

AE 4070 Introduction to Propeller and Rotor Theory

Catalog Data: AE 4070 Introduction to Propeller and Rotor Theory (3-0-3).

A study of the theory and equations used in the design of propellers and helicopter rotors.

Textbook: At the level of J. Seddon: Basic helicopter Aerodynamics, AIAA 1990.

Coordinator: L. N. Sankar, Regents' Professor

Goals: To provide students an understanding of helicopter blade motion and control and a simplified performance analysis for preliminary design.

Prerequisites by Topic: AE 3021

1. Reynolds number and Mach number effects.
2. Two-dimensional airfoil theory and experimental characteristics.
3. Three-dimensional wing theory (Prandtl's lifting line approach).
4. Conservation laws for mass, momentum, and energy transport.
5. Rigid body dynamics.

Topics:

1. Outline for helicopter performance analysis with discussion of design implications and compromises.
2. Classical momentum and energy theories for an actuator disk.
3. Nondimensional variation of average induced velocity with vertical flight speed for rotors.
4. Combined axial momentum and blade element relations
5. Rotor in descent
5. Physical concepts of blade motion and rotor control.
6. Simplified forward flight analysis for preliminary design verification.
7. Overview of helicopter stability and control