Course Syllabus

Department/Faculty
School of Engineering

Graduate Program
Materials Engineering and Nanotechnology

Degree
☒ Academic Master's ☒ Doctorate (PhD) ☐ Professional Master's

Course Name
Failure Analysis and Preventive Actions

Professor(s)
Prof. Jan Vatavuk, PhD.

Office hours
48

Course Overview

The main concern of the technical exposition is related to project parameters and the materials response to achieve a high product performance. The students' must be able to analyze the mechanical loading in the different applications, to select the best material and processing in order to reduce costs to improve the productivity. For this purpose a mechanical approach will be made with emphasis on metallic materials, defining elastic and plastic deformation, mechanical loading, as well as speed and temperature deformation effects. The microstructure effect on the ductile brittle impact transition temperature will be considered, as well as the fracture mechanics concepts in a wide toughness range, including ceramic materials. In order to improve learning, fracture surfaces will be analyzed in a wide range of loading conditions and materials response. The cases include examples from the literature as well as failures related to the instructor own experience.

Program content:
1 - Elastic and plastic deformation. Crystalline nature of metals. Physical Metallurgy Principles.

2 - Mechanical loading. Mohr circle.

3 – Temperature and deformation speed on materials response including notched samples.

4 - Factors influencing the fragile ductile metals behavior: Internal and external factors.

5 – Elements of fracture mechanics: crack tip plasticity of the; Design criteria. Transition temperature. Microstructural aspects of fracture toughness. The FAD curve.

7 - Systematic approach to interpretation of fractures.

8 - Fracture surfaces - Practical analysis of. Mechanisms of fracture.

9 – Toughness measurements in fragile materials.

10 - Creep and Fatigue.

11 - Practical cases.

Campus Higienópolis: *Rua da Consolação, 896 – Edifício João Calvino - 8º andar ● Consolação ● São Paulo - SP ● CEP 01302-907*
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Letter Grade Assignment
Grade A (Excellent) - Grade points between 9 and 10
Grade B (Good) - Grade points between 8 and 8.9
Grade C (Satisfactory) - Grade points between 7 and 7.9
Grade D (Unsatisfactory) - Grade points between 0 and 6.9

Texts, Materials, and supplies

ANDERSON, T. L. **Fracture Mechanics: fundamentals and applications**. 3 ed. Boca Raton: Taylor & Francis, 2005.

HERTZBERG, R. W. **Deformation and Fracture Mechanics of Engineering Materials**. 4 ed. New York: John Wiley & Sons, 1996.

JANSSEN, M.; ZUIDEMA, J.; WANHILL, R. J. H. **Fracture mechanics**. New York: Spon Press, 2004

JONES, D.R.H. (Ed.). **Failure Analysis Case Studies II**. USA: Pergamon, 2001.

VATAVUK,J.; CANALE, L. C.F. **Steel Failures due to Tempering and Isothermal Heat Treatment.** USA: ASM Failure Analysis of Heat Treated Steel Components, 2008