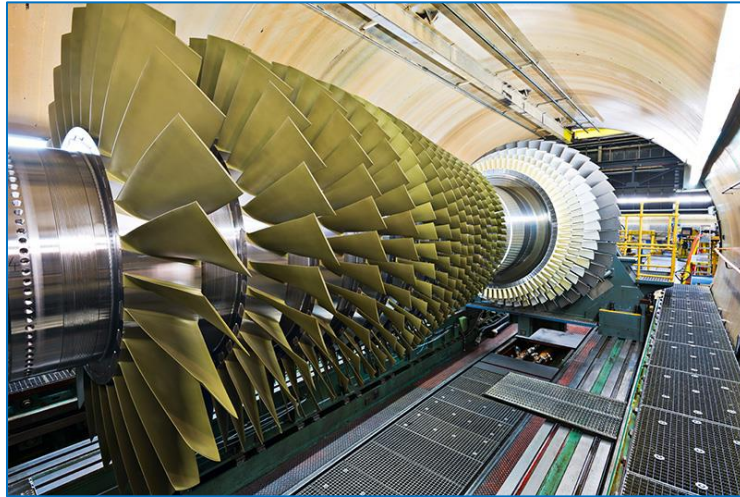




MU154: Axial Compressor Design and Performance

Training Description:

This course covers fundamental and advanced principles of axial flow compressor design, including construction, operating principles, materials selection, design, performance testing and monitoring, applications, maintenance and operational considerations, and applicable codes and standards. The interaction between aerodynamics and mechanical integrity requirements are key factors influencing a design.

In addition, the participant must understand the compromises and limitations imposed by the turbine on the compressor design and performance.

Training Objectives:

The aim of the course is to familiarise the participants with overall axial compressors, compressor design and performance principles through lectures, tutorials, practical sessions and a fully interactive hand worked design example coupled with a computer based design optimisation workshop.

By the end of the training, participants will be able to:

- ✓ Select an appropriate shape and geometry for the compressor annulus diagram
- ✓ Assess the interactions between aerodynamic and mechanical integrity requirements
- ✓ Select the number of stages needed for a given overall pressure ratio
- ✓ Assess the need for variable geometry, bleed, multi-shafting etc., to provide adequate off design performance
- ✓ Know the fundamental and advanced construction and operating principles of axial flow compressors
- ✓ Learn the advantages, applications and limitations of axial flow compressors
- ✓ Be familiar with the rules of thumb for axial flow compressor design
- ✓ Learn what to consider in material selection

Training Designed for:

The course is intended to those with none or modest experience in compressor technology, axial compressor technology in the design, manufacturing and user industries.

Training Requirement:

"Hand's on practical sessions, equipment and software will be applied during the course if required and as per the client's request."

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client's learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Program:

FIVE DAYS:

- ❖ PRE-TEST
- ❖ Course Introduction
- ❖ Axial flow compressor construction

- ❖ Operating principles and major components
- ❖ Characterization of axial flow compressor selected material
- ❖ Performance, design and dimensional analysis
- ❖ Recent developments and applications of axial flow compressors
- ❖ Codes standards, specifications and procedures
- ❖ The Problem of Compression:
 - The basic diffusion process, analogy with conical diffusers, definition of pressure losses; separation and friction losses. Definition of pressure recovery parameters, loading parameters, etc.
- ❖ The Compressor Cascade
 - Performance: correlations, deflection, pressure losses, deviation, choice of incidence. Limitations due to stall and choke. Effect of space to chord ratio, stagger, camber, etc. Reynolds and Mach number effects, alpha-Mach number diagrams. Transonic/supersonic cascade performance, unique incidence. Diffusion factor, choice of base profile and blade numbers. Standard blade base profiles, C4, NACA 65, double circular arc etc. A general discussion on controlled diffusion blading. Tutorial examples
- ❖ The Axial Compressor Stage
 - Stage loading and flow parameters, limitations in design on pitch line basis. Definition and choice of reaction or blade outlet angle at design, effect on stage efficiency. Limitations imposed with zero Alpha 0 stages. The ideal and real stage characteristic, limitations due to stall and choke
- ❖ Radial Equilibrium
 - The free vortex solution, limitations due to hub/tip ratio. Alternative solutions: prescribed vortex, half vortex and graded work applied to fans and low hub/tip compressor stages
- ❖ Compressor Overall Performance
 - Definition of isentropic and polytropic efficiency, effect of pressure ratio, overall performance characteristics, surge and surge margin definitions, effect of inlet temperature and pressure changes, running line, choking effects. Effects on performance of: inlet flow distortion, tip clearance, snubbers, bleed slots etc.
- ❖ Off Design Performance
 - Types of stall, rotating stall, flutter. Demonstration using compressor test rig. Use of variable IGV/stators, bleed, multi-spooling, variable axial temperature rise distribution
- ❖ Installed Compressor Performance
 - Choice of overall annulus geometry: design for rising line, constant mean diameter, falling line. Choice of axial spacing, aspect ratio, limitations of rear hub/tip ratio
- ❖ Mechanical Integrity
 - Loads acting on the compressor. Strength criteria and some associated factors. Fatigue and multi-axial fatigue. Selection of materials. Blade vibration and what to do about resonances. A general discussion on compressor blade and disc design
- ❖ Compressor Design Example
 - A full pitch line multi-stage compressor design is undertaken by course delegates which involves extensive use of Q-curves. Subsequently a design optimisation workshop is

undertaken using a unique computer based programme.

- ❖ **Practical Session**
- ❖ Course Conclusion
- ❖ POST-ASSESSMENT and EVALUATION

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Gamification, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

TBA as per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:

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