M.Sc.(Mathematics) (Old / CBCS Pattern) Third Semester

MSC2393 / PSCMTHT14-1 - Paper-III : Fluid Dynamics-I

P. Pages : 2 **GUG/W/18/11282**

Time : Three Hours * 3 3 8 5 * Max. Marks : 100

Notes : 1. Solve all **five** questions.
2. Each question carries equal marks.

UNIT – I

1. a) Obtain the equation of continuity. **10**

b) Test whether the motion specified by **10**

$$q = \frac{k^2(x_j + y_i)}{x^2 + y^2}(k = \text{const.})$$

is possible motion for an incompressible fluid. If so determine the equation of the streamlines. Also test whether the motion is of the potential kind and if so determine the velocity potential.

OR

c) The liquid flowes through the pipe whose surface is the surface of revolution of the curve **10**
$y = a + \frac{kx^2}{a^2}$ about the x-axis $(-a \le x \le a)$ if the liquid enters at the end $x = -a$ of the pipe with velocity V. Show the time taken by the liquid partical to travers the entire length of the pipe from $x = -a$ to $x = +a$ is $\left\{2a / v\left(1+k^2\right)\right\}\left(1+\frac{2}{3}k+\frac{1}{5}k^2\right)$

d) Obtain the Bernoulli's Equation. **10**

UNIT – II

2. a) Discuss the images in a Rigid Infinite plane. **10**

b) Describe the irrotational motion of an incompressible liquid for the complex potential is **10**
$w = ik\log z$. Two parallel line Vortices of strength $k_1k_2\left(k_1+k_2 \neq 0\right)$ in unlimited liquid cross the z-plane at a point A, B respectively. The centre of mass of masses k_1 at A and k_2 at B is G show that if the motion of liquid is due to solely to these vortices, G is fixed pt about which A, B move in circles with angular velocity $\left(k_1+k_2\right)/(AB)^2$

OR

c) Prove that Let f(z) be the complex velocity Potential for the flow having no rigid boundaries and such that there are no singularities of flow within the circle | z | = a then on introducing the solid circular cylinder | z | = a in to the flow, the new complex velocity potential is given by $w = f(z) + \overline{f}\left(a^2 / z\right)$ for $|z| \ge a$. **10**

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d) Show that how the circle theorem is applied to determine modified flow when a long circular cylinder is introduced into a given two dimensional flow. **10**

UNIT – III

3. a) Discuss the first law of thermodynamics. **10**

b) Find the profile $\phi(x,t)$ of one dimensional propagation if at t = 0 $\phi = F(x), \frac{\partial \phi}{\partial t} = G(x)$. **10**

OR

c) Discuss on progressive and stationary wave. **10**

d) Discuss two dimensional wave equation. **10**

UNIT – IV

4. a) Discuss the equation of Motion of a Gas. **10**

b) Describe Isentropic Gas flow. **10**

OR

c) Define sonic and supersonic flow show that supersonic flow is characterized by a domain of dependence. **10**

d) Discuss Elementary Analysis of Normal shock waves. **10**

5. a) Show that equipotentials are cut orthogonally by the streamlines. **5**

b) Define sources, sinks & doublets. **5**

c) Write a short notes on specific heats of a gas. **5**

d) Explain the speed of sound in a gas. **5**

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