# COURSE OVERVIEW ME0015
# Centrifugal Compressor & Steam Turbine Design, Performance, Operation, Maintenance & Troubleshooting

**Course Title**
Centrifugal Compressor & Steam Turbine Design, Performance, Operation, Maintenance & Troubleshooting

**Course Date/Venue**
November 03-07, 2024/TBA Meeting Room, Gezi Hotel Bosphours, Istanbul, Turkey

**Course Reference**
ME0015

**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.***

Centrifugal Compressors and Mechanical Drive Steam Turbines are used extensively in the process industries. There are many types with widely varying configurations and applications. Compressors and steam turbines represent a significant part of the capital and operating costs of most plants, and optimizing their selection is therefore, of major economic importance.

The course deals with design features, efficiencies, operating characteristics, reliability and maintenance implications of centrifugal compressors and their steam turbine drivers.

The course will cover the operating principles of centrifugal compressors and steam turbines, specifications, their design, thermodynamics, effects of efficiency on operating costs, energy usage, and effect on plant costs, materials of construction, selection, troubleshooting and maintenance.

The course will also cover plant run-length extension surveys, organizing for successful turnarounds and on-going reliability improvement, and preventive vs. predictive maintenance strategy decisions.

The course will provide the participant with a basic as well as advanced centrifugal compressor and steam turbine technology knowledge inventory required to successfully select, apply, operate, troubleshoot and maintain compression and steam turbine equipment.

Upon completion of this course, participants will have gained a thorough understanding of the various centrifugal compressor and steam turbine configurations available to most industrial users, including mechanical design features, sizing and application criteria, maintainability, reliability, vulnerability and troubleshooting issues. Participants will learn simple techniques and short-cut methods of machinery sizing and selection. This replaces tedious hand or other methods of calculation and will serve as a fast way to arrive at sensitivity or influence of parameter changes on equipment performance.

Participants will be able to determine the most appropriate and efficient matching of steam turbine drivers to compressors. Participants will also acquire knowledge of operating and maintenance issues by getting to know mechanical design, machinery components, connecting piping design as well as proven approaches to monitoring, troubleshooting and maintaining compressor installations.

## Course Objectives

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

- Apply a comprehensive knowledge in the mechanical design, performance, operation, maintenance and troubleshooting of centrifugal compressor and steam turbine
- Illustrate the different alignment techniques and support criteria for centrifugal compressor and steam turbines
- Describe parameters of thermodynamics, capacity, power, efficiency, gas properties and intercooling for turbocompressors
- Select centrifugal process compressors by utilizing calculation methods, characteristic curves and stability criteria
- Employ the proper procedure for compressor train inspection, maintenance, overhaul and repair
- Explain in detail the mechanical design, configurations, application ranges and constraints for steam turbines
- Identify the different turbine components which include turbine rotors, balancing, rotor dynamics, casings, bearings, shaft sealing devices and lube oil management
- Perform the selection and sizing of steam turbines for compressor drives and recognize the operation and maintenance of steam turbines
- Emphasize approaches to machinery troubleshooting, cite examples from recent failure incidents attributed to design defects and maintenance deficiencies
- Explain the difference between predictive and preventive maintenance techniques and determine which method to use
- Carryout machinery reliability audits and reviews as well as recognize the importance of reliability enhancement efforts

## Who Should Attend

This course provides an overview of all significant aspects and considerations of centrifugal compressor & steam turbine for those directly involved in the design, performance, operation, maintenance and troubleshooting of such equipment. This course is also intended for rotating equipment and machinery engineers, plant and maintenance engineers and other technical staff involved in turbomachinery management, operation and maintenance. Further, it is suitable for operations, process and process unit contact, mechanical and project engineers.

## 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:

**Mr. Emad Al-Hasany** is a **Senior Engineer** with **Offshore & Onshore** experience within the **Oil & Gas**, **Refinery** and **Petrochemical** industries. His wide expertise covers in the areas of **Centrifugal Compressor & Steam Turbine** Design, Performance, Operation, Maintenance & Troubleshooting, **Heat Exchangers & Fired Heaters** Operation & Troubleshooting, **Heat Medium Fired Heater** Troubleshooting & Maintenance, **Pumps**, **Compressors**, **Turbines** & Troubleshooting, **Centrifugal Compressor & Steam Turbine**, **Valves**, **Safety Relief Valve Sizing**, Selection, Operation, Inspection, Maintenance & Troubleshooting, **Tank & Tank Farms**, **Hydraulic Pump**, **Well Engineering**, **Pumps**, **Turbines**, **Compressors**, **Process Plant Commissioning**, **Cost Estimation**, **Process Plant Start-Up Management**, **Clean Fuel** Technology & Standards, **Process Reactor** Operation & Troubleshooting, **Process Equipment** Design, Sizing, Selection, Applications & Troubleshooting, **Process Engineering Calculations**, **Gas Processing Plant** Operations & Control, **Gas Processing** Monitoring & Troubleshooting, **Process Plant** Optimization & Energy Conservation, **Hydro-Treating** Technology, **Oil & Gas** Field Operations, **Oil Movement**, Storage & Troubleshooting, **Start-Up & Shutdown**, **Gas/Oil Separates**, **Surge Vessels**, **Sludge Catcher**, **Knockout LP & HP Flare System**, **Close & Open Drain System**, **Skimmer Pit Evaporation Pit System**, **Filters**, **Driers**, **York Refrigeration Compressors**, **Heaters & Combustion Gases Fire**, **Emergency Diesel Generators**, **Electrical & Diesel Fire Water Pumps**, **Gas & Fire Detectors**, **Pig Launcher**, **Purging Pipelines**, **Pressurized Vessels**, **Heat Exchangers**, **Atmospheric**, **Flash**, **Vacuum**, **Azeotrpic**, **Weiss Fractional Distillation**, **Oil & Gas Treatment**, **Separators**, **Filtration**, **Dehydration (Glycol & Molecular Sieves System**), **Fire Tube Heaters**, **Combustion Gas**, **Temperature Level**, **Control Valves**, **Solenoid Valves**, **Cascade Control**, **Switches**, **Transmitter**, **Transducer**, **RTD Sensitivity**, **Orifice Plat**, **I/P Converter**, **Rot Meter**, **Floating**, **Displacer**, **DP Cells**, **PIDs**, **Flare Blowdown & Pressure Relief Systems**, **Acidation**, **Wellheads** Preparing & Maintenance, **Well Operations & Surveys**, **Well Stimulation**, **Logging** and **Reservoir Engineering**. Further, he is also well-versed in **HYSYS**, **PRO II**, **OLGA**, **PIPESIM, PETREL**, **Artificial Lift**, **First Aid & Firefighting**, **Environment Protection**, **NORM Awareness**, **SHOC** (**Safe Handling of Chemicals**), **Permit to Work** (**PTW**), **HSE** Auditing & Reporting, **Emergency Response**, **Defensive Driving**, **H2S**, **Accident/Incident Investigation**, **Process Safety Management**, **Root Cause Analysis**, **OSHA** General Industry, **Water Injection**, **Water Treatment**, **HAZOP**, **Risk Assessment**, **Gas Chromatography**, **Corrosion** and **Cathodic Protection**.

During his career life, Mr. Emad has gained his practical and field experience through his various significant positions and dedication as the **Production Main Station Manager**, **Manager**, **Production Superintendent**, **Production Supervisor**, **Production Engineer**, **Mechanical Engineer, HAZOP Consultant**, **Instructor** and **Lecturer** for various companies and universities such as the AL-Euphrates University, Dero Oilfields, Syrian Petroleum Company (SPC), Kokab Co. and Alharratah Oilfield.

Mr. Emad has a **Master** degree in **Production Engineering** and a **Bachelor** degree in **Petroleum Engineering**. Further, he is a **Certified Instructor/Trainer** and has further delivered numerous training, courses, workshops, seminars and conferences worldwide.

## 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.

## Accommodation

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

## 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.

## 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, 03rd of November 2024***

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| *0730 – 0800* | *Registration & Coffee* |
| *0800 – 0815* | *Welcome & Introduction* |
| *0815 – 0830* | ***PRE-TEST*** |
| *0830 – 0930* | ***Introduction to Compressor Types***<br>*Centrifugal • Axial • Reciprocating • Helical Screw • Ranges of Application and Limitations* |
| *0930 – 0945* | *Break* |
| *0945 – 1100* | ***Mechanical Design of Centrifugal Compressors***<br>*Compressor Side Streams • Rotors • Balancing* |
| *1100 – 1215* | ***Mechanical Design of Centrifugal Compressors (cont'd)***<br>*Rotor Dynamics • Impellers • Casings* |
| *1215 – 1230* | *Break* |
| *1230 – 1420* | ***Mechanical Design of Centrifugal Compressors (cont'd)***<br>*Bearings • Seals • Couplings • Controls* |
| *1420 – 1430* | ***Recap***<br>*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, 04th of November 2024**

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|---|---|
| 0730 – 0930 | ***Alignment Techniques & Support Criteria***<br>*Review of Dial Indicator Methods • Laser Optic Cold Alignment • On-Stream (Hot) Alignment Verification Techniques* |
| 0930 – 0945 | *Break* |
| 0945 – 1100 | ***Basic Compressor Parameters***<br>*Thermodynamics • Capacity • Power • Efficiencies • Gas Properties • Intercooling* |
| 1100 – 1215 | ***Selection of Centrifugal Process Compressors***<br>*Calculation Methods • Characteristic Curves • Stability* |
| 1215 – 1230 | *Break* |
| 1230 – 1420 | ***Compressor Train Inspection, Maintenance, Overhaul & Repair–IMO&R***<br>*IMO&R Planning • Execution • Documentation* |
| 1420 – 1430 | ***Recap***<br>*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, 05th of November 2024**

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|---|---|
| 0730 – 0930 | ***Compressor Train Inspection, Maintenance, Overhaul & Repair–IMO&R (cont'd)***<br>*IMO&R • Q & As • Troubleshooting* |
| 0930 – 0945 | *Break* |
| 0945 – 1100 | ***Steam Turbines***<br>*Operating Principles & Mechanical Design • Impulse Turbines • Reaction Turbines* |
| 1100 – 1215 | ***Steam Turbines (cont'd)***<br>*Application Ranges • Configurations • Application Constraints* |
| 1215 – 1230 | *Break* |
| 1230 – 1420 | ***Turbine Components***<br>*Turbine Rotors • Blading • Diaphragms • Nozzles • Steam Chests • Glands & Gland Systems • Bearings* |
| 1420 – 1430 | ***Recap***<br>*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, 06th of November 2024**

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| 0730 – 0930 | ***Turbine Components (cont'd)***<br>*Balancing • Rotor Dynamics • Governing Systems • Lube Oil Management* |
| 0930 – 0945 | *Break* |
| 0945 – 1100 | ***Selection & Sizing of Steam Turbines for Compressor Drives***<br>*Steam (Water) Rates • Condensing and Backpressure Turbines • Single and Multistage Types • Process Considerations* |
| 1100 – 1215 | ***Operation & Maintenance of Steam Turbines***<br>*Commissioning • Startup • Run-In & Shut-down • Surveillance & Health Monitoring • Performance Measurement • Monitoring and Tracking* |
| 1215 – 1230 | *Break* |

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|---|---|
| *1230 – 1420* | ***Operation & Maintenance of Steam Turbines (cont'd)***<br>*Steam Turbine Washing • Steam Turbine Inspection • Maintenance Overhaul & Repair (IMO&R)* |
| *1420 – 1430* | ***Recap***<br>*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, 07th of November 2024***

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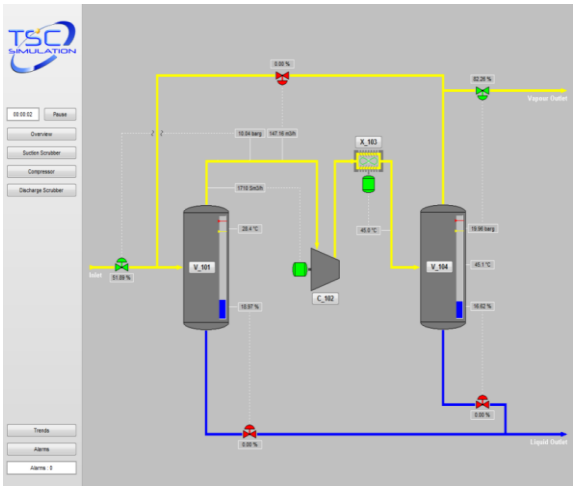
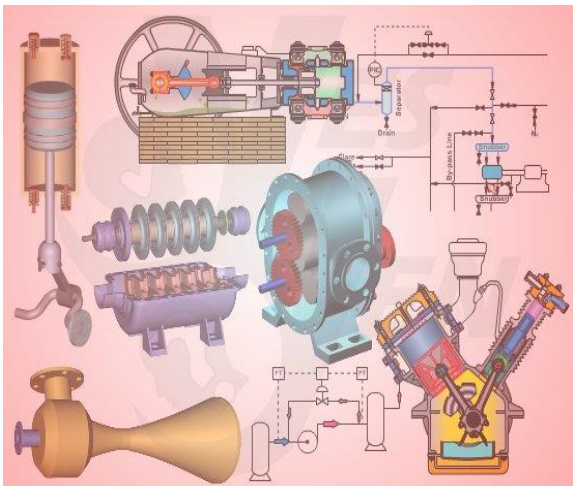
| *0730 – 0930* | ***Basic Approaches to Machinery Troubleshooting***<br>*Examples from Recent Failure Incidents Attributed to Design Defects • Processing & Manufacturing Deficiencies • Assembly Errors • Off-Design or Unintended Service Conditions • Maintenance Deficiencies, etc.* |
| *0930 – 0945* | *Break* |
| *0945 – 1100* | ***Predictive vs. Preventive Maintenance Techniques***<br>*Determination of Which Method to Use* |
| *1100 – 1215* | ***Machinery Reliability Audits & Reviews***<br>*Overview* |
| *1215 – 1230* | *Break* |
| *1230 – 1345* | ***Machinery Reliability Audits & Reviews (cont'd)***<br>*Reliability Impact on Plants* |
| *1345 – 1400* | ***Course Conclusion***<br>*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)

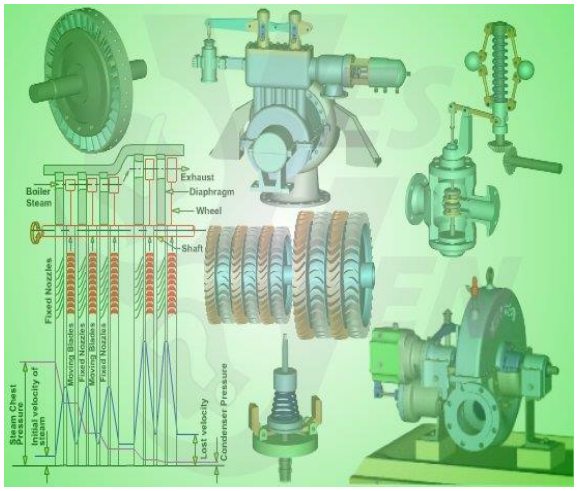
Practical session will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using the state-of-the-art simulators “SIM 3300 Centrifugal Compressor”, “CBT on Compressors” and “Steam Turbines & Governing System CBT”.



**SIM 3300 Centrifugal Compressor Simulator**



**CBT on Compressors**




**Steam Turbines & Governing System CBT**

## Course Coordinator

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