

COURSE CODE	COURSE TITLE	L	T	P	C
1152AE122	Helicopter Theory	3	0	0	3

Course Category:

Programme Elective

a) Preamble :

This course gives knowledge about the different helicopters, its configurations and control techniques. The main focus will be on how rotor generates thrust, how it could be modelled and how pitch of the each blade is controlled for stability and control.

b) Prerequisite Courses:

Engineering Mechanics
Incompressible flow Aerodynamics

c) Related Courses:

Propeller Theory

d) Course Educational Objectives :

- To understand the Helicopter flight dynamics and control
- To familiarize with blade dynamics of a helicopter rotor.

e) Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Identify different helicopter and rotor configurations and its functions	K2
CO2	Estimate the helicopter and rotor performance in hover and vertical flight.	K3
CO3	Estimate the helicopter and rotor performance in Forward flight.	K3
CO4	Describe the helicopter rotor dynamics	K3
CO5	Explain the helicopter stability	K3

f) Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			H				H				
CO2	H			H				H				
CO3	H			H				H				
CO4	H			H				H				
CO5	H			H				H				

H- High; M-Medium; L-Low

g) Course Content :

UNIT I INTRODUCTION 9

Historical Development of Helicopters, Helicopter Configuration, Control Requirements, Types of Rotor Systems, Basic Power Requirements.

UNIT II HOVERING & VERTICAL FLIGHT THEORY 9

Momentum Theory, Blade Element Theory, Combined Blade Element and Momentum theories for non-uniform inflow calculation, Blade twist-linear, Ideal & Optimum twist, Momentum theory for vertical flight, Autorotation, Ground effect.

UNIT III FORWARD FLIGHT THEORY 9

Momentum Theory, Variable In-flow Models, Blade Element Theory, Rotor Reference Planes, Hub Loads, Power variation with forward speed, Rotor Blade flapping Motion.

UNIT IV TRIM AND ROTOR BLADE DYNAMICS 9

Helicopter Trim, Isolated flap dynamics in uncoupled mode, Pitch-Flap coupling, Pitch-Lag coupling, Flap-Lag coupling, Isolated lag dynamics in uncoupled mode, Isolated torsional dynamics in uncoupled mode, Coupled Flap-Lag dynamics.

UNIT V STABILITY AND CONTROL 9

Static stability – Incidence disturbance, forward speed disturbance, angular velocity disturbance, yawing disturbance, Dynamic Stability.

Total : 45 Hrs

h) Learning Resources

i. Text Books :

1. C. Venkatesan, “Fundamentals of Helicopter Dynamics”, CRC Press publication

ii. Reference:

1. A. R. S. Bramwell, George Taylor Sutton Done, David Balmford , “Bramwell's Helicopter Dynamics”, Butterworth-Heinemann