COURSE OVERVIEW ME0398
Pumps, Compressors, Turbines & Troubleshooting

Course Title
Pumps, Compressors, Turbines & Troubleshooting

Course Date/Venue
January 21-25, 2024/Meclis 1 Meeting Room, Divan Istanbul Sisli, Istanbul, Turkey

Course Reference
ME0398

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.

This course is designed to provide delegates with a detailed and up-to-date overview of the fluid mechanic fundamentals and operating practice of pumps, compressors and turbines. It will address aspects of both axial and centrifugal compressors. Upon the successful completion of this course, participants will have acquired the practical knowledge to enable them not only to choose the correct device for a particular application but also be in a position to resolve many commonly occurring operating problems.

The course is ideal for those personnel in the oil, gas, petrochemical, chemical, power and other process industries who require a wider and deeper appreciation of pumps, compressors and turbines, including their design, performance and operation. No prior knowledge of the topic is required. Participants will be taken through an intensive primer of turbo-machinery principles, using the minimum of mathematics, and will learn how to solve the many and varied practical industrial problems that are encountered. The course makes use of an extensive collection of VIDEO material.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply a comprehensive knowledge in pumps, compressors & turbines and troubleshoot rotating equipment in a professional manner
- Identify the different types of turbomachinery including basic design aspects and highlighted problem areas
- Minimize the compressor work by understanding the processes involved and identifying their efficiency
- Discuss the axial flow compressor and the corresponding velocity triangles including torque and power calculations
- List the different types of centrifugal machines including their design, installation, operation, maintenance, re-rate/retrofit and troubleshooting
- Recognize the various beneficial design aspects of turbomachines and understand the crucial process of cavitation in pumps
- Carryout the proper methods of centrifugal pumps installation, operation, maintenance and troubleshooting

Who Should Attend

This course provides an overview of all significant aspects and considerations of pumps, compressors and turbines for those who are involved in the design, selection, maintenance or troubleshooting of such equipment. This includes maintenance, reliability, integrity, engineering, production and operations managers, engineers and other technical staff. Project managers and engineers will also benefit from this program.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

US$ 6,000 per Delegate + **VAT**. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Dr. Ahmed El-Sayed, PhD, MSc, BSc, is a **Senior Electromechanical Engineer** with over **30 years** of extensive experience in **Oil**, **Gas**, **Refinery**, **Petrochemical**, **Power** and **Utilities** industries. He specializes in **Troubleshooting Piping** & **Pipe Support** Systems, Layout of **Piping** Systems & Process Equipment, Pressure Vessels, **Piping** and Heat Exchangers, Pump, Valves, **Piping** System, Tank, Vessel, Boiler and Turbine Installation, **Piping Vibration**, Compressor Analysis and **Piping Vibration**, **ASME B31.1 Power Piping** Design, Analysis and Fabrication, **Pipe Support** Design & **Piping Stress Analysis**, Application of Standards in Boiler, Pressure Vessel & **Piping** Systems, **Pipe Support** Design & **Piping Stress** Analysis, **Piping** Design, Construction & Mechanical Integrity, **Pumps, Compressors & Turbines**, Reliability Engineering Analysis (**RE**), **Reactive & Proactive** Maintenance, **Pumps**, **Valves**, **Boilers**, **Pressure Vessels**, **Heat Recovery Steam Generators** (**HRSG**), **Bearings**, **Compressors**, **Motors**, **Turbines**, **Actuators**, **Carbon Footprint**, **Energy Efficiency**, **Power Plant Performance & Efficiency**, **P&ID**, **Engineering Drawing**, **Codes & Standards**, **Hydraulic Systems,** Reliability Centered Maintenance (**RCM**), **Reliability Maintenance**, **Condition Based Maintenance & Condition Monitoring**, Root Cause Analysis (**RCA**) and **Maintenance Planning & Scheduling**, **Shutdown & Turnaround**. He is currently the **Systems Control Manager** of **Siemens** where he is in-charge of Security & Control of power generation systems and he further takes part in the DCS implementation and commissioning.

During his career life, Dr. Ahmed has been actively involved in a variety of industrial activities including **Maintenance Planning & Scheduling**, **Reliability & Maintenance Management** and **Plant Shutdown & Turnarounds**. Moreover, he is an **authority** in vibration analysis, mechanical failure analysis, accident reconstruction, shock testing, measurement, analysis, calibration, ESS, HALT and HASS.

Dr. Ahmed is well-versed and conversant in the designed and applied automatic control systems using analogy instrumentation and computer-based control systems for a variety of industries with both analogue and discreet logic automatic control and implementation. Likewise, he is in-charge with troubleshooting and PID loop tuning of simple to complex systems installed and is involved in the design, implementation and documentation of emergency shut-down and safety instrumentation systems for a various processes especially for **hydraulics**, **steam turbines**, **gas turbines**, **boilers**, **heat recovery steam generators** and **large pumping systems**.

Dr. Ahmed has **PhD**, **Master's** & **Bachelor's** degree in **Electromechanical and Instrumentation Engineering** from the **University of Wisconsin** (**USA**). Further, he is a **Certified Instructor/Trainer** and has **numerous papers** published internationally in the areas of **superconductive magnetic energy storage** (SMES), SMES role in power systems, power system blackout analysis, intelligent load shedding techniques for preventing power system blackouts and intelligent control of **boilers**, **heat exchangers** and **pumping systems**.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1: ***Sunday, 21st of January 2024***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Turbomachinery*** *Highlighted Problem Areas*
0930 – 0945	*Break*
0945 – 1000	***Ideal Gas Equation & Practical Application*** *Isentropic Processes • Property Diagrams Involving Entropy*
1000 – 1100	***Isentropic Processes of Ideal Gases*** *Constant Specific Heats • Relative Pressure and Relative Specific Volume*
1100 – 1230	***Minimizing Compressor Work*** *Polytropic Processes • Multi-Stage Compression with Inter-Cooling • Isentropic Efficiency of Turbines • Isentropic Efficiency of Compressors and Pumps*
1230 – 1245	*Break*
1245 – 1330	***Momentum & Bernoulli's Relations*** *General Relationship • Relationships for Incompressible Fluids*
1330 – 1420	***VIDEO: Basic Pump Types & Technology***
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2: ***Monday, 22nd of January 2024***

0730 – 0800	***General Description of Turbomachines*** *Centrifugal Pump • Centrifugal Turbine • Centrifugal Air Compressor*
0800 – 0830	***Impulse Turbine*** *Velocity Triangles*
0830 – 0900	***Axial Flow Compressor*** *Velocity Triangles • Torque Calculation and Torque Coefficient • Power Calculation and Power Coefficient*
0900 – 0930	***Centrifugal Machines*** *Torque Calculation • Head Coefficient • Flow Coefficient • Torque Coefficient*
0930 – 0945	*Break*
0945 – 1015	***Performance Curves***
1015 – 1100	***Centrifugal Pump*** *Centrifugal Multistage Pump • Mixed Flow Machines • Centrifugal Air Compressor*
1100 – 1130	***Affinity Laws*** *Effect of Impeller Speed •Effect of Impeller Diameter*
1130 – 1200	***Specific Speed***
1200 – 1230	***Specific Radius***
1230 – 1245	*Break*
1245 – 1315	***Hydraulic Turbines***

1315 – 1330	***VIDEO: Fundamentals of Pump Performance 1***
1330 – 1400	***Design Aspects of Turbomachines*** *Linear Cascades • Radial Cascades • Three- Dimensional Aspects of Axial- Flow Machines •Elementary Design Considerations*
1400 – 1420	***Cavitation***
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3: ***Tuesday, 23rd of January 2024***

0730 – 0930	***Centrifugal Pumps Basics*** *Types of Centrifugal Pumps • Self- Priming Pumps • Specific Speeds • Suction Specific Speed • Best Efficiency Point • Affinity Laws*
0930 – 0945	*Break*
0945 – 1100	***Centrifugal Pump Design*** *Balancing Disc • Impeller NPSHR • Impeller Centre-Rib • Mechanical Seals • Velocity Head*
1100 – 1230	***Pump Sales*** *Affinity Laws •Pump Software • Suction Lift • Viscosity • Re-Rate/Retrofit • Head-Rise • Radial/Horizontal Split Case*
1230 – 1245	*Break*
1245 – 1330	***Centrifugal Pump Installation*** *Foundation • Soft Foot • Suction Pipe • Suction Strainer*
1330 – 1420	***VIDEO: Fundamentals of Pump Performance 2*** *Discussion Forum*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4: ***Wednesday, 24th of January 2024***

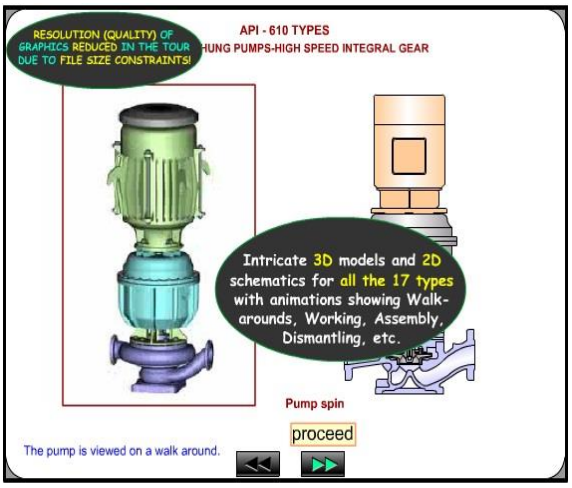
0730 – 0930	***Centrifugal Pump Operation*** *Start-Up • Minimum Flow • Maximum Pump RPM • Motor Amps/Specific Gravity • Entrained Gas*
0930 – 0945	*Break*
0945 – 1100	***Centrifugal Pump Operation (cont'd)*** *Operation at Shut Off • Temperature-Rise • Thermal Shock*
1100 – 1230	***Centrifugal Pump Maintenance*** *Case Gasket • Checking for Wear Clearance • Oil Change • Storage*
1230 – 1245	*Break*
1245 – 1315	***Centrifugal Pump Re-Rate/Retrofit*** *Impeller Cut • NPSH • De-Staging • Electric Motor Sizing • Viscosity Changes*
1315 – 1420	***VIDEO: Hydraulic Loads, Critical Speed & Torque*** *Discussion Forum*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

Day 5: **Thursday, 25th of January 2024**

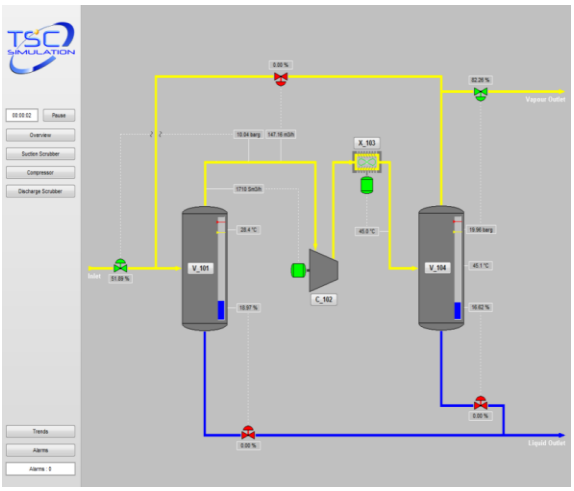
0730 – 0830	***Centrifugal Pump Troubleshooting*** *Bearing Failures • Bearing Housing Oil Leakage • Cavitation Noise and Damage*
0830 – 0930	***VIDEO: Bearings, Seals & Couplings***
0930 – 0945	*Break*
0945 – 1100	***Centrifugal Pump Troubleshooting (cont'd)*** *Impeller Cavitation/Erosion • Vibration • Cracked Volute Tongues • NPSH • Viscosity Effects*
1100 – 1230	***Group Discussions***
1230 – 1245	*Break*
1245 – 1345	***VIDEO: Special Pump Topics & Final Discussion***
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Simulator (Hands-on Practical Sessions)

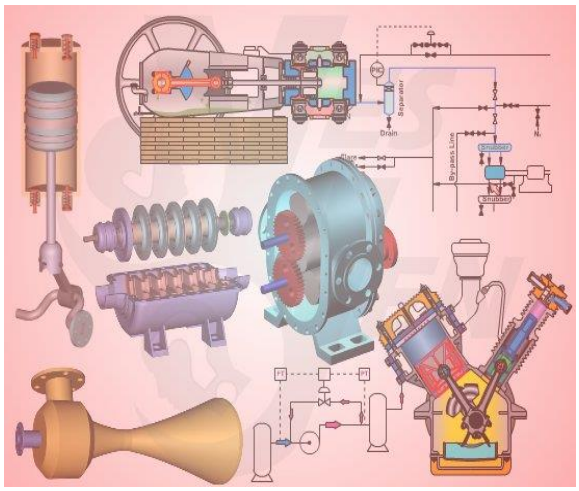
Hands-on practical sessions will be arranged for all participants throughout the course duration using "Centrifugal Pumps and Troubleshooting Guide 3.0", "SIM 3300 Centrifugal Compressor Simulator", "CBT on Compressors" and "Steam Turbine & Governing System CBT" simulators.



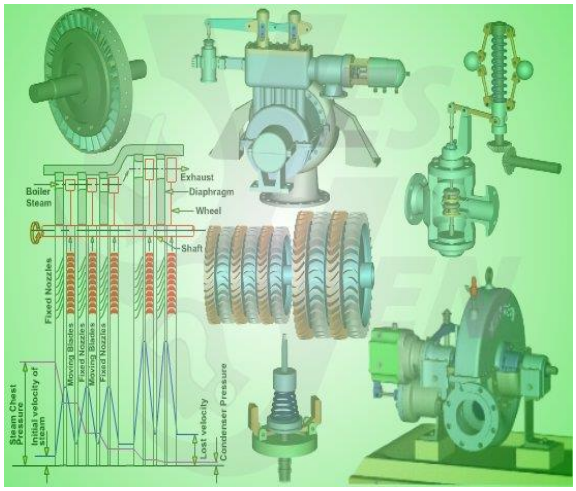
Centrifugal Pumps and Troubleshooting Guide 3.0



SIM 3300 Centrifugal Compressor Simulator



CBT on Compressors



Steam Turbine & Governing System CBT

Course Coordinator

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