4/4 B.Tech. EIGTH SEMESTER

AE8T3C **HELICOPTER ENGINEERING** **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 30 marks**
Tutorial: 1 periods/week **Semester end examination: 70 marks**

Objectives:

1. This course is mainly about rotary-wing aerodynamics, with applications to helicopters. The unique features of a helicopter are caused by the rotor. In a forward flight, the advancing side of the rotor will experience different loads as the retreating side of the rotor, and thus the blades must be allowed to flap and to feather.
2. Students can able to understand three ways to estimate the relationship among thrust, power requirement, and payload: Momentum theory, Blade element theory, and Vortex theory.
3. Students should be able to understand the flight operations of single rotor helicopters, and should be able to calculate the power requirement for lifting a certain payload, or thrust available for given amount of power.
4. Students should be able to assess effects of helicopter design changes and ambient conditions on the predicted thrust capabilities and power requirements.

Learning outcomes:

At the end of course the student will able to:

1. Understand various helicopter parts and its types based on rotor and anti torque rotor system, hinges, cyclic and collective pitch change
2. Learn the momentum analysis and blade element theory and their numerical. Evaluate figures of merit, profile and induces power estimation, constant chord and ideal twist rotors.
3. Analyze and power estimate in forward flight (induced, profile, parasite power) and their performance curves with altitude and basic stability and control of helicopter.
4. Study performance of VSTOL and STOL aircraft and their charecteristics.

UNIT - I

ELEMENTS OF HELICOPTER AERODYNAMICS

Configurations based on torque reaction - Jet rotors and compound helicopters.

UNIT – II

ROTOR CONTROL

Methods of control - Collective and cyclic pitch changes - Lead-lag and flapping hinges

UNIT - III

IDEAL ROTAR THEORY

Hovering performances - Momentum and simple blade element theories

UNIT – IV

ROTOR PERFORMANCE

Figures of merit - Profile and induced power estimation - Constant chord and ideal twist rotors.

UNIT - V

POWER ESTIMATES

Induced, Profile and Parasite power requirements in forward flight - Performances curves with effects of altitude.

UNIT – VI

STABILITY AND TRIM

Preliminary ideas on helicopter stability

UNIT - VII

LIFT AND CONTROL OF V/STOL AIRCRAFT

Various configurations - Propeller, Rotor ducted fan and jet lift - Tilt wing and vectored thrust - Performances of VTOL and STOL aircraft in hover, Transition and Forward motion.

UNIT - VIII

GROUND EFFECT MACHINES

Types - Hover height, Lift augmentation and power calculations for plenum chamber and peripheral jet machines – Drag of hovercraft on land and water. Applications of hovercraft

Learning resources

Text books:

1. Johnson, W., “Helicopter Theory”, Princeton University Press, 1980
2. McCormick, B.W., “Aerodynamics, Aeronautics & Flight Mechanics”, John Wiley, 1995

References:

1. Gessow, A., and Myers, G.C., “Aerodynamics of Helicopter”, Macmillan & Co., N.Y, 1987
2. McCormick, B.W., “Aerodynamics of V/STOL Flight”, Academics Press, 1987
3. Gupta. L, “Helicopter Engineering”, Himalayan books, 1996