

PE-485-CV-19
M.A./M.SC. MATHEMATICS (4th Semester)
Examination, June 2022
Paper-VI
FLUID MECHANICS-II

Time : Three Hours]

[Maximum Marks : 80
[Minimum Pass Marks : 29

Note : Answer from both the Sections as directed. The figures in the right-hand margin indicate marks.

Section-A

1. Answer the following multiple choice type questions:

1x10=10

- (a) A circular cylinder is placed in a uniform stream, then the force or couple acting on the cylinder is.
a). Zero b). non-zero c). Infinite d). Oscillating
- (b) When a circular cylinder is placed in a uniform stream the couple acting on the cylinder is.
a). Zero b). Infinite c). Finite but not zero d). none of these
- (c) If ϕ be the velocity potential due to a simple three dimensional source, then in used symbol.
a). $\phi = m/r$ b). $\phi = -m/r$ c). $\phi = m/r^2$ d). $\phi = -m/r^2$
- (d) The equation of lines of flow relative to a sphere is.
a). $\sin^2 \theta = (r^3 - a^3)/cr$ b). $\sin^2 \theta = (r^3 + a^3)/cr$
b). c). $\sin^2 \theta = cr(r^3 + a^3)$ d). $\sin^2 \theta = cr(r^3 - a^3)$
- (e) In usual symbols the velocity potential due to a three dimensional doublet is.
a). $2\mu \frac{\partial}{\partial s} \left(\frac{1}{r} \right)$ b). $3\mu \frac{\partial}{\partial s} \left(\frac{1}{r} \right)$ c). $4\mu \frac{\partial}{\partial s} \left(\frac{1}{r} \right)$ d). None of these
- (f) In usual notation, the stokes's stream function for a simple source on the axis of x is
a). $m \sin \theta$ b). mx c). mx/r d). mx/r^2
- (g) The differential equations of vortex lines are.
a). $dx/u = dy/v = dz/w$ b). $dx/\Omega_x = dy/\Omega_y = dz/\Omega_z$
c). $dx/dt = u, \quad dy/dt = v, \quad dz/dt = w$ d). None of these
- (h) At an integral point in a fluid, vortex lines.
a). Can originate b). Can terminate c). Can not originate d). None of these
- (i) If K be the circulation in the circuit embracing the vortex than.
a). $w = (ik \log z)/2\pi$ b). $w = -(ik \log z)/2\pi$
c). $w = (k \log z)/2\pi u$ d). None of these
- (j) In an infinite liquid at rest at infinity when the components of spin are known, then there could.
a). Infinite types of motion b). Only one type of motion
c). Two type of motion d). None of these

2. Answer the following questions:-

2x5=10

- (a) To find the K.E when an elliptic cylinder rotates in an infinite mass of liquid at rest at infinity.
- (b) Define three Dimensional Doublet.
- (c) Define Vorticity in vortex motion.
- (d) Write short notes about vortex sheet.
- (e) Define vortex outside a circular cylinder.

Section-B

12x5=60

Answer the following question.

3. To determine ϕ and ψ for a liquid streaming past a fixed elliptic cylinder with velocity U parallel to major axis of the section.

OR

Find Kinetic energy of elliptic cylinder.

4. An elliptic cylinder is filled with liquid which has molecular rotation w at every point and whose particles move in planes perpendicular to the axis. Prove that the stream lines are similar ellipse described in periodic time $\pi(a^2 + b^2)/wab$

OR

Find the motion of a sphere in an infinite mass of liquid at rest at Infinity.

5. Show that when a sphere of radius a moves with uniform velocity v through a perfect incompressible infinite fluid the acceleration of a particle of fluid at $(r, 0)$ is

$$3u^2 \left(\frac{a^3}{r^4} - \frac{a^6}{r^7} \right)$$

OR

Show that the total energy of progressive wave is half Kinetic energy and half potential energy.

6. Find the necessary and sufficient condition that vortex lines may be at right angles to the stream lines.

OR

In an incompressible fluid the vorticity at every point is constant in magnitude and direction show that the components of velocity u, v, w are solution of Laplace's equation.

7. Define equation of continuity in three Dimensional flows.

OR

Define progressive waves on the surface of a canal of uniform breadth and depth.