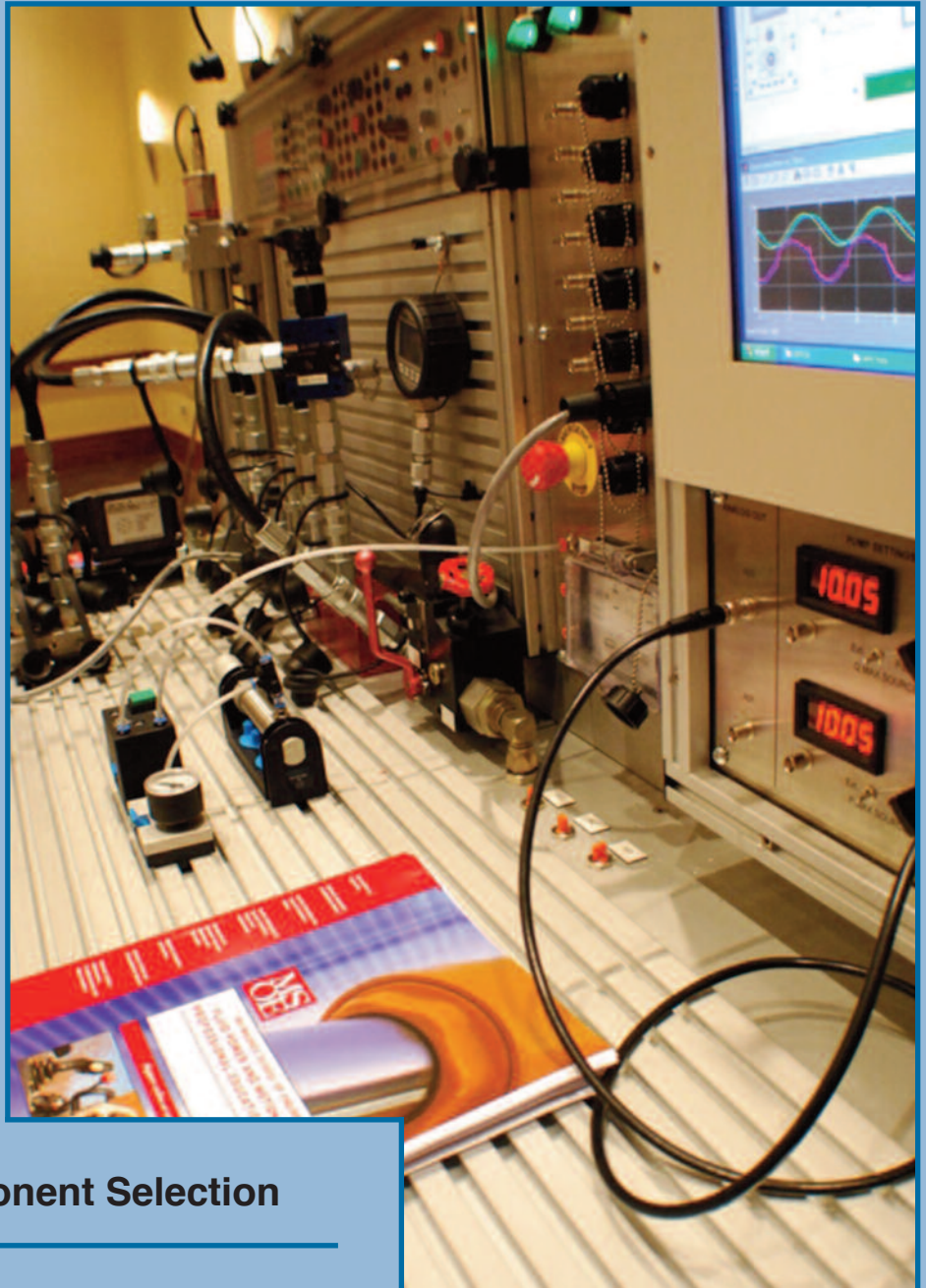


Universal Fluid Power Trainer (UFPT)



Milwaukee School of Engineering
Applied Technology Center™
Department of Professional Education

The UFPT is a **modular, smart and unique** fluid power and motion control training unit. It contains an excellent integration of industrial-grade hardware and built-in software licenses to help teach and demonstrate fluid power technology through the following steps:



Circuit **Design** and Component Selection

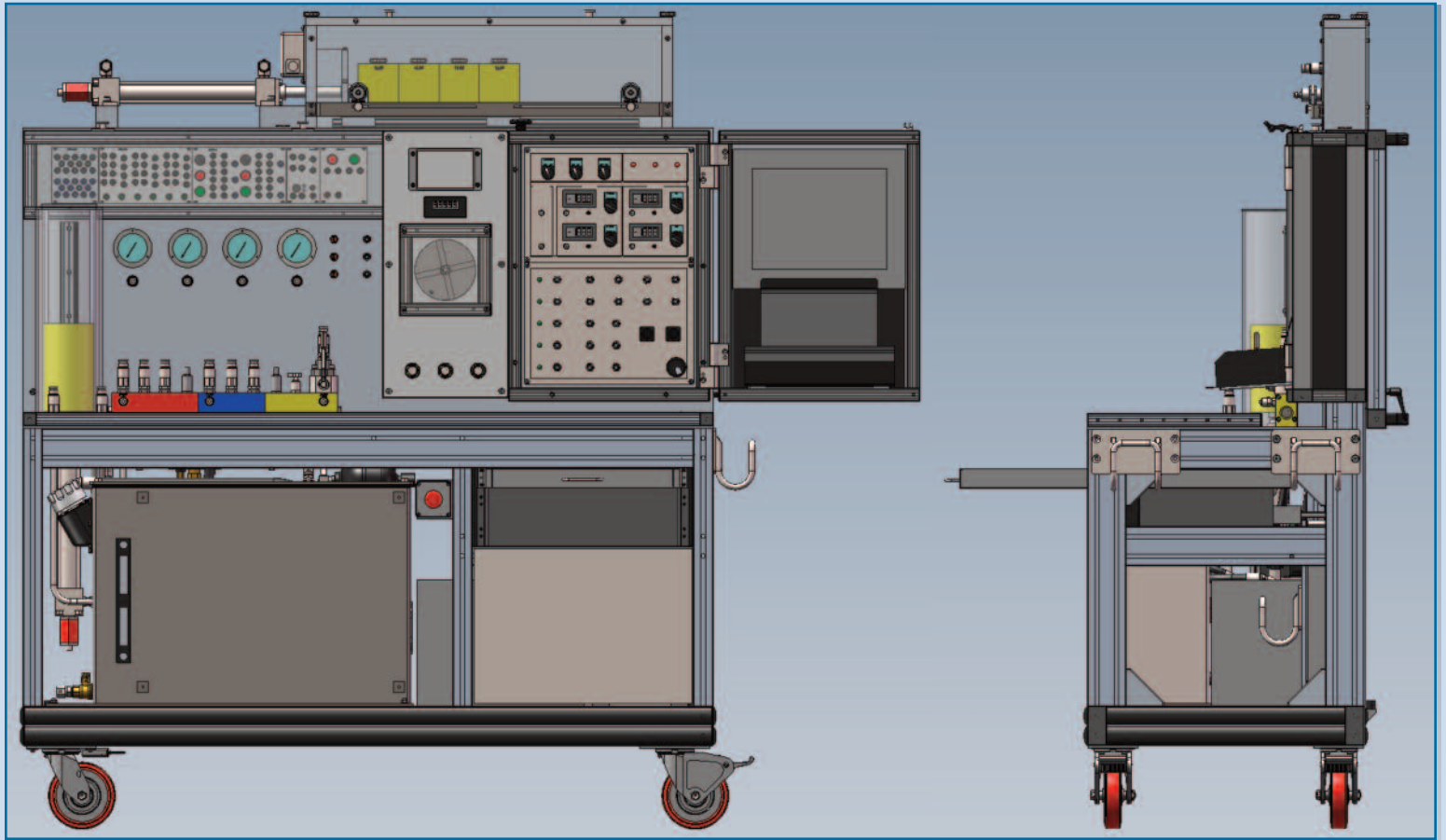
Functional **Animation**

Mathematical **Modeling**

Performance **Simulation**

Prototyping with Hardware-in-the-Loop

Performance Analysis and **Data Acquisition**



Why it is called universal?

The integrated hardware and software offer universal capabilities to demonstrate fluid power and motion control technology. The following are the general features:

Covered disciplines:

- Hydraulics, electro-hydraulic, pneumatic, electro-pneumatic and motion control

Training contents:

- Basic to advanced level, standard and tailored courses for industrial and mobile applications

Control mode:

- Manual, PC-based and PLC-base control

Controlled axes:

- Linear and rotational axis

Controlled parameters:

- Position (linear – angular); Flow/velocity (linear – angular); Pressure/Force/Torque

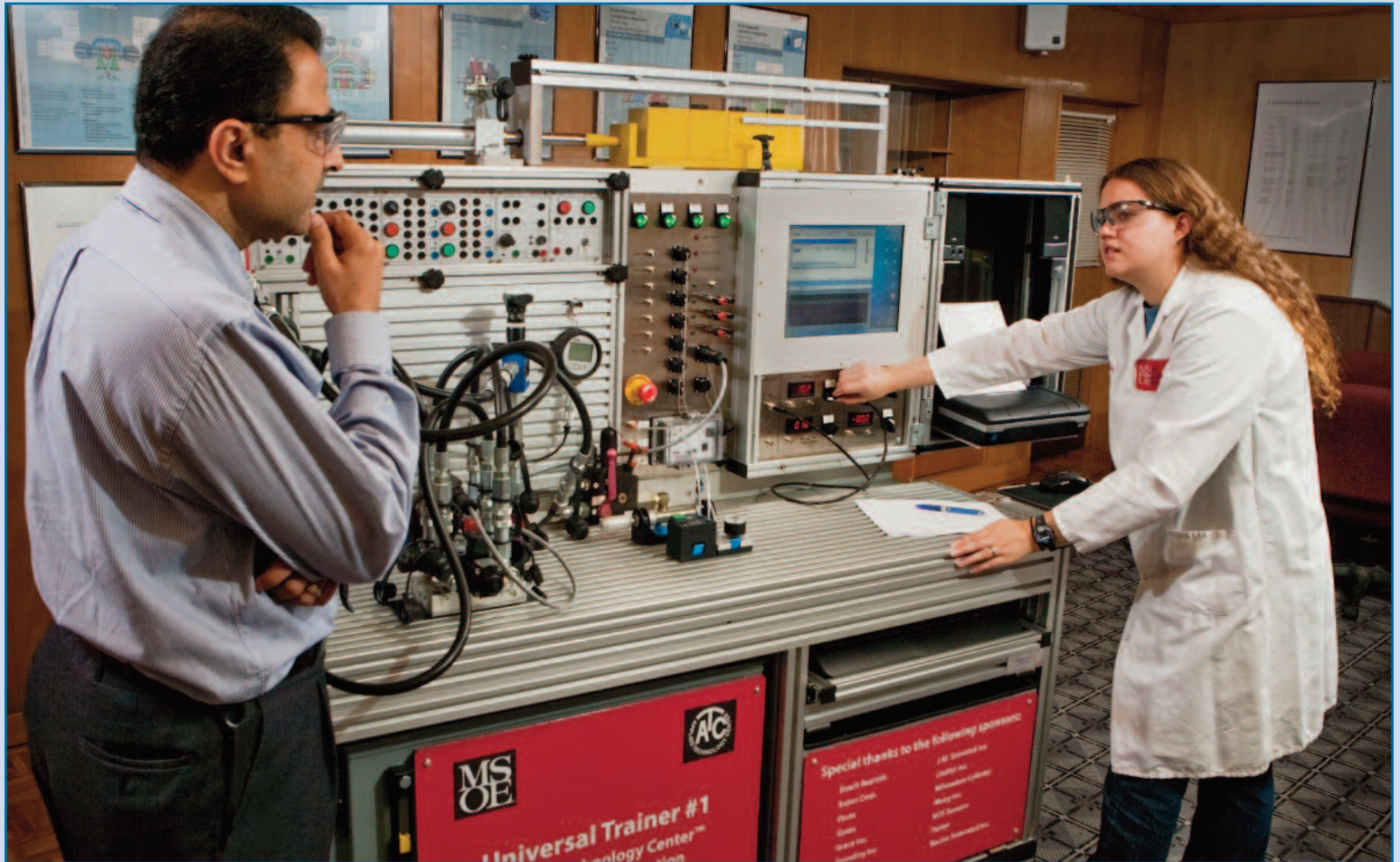
Data acquisition:

- Digital switches (position – pressure – level) and analog transducers (pressure – flow – rpm – torque)

Frame:

- Transportable frame, wheeled on industrial casters, single frame for all components
- Components are industrial-grade and connected by ISO interchangeable quick-disconnects

Main Working Unit

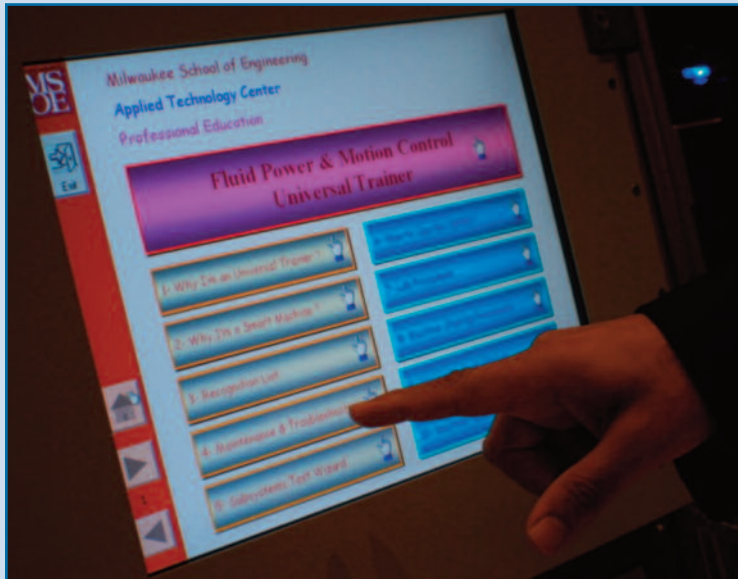
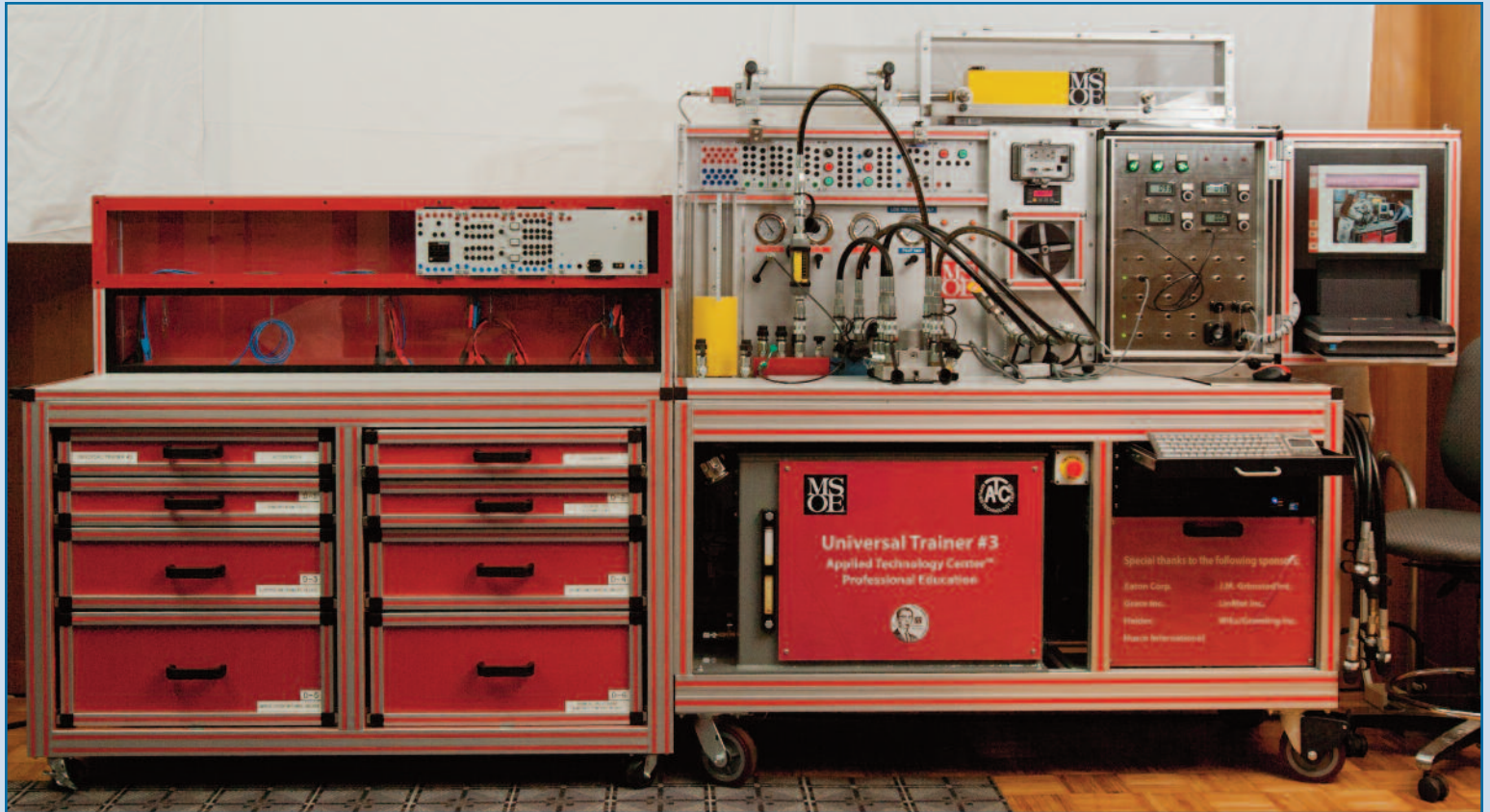


Storage Cabinet



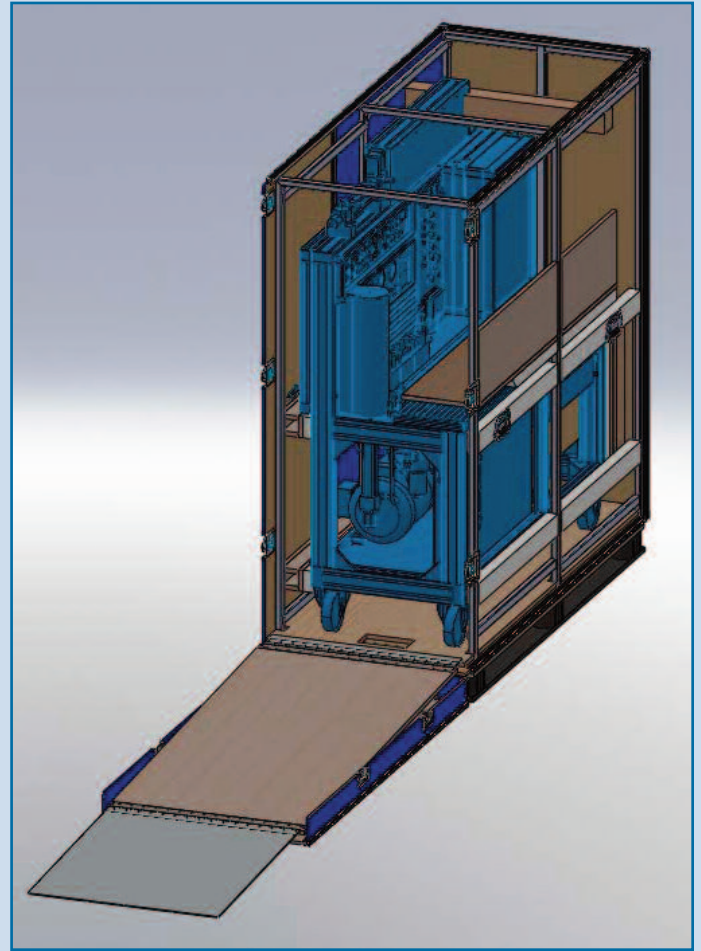
What is meant by the term modular?

The UFPT consists of main working unit and a storage cabinet. The storage cabinet contains different groups of components based on the needs of each client. The unit was designed to be flexible so it can accommodate future upgrades.



Why is the UFPT considered “smart”?

- **Interactive lab manual:** Instructions for self-guided experiments
- **HMI and touch screen:** Human-machine interface with Windows®-based operating system
- **Power access:** Separate access to hydraulic power and pneumatic power
- **Software:** Machine loaded by latest version of Matlab-Simulink and Automation Studio
- **Electro-hydraulic variable pump:** Flexible pump control mode of the user's choice
- **Critical conditions monitoring:** Pump cavitation, reduced oil level and filter clogging
- **Built-in printer:** In-field printing capabilities
- **Internet access:** Wireless Internet access
- **Smart maintenance:** Full documentation; troubleshooting and sub-systems test wizard
- **Mobilized:** Easy crating and shipping in a custom protective crates



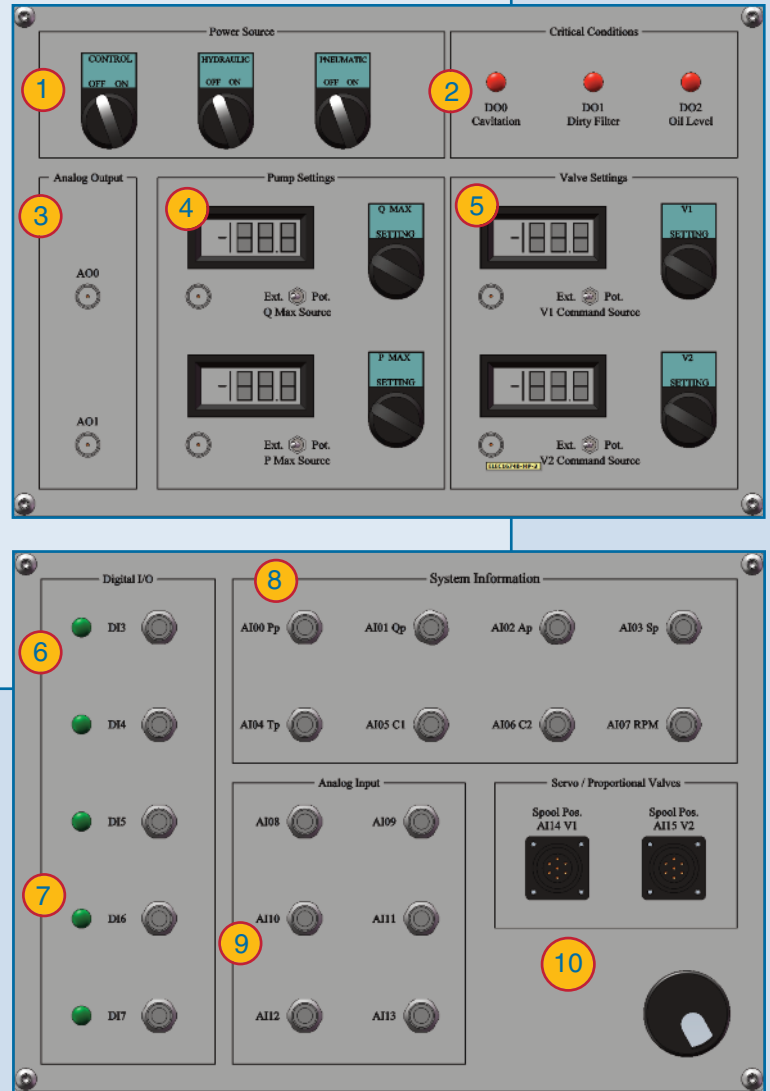
What makes the UFPT unique?

Below are key features that make this a unique training unit:

- **Software-hardware integration:** The UFPT contains the latest modeling and simulation software licenses built-in, including Automation Studio™ and MATLAB-Simulink, with a real-time window workshop and control tool box for system prototyping with hardware-in-the-loop.
- **Power supply:** Electro-hydraulic controlled variable displacement pump in addition to air compressor for pneumatic systems. Pump controller is accessible manually and electronically to vary the pump control mode.
- **Data acquisition:** The loaded software, feedback utilities and data acquisition capabilities make the UFPT usable for research within its power level.
- **Modularity:** It has been designed on a modular bases so that it accepts future upgrades.
- **Brand-neutral:** Most of the training units available in the market are built by fluid power components manufacturers to promote their products. UFPT's modules and components have been selected on the basis of technology training rather than specific product or brand training.
- **Compactness and mobilization:** UFPT has been designed to accommodate four students. It has been dimensioned to pass through standard-sized doors, with a robust machine frame and industrial casters that make it easy to move. It's easy to crate and ship for off-campus use.
- **Plug and play:** It does not need special electrical arrangements. Since only a 120 Volt and 20 Amp separate circuit is required, it can be plugged into a standard wall power outlet.

What data acquisition capabilities are available in the machine?

- 1 Separate access to hydraulic/pneumatic/DC power supply
- 2 Critical condition monitoring
- 3 Two configurable analog outputs
- 4 Manual or remote adjustment of pump max flow and max pressure
- 5 Proportional and servo valve spool position—manual or remote adjustment
- 6 Three digital inputs for pressure and proximity switches
- 7 Two digital outputs for ON/OFF valves
- 8 System information monitoring. Cylinders position, motor RPM, pump flow, pump pressure, oil temperature
- 9 Six analog inputs
- 10 Two, seven-pin sockets for proportional and servo valves



What if the technology changes in the future?

The modular design of the machine makes it adaptable for future upgrades. The following key points make the unit good for consecutive generations:

- The selected hardware-software integration is the state-of-the-art
- Most of the components are not permanently mounted on the working unit so they are easy to replace if they became obsolete
- The machine is designed for PC-based control concept so that it can be continuously updated with the latest software versions
- All electrical connections and cables are industrial grade
- We will inform our clients about future software and hardware upgrades

What if a unit of higher power is required?

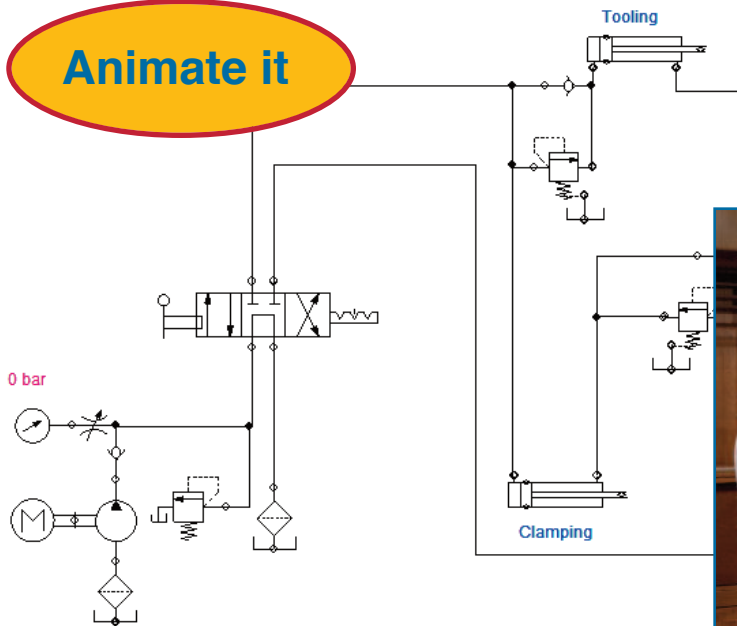
Our experts are available to design test stands with various power ratings.

What types of experiments can be performed on the machine?

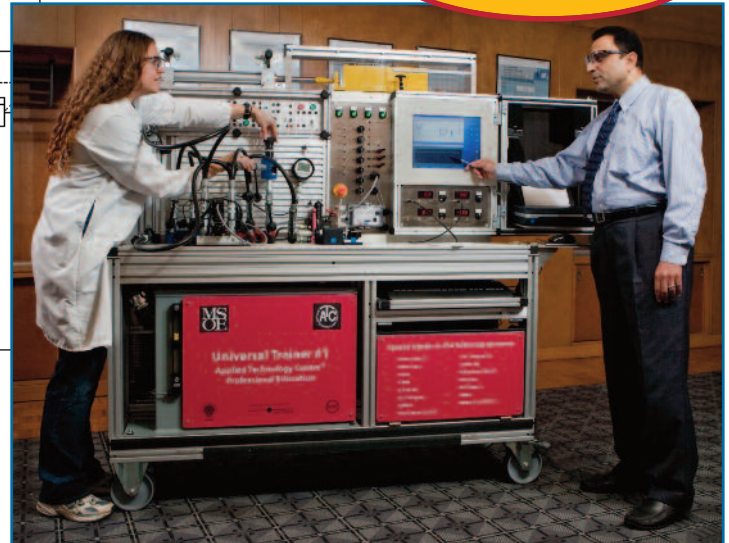
The below list is a sample of documented experiments. Every instructor is free to use his or her creativity to develop experiments beyond the presented list.

Lab #	Lab Name
	Introduction to Hydraulic Systems Seminar
1	Energy Losses in a Hydraulic System
2	Power Distribution in a Hydraulic System
3	Valve Coefficient Development
4	Motion Control of Hydraulic Cylinder
5	Control of Overrunning (Vertical) loads
6	Speed Control of a Hydraulic Cylinder
7	Boosting Speed of a Hydraulic Cylinder
8	Sequence Control
	Hydraulic System Modeling and Simulation Seminar
9	Pump Static Characteristic Measuring
10	Pump Step Response Measuring
11	Hydraulic Motor U-n Static Characteristics
12	Identify Hydraulic Motor Dynamics
13	Identify Horizontal Cylinder Dynamics
14	Proportional Valve Flow Gain Measuring
15	Servo Valve Flow Gain Measuring
16	EH Position Controlled Hydraulic Cylinder Step Response
17	EH Position Controlled Hydraulic Cylinder Frequency Response
18	EH Speed Controlled Hydraulic Motor Step Response
19	EH Speed Controlled Hydraulic Motor Frequency Response
	Electro-hydraulic Components and Systems Seminar
20	Cylinder Extension upon Pressing a Push-Button
21	Signal Storage by Electrical Self Locking
22	Drive a Hydraulic Actuator by Latching Circuit
23	Position-dependent Cylinder Deceleration
24	Pressure-dependent Cylinder Reversal
25	Event-dependent Warning Circuit
26	Cylinder Motion Control Performance using Switching Valve versus Proportional Valve
27	Cylinder Motion Control Performance using Servo Valve versus Proportional Valve
28	Digital Control of EH Variable Displacement Pumps
29	Digital Control of a Hydraulic Cylinder Position
30	Pressure- and/or Position-dependent Sequence Control
31	Analog/Digital Time-dependent Sequence Control

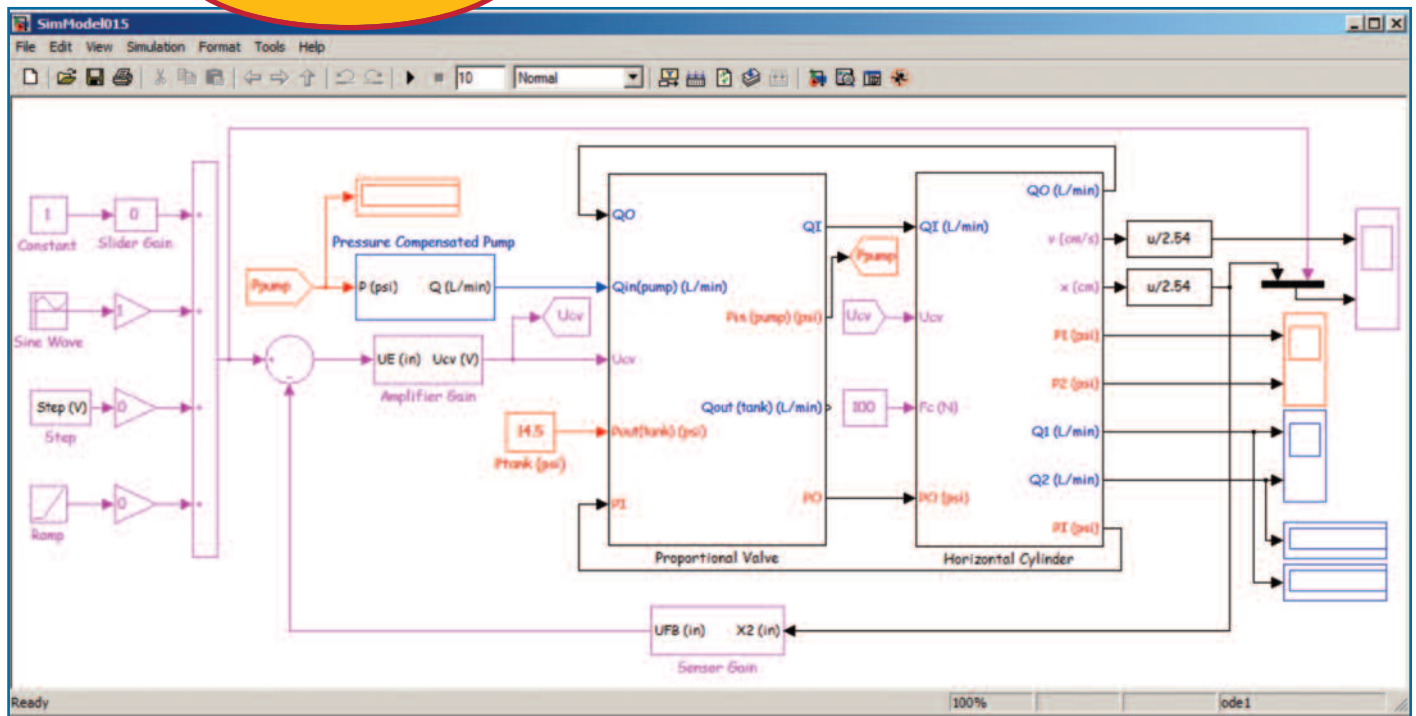
Animate it



Practice it



Simulate it



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