

# GUJARAT TECHNOLOGICAL UNIVERSITY

## AERONAUTICAL ENGINEERING HELICOPTER ENGINEERING

SUBJECT CODE: 2180108

**B.E. 8 SEMESTER**

**Type of course:** Theoretical

**Prerequisite:** Aircraft Design, Aircraft Science

**Rationale:** The aerodynamics of a rotary wing aircraft differs significantly from that of a fixed wing aircraft and it is important to study this variation to understand the working of a helicopter. The physics and underlying theories required to be studied before actually embarking upon the design of a helicopter are included within this content.

### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	0	3	70	20	10	0	0	0	100

### Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<b>Introduction:</b> Chronological development, Types of main rotor configurations, Types of helicopters	<b>03</b>	<b>10</b>
2	<b>Fundamentals of Rotor Aerodynamics:</b> Introduction, Disc loading, Power loading, Induced inflow ratio, Thrust and Power coefficients, Figure of Merit, Rotor solidity, blade loading coefficients, Blade lock number	<b>06</b>	<b>10</b>
3	<b>Momentum Analysis:</b> Introduction to hover, axial climb and descent, forward flight	<b>08</b>	<b>20</b>
4	<b>Blade element Analysis:</b> Introduction to hover, axial climb and descent, forward flight	<b>09</b>	<b>20</b>
5	<b>Basic helicopter Performance:</b> Hovering and axial climb performance, forward flight performance: Induced power, blade profile power, parasitic power, climb power, Tail rotor power, Total power	<b>04</b>	<b>20</b>
6	<b>Conceptual design of helicopters:</b> Introduction, Design requirements, Design of main rotor: rotor diameter, tip speed, rotor solidity, number of blades, blade twist, blade planform and tip shape, airfoil sections	<b>05</b>	<b>10</b>

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25%	30%	10%	20	15	0%

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

1. Helicopter Performance, Stability, and Control Raymond Prouty Krieger Publishing Company
2. Principles of Helicopter Aerodynamics J. Gordon Leishman, Cambridge University Press

### Course Outcome:

After learning the course the students should be able to:

1. Understand the significance of replacing existing metal structures with composite materials wherever beneficial
2. Highlight the appropriate use of composite structures in the industry
3. Comprehend the complexity of design of composite materials and structures
4. Mainly understand the mechanics of composite materials

**List of Open Source Software/learning website:** <http://nptel.ac.in/>

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be submitted to GTU.

1. Chronological development of helicopters
2. Chronological development of engine in helicopters
3. Axial flow states of helicopter
4. Blade element analysis in forward flight
5. Blade element analysis in hover and axial flight
6. Momentum analysis in hover and axial flight
7. Momentum analysis in forward flight
8. Conceptual design of main rotor
9. Making of a innovative hovering model
10. Performance of helicopters
11. Types of airfoils used in helicopter main rotor
12. Differences between main rotor and tail rotor
13. Autorotation and Ground Effect
14. Blade vortex interaction
15. Working and mechanism of Swashplate