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B. Tech Aerospace Engg. (Semester – 3rd)
AERODYNAMICS
Subject Code: BASES1302
Paper ID: [19113003]

Time: 03 Hours **Maximum Marks: 60**

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A **(2 marks each)**

Q1. Attempt the following:

a) Define the term "Viscosity". Show its dependence on temperature for liquids as well as for gases.

b) How streaklines are different from streamlines?
c) State the concept of velocity divergence.
d) Enlist various Application of momentum equation.
e) What is the significance of velocity potential function and stream function?
f) State the principle of superposition.
g) What is boundary layer? Also state its' significance in aerodynamics.
h) What is the cause of skin friction drag?
i) Differentiate the Newtonian and Non-Newtonian fluids with reference to properties.
j) What is the consideration to apply Bernoulli's equation on real fluids.

Section – B **(5 marks each)**

Q2. The velocity potential for a two-dimensional potential flow is given by $\phi = x(2y - 1x)$. Determine (i) The velocity at point P (1, 5) and (ii) The value of stream function y at the point P.

Q3. Derive Bernoulli's equation for real fluids.

Q4. Discuss the limitations of Prandtl's Boundry Layer Theory.

Q5. An airfoil is moving in the air with a speed of 50 m/s, air density at sea level being 1.225 kg/m3, and a circulation of 200 m2/s around the moving body. Find the lift using the Kutta Joukowski Theorem. Also indicate the direction of lift.

Q6. Find out whether the flow in a pipe having a diameter of 20 mm, fluid velocity of 2.5 m/s, 900 kg/m^3 as the relative density and the viscosity of the fluid as 0.4 Ns/m^2, the flow is laminar or turbulent

Section – C **(10 marks each)**

Q7. Derive Euler's equation of motion in Cartesian coordinates.

Q8.

a) Determine the area of the region R on *xy* plane bounded by the curves $y = x+2$ and $y = x^2$ by evaluating a double integral.

b) Calculate the volume of the solid below the surface defined by the function $f(x,y) = 4+\cos x + \cos y$, above the region R on the *xy* plane $(z = 0)$, bounded by the curves $x = 0$, $x = \pi$, $y = 0$ and $y = \pi$ by evaluating a double integral.

Q9. Discuss the Buckingham-pi theorem of dimensional analysis.