GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3170113
Semester –VII
Subject Name: Helicopter Engineering

Type of course: Professional Elective

Prerequisite: Fundamentals of Aeronautical Engineering, Aerodynamics, Flight Mechanics, Aircraft Structure etc.

Rationale: Helicopters are widely used in civil and military aviation sectors nowadays for utility, surveillance, air lift- rescue, attack, agriculture, recreational purposes. This course imparts fundamental knowledge regarding principles, operation and helicopter flight mechanics.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs
1	**Types of Rotorcraft Systems:** Types of Rotorcraft- Auto gyro, Gyrodyne, Helicopter- Main Rotor system- Features of fully articulated rotor system- Features of semi rigid rotor system, Features of Rigid Rotor systems, Transmission Systems, Main rotor drive systems, Tail rotor drive systems, Helicopter Controls, Collective and Cyclic Pitch Controls, Anti Torque pedals, Throttle Controls.	7
2	**Helicopter Aerodynamics:** Blade Twist, Effect of Centre of Pressure, Forces acting upon main rotor blades in rotation, Variation of Lift, Lift Dissymmetry, Lateral Flapping, Effect of Flapping, Coriolis Forces and the Drag Hinge, Rotor Lift, Reaction Torque, Compressibility Effects, Air Flow through rotors, Translational Lift, Transverse Flow effect, Ground Effect.	6
3	**Helicopter Performance:** Power requirements, Induced Power, Profile Power, Parasite Power, Total Power, Effect of Wind, Effects of High Density Altitude, Effects of weight, Effects of High Density Altitudes, Take off and Landing performance, High performance take off, Limiting High Speed Envelope (Deadman's curve) Auto rotation, Anti Torque system failure, Settling with power, Limitations of rotor rpm, Retreating blade stall.	7
4	**Stability and Control:** Trim, Hower Trim, Trim in forward flight, Damping, Static Stability: Speed stability, Angle of attack stability, Static Directional stability, Directional stability, dihedral effect, Side force, Contribution of horizontal stabilizer,	7

	Determination of stability characteristic through flight test, Speed stability, angle of attack stability, Directional stability, Dynamic stability: Hovering dynamic stability, Forward speed dynamic stability, Directional stability, Stability augmentation system.	
5	**Strength and Design requirements:** V-N Diagram, Maneuvering loads, Side Slip Envelope, Load factor during Bank, Rotor structure, Ground loads, Vibrations- Low, Medium and High frequency vibration, Service Life, Corrosion, Creep Fatigue, Structural Materials, Parameters influencing the main rotor design, Rotor efficiency, Rotor Thrust, Power available to main rotor, Parameters influencing main rotor design.	**7**
6	**Transmission systems:** Spur Gear, Helical Gear, Bevel Gear, Hypoid Gears, Warm Gears, Epicycle or Planetary gear train, Pinion Clutch, Centrifugal clutch, Friction or Belt drive clutch, Freewheeling Unit, Rotor brake, Tail Rotor System.	**6**
7	**Weight and Balance:** Weight Limits, C.G. Limits, Effects of too far forward C.G. Effects of too far aft C.G. Movement, Weighing of Helicopter, Landing of Helicopter	**5**
	Total Hours	**45**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20%	**20%**	**40%**	**-**	**-**	**20**

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 Engineering by Mr. Lalit Gupta – Himalayan Books
2. Principles of Helicopter Aerodynamics J. Gordon Leishman, Cambridge University Press
3. Helicopter Performance, Stability, and Control Raymond Prouty Krieger Publishing Company
4. Helicopter Maintenance, By Joseph Schafer, By Avotek- (Aviation Training Text Book)

Course Outcomes:

Upon completion of this course students should be able to:

Sr. No.	CO statement	Marks % weightage
CO1	Comprehend and explain aerodynamics and various types of components of helicopters.	30%

CO2	Obtain basic knowledge of Helicopter operations, performance and controls.	30%
CO3	Obtain basic knowledge of helicopter design requirements.	20%
CO4	Demonstrate the transmission systems and balancing of helicopters.	20%

List of Open Source Software/learning website:
https://nptel.ac.in/