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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 ψ 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/m³ as the relative density and the viscosity of the fluid as 0.4 Ns/m², 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.