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B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester:III**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 19AE3DCAFM **Max Marks: 100**
Course: Aero Fluid Mechanics **Date: 19.09.2023**

Instructions: 1. Answer any five questions choosing one full from each unit.
2. Missing data, if any may suitable assumed
3. Sketch the figures wherever necessary.
4. Use of logarithmic tables and scientific pocket calculator is allowed

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1. a) Define the following terms with an example: 6
   i. Surface tension,
   ii. Cavitation,
   iii. Center of pressure,
   iv. Center of buoyancy.

   b) Derive the expression for total pressure and center of pressure for an inclined plate submerged in liquid. 7

   c) A wooden cylinder of sp.gr. 0.6 and circular cross section is required to float in oil of sp.gr. 0.9. Find the L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the length of cylinder and D is its diameter. 7

UNIT - II

2. a) Briefly distinguish the stream line, streak line, path line and time lines. 6

   b) Derive the expression for the total acceleration of a fluid particle. 7

   c) In a 2D incompressible flow, fluid velocity vector is given by $\boldsymbol{V} = 3x\boldsymbol{i} - 3y\boldsymbol{j}$, Find the equation of stream line passing through (1,1). 7

OR

3. a) State the governing equations of fluid kinetics with neat sketch of a fluid element. 9

   b) For a the steady, 2D incompressible velocity field $\boldsymbol{V} = a\,(x^2 - y^2)\,\boldsymbol{i} - 2axy\,\boldsymbol{j}$, determine the resulting pressure distribution when z direction is "up" 11

UNIT - III

4. a) Derive an expression for Euler's equation of motion along the stream line. 6

   b) Write the procedure for using Buckingham's Pi Theorem 5

   c) The pressure drop in an Aero plane model of size 1/10 of its prototype is 80 N/cm^2. The model is tested in water (viscosity 0.01 poise). Find the corresponding pressure drop in the prototype. Take density and viscosity of air as 1.24 kg/m^3 and 0.00018 poise respectively. 9

UNIT - IV

5. a) Derive the Hagen – Poiscuille head loss expression for flow in circular pipes. 12

   b) Find the displacement, energy and energy thicknesses for a velocity distribution in the boundary layer given by $\frac{u}{U}=\frac{y}{\delta}$, where u is the velocity at a distance y from the plate and $u = U$ at $y = \delta$ where δ is boundary layer thickness. 8

UNIT - V

6. a) Derive the stream potential, velocity and pressure functions for a flow around a circular cylinder. 10

   b) Derive the stream function and potential function for a free vortex flow. 10

OR

7. a) Prove that (i) $\frac{T_0}{T} = 1 + \left(\frac{\gamma-1}{2}\right) M^2$ (ii) $\frac{P_0}{P} = \left[1 + \left(\frac{\gamma-1}{2}\right) M^2\right]^{\gamma/\gamma-1}$. 10

   b) Explain the propagation of sound waves in different Mach regions. 10

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