Reg.No. _____

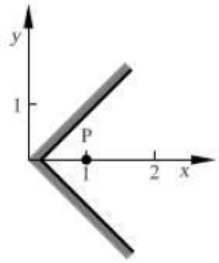
Karunya UNIVERSITY

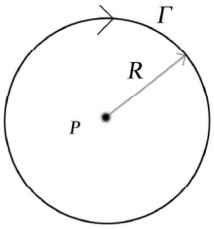
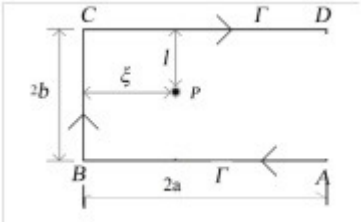
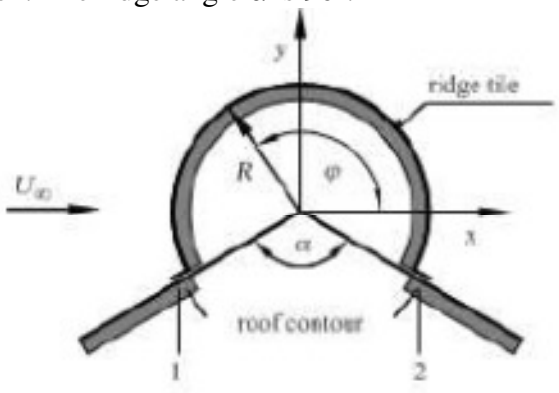
(Karunya Institute of Technology & Sciences)
(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

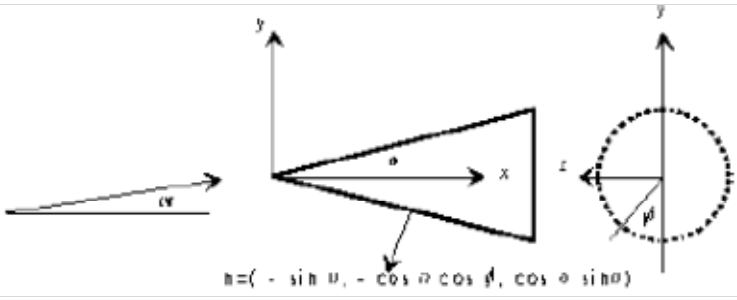
End Semester Examination – Nov/Dec – 2016

Code : 14AE3006 | **Semester : 2016-17 ODD**
Sub. Name : Advanced Aerodynamics | **Duration : 3hrs** | **Max. marks : 100**

ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)

Q. No.	Sub Div.	Questions	Course Outcome	Marks
1.	a.	For the 3D flow with velocity components given by $v_y = \frac{y}{(x^2+y^2+z^2)^{\frac{3}{2}}}$ and $v_z = \frac{z}{(x^2+y^2+z^2)^{\frac{3}{2}}}$. i. Find missing velocity component ii. Find whether flow is rotational or Irrotational.	CO 1	1 2 8
		(OR)		
2.	a.	For two-dimensional incompressible flow in cylindrical polar coordinates (r, θ), the radial velocity is given by $v_r = \frac{3}{2} A r^{\frac{3}{2}} \cos\left(\frac{3\theta}{2}\right)$. i. Find the circumferential velocity v_θ ii. Find the stream function iii. Find whether flow is rotational or irrotational.	CO 1	8 7 5
3.	a.	The steady irrotational two dimensional flow of an incompressible fluid along an inside corner has velocity components $u = 2\,\alpha\, x\, y$ and $v = \alpha(x^2 - y^2)$ with $\alpha \geq 0$. The boundary of semi-infinite flow field is given by the two straight lines $y = \frac{1}{\sqrt{3}}\, x$ and $y = -\frac{1}{\sqrt{3}}\, x$ for $x \geq 0$.  i. How many stagnation points are there in the flow field. State their coordinates. ii. Determine the equation y = f(x) of the streamline that passes through the point P1 (1,0). iii. Consider another point P2 with x = 2 on the same streamline that passes though point P1. How much time Δt elapses as the fluid element moves along this streamline from P1 to P2?	CO 2	5 6 9
		(OR)		
4.	a.	For a vector field defined as $\vec{F} = (x+y)\vec{i} + (x^2 - y)\vec{j}$. i. Find the circulation about unit square with bottom left corner at origin. ii. Find the along the sides of square described by x=±2 and y=±2.	CO 2	1 0 1 0

5.	a.	A two dimensional flow field is described by velocity components u= ax and v = - a y(a is positive constant). i. Find the streamlines of the flow field. ii. What is the rotation ω of the flow field? iii. A dust particle with no mass is placed at time $t=t_o$ on the point (x_o, y_o). iv. At what time t_e the particle reaches point (x_e,y_e) of the streamline.	CO 1	 6 5 5 4
		(OR)		
6.	a.	Find the velocity induced by the line vortex in the form of a circle as shown below at its centre. 	CO 2	1 0
	b.	Find the velocity induced by the line vortex in the form of a horseshoe as shown below at the point P. 	CO 2	1 0
7.	a.	A model to describe the inviscid flow past the ridge of a roof is obtained by superimposing a flow with velocity U past a circular cylinder of radius R on the flow of a potential vortex. The ridge angle α is 90^o.  i. What circulation Γ of the potential must be chosen to correctly model the inviscid flow past the ridge? ii. What is the force acting on the ridge if the pressure of the flow below the ridge is p_∞ and the depth of the ridge is unity.	CO 2	 1 2 8
		(OR)		
8.	a.	Prove using Euler equations and shock relations that for Hypersonic flow, Mach number independence principle holds.	CO1	2 0
		Compulsory:		
9.	a.	Consider a sharp cone with half cone angle θ at an angle of attack α. Using Modified Newtonian theory, determine i. Axial Force coefficient ii. Normal force coefficient	CO 2	 1 0 1 0

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