REV-01
MSM/07/12

2024/05

SET A

M.SC. MATHEMATICS
FOURTH SEMESTER
FLUID DYNAMICS
MSM - 403D

[USE OMR FOR OBJECTIVE PART]

Duration: 1:30 hrs. **Full Marks: 35**

(Objective)

Time: 15 mins. **Marks: 10**

Choose the correct answer from the following: ***1×10=10***

1. Fluid is a substance which offers no resistance to change of
   a. Pressure b. Flow
   c. Shape d. Volume
2. If every particle of the fluid has irregular flow, then the flow is said to be
   a. Laminar b. Turbulent
   c. Fluid flow d. Both a and b
3. According to the equation of continuity, when water falls its speed increases, while its cross-sectional area
   a. Increases b. Decreases
   c. Remain same d. Different
4. Liquids
   a. Cannot be compressed b. Occupy definite volume
   c. Are not viscous d. None
5. The Continuity equation is connected with
   a. Viscous fluid b. Compressibility of fluids
   c. Conservation of mass d. None
6. Navier Stoke's equation is
   a. Linear b. Parabolic
   c. Hyperbolic d. Non-linear
7. An example of non-Newtonian fluid is
   a. Air b. Blood
   c. Gas d. None
8. The Group velocity and wave velocity for shallow water is
   a. Equal b. Equivalent
   c. Zero d. None
9. The unit of viscosity is
   a. M^2/sec b. Kg-sec/M
   c. Newton-sec/M^2 d. None

10. Stream function satisfies if it is
    a. Incompressible
    b. One dimensional
    c. Two dimensional
    d. Both a and c

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(Descriptive)

Time : 1 hr. 15 mins. **Marks: 25**

[Answer question no.1 & any two (2) from the rest]

1. Show that the total energy of a progressive wave is half Kinetic Energy and half Potential Energy. **5**

2. Define group velocity. Show that the group velocity for deep water is half the wave velocity whereas for shallow water the group velocity and wave velocity are equal. **10**

3. Derive Navier Stoke's equation for a viscous fluid. **10**

4. Prove that the velocity of propagation c of surface waves of length λ in a rectangular canal of depth h is given by the formula **10**

$$c^2 = \frac{g\lambda}{2\pi}\tanh\frac{2\pi h}{\lambda}.$$

5. Show that $u = \frac{ax-by}{x^2+y^2}, v = \frac{ay+bx}{x^2+y^2}, \quad w = 0$ are the velocity components of a possible liquid motion. Is this motion irrotational? Also, show that the velocity potential is $\phi = b\tan^{-1}\left(\frac{x}{y}\right) - \frac{a}{2}\log\left(x^2+y^2\right)$ and stream lines are **10**

$$z = C_1 \text{ and } a\tan^{-1}\left(\frac{x}{y}\right) + \frac{b}{2}\log\left(x^2+y^2\right) = C_2.$$

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