



# Milwaukee School of Engineering Applied Technology Center

Department of Professional Education and Research Development

On Campus – On Customer site - International



Professional Training  
=  
Professional Work Force!



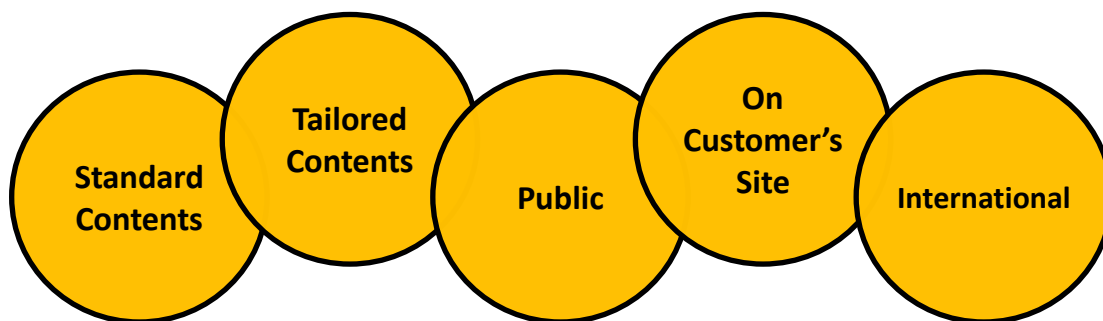


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# Why MSOE?

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- **MSOE is a leader in fluid power research and education for more than 50 years.**
- **MSOE provides training on campus, at customer sites and internationally.**
- **MSOE certifies all courses and eligible to grant Continuing Education Credit Units (CEU) for the participants of the professional education programs.**
- **MSOE is one of the most recognized institutions nationwide in terms of fluid power practical-oriented education.**
- **MSOE provides long term technical skills development solutions for industry.**

## **Milwaukee School of Engineering:**

MSOE is a private, non-profit university with about 2,600 students that was founded in 1903. MSOE offers bachelor's and master's degrees in engineering, business, mathematics and nursing, as well as professional education courses and certifications in fluid power. The university has a national academic reputation; longstanding ties to business and industry; and dedicated professors with real-world experience.

Sheku Kamara is the dean of applied research at Milwaukee School of Engineering (MSOE) and oversees the activities of the Applied Technology Center™ (ATC). The ATC uses MSOE faculty, staff and student expertise to solve technological problems confronting business and industry. The center undertakes more than 250 industry-sponsored research projects that are focused on providing real solutions to some of industry's biggest problems every year. This work is completed through several centers of excellence within the ATC including the Center for BioMolecular Modeling (CBM), Fluid Power Institute™ (FPI), Professional Education Research & Development (PERD) and the Rapid Prototyping Center (RPC). Since 2004, he has been a technical advisor to the [RAPID conference](#) organized by SME and past chair of the [Additive Manufacturing Users Group \(AMUG\)](#). Kamara is the 2008 recipient of the prestigious Karl O. Werwath Engineering Research Award from MSOE. In 2010, he was named a Laser Sintering DINO (Distinguished Innovator Operator Award) from the Additive Manufacturing Users Group and a member of the board of directors for the Wisconsin Manufacturing Extension Partnership (WCMP). Kamara holds the RTAM Master Level Certificate on additive manufacturing from SME and a Bachelor of Science in Mechanical Engineering with Honors from the University of Sierra Leone and a Master of Science in Engineering from MSOE.



**Kamara Sheku**  
Dean of Applied  
Technology Center

Other major centers of excellence and cooperative ventures within the ATC include:

- ❖ Professional Education and Research Development (PERD).
- ❖ Rapid Prototyping Center (additive manufacturing).
- ❖ Center for Bio-Molecular Modeling (CBM).
- ❖ Clinical and Translational Science Institute (CTSI).
- ❖ Construction Science and Engineering Center.
- ❖ Engineering Research Center for Compact and Efficient Fluid Power (CCEFP).
- ❖ Mid-West Energy Research Consortium (M-WERC).
- ❖ Nano-Engineering Laboratory.
- ❖ Photonics and Applied Optics Center.
- ❖ Wisconsin Center for Commercialization Resources (WCCR).
- ❖ Wisconsin Space Grant Consortium.



# Professional Education

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MSOE seminars offer participants the opportunity to explore technological developments and current applications and techniques. The programs are designed to keep practicing engineers abreast of new developments and applications, and to provide a basic understanding of the technology to new entrants into the field.

## **MSOE seminars:**

- Are based on applied research conducted by scholars.
- Use state-of-the-art laboratories with industrial-grade training equipment.
- Use a hands-on approach to reinforce the concepts presented in class.
- Applications-oriented and often customized to the industry or companies of seminar participants.
- Are offered on the basis of strong long-term partnerships with set objectives and outcomes.

## **On-site seminars:**

MSOE seminars are available for an on-site presentation at your company. The curriculum may be presented in its original format or be modified to meet your specific needs. Confidentiality protected!

## **MSOE's seminars are unique in the industry because:**

- Seminar instructors are experts in their fields, including certified fluid power specialists, Professional Engineers and Ph.D.s.
- Attendees are exposed to the latest fluid power research and industry projects developed at the Fluid Power Institute.
- Professional education seminars use the latest software versions of MATLAB®/Simulink® and Automation Studio in the advanced courses.
- Attendees can network and build professional relationships while benefitting from training, research and industrial projects.



**Dr. Medhat Khalil**

Director of Professional Education & Research Development (PERD)

[www.msoe.edu/seminars](http://www.msoe.edu/seminars)

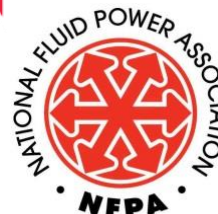
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1025 N. Broadway,  
Milwaukee, WI, 53202-3109, USA







For more than 50 years, MSOE's Fluid Power Institute has been a leader in fluid power research and education. As a part of MSOE's practical, applications-oriented education philosophy, FPI staff and students conduct research and analysis for agriculture, construction, mining off-highway and industrial fluid power applications. Its client list includes global companies such as Caterpillar, CNH, Exxon-Mobil, Husco International, John Deere, Parker Hannifin and Sun Hydraulics.

Premier companies choose the Fluid Power Institute as a partner because of its expertise in evaluating a wide range of hydraulic components and machinery. FPI engineers design and build specialized power supplies and instrumentation systems for pump, motor and fluid efficiency testing. The range of power FPI has available to conduct high-pressure endurance testing of hoses, valves, tubes, plugs and seals is also unique; cylinders as short as a pencil, and as long as a semi-trailer can be evaluated.

The FPI has two facilities that enable it to evaluate a remarkable range of equipment:

#### **On Campus FPI Laboratory**

2,400 square foot, Eight test-cells, endurance, fatigue, performance and efficiency tests.

#### **Off-campus FPI Laboratory**

12,000 square-feet, high-bay ceiling, drive-in access, reconfigurable workspace and major hydraulic power capabilities.

FPI's newly established off-campus laboratory is located in the Chase Commerce Center on the south side of Milwaukee. This facility is especially suited for evaluating large components, systems and vehicles. A reconfigurable work space enables FPI engineers to customize power and test conditions using a variety of methods.



**Timothy Kerrigan**

Director of Fluid  
Power Institute

[www.msoe.edu/fpi](http://www.msoe.edu/fpi)





FPI has the ability to design test plans that meet the unique requirements of its clients. Our engineers and students work closely with clients to determine their exact needs. Systems are designed, built and instrumented to test equipment under the appropriate duty cycle. Tests can be conducted according to customer specifications, ASTM, ISO, NFPA or SAE standards.

## Engineering Services

The key to developing a reliable, available and maintainable fluid power system is to make it an integral part of the engineering process, and to eliminate failures and failure modes through identification, classification, analysis and removal or mitigation. When developing fluid power systems, it is imperative to select the right activities and to conduct those activities at the right time. The engineering faculty and staff at FPI are experts in fluid power application from a simple design to an efficient and reliable hydraulic or pneumatic system.

## Tribology Services

The FPI has been a leader in contamination analysis and filtration technology for decades. In the 1980's, FPI pioneered the use of automatic particle counters in hydraulic fluid analysis. In the 1990's, FPI pioneered the development of surgically clean fluids for initial-fill applications. In the 2000's FPI was the very first to use Atomic Force Microscopy in wear particle analysis. FPI's role as a practitioner and educator in these areas has truly advanced the fluid power industry. Our current research thrust incorporates the study and formulation of energy-efficient hydraulic fluids-an endeavor funded by a grant from the National Science Foundation and industry partners.

Many of the world's largest equipment manufacturers use FPI to test new hoses, tubes, cylinders, coolers, reservoirs, pumps, bearings and valve assemblies to determine the type and size of manufacturing contamination, left in the component as received by the customer. Through the use of advanced diagnostic methods such as ferrography, atomic force microscopy, stereomicroscopy and laser particle imaging, early detection and root-cause analysis are possible.



**Dr. Medhat Khalil**  
**Director of Professional Education and  
Research Development**

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Dr. Medhat Khalil, for 17 year, is working as the Director of Professional Education & Research Development at the Applied Technology Center, Milwaukee School of Engineering, Milwaukee, WI, USA. Medhat has bachelor's degree in mechanical engineering from Military Technical College (MTC), Cairo, Egypt. He got his master's degree in Mechanical Engineering from Cairo University, Cairo, Egypt. Medhat has couple of PHD Degrees. The first one is in Mechanical Engineering from Cairo University. The second Ph.D. in Mechanical Engineering and Post-Doctoral Industrial Research Fellowship from Concordia University in Montreal, Quebec, Canada. Medhat authored several textbooks in the field of fluid power. He participated in many technical conferences and published several reviewed technical papers. Medhat has been certified by the International Fluid Power Society ([IFPS](#)) as: Certified Fluid Power Hydraulic Specialist (CFPHS) and Certified Fluid Power Accredited Instructor (CFPAI). Medhat is a member of many grand institutions such as Center for Compact and Efficient Fluid Power Engineering Research Center ([CCEFP](#)), listed Fluid Power Consultant by the National Fluid Power Association ([NFPA](#)), and listed professional instructor by the American Society of Mechanical Engineers ([ASME](#)), and National American Die Casting Association ([NADCA](#)). Medhat has been assigned as the chair of the education committee for the International Fluid Power Exposition since 2017. Medhat developed and taught countless courses for industry professionals worldwide. He has a balanced academic and industrial experience. Medhat had worked for several world-wide recognized industrial organizations such as Rexroth in Germany and CAE in Canada. Medhat has designed several hydraulic systems and developed analytical and educational software. Medhat also has vast experience in modeling and simulation of dynamic systems using Matlab-Simulink. Medhat was the designer and founder of the Universal Fluid Power Trainers. Medhat was the recipient of the "Otto Maha Pioneers in Fluid Power" award in 2012 and the "[IFPS-Hall of Fame](#)" award in 2021.





## Dr. Daniel Williams

is an associate professor in MSOE's Mechanical Engineering department. He earned his bachelor's degree in mechanical engineering from the University of Wisconsin-Platteville and his master's degree and Ph.D. in mechanical engineering from the University of Wisconsin-Madison. Williams has more than 20 years of industry engineering experience. He worked for two years as a design engineer at Snap-On Tools Corporation in Kenosha, Wis. Following graduate studies, Williams worked for 18 years in John Deere's Construction & Forestry Division in Dubuque, Iowa, where he specialized in machine systems simulation—hydraulics, drive train, rigid body dynamics and controls—and control design. Dan has also been a member of the full-time faculty at Loras College in Dubuque, where he taught courses in the electromechanical engineering program for five years.



**Paul Michael, C.L.S.,** is a research chemist in MSOE's Fluid Power Institute. He earned his B.S. in chemistry at the University of Wisconsin, Milwaukee and graduated with distinction from Keller Graduate School of Management. He has more than 30 years of experience in the formulation and testing of hydraulic fluids and lubricants. Paul is an STLE certified Lubrication Specialist and chairs the NFPA Fluids Committee. In addition to his research in contamination analysis, he is currently investigating energy efficient hydraulic fluids in the NSF funded multi-university Center for Compact and Efficient Fluid Power. Michael was a recipient of the Otto J. Maha Pioneers in Fluid Power Award in 2012.

## Milwaukee: A fluid power industrial hub

The following fluid power related component manufacturers, machine builder, service providers, associations and organization are samples of Milwaukee-based or at least have a subsidiary in the city of Milwaukee:

- ❖ Actuant.
- ❖ Caterpillar Mining.
- ❖ CASE.
- ❖ Eaton R&D.
- ❖ Fluid System Components.
- ❖ Grimstad.
- ❖ GS- Hydraulics.
- ❖ Husco International.
- ❖ Milwaukee Cylinders.
- ❖ Milwaukee School of Engineering.
- ❖ Motion Industries.
- ❖ Milwaukee Hydraulics.
- ❖ National Fluid Power Association (NFPA)
- ❖ Norman Equipment.
- ❖ Oilgear.
- ❖ Poclain Hydraulics.
- ❖ P & H Mining.
- ❖ PUTZMEISTER America.
- ❖ Racine Federated.





# Department of Professional Education

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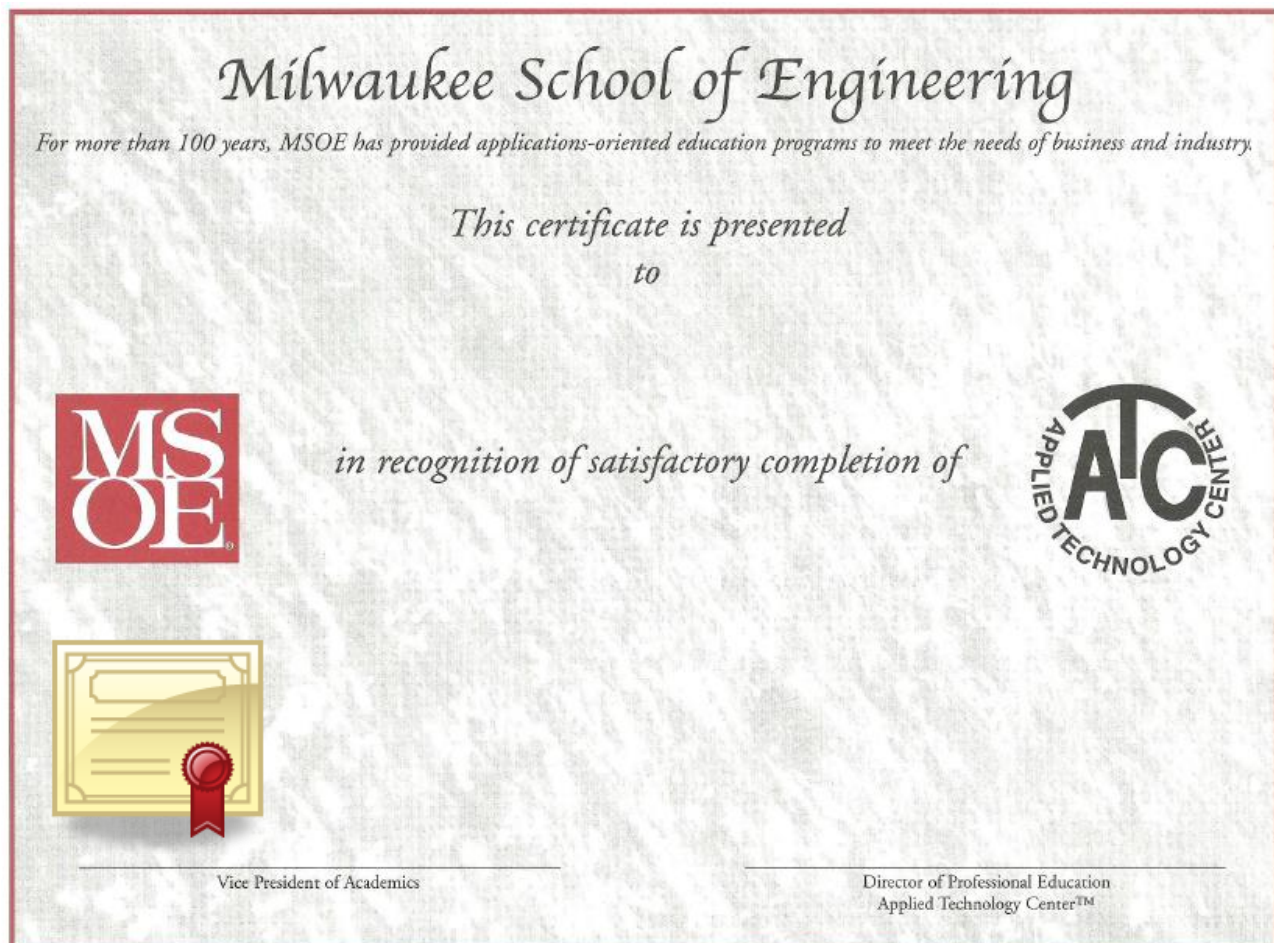
UNIVERSITY

## Certification and Continuing Education Credit Units

The Professional Education Department authorizes Continuing Education Credit Units (CEUs) for seminar participants. For every 1 contact hour, 0.1 CEU is granted. For example, 10 Hours seminar participant deserve 1 CEU.

For an institution to be eligible to grant CEU, it must meet certain criteria:

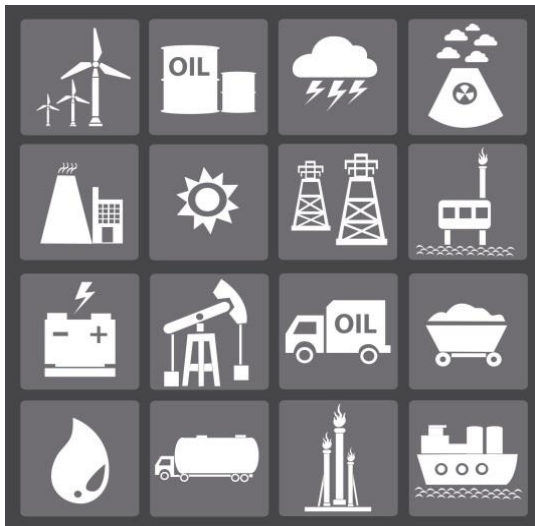
- ❖ It should be a recognized institution.
- ❖ Courses must be with learning objectives.
- ❖ Presenter must be qualified instructor.
- ❖ Records of participants must be kept and maintained.
- ❖ Participants must be certified either by a certification exam or hands-on practice.





## Targeted Clients

We provide quality training for professionals from  
**Industrial and Mobile Applications.**

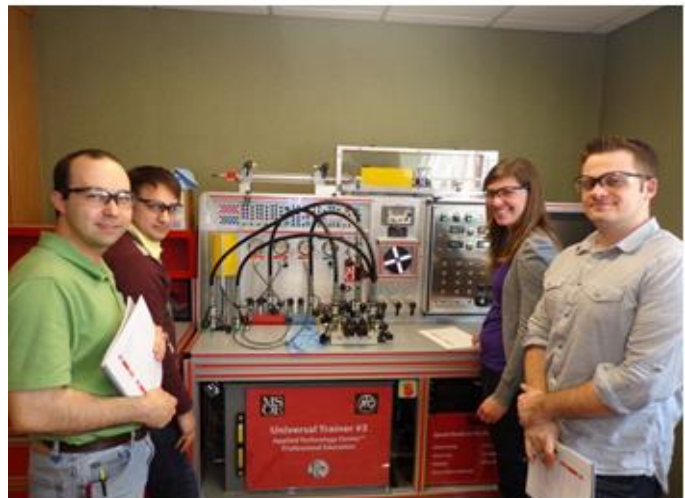
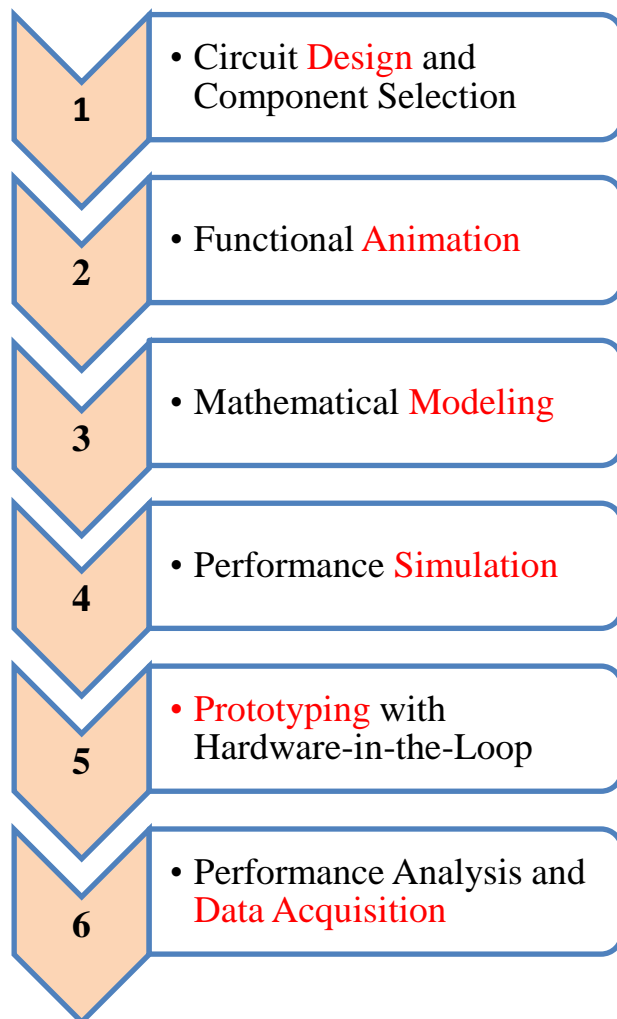


- ❖ Steelworks and Metal Forming.
- ❖ Molding and Die Casting Industries.
- ❖ Forging and Extrusion Works.
- ❖ Machine Tools.
- ❖ General Manufacturing.
- ❖ Industrial Automation.
- ❖ Process Engineering.
- ❖ Wood, Paper and Glass Industries.
- ❖ Pharmaceutical Industries.
- ❖ Chemical and Petrochemicals.
- ❖ Food Industries.
- ❖ Power Plants.
- ❖ Renewable Energy.
- ❖ Material Handling.



- ❖ Earth Moving Machines.
- ❖ Construction Machines.
- ❖ Lifting Equipment.
- ❖ Agricultural Machines.
- ❖ Oil & Gas Industries.
- ❖ Offshore Equipment.
- ❖ Mining Equipment.
- ❖ Marines & Shipbuilding.
- ❖ Defense Systems.
- ❖ Aerospace Industries and
- ❖ Airport Service Machines.
- ❖ Rail-way Vehicles.
- ❖ City service Vehicles.
- ❖ Automotive engineering.

## Training Equipment



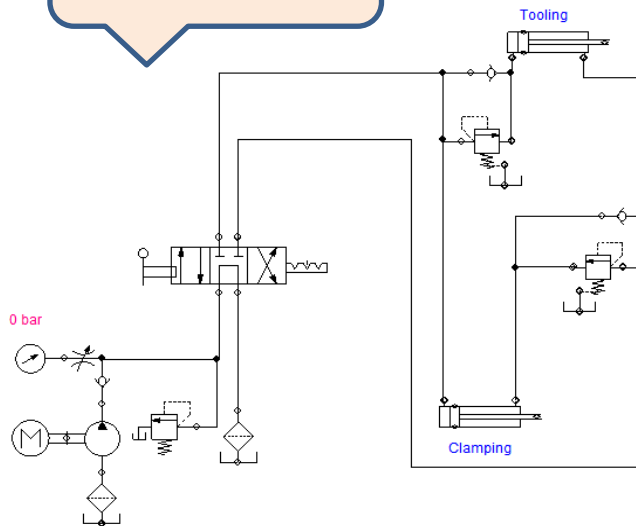
The state-of-the-art Universal Fluid Power Trainer (UFPT) has been designed by Dr. Khalil. Four fully functional units have been added to the department of Professional Education to be used by seminar participants to practice designing, animating, simulating and building hydraulic circuits. The machines are universal, transportable and compact so that it can be shipped to the customer's site.

**To learn more about the Universal Fluid Power Trainers:**

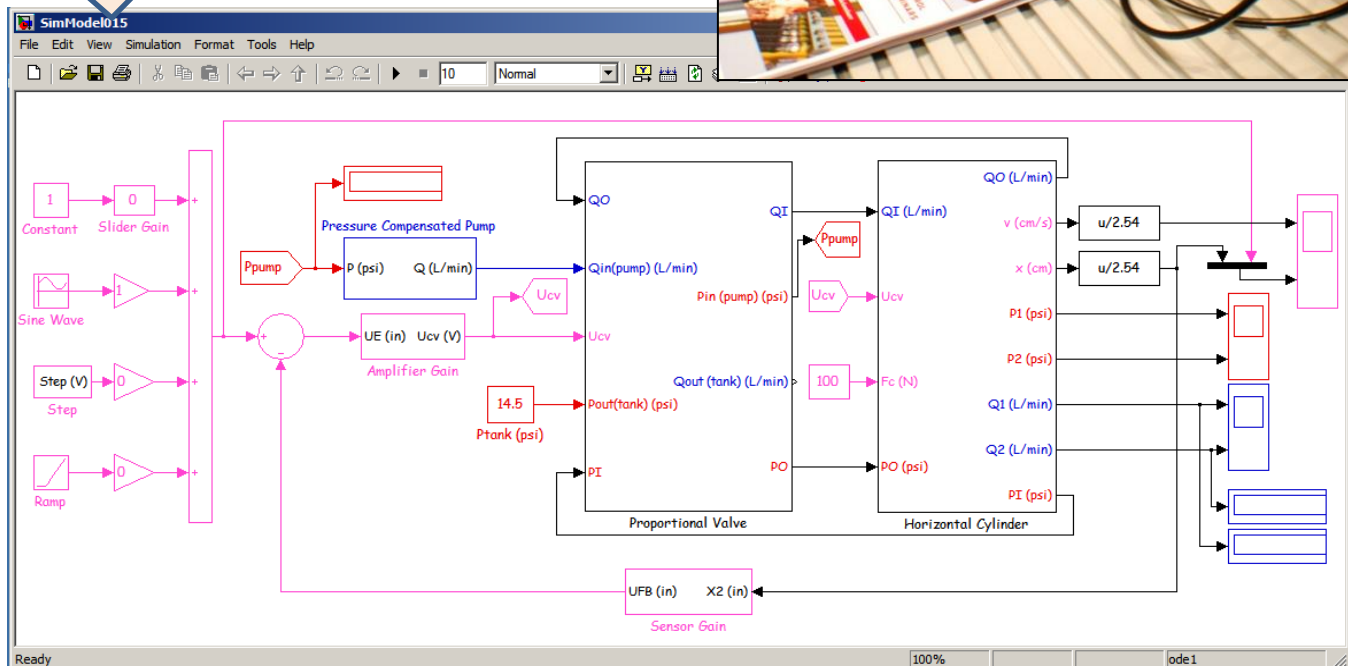
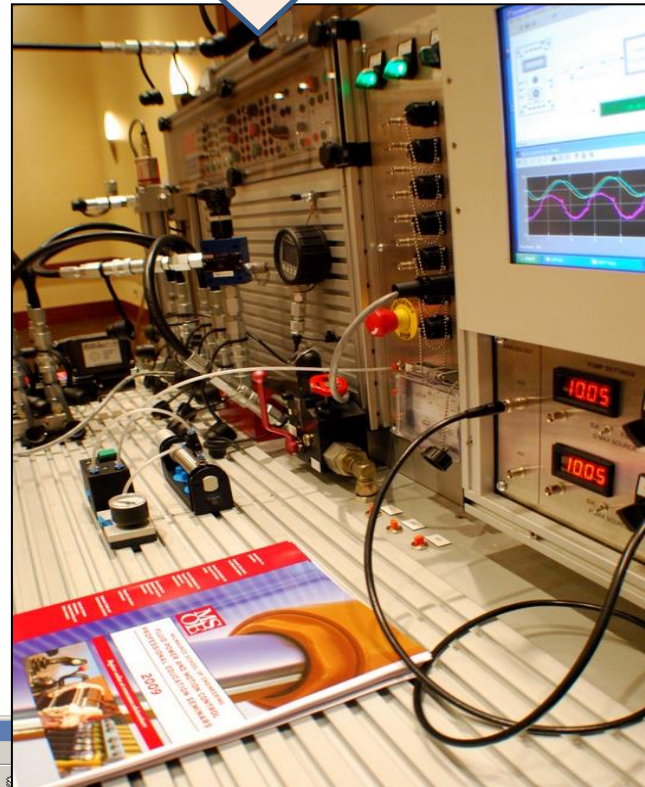
<http://www.msoe.edu/seminars>

Animate it

Practice it

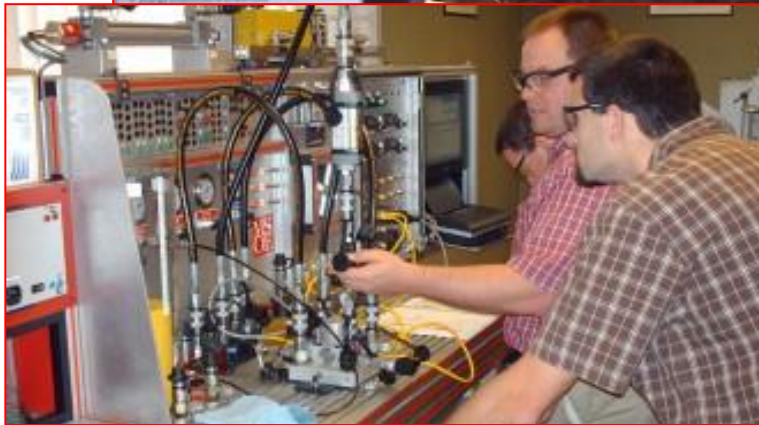


Simulate it





## Photo Gallery



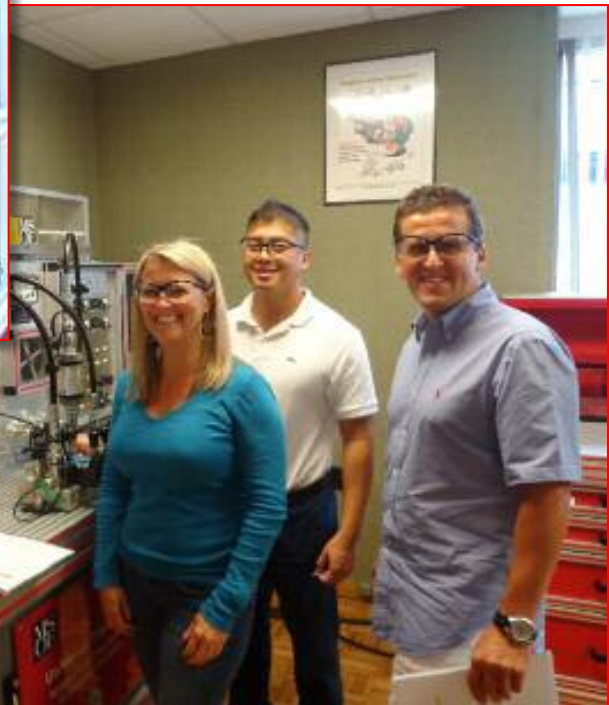




# Department of Professional Education

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# Department of Professional Education

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## Logistics

### **Air Travel to Milwaukee:**

Book your flight to Mitchell International Airport (Airport Code: MKE), it is a 15-minute taxi ride to downtown Milwaukee.

**Plases Review your Confirmation Letter**  
**Public Classes are held in one of the following two locations**

### [Location 1 – MSOE Campus](#)

- 429 E. State Street, Milwaukee, WI 53202. [MAP](#)
- Training room # S100 on the first floor in the Science Building.
- Contact: Dr. Medhat Khalil Tel: 1-414-940-2232.

### [Location 2 - GS Global Resources](#)

- 926 Perkins Drive, Mukwonago, WI 53149. [MAP](#)
- Training room # 5050 on the second floor.
- Contact: Jeanette Cutberth Tel: 1-262-378-5225.

### **Dressing:**

Dress casual and comfortable. Look up Milwaukee weather forecast to plan your trip.  
[www.weather.com](http://www.weather.com), zip code: Mukwonago, WI 53149.

### **Parking:**

Seminar participants will be given free parking spots.





# Department of Professional Education

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### Where to Stay:

The following are the hotel recommendation around the seminar location:

#### Location 1 – MSOE Campus

##### [Hyatt Regency Milwaukee](#)

1234-276 (414)  
1234-233 (800)  
333 W. Kilbourn Ave.  
\$119 plus tax per night  
[www.hyatt.com](http://www.hyatt.com)

##### [The Astor Hotel](#)

4220-271 (414)  
924 E. Juneau Ave.  
\$69 per week night plus tax  
[www.thehotelastor.com](http://www.thehotelastor.com)

#### Location 2 – GS Global Resources

##### [La QUINTA Inns & Suites](#)

15300 West Rock Ridge Road  
New Berlin, WI 53151  
1-262-717-0900

Rates are usually around \$89.00. GS Global Resources has a Corporate Rate of 20% discount. When you call the above number you will get an auto attendant, press 6 for the front desk to ask for the GS Global Resources rate.

##### [Holiday Inn Express & Suites](#)

15451 W. Beloit Road  
New Berlin, WI 53151  
1-800-392-1019

Rates are usually around \$133.00. GS Global Resources has a Corporate Rate of \$84. When you call to make your reservation, please mention this special rate.

##### [Quality Inn & Suites](#)

2929 O'Leary Lane  
East Troy, WI 53120  
1-262-642-2100

Ask about GS Global Resources Corporate Rate.

##### [Eagle Centre House Bed and Breakfast](#)

W370 S9590, Hwy 67  
Eagle, WI 53119  
262-363-4700



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# Department of Professional Education

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## Registration



**Fax to:** +1-414-277-7470



**Mail to (Att. Dr. Medhat Khalil)**  
Applied Technology Center  
Milwaukee School of Engineering.  
1025 N. Broadway, Milwaukee, WI, 53202-3129



**Call:** +1-414-277-7195 **OR:** +1-414-277-7269



[www.msoe.edu/seminars](http://www.msoe.edu/seminars)



[khalil@msoe.edu](mailto:khalil@msoe.edu)

### **Cancellation Policy:**

- MSOE reserves the right to cancel a seminar if minimum enrollment is not met.
- Cancellation from the client side subject to the following conditions:
  - Three weeks before the seminar date are subject to a \$200 cancellation fee with a refund of the remainder.
  - Cancellations two weeks before the seminar date are subject to a \$400 cancellation fee with a refund of the remainder.
  - Cancellations one week before the seminar date are subject to a \$600 cancellation fee and the remaining funds will be used as a credit towards any future seminar, subject to availability.



# Department of Professional Education

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## Seminar Registration Form

Please enroll the individual (s) listed below in:

Seminar #	Seminar Name	Seminar Date

Name: -----

Title: -----

Tel: -----

Email: -----

Company: -----

Address: -----

Payment Method:

☐ Company Purchase Order: PO# -----

☐ Charge Seminar Fee (s) to ☐ Master ☐ VISA ☐ Discover ☐ A. Express

Account Number ----- Expiration Date: -----

-----  
Name on the Card

-----  
Signature





# Department of Professional Education

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## Seminar Registration Form

Please enroll the individual (s) listed below in:

Seminar #	Seminar Name	Seminar Date

Name: -----

Title: -----

Tel: -----

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Company: -----

Address: -----

Payment Method:

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☐ Charge Seminar Fee (s) to ☐ Master ☐ VISA ☐ Discover ☐ A. Express

Account Number ----- Expiration Date: -----

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Name on the Card

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Signature



**We serve** both industrial and mobile applications!



**We are** the sole provider of fluid power training to largest construction companies nationwide

**We are** member of:



**CENTER FOR COMPACT AND EFFICIENT FLUID POWER**



NSF A National Science Foundation Engineering Research Center





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# Fluid Power Training

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## Hydraulic Specialist Certification Review Session

### Course Description:

This 18-hours 3-days review session is conducted at MSOE followed by the certification exam on the fourth day. The objective of the course is to walk the participants through the study manual provided by IFPS in order to maximize their chance to pass the certification exam.



### What is the IFPS?

The International Fluid Power Society is the only organization that offers comprehensive technical certification for all professionals in the field of fluid power and motion control industry.

### What is the Process of Certification?

After 3-days review session provided by MSOE, participants will take the certification exam on fourth day. Exam will be provided and proctored by IFPS. The test is 3-hours, 50-questions, and multiple-choice type of test. You need to get 35 correct answers out of 50 questions. If you fail, you can re-schedule taking the exam at a later time. If you pass, you will be issued a "Hydraulic Specialist" certificate. The certificate is good for five years, after five years you do not need to retake the exam, you need only to report to IFPS indicating that you are still working in the field.

### Why Get Certified?

- The "Hydraulic Specialist" certification is an internationally recognized certification.
- The certificate is portable - it goes with the individual wherever they work.
- Certifications help an individual to advance his career and introduce himself to the global job market.
- Certification sets an individual apart as a leader in their chosen field of work.
- Certification will help a vendor provide over-the-top quality and acquire ISO certification easily.
- Certified personnel help make the work environment safe and improve the safety, reliability and efficiency of a machine operation.





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# Fluid Power Training

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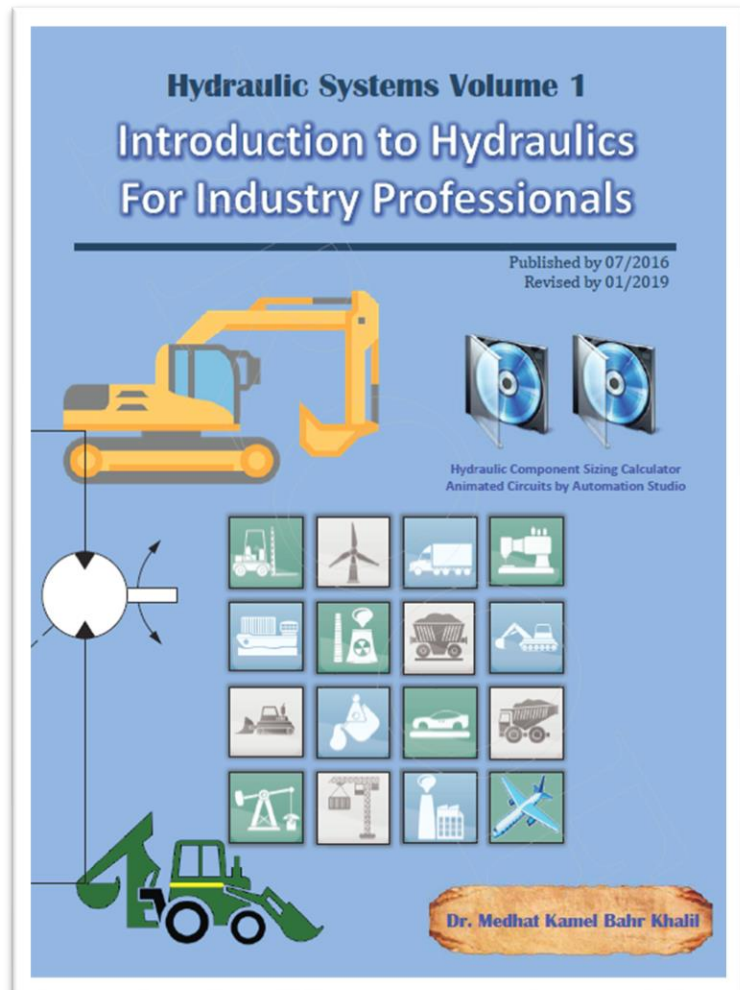
## Course Agenda

	Course Agenda: AM Session (9-Noon) Lunch Hour (Noon - 1 pm) PM Session (1 - 4)	
	Day 1	Hr
AM	Registration and Orientation Session	0.5
	Job Responsibility 1: Understand the Function of Hydraulic Components in Circuits	2.5
PM	Job Responsibility 1: Continue	1.5
	Job Responsibility 2: Analyze Loads and Motion	1.5
	Day 2	Hr
AM	Job Responsibility 3: Select Components for Hydraulic Systems	3.0
PM	Job Responsibility 4: Analyze and Troubleshoot Hydraulic Systems	1.5
	Job Responsibility 5: Electrohydraulic Control Systems	1.5
	Day 3	
AM	Pretest 1 and 2	3.0
PM	Pretest 3 and 4	3.0
	Total	18
	Day 4	
AM	Certification Exam	3

## HSV1- Introduction to Hydraulic Systems for Application Engineers

### Course Description:

This 27-hour 5-day seminar is designed to acquaint individuals with the fluid power field and provide a practical working knowledge of this important and growing industry. This program features laboratory sessions where participants will gain practical experience working with actual fluid power components and systems. Specifically, laboratory sessions will treat the disassembly, inspection and assembly of individual components, as well as system design examples. This class explores not only how hydraulic components work, but why it works this way.



**ISBN: 978-0692622360**

## Course Agenda

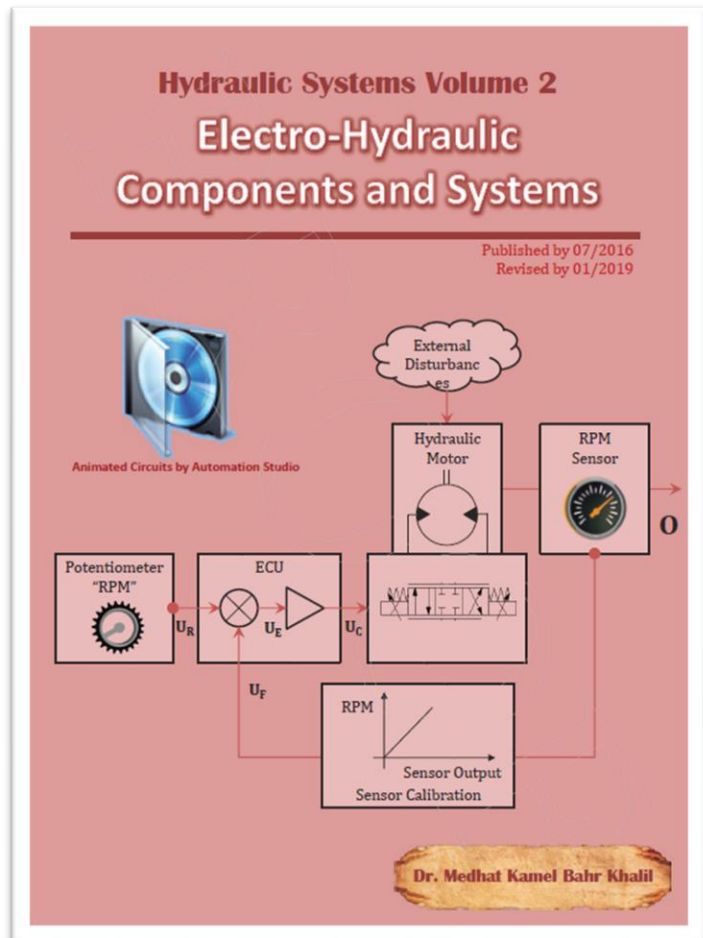
Course Agenda: AM Session (9-Noon) Lunch Hour (Noon - 1 pm) PM Session (1 - 4)		
	<b>Day 1</b>	<b>Hr</b>
	Registration and Orientation Session	0.5
AM	<b>CH01:</b> Hydraulic Systems Overview	1.5
	<b>CH02:</b> Basic Concepts Review	1
	<b>CH02:</b> Contd.	1.5
PM	<b>Lab 1:</b> Energy Losses in Hydraulic Conductors	1
	<b>CH03:</b> Hydraulic Component Sizing Calculations	0.5
	<b>Day 2</b>	<b>Hr</b>
AM	<b>CH04:</b> Hydraulic Pumps and Motors	3
	<b>Lab 2:</b> Power Distribution in a Hydraulic System	1
PM	<b>CH04:</b> Contd.	1.5
	Inspect Pumps and Motors	0.5
	<b>Day 3</b>	<b>Hr</b>
AM	<b>CH05:</b> Hydraulic Valves Overview	3
	<b>Lab 3:</b> Valve Coefficient Development.	0.5
PM	<b>CH05:</b> Contd.	0.5
	<b>CH06:</b> Hydraulic Linear and Rotary Actuators.	1.5
	<b>Lab 4:</b> Motion Control of Hydraulic Cylinder.	0.5
	<b>Day 4</b>	<b>Hr</b>
	<b>CH07:</b> Hydraulic Accumulators.	0.5
AM	Inspect Valves, Actuators and Accessories.	0.5
	<b>CH08:</b> Hydraulic Circuits for Basic Applications.	2
	<b>CH08:</b> Contd.	0.5
PM	<b>Lab 5:</b> Control of Overrunning Loads.	1
	<b>CH08:</b> Contd.	0.5
	<b>Lab 6:</b> Speed Control of Hydraulic Actuator.	1
	<b>Day 5</b>	<b>Hr</b>
	<b>CH08:</b> Contd.	1
	<b>Lab 7:</b> Boosting Speed of Hydraulic Cylinder.	1
AM	<b>CH08:</b> Contd.	0.5
	<b>Lab 8:</b> Sequence Operation of Hydraulic Cylinder.	0.5
	Machine shutdown Procedure.	
	<b>Total</b>	<b>27</b>



## HSV2- Electro-Hydraulic Components and Systems

### Course Description:

This 27-hour 5-day seminar is designed to cover the knowledge of electrohydraulic components and systems. The state-of-the-art Universal Fluid Power Trainers are used to demonstrate the theory presented. The introductory part of the course covers the applications of electro-hydraulic systems and the benefits of converting the classical hydro-mechanical solutions into electro-hydraulic solutions. The core part of the course covers the knowledge of electrohydraulic valves including solenoid operated valves, proportional valves and servo valves. The course also covers the basic functions that are built on the electrical control units and drivers for such valves, e.g., gain adjustor, overload protection, null adjustment, ramp generator, dead-band eliminator, dither, and pulse width modulation. The course also discusses system design considerations and the technicalities of in-field tuning of open-loop and closed-loop electro-hydraulic systems.



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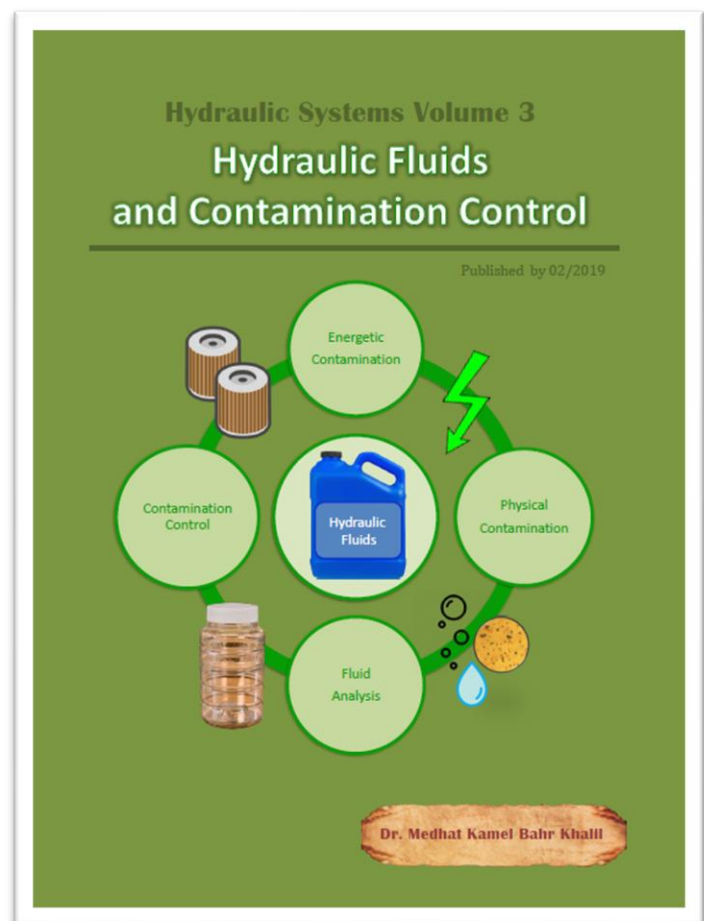
## Course Agenda

	Course Agenda: AM Session (9-Noon) Lunch Hour (Noon - 1 pm) PM Session (1 - 4)	
	<b>Day 1</b>	<b>Hr</b>
	Registration and Orientation Session	0.25
AM	<b>CH01:</b> Hydro-Mechanical vs. Electro-Hydraulic Solutions	2.25
	<b>CH02:</b> Electro-hydraulic System Application	0.5
	<b>CH03:</b> Switching (ON/OFF) Valves-Construction and Operation	2
PM	Lab Manual - UFPT	0.5
	Lab20: Cylinder extension upon pressing a push-button	0.5
	<b>Day 2</b>	<b>Hr</b>
	<b>CH04:</b> Switching (ON/OFF) Valves-Circuits for Basic Functions	1.5
	Lab21: Signal storage by electrical self-locking	0.25
AM	Lab22: Electrical locking by means of contactors contact	0.5
	Lab23: Position-dependent cylinder deceleration	0.5
	Lab24: Pressure-Dependent cylinder reversal	0.25
	Lab25: Event-Dependent warning circuit	0.25
PM	<b>CH04:</b> Contd. (Practice building circuits without instructor's orientation).	1.25
	<b>CH05:</b> Proportional Valves	1.5
	<b>Day 3</b>	<b>Hr</b>
	<b>CH05:</b> Contd.	2
AM	Lab26: Cylinder Motion Control Performance using Switching Valve vs. Prop.Valve	0.5
	<b>CH06:</b> Servo Valves	0.5
	<b>CH06:</b> Contd.	2.5
PM	Lab27: Cylinder Motion Control Performance using Servo Valve vs. Proportional Valve	0.5
	<b>Day 4</b>	<b>Hr</b>
	<b>CH07:</b> Electro-hydraulic System Design Considerations	1
AM	Lab28: Digital Control of EH Variable Displacement Pumps	0.5
	<b>CH08:</b> Control Electronics for Electro-Hydraulic Systems	1.5
	<b>CH08:</b> Contd.	1
PM	Lab29: Digital Control of E.Hydraulic Cylinder Position + Machine Shutdown Procedure	1
	<b>CH09:</b> Valve Selection for an Electro-Hydraulic Controlled Actuator	1
	<b>Day 5</b>	<b>Hr</b>
AM	<b>CH09:</b> Contd.	2
	<b>CH10:</b> Electro-hydraulic Valves Commissioning and Maintenance	1
	<b>Total</b>	<b>27</b>

## HSV3- Hydraulic Fluids and Contamination Control

### Course Description:

Contamination control is a crucial for hydraulic systems to survive and to sustain their reliability and performance. Hydraulic fluids are inevitably contaminated by various sources. Hydraulic fluid contamination is not limited to just the particulate contaminants as many people may think. Hydraulic fluid contamination can be broadly defined as any internal or external reason that can change the properties or performance. Therefore, this 2-days (12-hour) seminar is designed to cover the knowledge of hydraulic fluids and contamination control. The seminar discusses thoroughly the different types of hydraulic fluids, their properties and standard methods of testing. The seminar also covers all types of contamination, their sources, effects, and best practices to avoid and control them.



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# Fluid Power Training

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## Course Agenda

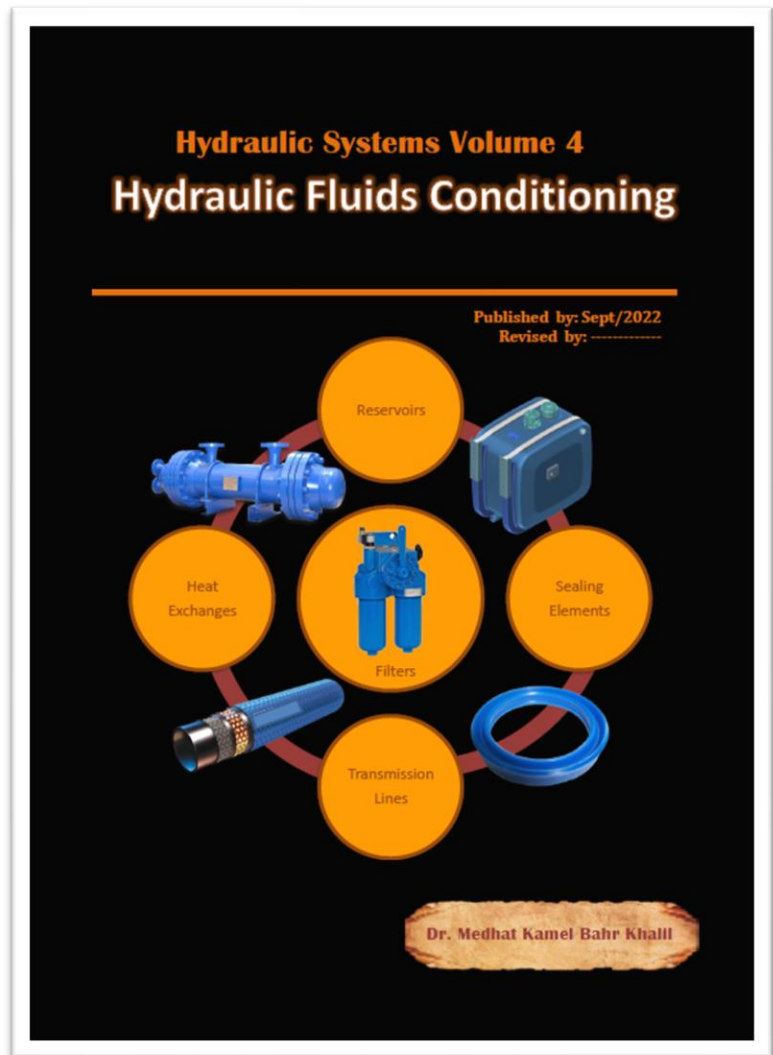
	Course Agenda: AM Session (9-Noon) Lunch Hour (Noon - 1 pm) PM Session (1 - 4)	
	<b>Day 1</b>	<b>Hr</b>
AM	<b>CH01:</b> Introduction	0.5
	<b>CH02:</b> Hydraulic Fluids	2.5
PM	<b>CH03:</b> Energetic Contamination	0.5
	<b>CH04:</b> Gaseous Contamination	0.5
	<b>CH05:</b> Fluidic Contamination	1.0
	<b>CH06:</b> Chemical Contamination	1.0
	<b>Day 2</b>	<b>Hr</b>
AM	<b>CH07:</b> Particulate Contamination	1.0
	<b>CH08:</b> Hydraulic Fluid Analysis	2.0
PM	<b>CH09:</b> Hydraulic Filters Performance Ratings	2.0
	<b>CH10:</b> Contamination Control in Hydraulic Transmission Lines	1.0
	<b>Total</b>	<b>12</b>

## HSV4- Hydraulic Fluids Conditioning

### Course Description:

This 2.5-days (15-hour) seminar is designed to cover the knowledge related to conditioning of hydraulic fluids such as hosing in reservoirs, sealing, transmission through conductors, temperature control, and filtration. Each of the fluid conditioning requirement is thoroughly discussed showing various techniques, sizing calculations, and selection criteria. The book is unique in the amount of literature gathered from leading manufacturers of reservoirs, seals, transmission lines, heat exchangers, and filters.

This seminar and HSV3 form a very important knowledge foundation for both design engineers and system operators as well.



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# Fluid Power Training

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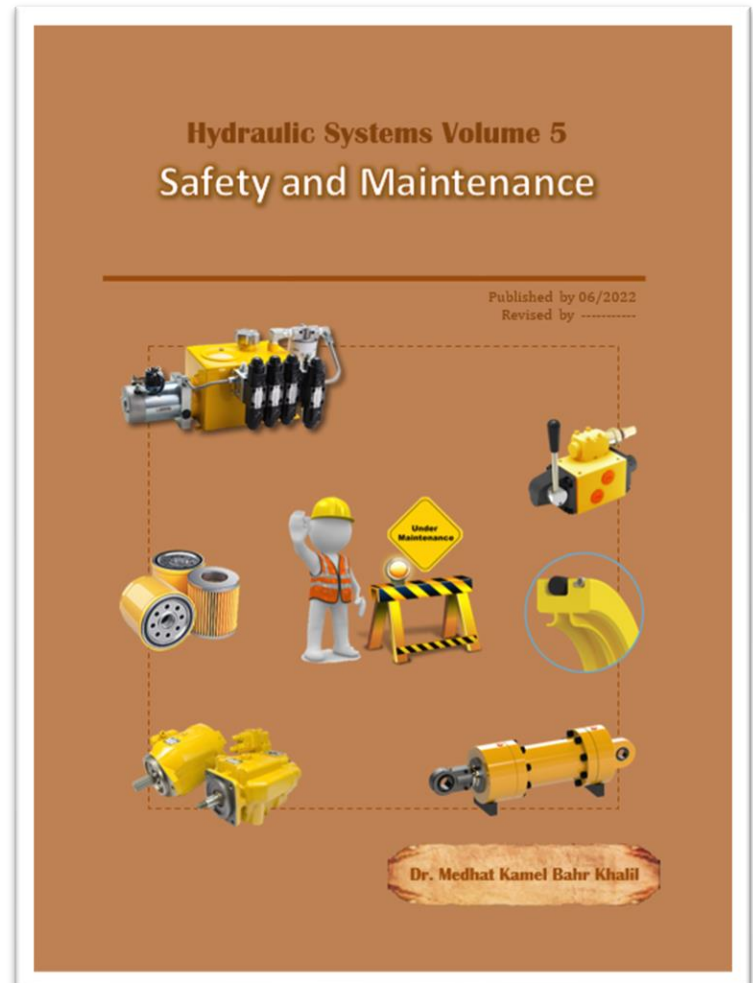
## Course Agenda

Course Agenda: AM Session (9-Noon) Lunch Hour (Noon - 1 pm) PM Session (1 - 4)		
	Day 1	Hr
	Registration and Orientation Session	-
AM	CH01: Introduction	1.0
	CH02: Hydraulic Reservoirs	0.5
PM	CH03: Hydraulic Transmission Lines	3.0
	Day 2	Hr
AM	CH04: Hydraulic Sealing Elements	3.0
PM	CH05: Hydraulic Heat Exchangers	3.0
	Day 3	Hr
	CH06: Introduction to Hydraulic Filters	2
AM	CH07: Filter Media and Filtration Mechanisms	0.5
	CH08: Filter Selection Criteria	0.5
	Total	15



## HSV5- Safety and Maintenance

This 3-Days (6 hours/day, total of 18 hours) seminar is targeting industry professionals who are in charge of operating, maintaining, and troubleshooting hydraulic systems. This seminar is also a great learning source for mechanical engineers and service manuals technical writers. The seminar starts by introducing best practices for safe design, commissioning, operating and servicing hydraulic components. The seminar then presents the maintenance concepts and measuring instruments commonly applicable for hydraulic system maintenance. The seminar follows that by presenting five sets of best practices for each of the following components: pumps, motors, cylinders valves, accumulators, reservoirs, transmission lines, heat exchangers, and filters.



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# Fluid Power Training

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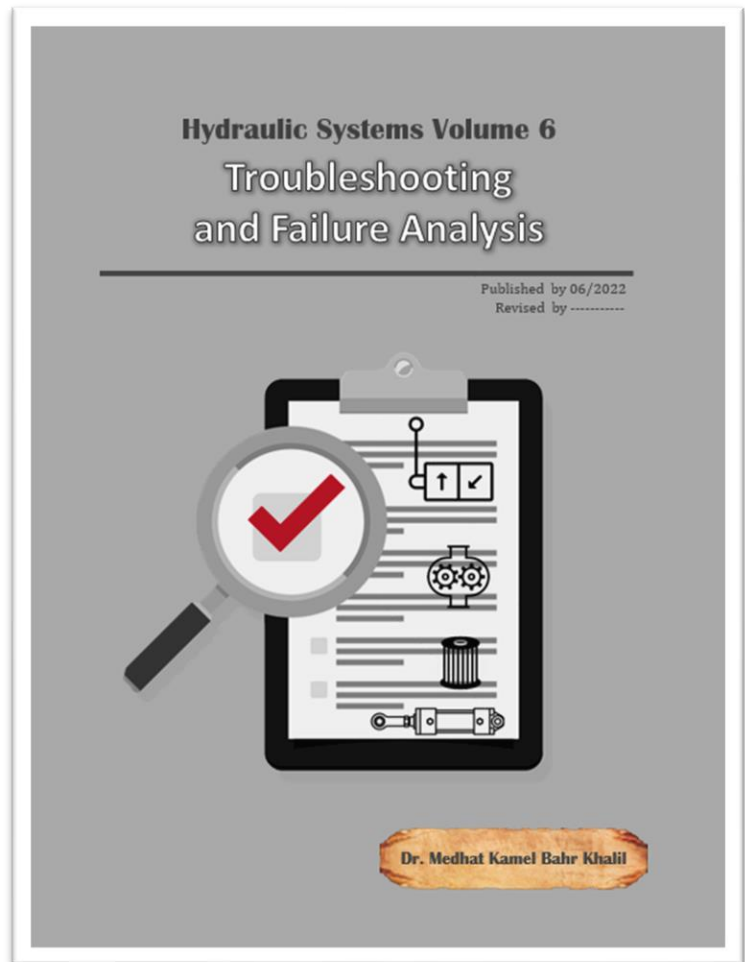
## Course Agenda

Course Agenda: AM Session (9-Noon) Lunch Hour (Noon - 1 pm) PM Session (1 - 4)		
	<b>Day 1</b>	<b>Hr</b>
	Registration and Orientation Session	-
AM	<b>CH01:</b> Hydraulic System Safety	3
	<b>CH02:</b> Basic Concepts of Hydraulic System Maintenance	1
PM	<b>CH03:</b> Hydraulic Measuring Instruments	2
	<b>Day 2</b>	<b>Hr</b>
AM	<b>CH04:</b> Maintenance of Pumps	2
	<b>CH05:</b> Maintenance of Motors	1
PM	<b>CH06:</b> Maintenance of Cylinders	1
	<b>CH07:</b> Maintenance of Valves	1
	<b>CH08:</b> Maintenance of Accumulators	1
	<b>Day 3</b>	<b>Hr</b>
AM	<b>CH09:</b> Maintenance of Reservoirs	0.5
	<b>CH10:</b> Maintenance of Transmission Lines	2.5
PM	<b>CH011:</b> Maintenance of Heat Exchangers	1
	<b>CH012:</b> Maintenance of Filters	2
	<b>Total</b>	<b>15</b>

## HSV6- Troubleshooting and Failure Analysis

This 2-Days (6 hours/day, total of 12 hours) seminar is targeting industry professionals who are in charge of operating, maintaining, and troubleshooting hydraulic systems. This seminar is also a great learning source for mechanical engineers and service manuals technical writers. The seminar presents more than 40 troubleshooting charts to cover system-level and components-level troubleshooting including hydraulic fluids, pumps, motors, valves, cylinders, accumulators, reservoirs, transmission lines, heat exchanges, filters, and sealing elements. The seminar also presents proposed inspection sheets for the aforementioned components and investigations for the typical types of failures for each component.

This seminar and HSV5 form a very important knowledge foundation for both design engineers and system operators as well.



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## Course Agenda

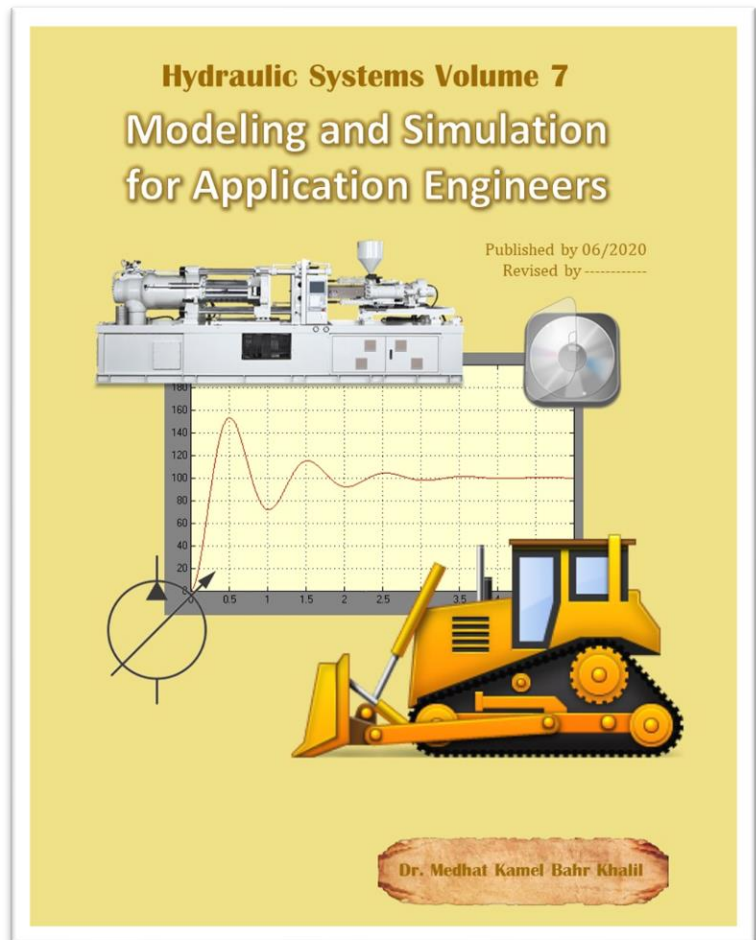
Course Agenda: AM Session (9-Noon) Lunch Hour (Noon - 1 pm) PM Session (1 - 4)		
	<b>Day 1</b>	<b>Hr</b>
	Registration and Orientation Session	-
AM	<b>CH01:</b> Hydraulic Systems Troubleshooting Logic Methodology	0.5
	<b>CH02:</b> Basic Troubleshooting Equipment	0.5
	<b>CH03:</b> Troubleshooting and Failure Analysis of Sealing Elements	2.0
	<b>CH04:</b> Troubleshooting and Failure Analysis of Pumps	2.0
PM	<b>CH05:</b> Troubleshooting and Failure Analysis of Motors	0.25
	<b>CH06:</b> Troubleshooting and Failure Analysis of Cylinders	0.75
	<b>Day 2</b>	<b>Hr</b>
	<b>CH07:</b> Troubleshooting and Failure Analysis of Valves	0.5
	<b>CH08:</b> Troubleshooting and Failure Analysis of Accumulators	0.5
AM	<b>CH09:</b> Troubleshooting and Failure Analysis of Reservoirs	0.5
	<b>CH010:</b> Troubleshooting and Failure Analysis of Trans. Lines	0.5
	<b>CH11:</b> Troubleshooting and Failure Analysis of Heat Exchangers	0.5
	<b>CH12:</b> Troubleshooting and Failure Analysis of Filters	0.5
PM	<b>CH13:</b> Hydraulic Systems Troubleshooting	2.0
	<b>CH14:</b> Examples of Hydraulic Systems Troubleshooting	1.0
	<b>Total</b>	<b>12</b>



## HSV7- Hydraulic System Modelling and Simulation for Application Engineers

### Course Description:

This 27-hour 5-day presents lumped modeling technique, using Matlab-Simulink, to model discrete hydraulic components that can be recharacterized and used repeatedly in system models. The course applies the lumped modeling concept on hydraulic fluids, transmission lines, pumps, motors, cylinders, pressure relief valves, flow control valves, proportional valves, and servo valves. The course uses the component lumped models to assemble electrohydraulic cylinder position control system and electrohydraulic motor speed control as case studies. The course contains several lab exercises to develop the static characteristics, step response and frequency response of several components. The course also capture the dynamics of control systems to validate the models.



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## Course Agenda

	Course Agenda: AM Session (9-Noon) Lunch Hour (Noon - 1 pm) PM Session (1 - 4)	
	<b>Day 1</b>	<b>Hr</b>
	Registration and Orientation Session	0.25
AM	<b>CH01:</b> Introduction to Physical System Modelling and Simulation	0.75
	<b>CH02:</b> Modeling and Simulation of First-Order Dynamic Systems	2
PM	<b>CH03:</b> Modeling and Simulation of Second-Order Dynamic Systems	2
	<b>CH04:</b> Hydraulic Components Modeling Approaches	1
	<b>Day 2</b>	<b>Hr</b>
AM	<b>CH05:</b> Modeling of Fluid Properties	1.5
	<b>CH06:</b> Hydraulic Conductors Modelling	1.5
	<b>CH07:</b> Modeling of Hydraulic Pumps	2
PM	<b>Lab09:</b> Pump Static Characteristic Measuring	0.5
	<b>Lab10:</b> Pump Step Response Measuring	0.5
	<b>Day 3</b>	<b>Hr</b>
	<b>CH08:</b> Modeling of Hydraulic Motors	2
AM	<b>Lab11:</b> Hydraulic Motor U-n Static Characteristics	0.5
	<b>Lab12:</b> Identify Hydraulic Motor Dynamics	0.5
PM	<b>CH09:</b> Modelling for Hydraulic Cylinders	2.5
	<b>Lab13:</b> Identify Horizontal Cylinder Dynamics	0.5
	<b>Day 4</b>	<b>Hr</b>
	<b>CH10:</b> Modeling of Hydraulic Valves	2
AM	<b>Lab14:</b> Proportional Valve Flow Gain Measuring	0.5
	<b>Lab15:</b> Servo Valve Flow Gain Measuring	0.5
	<b>CH11:</b> Modeling of Hydraulic Control Systems (Cylinder Position Control)	2
PM	<b>Lab16:</b> EH Position Controlled Hydraulic Cylinder Step Response	0.5
	<b>Lab17:</b> EH Position Controlled Hydraulic Cylinder Frequency Response	0.5
	<b>Day 5</b>	<b>Hr</b>
	<b>CH11 (continue):</b> Modeling of Hydraulic Control Systems (Motor Speed Control)	2
AM	<b>Lab18:</b> EH Speed Controlled Hydraulic Motor Step Response	0.5
	<b>Lab19:</b> EH Speed Controlled Hydraulic Motor Frequency Response	0.5
	<b>Total</b>	<b>27</b>





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