COURSE OVERVIEW ME0908
Basics of Rotating Equipment/System (E-Learning Module)

Course Title
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Course Reference
ME0908

Course Format & Compatibility
SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

Course Duration
30 online contact hours
(3.0 CEUs/30 PDHs)

Course Description

This E-learning course is designed to provide participants with a basic overview of rotating equipment/system. It covers the turbo-machinery and machine that extract energy; the gas turbines, steam turbines, hydraulic turbines and wind turbines; the classification of pumps and the advantages of dynamic, rotary pumps and reciprocating pumps; the fluid and physics basics; the continuity equation (conservation of mass), Bernoulli's principle, classification of pumps, theory of gas compression, Boyle's law and Charles's law; the heat transfer and its applications; the heat transfer fundamentals, heat transfer methods and classification of pumps; the typical operating regimes of various compressors; the generation of centrifugal force and conversion of kinetic energy to pressure energy; the classification and three categories of centrifugal pumps; and the opposite impellers multi-stage.

During this course, participants will learn the impellers in row multi-stage, pump rotor axial thrust, balancing drum and balancing disk; the centrifugal pumps construction and centrifugal pumps arrangement; the single volute, double volute, discharge outlet, seals and wear rings; the wear ring clearance, impeller size, liquid cleanliness and impeller RPM; the principles of operation of rotary pumps comprising of external gear pumps, internal gear pumps, lobe pumps, vane pumps and screw pumps; and the horizontally split versus vertically split process centrifugal compressors.

Course Objectives

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

- Apply and gain a basic knowledge on rotating equipment/system
- Describe turbo-machinery and machine that extract energy as well as differentiate gas turbines versus steam turbines and hydraulic turbines and wind turbines
- Recognize the classification of pumps and the advantages of dynamic, rotary pumps and reciprocating pumps
- Discuss the fluid and physics basics including energy, kinetic energy, potential (gravitational) energy, mechanical energy and pressure energy
- Describe the continuity equation (conservation of mass), Bernoulli's principle, classification of pumps, theory of gas compression, Boyle's law and Charles's law
- Employ heat transfer and identify its applications
- Discuss heat transfer fundamentals, heat transfer methods and classification of pumps
- Carryout the typical operating regimes of various compressors that include dynamic, centrifugal and rotary compressors
- Describe the generation of centrifugal force and conversion of kinetic energy to pressure energy
- Recognize the classification and three categories of centrifugal pumps
- Identify opposite impellers multi-stage, impellers in row multi-stage, pump rotor axial thrust, balancing drum and balancing disk
- Employ centrifugal pumps construction and centrifugal pumps arrangement
- Differentiate single volute versus double volute and recognize discharge outlet, seals and wear rings
- Determine wear ring clearance, impeller size, liquid cleanliness and impeller RPM
- Discuss the principles of operation of rotary pumps comprising of external gear pumps, internal gear pumps, lobe pumps, vane pumps and screw pumps
- Differentiate horizontally split versus vertically split process centrifugal compressors

Who Should Attend

This course provides a basic overview of all significant aspects and considerations of rotating equipment/system for mechanical engineers, rotating equipment engineers, supervisors and other technical staff. Further, the course is suitable to all other engineering disciplines who are dealing with rotating equipment such as process engineers, chemical engineers, electrical engineers, plant engineers, project engineers and instrumentation engineers.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- USA International Association for Continuing Education and Training (IACET)

  Haward Technology is an Authorized Training Provider by the International Association 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 1-2013 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 1-2013 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 Association 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.

Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test

Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

Course Fee

As per proposal

Course Contents

- Overview of Rotating Equipment
- What is meant by “Turbo-machinery”?
- Machines that Extract Energy
- Gas turbines run on gas
- Steam turbines run on steam
- Hydraulic turbines run on water while Wind turbines run on air
- Pumps Add Energy to Fluids
- Classification of Pumps
- Dynamic Pumps
- Positive Displacement Pumps
- Reciprocating pumps
- Dynamic (Rotary) pumps
- Pumps Classification
- Advantages of Dynamic (Centrifugal Pumps)
- Advantages of Rotary Pumps
- Advantages of Reciprocating Pumps
- Fluid and Physics Basics
- Energy

- Kinetic Energy
- Potential (Gravitational) Energy
- Mechanical Energy
- Pressure Energy
- Pressure, Gage & Absolute
- Fluid Mechanics
- Flow Trough Pipes
- The Continuity Equation (Conservation of Mass)
- Fluid Flow
- Bernoulli's Principle
- Vapor Pressure
- Specific Gravity
- Viscosity
- Heat Transfer & Its Application
- Temperature and Heat
- The Temperature Units
- Measuring Units of Heat
- Heat Transfer Fundamentals
- Heat Transfer Methods
- Classification of Pumps
- Theory of Gas Compression
- Gas Compression
- Air
- Boyle's Law
- Theory of Gas Compression
- Charles's Law
- Combined Gas Law
- How Compressors Work
- Types of Compressors
- Compressors
- Typical Operating Regimes of Compressors
- Dynamic compressors
- Centrifugal Compressor
- Rotary Compressor

- Quiz of section 1
- Centrifugal Pumps
- How Do Centrifugal Pumps Work?
- Centrifugal Single Volute Pump
- Generation of Centrifugal Force
- Conversion of Kinetic Energy to Pressure Energy
- Centrifugal Pumps are classified into three general categories
- Classification of Centrifugal Pumps
- Radial Flow Pump
- Axial Flow Pump
- Mixed Flow Pump
- Classification With Respect To The Liquid Flow
- The Centrifugal Pump Spectrum
- Centrifugal Pumps Construction
- Impeller
- Impeller – Open Type
- Impeller – Semi Open Type
- Impeller – Closed type
- Impeller Vanes
- Impeller Suction
- Impeller Positioning
- Impeller Number
- Opposite Impellers Multi-Stage
- Impellers in Row Multi-Stage
- Pump Rotor Axial Thrust
- Unbalance on Each Impeller = Pd – Ps
- Balancing Drum
- Balancing Disk
- Other Centrifugal Pumps
- Multi-Stage Horizontally Split Case Pump
- Centrifugal Pumps Arrangement
- ANSI Pump Unit
- Premium Fabricated Steel
- Baseplates

- Shaft
- Casing
- Diffuser
- Vaned Diffuser
- Single Volute vs Double Volute
- Discharge Outlet
- Seals
- Wear Rings
- Wear Ring Clearance
- The impeller size
- The liquid cleanliness
- Impeller RPM
- Small clearance
- Big clearance than the specified value
- Quiz of section 2
- Positive Displacement Pumps
- Rotary Pumps
- Rotary Pumps – External Gear Pumps
- Rotary Pumps – Internal Gear Pumps
- Rotary Pumps – Lobe Pumps
- Rotary Pumps – Vane Pumps
- Principles of Operation
- Rotary Pumps – Screw Pumps
- Pumps – Advantages
- Rotary Pumps – Disadvantages
- Double Acting Piston Pump
- Single Plunger Reciprocating Pump
- Three Plunger Reciprocating Pump
- Pressure Pulsation Dampener on the Discharge Side
- Pressure Pulsation Dampener
- Packing
- Reciprocating Pumps – Bent Axis Piston Pump
- Reciprocating Pumps – Swash Plate Piston Pump
- Variable displacement

- Axial Piston Pump
- Diaphragm Pumps
- Quiz for section 03
- Centrifugal Compressors
- How Centrifugal Compressor Works?
- Centrifugal Compressor Components
- Compressor Casing
- Horizontally Split Process Centrifugal Compressors (MCH)
- Vertically Split Process Centrifugal Compressors (BCH)
- Overhung Centrifugal Compressors (POB)
- Suction Plenum
- Guide Vanes
- The Function of the Guide Vanes
- Fixed guide vanes
- Impellers
- The Compressor Rotor
- Semi – Open Impeller
- High-pressure, vertically split centrifugal compressor
- Multi-stage Centrifugal Compressor
- Shafts
- Shaft sleeve between two impellers
- Diffuser
- Vaned Diffuser
- U Bend and Return Channel
- Aerodynamic Parts of Centrifugal Compressor
- Discharge Volute
- Centrifugal Compressors – Arrangement
- Balancing Drum
- Rotor Assembly
- Centrifugal Compressors Surge Protection
- Centrifugal Compressors Surge Protection
- Dynamic Compressors – Centrifugal
- Surge – Definition
- What Does Surge Do?

- Surge Protection
- Quiz of section 04
- Positive Displacement Compressors
- Reciprocating Compressors
- Reciprocating Compressors - Theory
- Reciprocating Compressors – Main Parts
- Cylinders
- Pistons and Rods
- Valves
- Disadvantages
- API Standards
- Summary
- Rotary Compressors
- Rotary Compressors – Screw Type
- Screw Compressor
- Compression Process
- Rotary Screw Compressors
- Rotary Screw Features
- Rotary Compressors – Lobe Type
- Rotary Compressors – Rotary Vane Type
- Vane Compressors
- Rotary Compressor
- Vane-Type Rotary Compressors
- Quiz of Section 05
- Steam Turbines
- Steam Turbine - Introduction
- Steam Turbine – Theory of Operation
- Classification of Steam Turbines
- Condensing
- Non-Condensing / Back Pressure
- Extraction
- Steam Turbines
- Multi-Stage Steam Turbine Generator
- Type of Steam

- Components of Steam Turbines
- Casing and Steam Path
- Steam End
- Fixed Nozzle
- Nozzle Diaphragm
- Turbine Diaphragm & Nozzles
- Rotating Blades
- Turbine & Lower Casing
- Impulse Turbine Nozzle Position
- Impulse Turbine Wheel Section
- Reaction Turbine Stationary and Rotating Blade Arrangement
- Turbine Blades
- Steam Turbines Seals
- Shaft Sealing, Labyrinth Seals vs Carbon Seals
- Carbon packing
- Steam Turbines Standards
- API Standards
- Quiz of section 06
- Gas Turbines
- Gas Turbines Components
- Axial-Flow Compressors
- Axial-Flow Compressors Function Description
- Compressor Design and Operation
- Bernoulli's Theorem
- Case
- The case of an axial flow compressor
- Compressor Extraction
- Stator
- Rotor
- Axial Compressors - Compressor Surge
- Axial-Flow Compressors - Inlet Guide Vanes (IGV)
- Variable Inlet Guide Vane System
- Axial-Flow Compressors - Bleed Valves
- Compressor Bleed Valves

- The Back Work Ratio
- Combustors
- Combustion Section
- Main Components
- Reverse Flow
- Temperature Profile
- Combustion Liner
- Combustors Fuel Nozzles
- Combustors Spark Plugs
- Combustors Cross Fire Tubes
- Ignition and Crossfire
- Combustors Flame Detectors
- Combustors Transition Piece
- Transition Piece
- Nozzle & Transition Piece Assembly
- Combustion Processes
- Power Turbine
- Power Turbine Function Description
- Turbine Nozzle
- High Pressure Turbine Nozzle Assembly
- Turbine Stationary Nozzles
- Turbine Rotor
- Development of Gas Turbines
- Quiz of section 07
- Lubrication & Bearings
- The Importance of Lubricating
- Temperature Monitoring
- Objective Four
- Preventive Maintenance (PM)
- Lubrication
- Lubrication Storage and Handling
- Lubrication Storage and Handling – Best Practice
- Indoor Storage
- Temperature Monitoring

- Principles of Viscosity
- Effect of Temperature on Viscosity
- What is Grease?
- Hydrodynamic Lubrication
- Methods of Supply
- Hydrodynamic lubrication
- Advantages
- Disadvantages
- Components of a Hydrostatic System
- Hybrid Lubrication
- Components of a Hybrid System
- Oil Analysis
- On-Site Analysis versus Lab Analysis
- Lab Analysis
- Bearings
- Bearings - Introduction
- Anti-Friction Bearings
- Types of Rolling Elements
- Bearing loads
- Journal Bearings
- Hydrodynamic Journal Bearings
- Hydrodynamic Bearings – Working Principle
- Journal or Plain Bearings
- Tilting-Pad Journal Bearings
- Equalizing Tilting-Pad Thrust Bearings
- Combined Radial and Thrust Bearings
- Harmful Temperature Increase
- Improper Installation and Handing
- Describe the Causes of Bearing Failure
- Brinelling
- The Correct Amount of Lubricant
- Fatigue
- Look
- Anti-Friction Bearing Removal and Installation

- Bearing Life
- General Relationships on Bearing Life
- Performance Criteria and The Correct Grease
- How Much Moisture is Too Much?
- Effects of Corrosion - The Primary Challenge to Bearings
- in Industry
- The Facts of Unsatisfactory Bearing Life We have to Deal with…
- Attack the Root Causes and Maximize Bearing Life!
- Ball and Roller Bearing
- Failure Modes
- Overheating
- Failure Modes
- True Brinelling
- False Brinelling
- Normal Fatigue Failure
- Contamination
- Lubricant Failure
- Misalignment
- Loose Fits
- Tight Fits
- Table Plain (Journal) Bearing Failure Modes and their Causes
- Troubleshooting Journal Bearings
- Quiz of section 08