University of Brasilia
Graduate Program in Mechanical Sciences

COURSE INFORMATION

Program	Mechanical Sciences (53001010053P0)
Course unit	Wind Power Fundamentals
Code	PCMEC
Number	0084
Credit points	4
Professor	Antonio Cesar Pinho Brasil Junior
Prerequisites	No

OUTLINE

Objective:	This course aims to address contemporary issues related to the availability of energy for society and the sustainability of technological alternatives for conversion processes, with a specific focus on wind energy. Topics include an introduction to wind energy, atmospheric circulation and wind potential, aerodynamics of wind turbines, turbine components, and the development of wind park projects. Additionally, environmental impact studies will be explored. The course adopts a modular approach and utilizes case studies to consolidate concepts, with contributions from specialized speakers.
Purpose:	This course is designed to address contemporary challenges related to society's energy needs and the sustainability of technological solutions, particularly focusing on wind energy.
Contents:	**Module 1:** Introduction Windpower fundamentals. **Module 2:** Wind power potential and lumped system modelling Windpower potential – A simple wind speed model Wind turbine modeling. **Module 3:** Basic fluid mechanics equations. Integral balances: Mass. Momentum and energy. Navier-Stokes equations. Turbulence. **Module 4:** Momentum theory Basic concepts. Disc actuator formulation. Blade element momentum. **Module 5:** Airfoil theory Physics of airfoil flow. Airfoil databases. Flow simulation. **Module 6:** Numerical methods. BEM programming. CFD simulations. Module 7: Wake study. Fluid mechanics of turbine wakes. Modeling wake flows. **Module 8**: Wind tunnel experiments Scale analysis. Experimental approaches. **Module 9:** Design and optimization Glauert theory. Design of HAWT
Assessment	Homeworks (40%). Final project (60%) **Grades will be assigned to students based on the final grades obtained, according to the grading criteria of UnB. Cases not covered will be resolved by the discipline's professors**.
Reference:	1) KALMIKOV, A. Wind Power Fundamentals. In: Wind Energy Engineering. Elsevier, 2023. p. 23–27. 2) Burton, T., Sharpe, S., Jenkins, N., Bossanyi, E., 2001,Wind Energy Handbook, Wiley. 3) Hansen, M.O.L., 2000, Aerodynamics of wind turbines, James & James Pub. 4) A. P. Schaffarczyk, 2014, Introduction to Wind Turbine Aerodynamics , Springer. 5) Periodicals: Renewable energy. Wind energy journal. Wind energy engineering.