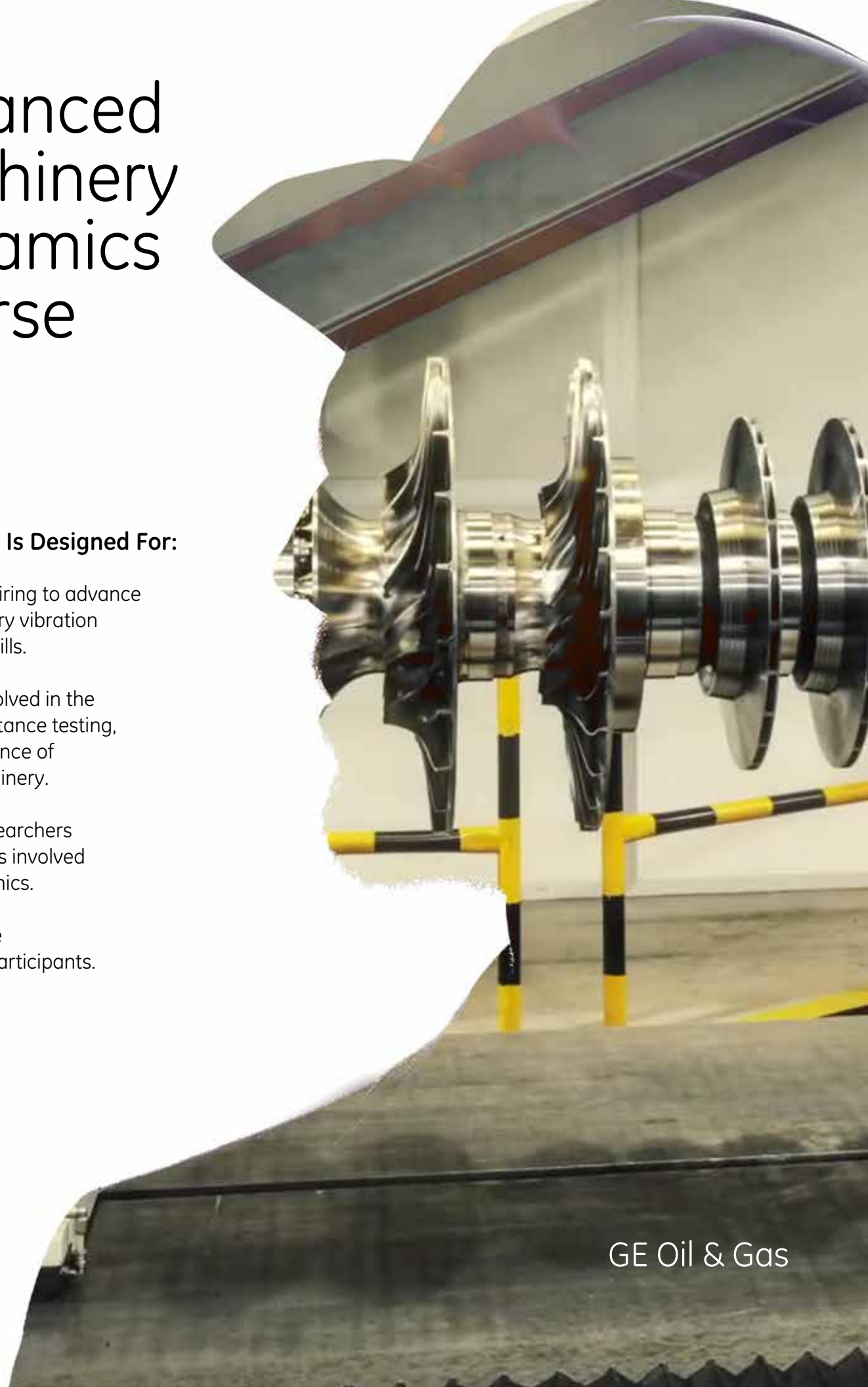
Advanced Machinery Dynamics Course



This Course Is Designed For:

Engineers desiring to advance their machinery vibration diagnostics skills.

Engineers involved in the design, acceptance testing, and maintenance of rotating machinery.

Academic researchers and professors involved in rotor dynamics.

Post-graduate engineering participants.

GE Oil & Gas

PREREQUISITES

Prior to this course, participants should have completed GE's Bently Nevada Machinery Diagnostics course or be ISO Category 3 certified.

GE's Bently Nevada Machinery Diagnostics course will be offered prior to this course for those who do not yet meet the prerequisite.

Although we will not refuse persons who do not meet the prerequisites, the Advanced Machinery Dynamics course will start where the Machinery Diagnostics course leaves off.

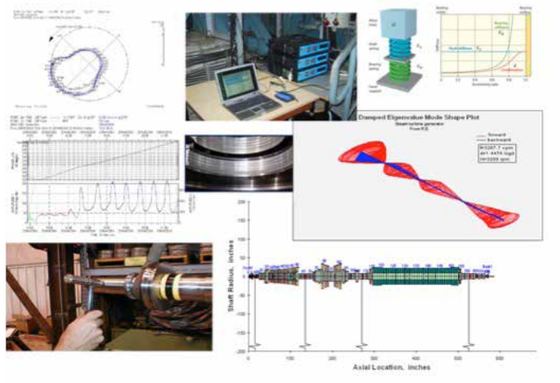
Without the prerequisites, participants will not get the expected return on their investment.

WHY GE'S BENTLY NEVADA FOR TRAINING?

For more than five decades, the Bently Nevada name has been synonymous with leadership in advanced, high-quality vibration and machinery condition monitoring solutions. This leadership has been earned from decades of rotor dynamics research, understanding the behavior of rotating and reciprocating machinery, that is then shared with global users, to ensure they get the most value from their solutions. The supplier of choice for nearly every major machinery manufacturer in the world, GE pioneered the condition monitoring industry with the commercially practical eddy-current proximity probe, vibration monitors, condition monitoring software and rotor dynamics research. The fundamental knowledge and expertise, which we share in our training programs, goes into every product, service and solution we deliver.

MAIN THEMES, TOPICS AND COURSE OBJECTIVES

Rotor Modeling as a Machinery Diagnostics Tool
In this module participants will be able to identify the design parameters that determine the rotor dynamic behavior. In workshops they will build a rotor model and verify its correctness on an actual machine model. Questions such as the ones listed below will be answered.



- What are critical speeds?
- How do critical speeds relate to resonances and natural frequencies?
- What is mode shape?
- What are undamped/damped modes?
- What effects do bearing characteristics have?

Understanding Anisotropic Systems
In this topic the participants will be introduced to anisotropic systems, be able to recognize machine behavior due to support stiffness anisotropy and be aware of the implications for balancing and determination of the SAF. Questions such as the ones listed below will be answered.

- How anisotropy of rotor support stiffness can cause split resonance?
- Why can your orbit be precessing in the opposite direction than shaft rotation between split resonances?

Balancing Machines
Participants will be able to differentiate between the various balancing methods and to state their advantages and drawbacks. A hands-on workshop will allow performing multi-plane balance. Questions such as the ones listed below will be answered.

- What are the balancing methods?
  - Influence vectors
  - Static/coupled
  - Polar (modal method)
- How can a thermal bow effect be balanced?
- What is the difference between rigid and flexible shaft?

Rotor to Stator Rubs
After a short review of rub fundamentals, the students will be presented with various case histories, after which they will be able to recognize machine rubs. Questions such as the ones listed below will be answered.

- How can orbit be used to detect rub?
- How can rub condition show fractional frequency component?
- What is the difference between the Newkirk and Morton type variable bow effect?

Diagnose and Control of Fluid Induced Instabilities
Participants will review how to recognize fluid instabilities, be able to explain the root cause of this type of malfunction, and show their understanding of design changes to prevent these malfunctions. Questions such as the ones listed below will be answered.

- Review fluid induced instabilities of rotors: whirl and whip
  - Can we observe reverse precession of vibration in case of fluid induced instability?
  - Can we have fluid instability in machine with tilt pad bearing?
  - Can the whirl frequency exceed 0.5X?
  - Can rotors, showing torsional or axial vibration, get unstable?

Shaft Cracks
Diagnosis of shaft crack will be revisited by the participants. After this they will be able to recognize the symptoms in the presented case histories. Questions such as the ones listed below will be answered.

- What are diagnostic rules for shaft crack detection?
- How can a cracked shaft generate strong 2X motion?

Gear Forces and Frequencies with Gear Failures Inspection
Participants will be able to recognize the different types of gears, be able to state their advantages and drawbacks, list the normal gear force directions and calculate the five discrete gear frequencies. Questions such as the ones listed below will be answered.

- Considering gear forces, how is it possible to predict position of the shaft in the bearings?
- What are the important frequencies to consider?

Torsional Vibration
Different Torsional Vibration Measurements will be explained with focus on the Time Interval Measurement (TIM) Based Torsional Vibration Measurement.

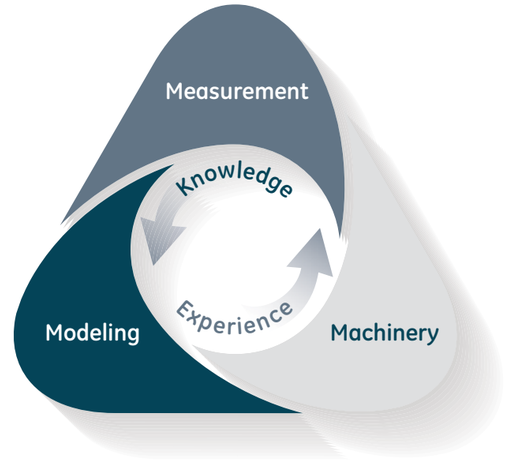
Why are torsional calculations important? What are the main types of excitation? How to measure torsional vibrations?

Introduction to Impact Testing and Analysis with Case History

Participants will be introduced to structural testing and the basics of modal analysis and shown how to use impact testing for the identification of component natural frequencies. An introduction to operating deflection shape (ODS) and mode shape analysis with a case history will also be presented.

- What are mode shapes?
- What is the difference between ODS and mode shapes?
- What is the coherence function?
- What are the most important things to consider when impact testing?

Note: For each theme described above, real case histories will be used to show practical use of techniques.



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