



## STABILITÉ DES MACHINES TOURNANTES

### EXPERIMENTAL METHODS IN MECHANICS

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| Lecturers : 16.0 | TC : 0.0 | PW : 8.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : AN

#### Objectives

Rotating machines as systems for propulsion (turbojet engines...), energy production (windmills, alternators...) or any system needing to rotate a shaft (pump, gyroscope, centrifuges...) hold an important place in everyday life. These machines obey the laws of dynamics and often evolve in a multiphysical context: fluid-structure interaction, mechatronics. This lesson's purpose is to provide the key elements for such systems modelling, concentrating on stability aspects. Indeed this point is essential because a lot of energy is concentrated in these machines and their stability is a major concern for their good functioning as well as for safety.

**Keywords :** Rotating machine. Stability. Vibration

#### Programme

I/ Reminder of rotating elastic structure equations, modal characteristics in fixed and rotating frame.  
II/ Linear systems stability analysis: equations with constant coefficients, equations with periodic coefficients. Introduction to non-linear systems stability  
III/ Rotors stability problems: phenomenological analysis, analysis of structural elements leading to instabilities:  
• Symmetry, dissipation, buckling in rotating parts • Bearings characteristics  
• Rotor / stator coupling • Fluid-structure coupling • Non - linear phenomena causing instability (bifurcation...)

#### Learning outcomes

- To understand rotordynamics specific points
- To know how to put into equations rotordynamics problems
- To know how to assess for a rotating machine dynamics and stability
- To know the different organs of a turbomachine

#### Independent study

**Objectifs :** To get informed of rotating machines state of the art

**Méthodes :** Research papers analysis, by binoms + presentation to the group

#### Core texts

R. Bigret, *STABILITÉ DES MACHINES TOURNANTES ET DES SYSTÈMES*, Publication CETIM, 1997  
F. F. Ehrich *HANDBOOK OF ROTORDYNAMICS*, Krieger Publishing Company, 2004  
M. I. Friswell, J. E. T. Penny, S. D. Garvey and A. W. Lees *DYNAMICS OF ROTATING MACHINES*, Cambridge Aerospace series, 2010

#### Assessment

Lab mark  
Paper comment mark  
Written exam mark