Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth semester B.Tech examinations (S), September 2020

Course Code: AO202

Course Name: AERODYNAMICS I

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks. Marks

1 a) Define vorticity and its value in rotational and irrotational flow? (3)

b) Consider a velocity of flow in an incompressible flow field is given by $u = y/(x^2 + y^2)$ and $v = -x/(x^2+y^2)$. Calculate the vorticity and identify what type of flow? (7)

2 a) A fluid flow is given by its velocity $V= 16x^3i - 20x^2y$. Find shear strain rate and state prove that the flow exist and is a rotational flow (10)

3 a) Is the stream lines and equipotential lines are orthogonal? Prove your statement. (5)

b) Derive the expression for velocity potential (ϕ) and stream function (ψ) for source and sink. And hence prove stream lines are straight lines and equipotential lines are circles. (5)

4 a) Consider a velocity field is where the x and y component of velocity are given by $u = cy/(x^2 + y^2)$ and $v = -cx/(x^2+y^2)$.Obtain the equation for stream line. (7)

b) Derive the equation of stagnation streamline for the combination of source-sink pair in a uniform flow and with neat sketch. (3)

PART B

Answer any three full questions, each carries 10 marks.

5 a) Magnus effect creates the aerodynamic forces over body. Justify the statement. (4)

b) Define Kutta condition with the help of a diagram? Apply the Kutta condition for an airfoil with cusped and finite angle trailing edge? (6)

6 "The pressure distribution over the top of the right circular cylinder is exactly balanced by the pressure distribution over the bottom of the cylinder". Which elementary flow combination contribute this effect. Derive the value of stream function and coeffient of pressure. Plot the graph between c_p and θ. Also calculate the points at which the static pressure is equal to free stream static pressure. (10)

7	a)	Explain Kutta Joukowski transformation.	(2)
	b)	Transform a right circular cylinder into a symmetrical airfoil by using Kutta Joukowski transformation. Also find maximum thickness to chord ratio.	(8)
8	a)	Derive Cauchy – Riemann relation.	(5)
	b)	Transform a uniform flow parallel to x axis, using the transformation formula $\xi = z^2$? Also draw the diagram.	(5)

PART C

Answer any four full questions, each carries 10 marks.

9	a)	State Biot Savarts law and derive an expression for the velocity induced by an infinite vortex filament at a point, which is at distance P from the filament. Also derive an expression for semi-infinite case.	(10)
10	a)	Derive an expression for fundamental equation of Prandtl's lifting line theory.	(10)
11	a)	Explain the starting vortex, bound vortex, horseshoe vortex and trailing vortex with neat sketches.	(10)
12	a)	Derive the boundary layer equation for a steady two dimensional incompressible flow.	(10)
13	a)	Derive the Blasius solution for an incompressible flow over a flat plate.	(10)
14	a)	Define and derive an expression for momentum and energy thickness.	(7)
	b)	Discuss the significance of Reynolds number in flow analysis. Also define Critical Reynolds number	(3)

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