COURSE OVERVIEW RE0978
Condition Monitoring and Predictive Maintenance

Course Title
Condition Monitoring and Predictive Maintenance

Course Reference
RE0978

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

Course Date/Venue

Session(s)	Date	Venue
1	June 30-Jul 04, 2025	Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
2	August 04-08, 2025	Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
3	September 07-11, 2025	Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE
5	November 23-27,. 2025	Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE

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 participants with a detailed and up-to-date overview of Condition Monitoring and Predictive Maintenance. It covers the reactive, preventive and predictive maintenance and the benefits and limitations of each strategy; the basics of condition monitoring (CM), asset criticality and risk-based maintenance; the condition monitoring technologies, basics of failure mechanisms, data acquisition and monitoring system architecture and the principles of vibration analysis; and the vibration monitoring techniques, vibration data interpretation and condition-based maintenance (CBM) planning; and the infrared thermography principles, applications of thermography in refineries and lubrication and oil analysis.

During this interactive course, participants will learn the tribology and wear mechanism analysis, ultrasonic testing techniques and integrating multiple techniques; the predictive maintenance tools and platforms, reliability-centered maintenance (RCM) and root cause failure analysis (RCFA); the failure prediction techniques, condition monitoring dashboards and KPIs; the digital twins and smart maintenance systems, condition monitoring program and troubleshooting common issues; the CM and PdM in turnaround and shutdown planning; the bad actors for maintenance and asset health audits before startup; the risk-based inspection during turnaround and internal audits for CM programs; and the KPI monitoring, feedback loops and annual review of PdM strategies.

Course Objectives

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

- Apply and gain an in-depth knowledge on condition monitoring and predictive maintenance
- Differentiate reactive, preventive and predictive maintenance and discuss the benefits and limitations of each strategy
- Explain the basics of condition monitoring (CM) and carryout asset criticality and risk-based maintenance
- Apply condition monitoring technologies covering vibration analysis, thermography, ultrasonic testing and lubricant analysis
- Discuss basics of failure mechanisms, data acquisition and monitoring system architecture and the principles of vibration analysis
- Carryout vibration monitoring techniques, vibration data interpretation and condition-based maintenance (CBM) planning
- Discuss infrared thermography principles, applications of thermography in refineries and lubrication and oil analysis
- Employ tribology and wear mechanism analysis, ultrasonic testing techniques and integrating multiple techniques
- Apply predictive maintenance tools and platforms, reliability-centered maintenance (RCM) and root cause failure analysis (RCFA)
- Carryout failure prediction techniques, condition monitoring dashboards and KPIs
- Discuss digital twins and smart maintenance systems, develop a condition monitoring program and troubleshoot common issues
- Apply CM and PdM in turnaround and shutdown planning, identify bad actors for maintenance and implement asset health audits before startup and risk-based inspection during turnaround
- Perform internal audits for CM programs and apply KPI monitoring and feedback loops and annual review of PdM strategies

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 condition monitoring and predictive maintenance for plant managers, operations managers, supply chain and logistics managers, maintenance engineers/technicians, reliability engineers, asset management professionals, industrial automation engineers, instrumentation and control engineers, data analysts/data scientists, quality assurance/quality control engineers, health, safety, and environmental (HSE) managers, consultants and service providers, vibration analysts, IT professionals, manufacturing engineers, maintenance planners and schedulers, executives and decision-makers.

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: -

- 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.

- 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.

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

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. Andrew Ladwig is a **Senior Process & Mechanical Maintenance Engineer** with over **25 years** of extensive experience within the **Oil & Gas**, **Refinery**, **Petrochemical & Power** industries. His expertise widely covers in the areas of **Maintenance Planning**, **Maintenance & Reliability** Management, **Material Cataloguing**, **Equipment** Maintenance, Root Cause Failure Analysis (**RCFA**), **Rotating Machinery** Troubleshooting, **Maintenance Auditing & Benchmarking**, **Condition Monitoring** Techniques, **Machinery Lubrication** Technology, **Lubricant Oil & Grease** Testing & Analysis, **Crude Oil** Storage & Management, **Ammonia Manufacturing & Process** Troubleshooting, **Crude Oil** Distillation, **Distillation** Operation and Troubleshooting, **Ammonia Storage & Loading** Systems, **Fertilizer Storage** Management (Ammonia & Urea), **Sulphur Recovery**, **Nitrogen Fertilizer** Production, **Refining Process &** Petroleum Products, Safe **Refinery Operations**, **Hydrotreating & Hydro-processing**, **Fractionation**, **Process Plant** Operations, **Storage Tanks** Operations & Measurements, **Process Plant** Troubleshooting & Engineering Problem Solving, **Process Plant** Performance, **Process Troubleshooting** Techniques, **Pressure Vessel** Operation, **Process Equipment** Performance & Troubleshooting, **Plant Startup & Shutdown** and **Flare & Relief** System. Further, he is also well-versed in **Compressors & Turbines** Maintenance, **Heat Exchanger** Overhaul & Testing Techniques, Balancing of **Rotating Machinery** (**BRM**), **Pipe Stress** Analysis, **Valves & Actuators** Technology, **Control Valve** Engineering, **Tank Design**, **Material Cataloguing**, Specifications, Handling & Storage, **Steam Trap** Design, Operation, Maintenance & Troubleshooting, **Steam Trapping & Control**, **Column**, **Pump & Exchangers**, Troubleshooting & Design, **Detailed Engineering Drawings**, Codes & Standards, **Production Optimization**, Permit to Work (**PTW**), Project Engineering, **Data** Analysis, **Process Hazard** Analysis (**PHA**), **HAZOP** Study, Sampling & Analysis, **Training** Analysis, **Job Analysis** Techniques, Storage & Handling of **Toxic Chemicals & Hazardous Materials**, **Hazardous Material** Classification & Storage/Disposal, **Dangerous Goods**, Environmental Management System (**EMS**), Supply Chain, Purchasing, Procurement, **Logistics** Management & **Transport** & **Warehousing** & **Inventory**, **Risk** Monitoring Authorized Gas Tester (**AGT**), Confined Space Entry (**CSE**), Personal Protective Equipment (**PPE**), Fire & Gas, First Aid and Occupational Health & Safety.

During his career life, Mr. Ladwig has gained his practical experience through his various significant positions and dedication as the **Mechanical Engineer**, **Project Engineer**, **Reliability & Maintenance Engineer**, **Maintenance Support Engineer**, **Process Engineer**, **HSE Supervisor**, **Warehouse Manager**, **Quality Manager**, **Business Analyst**, **Senior Process Controller**, **Process Controller**, **Safety Officer**, **Mechanical Technician**, **Senior Lecturer** and **Senior Consultant/Trainer** for various companies such as the Sasol Ltd., Sasol Wax, Sasol Synfuels, just to name a few.

Mr. Ladwig has a **Bachelor's** degree in **Chemical Engineering** and a **Diploma** in **Mechanical Engineering**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**) and has delivered various trainings, workshops, seminars, courses and conferences internationally.

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 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

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Overview of Maintenance Strategies*** *Reactive Versus Preventive Versus Predictive • Evolution of Maintenance Philosophies • Benefits and Limitations of Each Strategy • Integration with Asset Management Systems*
0930 – 0945	*Break*
0945 – 1045	***Basics of Condition Monitoring (CM)*** *Definition and Purpose of CM • CM versus Predictive Maintenance (PdM) • Role of CM in Reliability and Availability • Importance of Data-Driven Maintenance*
1045 – 1130	***Asset Criticality & Risk-Based Maintenance*** *Defining Asset Criticality • Failure Mode Effects and Criticality Analysis (FMECA) • Risk Ranking and Prioritization • Linking CM to High-Risk Equipment*
1130 – 1230	***Condition Monitoring Technologies Overview*** *Vibration Analysis • Thermography • Ultrasonic Testing • Lubricant Analysis*
1230 – 1245	*Break*
1245 – 1330	***Basics of Failure Mechanisms*** *Mechanical Fatigue and Wear • Thermal Degradation • Electrical Insulation Breakdown • Corrosion and Erosion Effects*
1330 – 1420	***Data Acquisition & Monitoring System Architecture*** *Sensors and Data Loggers • SCADA and DCS Integration • Online versus Offline Monitoring Systems • Data Storage and Transmission Protocols*
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

0730 – 0830	***Principles of Vibration Analysis*** *Types of Vibrations: Axial, Radial, Torsional • Frequency Domain Analysis (FFT) • Amplitude, Phase, and Waveform Interpretation • Resonance and Critical Speeds*
0830 – 0930	***Vibration Monitoring Techniques*** *Velocity, Acceleration, Displacement • Portable and Fixed Sensors • Route-Based versus Continuous Monitoring • ISO 10816 and Alarm Thresholds*
0930 – 0945	*Break*
0945 – 1100	***Vibration Data Interpretation*** *Bearing Faults Detection • Unbalance and Misalignment • Looseness and Soft Foot • Gear Mesh Issues*
1100 – 1230	***Case Studies in Refinery Rotating Equipment*** *Centrifugal Pumps • Compressors • Fans and Blowers • Motors and Gearboxes*
1230 – 1245	*Break*
1245 – 1330	***Condition-Based Maintenance (CBM) Planning*** *Decision-Making Based on Vibration Data • Maintenance Scheduling Criteria • Trend Monitoring • Alarm and Warning Level Setting*
1330 – 1420	***Vibration Monitoring Tools & Software*** *Overview of Handheld Devices • Smart Sensor Integration • Data Trending Tools • Reporting and Diagnostics Tools*
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

0730 – 0830	***Infrared Thermography Principles*** *Basics of Heat Radiation • IR Camera Types and Resolutions • Emissivity and Reflectivity Factors • Image Interpretation Techniques*
0830 – 0930	***Applications of Thermography in Refineries*** *Electrical Panels and Switchgear • Steam Traps and Piping Systems • Furnace Lining and Refractory Monitoring • Hotspot Detection in Rotating Equipment*
0930 – 0945	*Break*
0945 – 1100	***Lubrication & Oil Analysis*** *Importance of Lubricant Condition Monitoring • Types of Tests: Viscosity, TBN, TAN • Contaminants and Wear Particles • Oil Sampling Best Practices*
1100 – 1230	***Tribology & Wear Mechanism Analysis*** *Sliding, Abrasive, and Adhesive Wear • Metal Fatigue and Spalling • Ferrography and Spectroscopy • Root Cause Analysis of Lubrication Issues*
1230 – 1245	*Break*
1245 – 1330	***Ultrasonic Testing Techniques*** *Working Principle and Frequency Range • Airborne and Contact Ultrasound • Leak Detection and Steam Trap Monitoring • Bearing and Valve Condition Assessment*

1330 – 1420	***Integrating Multiple Techniques*** *Multi-Parameter Diagnostics • Cross-Verification Between Methods • Decision-Making and Confidence Levels • CMMS Integration and Automated Alerts*
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

0730 – 0830	***Predictive Maintenance Tools & Platforms*** *Overview of AI/ML in Predictive Maintenance • Predictive Modeling and Forecasting • Key Parameters and KPI Tracking • Integration with IoT Sensors*
0830 – 0930	***Reliability-Centered Maintenance (RCM)*** *Core Principles and Methodology • Functional Failure Analysis • Decision Logic for Maintenance Tasks • Practical Application in Refinery Context*
0930 – 0945	*Break*
0945 – 1100	***Root Cause Failure Analysis (RCFA)*** *Step-by-Step RCA Methodology • Tools: 5 Whys, Fishbone Diagram, Fault Tree • RCA Documentation and Reporting • Continuous Improvement Loop*
1100 – 1230	***Failure Prediction Techniques*** *Mean Time Between Failures (MTBF) • Weibull and Statistical Analysis • Remaining Useful Life (RUL) Estimation • Maintenance Interval Optimization*
1230 – 1245	*Break*
1245 – 1330	***Condition Monitoring Dashboards & KPIs*** *Setting Up Performance Dashboards • Visualizing Vibration and Thermal Trends • Alert Management and Escalation Protocols • Performance Benchmarking*
1330 – 1420	***Digital Twins & Smart Maintenance Systems*** *Concept and Architecture of Digital Twins • Digital Replicas of Critical Refinery Assets • Real-Time Simulation for Failure Prediction • Use of Digital Twins in Predictive Workflows*
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

0730 – 0830	***Developing a Condition Monitoring Program*** *Implementation Roadmap • Resource Planning and Training • Integration with Existing Systems • Stakeholder Engagement and Buy-In*
0830 – 0930	***Troubleshooting Common Issues*** *Sensor Placement and Wiring Errors • Data Quality and Noise Reduction • Communication Errors in Online Systems • Misinterpretation of Diagnostic Results*
0930 – 0945	*Break*
0945 – 1100	***CM & PdM in Turnaround & Shutdown Planning*** *Role in Pre-Shutdown Inspections • Identifying Bad Actors for Maintenance • Asset Health Audits Before Startup • Risk-Based Inspection During Turnaround*

1100 – 1230	***Refinery-Specific Applications & Case Studies*** *Case Study: Pump Bearing Failure Detection • Case Study: Electrical Panel Overheating • Case Study: Gearbox Oil Degradation • Case Study: Compressor Unbalance Resolution*
1230 – 1245	*Break*
1245 – 1345	***Auditing & Continuous Improvement*** *Internal Audits for CM Programs • KPI Monitoring and Feedback Loops • Lessons Learned and Corrective Actions • Annual Review of PdM Strategies*
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)

Practical sessions 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 simulator "iLearnVibration".

iLearnVibration Simulator

Course Coordinator

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