Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VIII • EXAMINATION – SUMMER 2015

Subject Code: 180102   **Date:07/05/2015**
Subject Name: Helicopter Engineering
Time:10:30 am to 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)** State the assumptions of blade element theory. Describe in detail blade element theory in hover with a neat sketch of the forces/velocities acting on the blade. Derive the coefficient of thrust. **07**

    (b) Sketch the velocity distribution over helicopter rotor in hover and forward flight. List and explain all the problems occurring in the helicopter due to such a velocity distribution. **07**

Q.2 **(a)** Describe the flow patterns in axial flight with sketches, graph and its explanation **07**

    (b) Explain the differences between requirements of an airfoil to be used in a helicopter rotor and an airplane. List the requirements of an airfoil of a helicopter rotor. Describe the concept of boundary layer on an airfoil surface. **07**

<div align="center">OR</div>

    (b) Describe momentum theory in hover and axial climb along with all its assumptions and a neat sketch **07**

Q.3 **(a)** 1. Explain the major differences between a transport helicopter and a utility helicopter **07**
        2. Explain Reverse flow region

    (b) Define and explain: **07**
        1. Advance ratio   2. Inflow ratio

<div align="center">OR</div>

Q.3 **(a)** Define the following: **07**
        1. Solidity
        2. Lock Number
        3. Disk loading
        4. Power loading
        5. Root-cutout
        6. Figure of Merit
        7. Downwash

    (b) Using momentum theory, describe forward flight and derive all the equations **07**

Q.4	**(a)**	Explain the behavior of power vs speed for a helicopter rotor.	**07**
	(b)	List and explain different main rotor configurations and explain their advantages and disadvantages. Draw a schematic of all these main rotor configurations and give suitable examples	**07**

OR

Q.4	**(a)**	Explain the steps of conceptual design of helicopter main rotor	**07**
Q.4	**(b)**	Write a short note on:	**07**

1. Degrees of freedom of a blade, explain what is steady state
2. Ground Effect

Q.5	**(a)**	Derive the equation for C_T using blade element theory.	**07**
	(b)	1. Explain Coriolis force & 2. Pre-twist in rotor blades	**07**

OR

Q.5	**(a)**	Explain the types of stall in an airfoil of a helicopter rotor blade	**07**
	(b)	Evaluate C_T and C_Q for a hovering helicopter weighing 10,000 kg at 65 percent radial station. The diameter of rotor is 10m. The four-bladed rotor is rotating at a speed of 380 rpm. Chord is 0.3m and NACA 0012 airfoil is used. Assume suitable data for evaluation.	**07**

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