Name: **Enrolment No:**	UPES

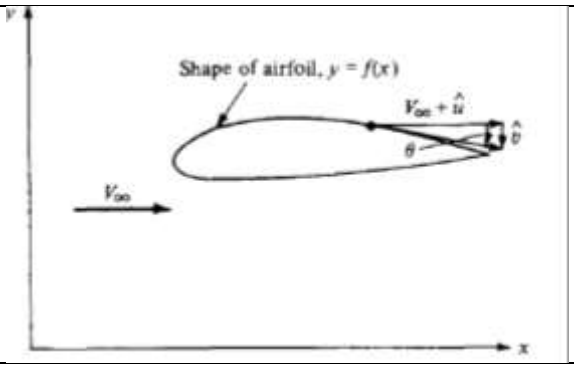
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Aerodynamics II (ASEG 3003) **Semester: V**
Programme: B.Tech ASE and B.Tech ASE+AVE
Time: 03 hrs. **Max. Marks: 100**
Instructions: Assume missing data, if any, appropriately.
Use sketches to justify your answer wherever required.

SECTION A

S. No.		Marks	CO
Q 1	Boeing 767 uses Supercritical airfoil initially developed by R. Whitcomb. Define its significance over conventional NACA airfoils.	**04**	**CO4**
Q 2	A monoplane weighing 84685 N has elliptic wing of span 16 m. When it flies at 328 km/h at sea level, determine the circulation around a section halfway between the wing root and the wing tip.	**04**	**CO3**
Q 3	Explain briefly about Whitcomb's Area Rule for fuselage shape.	**04**	**CO4**
Q 4	Consider a thin flat plate at 3-degree angle of attack. Calculate the: (a) lift coefficient, (b) moment coefficient about leading edge, (c) moment coefficient about the quarter chord point.	**04**	**CO2**
Q 5	Beechcraft model 18 the twin jet transport aircraft, for this airplane the zero-lift angle of attack is -2.1 degree, the lift slope of the airfoil section is 0.1 per degree, the lift efficiency factor $\tau = 0.06$, and the wing aspect ratio is 12. Airplane is cruising at a lift coefficient equal of 0.27. Calculate the angle of attack of airplane?	**04**	**CO3**
SECTION B			
Q 6	Transform a circle of radius *a* with the centre in the *z*-plane located on the *x*-axis, to an ellipse using Kutta−Joukowski transformation function: $$\zeta = z + \frac{b^2}{z}$$ Also, find an expression for fineness ratio of the transformed ellipse.	**10**	**CO1**

Q 7	Derive the relation for lift coefficient and lift slope for a cambered airfoil based on classical thin airfoil theory.	**10**	**CO2**
Q 8	The measured lift slope for the NACA 24012 airfoil is 0.1132 degree^{-1}, and $\alpha_{L=0}$= -1.4 degree. Consider a finite wing using this airfoil, with AR=10 and taper ratio = 0.9. Assume that $\delta = \tau$. Calculate the lift and induced drag coefficients for this wing at geometric angle of attack = 7 degree. **OR** Explain how the finite wing lift curve slope differs from that of an airfoil. Thus, derive a relation between the lift curve slope of a finite wing and airfoil.	**10**	**CO3**
Q 9	Explain Prandtl-Glauert Compressibility Correction. At a given point on the surface of an airfoil, the pressure coefficient is -0.3 at very low speeds. If the freestream Mach number is 0.6, calculate C_p at this point.	**10**	**CO4**
	SECTION-C		
Q 10	Explain the term conformal transformation. Apply the transformation formulae to transform a circle into a symmetrical airfoil. **OR** Analyze the complex potential function (w) for the following flows: (i) Uniform flow (U) in the direction of negative Ox axis. (ii) Point vortex with circulation (K) at the origin. (iii) Doublet of strength μ, at the origin in the direction of positive Ox axis.	**20**	**CO1**
Q 11	Applying Prandtl-Glauert Compressibility correction, find out the value centre of pressure Cp, coefficient of lift Cl and coefficient of moment Cm for the airfoil shown in below figure,	**20**	**CO4**

		 y Shape of airfoil, $y = f(x)$ $V_\infty + \hat{u}$ $\hat{v}$ θ V_∞ x			

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