Question Bank For PG Course

Mathematics

Paper-10A(ii)(NEW)

Special Paper: Applied Mathematics

FLUID MECHANICS: PGMT-XA

Question 1

Find the equation of streamline of a two-dimensional liquid motion, $(u, v, 0)$ is the velocity vector at a point

Question 2

Find relations between velocity potential and stream function in a two-dimensional irrotational motion

Question 3

Find the velocity potential of a fluid motion generated by a uniform stream U in the negative direction of x-axis past a fixed rigid cylinder with radius a.

Question 4

Find the complex potential of a two-dimensional liquid motion due to circulation with cyclic constant K about a fixed cylinder with radius a where $z = re^{i\theta}$

Question 5

Find the equation of a stream line due to an irrotational flow generated by a uniform moving sphere with velocity U and radius 'a' in (r, θ, φ) coordinate

Question 6

Find the equation of continuity for an axisymmetric liquid motion with velocity $(u, v, 0)$ in $(z, \widetilde{\omega}, \varphi)$ coordinate system.

Question 7

Find the velocity potential of an irrotational motion by a sink of strength $-$'m' placed at $(a, 0,0)$ in front of a rigid wall at $x = 0$

Question 8

Why a vortex tube cannot be originated or terminated within the fluid, $\vec{\Omega}$ being the vorticity vector in a fluid motion.

Question 9

Find the velocity of a vortex at $z = 0$ in a row of infinite vortices of equal strength 'k' placed at $z = 0, z = \pm a$ in a fluid medium

Question 10

What is the relation between phase velocity c and the group velocity c_g for a group of progressive waves $\eta = a\sin(mx - nt)$ moving as a group with nearly same velocity?

Question 11

Find the stream function for a pair of vortices with strength 'k' at $ae^{i\alpha}$ and '$-k$' at $-ae^{i\alpha}$ where $a \to 0, k \to \infty, 2ak = \mu$ and $z = re^{i\theta}$

Question 12

Find the total energy per wave length λ at any time for a stationary wave $\eta = a\ \sin mx \cos nt$, ρ, g being density and gravity respectively

Question 13

A simple harmonic progressive wave $\eta = a\sin(mx - nt)$ is propagating along a surface of a finite depth liquid of height 'h'. Find the difference between phase velocity of wave and wave length 'λ'.

Question 14

Write vorticity transport equation for a liquid motion of viscous incompressible fluid with vorticity vector $\vec{\Omega} = curl\ \vec{v}$ and γ is the viscosity coefficient.

Question 15

Find the differential equation satisfied by the velocity component ω along the axis of a viscous fluid flow through a pipe of uniform cross-section where P is the velocity gradient decreasing along the flow and μ is viscous coefficient of the fluid.

Question 16

What is the equation of streamline of a flow $u = x, v = -y$?

Question 17

What are the paths of the particles of a flow $u = \frac{x}{1+t}, v = \frac{y}{1+t}, w = \frac{z}{1+t}$?

Question 18

If the motion is irrotational in two dimensions then find the value of $\left(\frac{\partial q}{\partial x}\right)^2 + \left(\frac{\partial q}{\partial y}\right)^2$.

Question 19

What is the complex potential of a source of strength m at origin?

Question 20

Let $f(z)$ be the complex potential for a 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 $|z| = a$ into the flow, find the new complex potential.

Question 21

Find the equation of continuity for an axisymmetric liquid motion with velocity $(u, v, 0)$ in $(z, \tilde{\omega}, \varphi)$ coordinate system.

Question 22

An infinite row of equidistant rectilinear vortices are at a distance a apart. The vortices are of the same numerical strength k but they are alternately of opposite signs. Then find the complex potential.

Question 23

Find the velocity potential at any point (r, θ) of a liquid contained between two coaxial cylinder of radii $a, b\ (> a)$, which are moved suddenly parallel to themselves at the direction right angles with velocities U, V respectively.

Question 24

An infinite elliptic cylinder with semi axes a, b is rotating round its axis with angular velocity ω in an infinite liquid of density ρ which is at rest at infinity. If the fluid is under action of no force, find the moment of the fluid pressure on the cylinder round the centre.

Question 25

What is the relation between phase velocity c and the group velocity c_g for a group of progressive waves $\eta = a\sin(mx - nt)$ moving as a group with nearly same velocity?

Question 26

Find the stream function for a pair of vortices with strength 'k' at $ae^{i\alpha}$ and '$-k$' at $-ae^{i\alpha}$ where $a \to 0, k \to \infty, 2ak = \mu$ and $z = re^{i\theta}$

Question 27

What is the total energy per wave length λ at any time for a stationary wave $\eta = a\ \sin(mx - nt)$, ρ, g being density and gravity respectively.

Question 28

An infinite liquid of density ρ' lies above an infinite liquid of density ρ, the two liquids being separated by a horizontal plane surface. What is the velocity c of propagation of waves of length λ along the interface.

Question 29

There are two coaxial cylinders of radii a and $b(> a)$ through which laminar steady flow without body forces of an incompressible viscous fluid takes place along the axial directions. P is the pressure gradient and μ is viscous coefficient of the fluid. Then find the velocity profile.

Question 30

The steady laminar flow of viscous incompressible fluid between two infinite parallel plates is separated by a distance h. P is the pressure gradient and μ is viscous coefficient of the fluid. Find the velocity profile.