Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

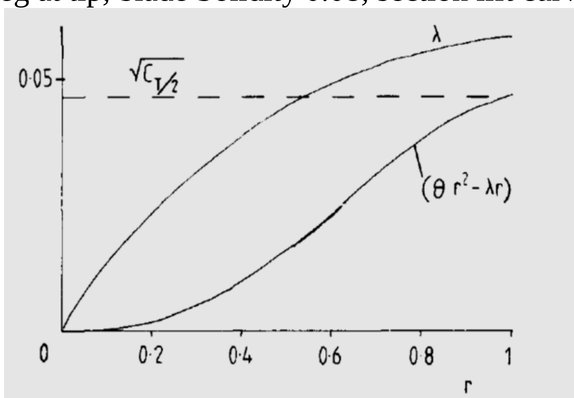
Course : Helicopter Engineering **Semester: VII**
Programme : B.Tech ASE **Time: 03 hrs.**
Course Code: ASEG 4007 **Max. Marks: 100**
Instructions : Provide neat sketch(s)

S. No.		Marks	CO
	SECTION A (20 MARKS)		
Q 1	Explain the *articulated rotor hinge* system of Helicopter.	**4**	**CO1**
Q 2	Show that rotor *induced velocity* is half of *free stream* velocity in hover	**4**	**CO2**
Q 3	Define *Figure of Merit* term for Helicopter.	**4**	**CO3**
Q 4	Derive equation for flapping motion of rotor blade.	**4**	**CO4**
Q 5	How *shock absorbers* function in Helicopter?	**4**	**CO5**
	SECTION B (40 MARKS)		
Q 6	Explain different flight control mechanism of Helicopter.	**10**	**CO1**
Q 7	Show that inflow factor for rotor in forward flight is given by $$\lambda = \frac{V \sin \alpha_r + v_i}{\Omega R}$$ Where α_r is angle of tip path plane with incoming flow.	**10**	**CO2**
Q 8	Derive expressions for flapping coefficients in Helicopter rotor.	**10**	**CO3**
Q9	What are different factors affecting stability of Helicopter. Explain them briefly.	**10**	**CO4**

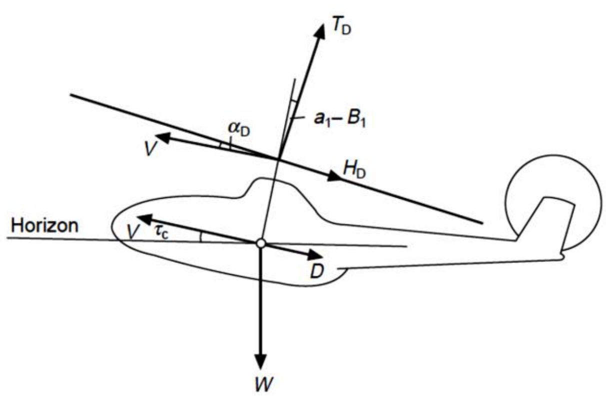
<table>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 10</td><td>Show that helicopter rotor thrust coefficient is given by

$$C_T = \frac{1}{2}\sigma a\left[\frac{1}{3}\theta - \frac{1}{2}\lambda\right]$$

Calculate thrust coefficient of rotor for three-quarter of radius with blade twist of 12 deg at root and 6 deg at tip, blade Solidity 0.08, section lift curve slope 5.7/rad, and



</td><td>20</td><td>CO2</td></tr>
<tr><td></td><td>or</td><td></td><td></td></tr>
<tr><td></td><td>Derive the longitudinal trim equation and trim angle of attack expression of Helicopter as shown below:



Calculate the trim angle of attack of four bladed helicopter in level flight at sea level at tip speed ratio 0.35. The Helicopter is represented by following data:

W = 45 000 N, solidity s = 0.05, R = 8 m, h = 0.25

δ = 0.013, ΩR = 208 m/s, S_{FP} = 2.3 m^2, b = 4, a = 5.7

Blade data: M_b = 74.7 kg; in terms of R, x_g = 0.45, e = 0.04</td><td>20</td><td>CO3</td></tr>
<tr><td>Q 11</td><td>Derive the non-dimensional longitudinal dynamic stability equation of Helicopter longitudinal motion.</td><td>10</td><td>CO4</td></tr>
<tr><td></td><td>Compare the Active and passive methods of vibration control in Helicopter.</td><td>10</td><td>CO5</td></tr>
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