efficiency** and **extended reliable performance** of power plants, pumping and fluid handling stations & similar facilities are greatly influenced by accurate design, selection, efficient operation and proper maintenance of hydraulic systems & associated components.



# Automatic Control Virtual Lab: Basics of Hydraulics

