GUJARAT TECHNOLOGICAL UNIVERSITY
BE- VIIIth SEMESTER–EXAMINATION – MAY- 2012

Subject code: 180102   **Date: 12/05/2012**

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)** Explain in detail the significance of velocity distribution in forward flight. **07**
Sketch the maximum velocity attained over a rotor in forward flight by
assuming suitable numbers for parameters required for calculating the
maximum velocity.

(b) Justify whether true or false, do not state without justification. **07**
1. Blade vortex interaction is higher for higher number of blades
2. Pre-twist eliminates retreating blade stall
3. Higher the advance ratio, higher is the forward speed
4. Tip weights in rotor blades help in increasing the frequency
5. In a co-axial rotor, both the rotors rotate at the same speed
6. Induced velocity is twice as that of the wake velocity
7. Root-cutout is provided to make the blade lighter

Q.2 **(a)** 1. Define induced velocity and disc loading and prove that induced velocity **04**
depends upon disc loading.
2. A 3-bladed rotor has a blade chord of 2m. For such a rotor if the solidity **03**
is restricted to 0.09, find out the radius of the rotor blade.

(b) Explain airfoil stalls in detail with all the relevant sketches. **07**

OR

(b) Derive lift, drag, power and torque using blade element theory. Labelled **07**
sketches are compulsory.

Q.3 **(a)** 1. Write a short note on Ground resonance and Coriolis force? **04**
2. List all the characteristics of an airfoil for a rotor. **03**

(b) 1. Describe autorotation in detail. **04**
2. As a designer what steps can be taken to delay compressibility effects **03**

OR

Q.3 **(a)** Describe conceptual design of a helicopter in detail. **07**

(b) 1. Explain the airfoil selection process. Indicate using a diagram/figure the **04**
maximum lift coefficient obtained for various airfoils. Explain the effect
of droop nose.
2. What is ideal power? State the equation. Would disc loading affect ideal **03**
power?

Q.4 **(a)** Explain in detail the flow states over a rotor in vertical flight. Draw all the **07**
necessary figures.

(b) 1. Explain the effect of pretwist in rotor blades, mention the range and also **04**
draw the variation.
2. Explain Figure of Merit. State the equation. Would disc loading affect **03**
Figure of Merit?

OR

Q.4 **(a)** Explain the aerodynamic environment over a rotor in forward flight; indicate all **07** the important parameters and regions in a labeled sketch. Also draw the distribution of angle of attack over the rotor disk in forward flight.

(b) Explain steady state motion. How many degrees of freedom does a blade have **07** and which are they? Write their equations. Which degree of freedom is used to balance the forces in forward fight due to velocity distribution? Explain the phenomenon in detail.

Q.5 **(a)** Explain momentum theory and list all the assumptions. Derive the equations for **07** climb using relevant sketches.

(b) Discuss and derive the equations for forward velocity with all relevant sketches. **07**

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

Q.5 **(a)** Explain momentum theory and list all the assumptions. Derive the equations for **07** descent using relevant sketches.

(b) Describe the power consumption in a helicopter in detail along with all relevant **07** sketches.

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