AE-686, Helicopter Theory: Dynamics and Aeroelasticity
Semester - I, 2017–18
Department of Aerospace Engineering, IIT Kanpur

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Class: W, F 12:00-1:20 pm; EEM117

Course Objective

To give an introduction to the basics of rotary wing aerodynamics, flight mechanics and aeroelasticity. The fundamentals of rotary wing aeromechanics are radically different from those of fixed wing, therefore a systematic coverage of helicopter technology from the most basic concepts is essential. The content of this course would enable students to initiate research in the area of helicopter technology as well as rotary wing unmanned aerial vehicles.

Course Content

- Historical development; helicopter and VTOL configurations
- Momentum theory: hovering and axial vertical flight, forward flight
- Blade Element Theory (BET): Hover and forward flight, Blade Element Momentum Theory
- Performance estimation: power required for hover, climb, level flight, maximum level speed, speed for best endurance and range
- Rotor blade and hub idealization
- Blade flap response
- Trim analysis: coupled trim
- Uncoupled flap, lag and torsion dynamics of rotor blade
- Flap-lag, flap-pitch, lag-pitch coupling
- Introduction to coupled flap-lag, flap-torsion stability (time permits)
- Elements of helicopter stability (time permits)

References

This being a PG course there is no prescribed text. However, the following books are recommended:

1. Principles of Helicopter Aerodynamics - Gordon J. Leishman, 2nd Edition, Cambridge Aerospace Series, 2006.
2. Rotorcraft Aeromechanics - Wayne Johnson, Cambridge University Press, Apr 2013.
3. Fundamentals of Helicopter Dynamics, C. Venkatesan, CRC Press, 2014.

4. Helicopter Flight Dynamics - Gareth D. Padfield, 2nd Edition, Wiley-Blackwell, May 2008.

5. Basic Helicopter Aerodynamics, J. Seddon, 3rd Edition, Wiley, 2011.

6. Helicopter Performance, Stability and Control, R. W. Prouty, Krieger Publishing Company, Florida, 1986.

Special Emphasis

- Being able to understand the fundamentals of aerodynamics and dynamics of rotary wing.
- Ability to write simulation codes to predict the aerodynamic performance of blade under different conditions.
- Ability to develop coupled trim analysis which is backbone of any helicopter research.
- Basic ideas related to helicopter design would be highlighted at various stages.

Attendance Policy

It goes without saying that 100% attendance is compulsory. Any student who is granted leave by the Convener, DPGC also must inform the instructor regarding his/her absence. All announcements for course would be done through class email list.

Discussion / Office Hours

Anytime! Scheduling a appointment through phone / email or WhatsApps is preferred, but you are walk in to my office at anytime for discussions beyond class hour.

Grading Policy

20%	Assignments (6–8)
30%	Term project: development of coupled trim analysis
20%	Midterm exam
30%	Final exam

Note: Assignments must be submitted on the due date. Late submission and copying of assignments will be penalized.