

**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**

January 05-09, 2025/Meeting Plus 9, City Centre Rotana Doha, Doha, Qatar

**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

### **Exclusive Smart Training Kit - H-STK®**



Participants of this course will receive the exclusive “Haward Smart Training Kit” (H-STK®). The H-STK® consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.

### **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.

### **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. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

**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:-


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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.

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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. Moayyad Sanori** is a **Senior Mechanical Engineer** with almost **30 years** of extensive experience within the **Oil & Gas, Petrochemical and Refinery Industries**. His expertise widely covers in the areas of **Centrifugal Compressor & Steam Turbine Design, Performance, Operation, Maintenance & Troubleshooting, Centrifugal Pumps & Compressors Overhauling, Fire Protection & Life Safety System Testing, Sprinkler System Inspection & Maintenance, Standpipe & Hose Systems, Fire Pump**

**Maintenance, Water Storage Tank Inspection, Valve Inspection & Testing, Safety Relief Valves, Air Compressor & Nitrogen Generators, Piping Assessment, Mechanical Pipe Fitting, Fire Pump Inspection & Testing, Fire Suppression Design, Fired Heaters & Exchangers, Process Plant Operation, Hydrocarbon Production Operation, Monitoring & Maintaining HSE Systems, Emergency & Critical Situations Control, Integrated Process Systems Start-up, Shutdown, Monitoring & Control, Process Plant Equipment Isolation, Mechanical Maintenance, Maintenance & Reliability Management, Preventive & Predictive Maintenance, Machinery Failure Analysis (RCFA), Condition Based Monitoring, Positive Displacement Pump, Heat Exchangers, Steam & Gas Turbine, Heat Recovery Steam Generator, Combined Cycle, Pipe Erection Installation, Welding Operations, Tank Pressure LPG, CNC Fabrication, Safety Valves, Distillation Columns, Gearbox, Pipe Fitting, Lathes, Milling, Diesel Engines, Boiler & Burners, Turbines & Motors, Power Piping, and ASNT-NDT Inspection Methods.** He is currently the **General Maintenance Supervisor** of **Jable Oil Services** with collaboration of **Waha Oil Company** wherein he is responsible in supervising the maintenance and operation of pumps, compressors, gas turbines, steam turbines, pipe testing and training of new employees.

During Mr. Moayyad's career he has handled key positions as such **Mechanical Maintenance Manager, Mechanical Maintenance Supervisor, Pipe Testing Supervisor, Radiation Supervisor, NDT Supervisor, General Maintenance Supervisor, Piping Testing Engineer, NDT Technician, Mechanical & Pipe Fitting Instructor** and **Pump Maintenance Technician** of various international companies including **Jordan Petroleum Refinery Company, Saudi Aramco, Rawabi Industrial Support Services, Experts Industrial Testing Company, Petra for Mechanical Testing Company** and **Al-Waei Metal Forming Establishment**.

Mr. Moayyad has an **Associate Diploma in Mechanical Engineering**. Further, he is a **Certified Instructor/Trainer, a Certified ASNT-NDT Level II** in Radiography (RT), Magnetic Particle Testing (MT), **Liquid Penetrant Testing (PT)** and **Ultrasonic Thickness Testing (UTT)** and a **Certified Assessor** by **City & Guilds Level 3 Certificate in Assessing Vocational Achievement** under the **TAQA Qualification (Training, Assessment & Quality Assurance)**. He has further delivered numerous trainings, courses, seminars, workshops and conferences internationally.

### 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, 05<sup>th</sup> of January 2025

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

#### Day 2: Monday, 06<sup>th</sup> of January 2025

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

#### Day 3: Tuesday, 07<sup>th</sup> of January 2025

0730 – 0930	<b>Compressor Train Inspection, Maintenance, Overhaul &amp; Repair-IMO&amp;R (cont'd)</b> IMO&R • Q & As • Troubleshooting
0930 – 0945	Break
0945 – 1100	<b>Steam Turbines</b> Operating Principles & Mechanical Design • Impulse Turbines • Reaction Turbines
1100 – 1215	<b>Steam Turbines (cont'd)</b> Application Ranges • Configurations • Application Constraints
1215 – 1230	Break



1230 – 1420	<b>Turbine Components</b> Turbine Rotors • Blading • Diaphragms • Nozzles • Steam Chests • Glands & Gland Systems • Bearings
1420 – 1430	<b>Recap</b> 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, 08<sup>th</sup> of January 2025**

0730 – 0930	<b>Turbine Components (cont'd)</b> Balancing • Rotor Dynamics • Governing Systems • Lube Oil Management
0930 – 0945	Break
0945 – 1100	<b>Selection &amp; Sizing of Steam Turbines for Compressor Drives</b> Steam (Water) Rates • Condensing and Backpressure Turbines • Single and Multistage Types • Process Considerations
1100 – 1215	<b>Operation &amp; Maintenance of Steam Turbines</b> Commissioning • Startup • Run-In & Shut-down • Surveillance & Health Monitoring • Performance Measurement • Monitoring and Tracking
1215 – 1230	Break
1230 – 1420	<b>Operation &amp; Maintenance of Steam Turbines (cont'd)</b> Steam Turbine Washing • Steam Turbine Inspection • Maintenance Overhaul & Repair (IMO&R)
1420 – 1430	<b>Recap</b> 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

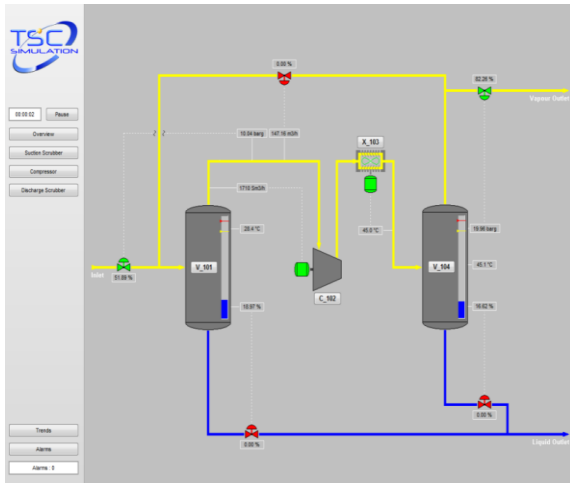
**Day 5: Thursday, 09<sup>th</sup> of January 2025**

0730 – 0930	<b>Basic Approaches to Machinery Troubleshooting</b> 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	<b>Predictive vs. Preventive Maintenance Techniques</b> Determination of Which Method to Use
1100 – 1215	<b>Machinery Reliability Audits &amp; Reviews</b> Overview
1215 – 1230	Break
1230 – 1345	<b>Machinery Reliability Audits &amp; Reviews (cont'd)</b> Reliability Impact on Plants
1345 – 1400	<b>Course Conclusion</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course
1400 – 1415	<b>POST TEST</b>
1415 – 1430	Presentation of Course Certificates
1430	Lunch & End of Course

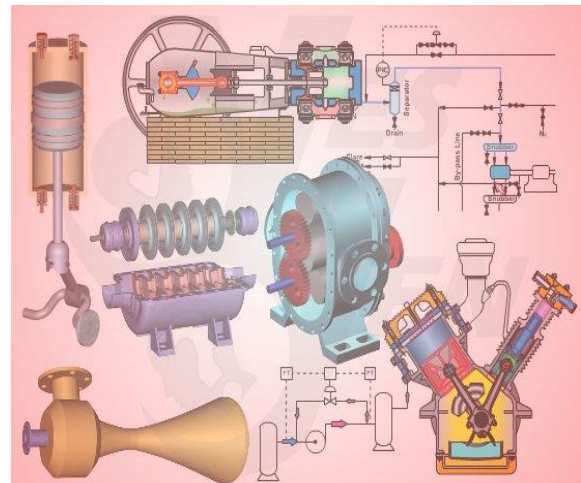


**Simulator (Hands-on Practical Sessions)**

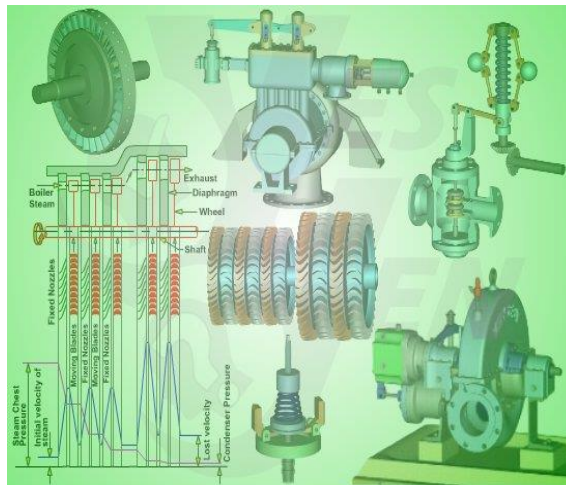
Practical session will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using the state-of-the-art simulators “SIM 3300 Centrifugal Compressor”, “CBT on Compressors” and “Steam Turbines & Governing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



**SIM 3300 Centrifugal Compressor Simulator**



**CBT on Compressors**



**Steam Turbines & Governing System CBT**

**Course Coordinator**

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