Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER–VIII • EXAMINATION – SUMMER • 2014

Subject Code: 180102 Date: 31-05-2014

Subject Name: Helicopter Engineering

Time: 10.30 am – 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Describe the considerations to be made while deciding an airfoil for a helicopter rotor. Starting from the fundamentals explain the concept of boundary layer along with neat sketches.	**07**
	(b)	Discuss the advantages/disadvantages of momentum and blade element theory. Derive equations for hover and axial flight using blade element theory in with a neat and labelled sketch of the forces/velocities acting on the blade.	**07**
Q.2	**(a)**	Describe main rotor configurations. Explain using a schematic the working principles of all these helicopters.	**07**
	(b)	How many degrees of freedom does a blade have? Explain steady state and write equations for all the degrees of freedom explaining each term with its physical significance.	**07**
		OR	
	(b)	Explain the behavior of power vs. forward speed for the main rotor of the helicopter. Discuss different types of power.	**07**
Q.3	**(a)**	Write a short note on: (1) Autorotation (2) Coriolis force	**07**
	(b)	Describe the types of stall and also draw the relevant sketches.	**07**
		OR	
Q.3	**(a)**	Using momentum theory, derive the equations for axial flight	**07**
	(b)	Using blade element theory, derive the equations for forward flight.	**07**
Q.4	**(a)**	1. Prove that wake velocity is twice the induced velocity 2. Describe Disk loading and power loading	**07**
	(b)	1. Explain the variation of lift blade from root to tip for a helicopter rotor blade 2. What is the function of a tail rotor, describe the alternatives of a tail rotor	**07**
		OR	
Q.4	**(a)**	1. Explain all the major differences in aerodynamic environment between a fixed wing and a rotary wing aircraft 2. Describe reverse flow region	**07**
Q.4	**(b)**	1. Describe Collective and cyclic pitch with sketches 2. Explain velocity distribution in forward flight and hover	**07**
Q.5	**(a)**	Describe in detail momentum theory in forward flight	**07**

	(b)	1.	Find out advance ratio and inflow ratio of a 4 bladed helicopter rotor weighing 25,000 kg and rotating at 360 rpm moving forward at 65m/sec and having a radius of 12m. Assume the angle of attack of 10 degrees. For the calculations use the induced velocity for hover (To be calculated using momentum theory)	**04**
		2.	Define these: 1. Solidity 2. Lock number 3. Advance ratio	**03**

OR

Q.5	**(a)**		Explain the types of a helicopter main rotor and further describe in detail about each of this type.	**07**
	(b)	1.	Mention the causes of high stresses and moments towards the blade root. Suggest the changes to reduce these stresses and moments.3	**04**
		2.	Describe all major differences between a utility and a combat helicopter	**03**

****