



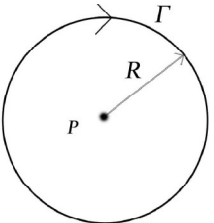
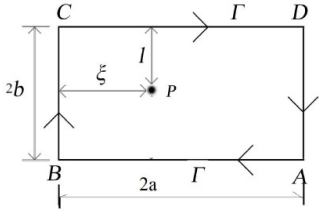
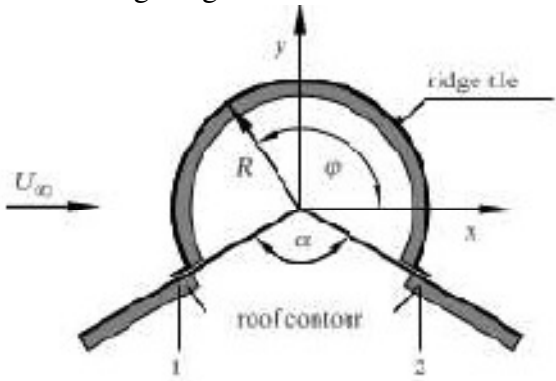
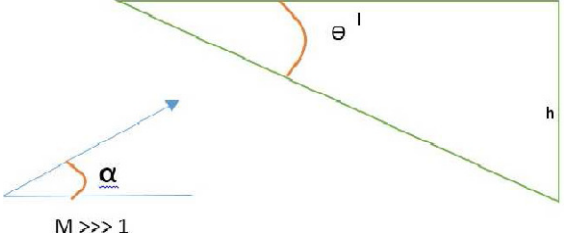
End Semester Examination – Nov/Dec – 2016

Code : 14AE3006
Sub. Name : Advanced Aerodynamics

Semester : 2016-17 ODD
Duration : 3hrs
Max. marks : 100

ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)

Q. No.	Sub Div.	Questions	Course Outcome	Marks
1.	a.	Consider the velocity field given by $u = x^2 - 2xy \cos y^2$. i. Find v-component of velocity so as to satisfy incompressible flow continuity equation for 2D incompressible flow field. ii. Find Stream function for flow field. iii. Find Vorticity for the flowfield.	CO 1	1 0 5 5
(OR)				
2.	a.	A gap of length l and time dependent height $h(t)$ is filled with incompressible fluid. The upper surface moves downward with constant velocity V_0 . The velocity distribution at the exit is given by $u(y) = U \frac{y}{h}$ i. Determine the gap height $h(t)$ for $h(t=0) = h_0$ ii. Calculate the maximum velocity U_0 at the exit of the gap	CO 1	5 1 5
3.	a.	A sink of strength $20\pi \frac{m^2}{s}$ is located 3m upstream of source of strength $40\pi \frac{m^2}{s}$. The combination is placed in uniform velocity field along the line joining the source and sink. It is noted that at a point 2.5m equidistant from both source and sink, the velocity is normal to the line joining source and sink. i. Find the velocity of Uniform flow field. ii. Find the velocity at the point mentioned above.	CO 2	1 0 1 0
(OR)				
4.	a.	A flow field has the velocity field given by $\vec{V} = (U + s y) \vec{i}$ where U and s are constants. i. Find the circulation about unit square with bottom left corner at origin. ii. Find the circulation around unit circle centred at origin. iii. Find the circulation about the ellipse with major axis of length 2 and minor axis of length 1 unit. The ellipse is centred at the origin..	CO 2	6 6 8
5.	a.	A two dimensional flow field is described by velocity components $u = ax$ and $v = -ay$ (a is positive constant).	CO 1	

		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 $t=t_0$ on the point (x_0, y_0) . iv. At what time t_e the particle reaches point (x_e, y_e) of the streamline.		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 rectangle as shown below at its centre. 	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 120° . 	CO 2	
		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.		1 2 8
(OR)				
8.	a.	What are the flow features which distinguish hypersonic flow from supersonic flow?	CO1	2 0
Compulsory:				
9.	a.	A half cone as depicted in the figure below can be used as lifting body. Evaluate Normal Force Coefficient C_N and Axial Force Coefficient C_A as function of angle of attack α for hypersonic flow using Modified Newtonian relation. 	CO 2	2 0

ALL THE BEST