frequency. Frequency denotes the number of oscillations per second.

The angle $(mx-nt)$ is called <u>phase angle</u> and n is called <u>phase rate</u>. If the equation of a progressive wave can be written in the form $y = a.\sin(mx-nt+\epsilon)$, then ϵ is called the <u>phase of the wave</u>.

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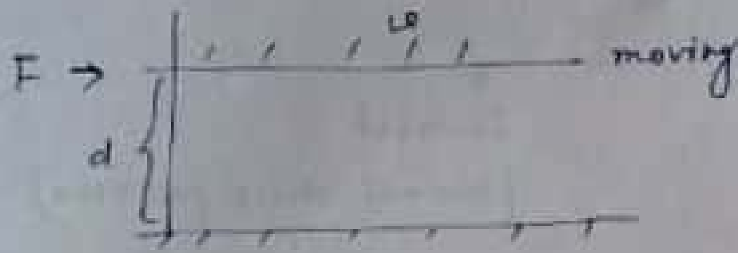
Fluid Mechanics

- Fluid state (Rest)
- Fluid Kinematic (Pressure absent)
- Fluid Dynamics (Pressure)

Fluid Kinematic, Fluid Dynamics: motion



$\therefore \; F \propto \left(\frac{v}{d}\right)$

$\Rightarrow F = \mu \frac{v}{d}$, μ = coefficient of viscosity

$\sigma_{ij,j} + \rho b_i = \rho \dot{v}_i$

equation of motion
- → condition of inviscid fluid : Euler equation of motion
- → condition of viscous fluid : Navier stokes equation of motion

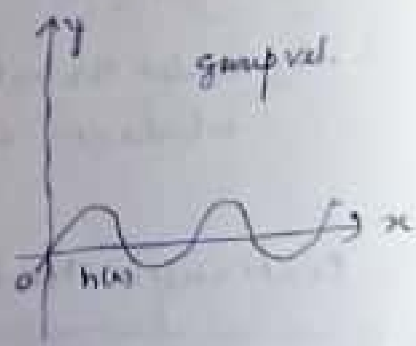
Water Waves (Inviscid fluid, normal force or pressure)

(Approximation theory)

$\lambda >> h$

$\lambda \leq h$

1. Progressive waves
(a) Long or tidal waves
(b) Surface waves
2. stationary waves
3. Solitary waves
4. Capillary waves



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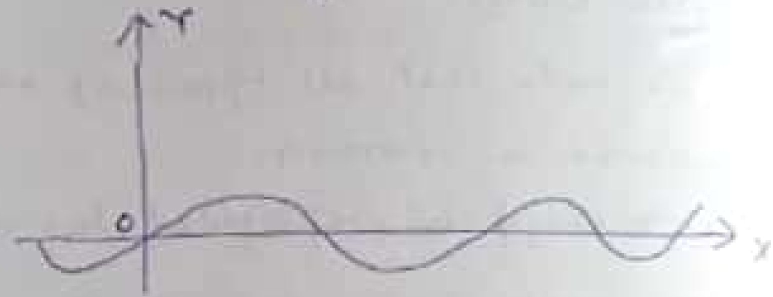
remain oscillating in the same positions and the free surface or density interface changes its shape is carried in different directions. If a disturbance is not small, then the particle below the free surface may change their positions finitely and the changes of the shape of the free surface may not be gradual. Motion of the liquid will be irrotational in general, since we consider the motion from rest due to some disturbances, we shall deal with the motion produced by small disturbances only. The changes of the shape of the free surface takes place slowly and gradually.



Taking the x-axis to be horizontal and the y-axis vertically upwards, a motion in which the vertical solution of the free surface is of the form,

$$y = a\sin(mx - nt) \longrightarrow (i)$$

where a, m, n are constants, is known as simple harmonic progressive wave (progressive wave is one in which the surface pattern more forward).

We can write (i) as

$$y = a\sin m\left(x - \frac{n}{m}t\right) \longrightarrow (ii)$$

If we increase t by τ and x by $\left(\frac{n}{m}\right)\tau$, then we find from the R.H. of (i)

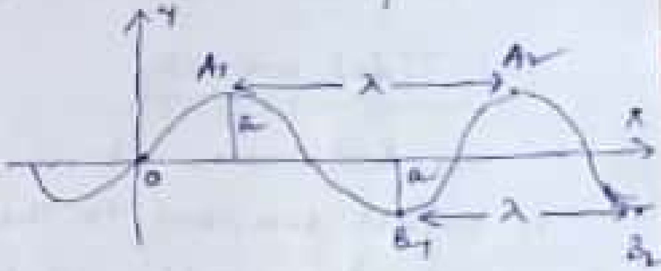
$$a \sin m\left[\left(x+\frac{n}{m}\tau\right)-\frac{n}{m}(t+\tau)\right]$$

$$= a \sin m\left(x-\frac{n}{m}t\right)$$

$$= y$$

Hence (11) shows that the wave profile $y = a \sin mx$ at time $t=0$ move with velocity $\frac{n}{m}$ $(=c,$ say$)$ in the positive direction, c is called the wave velocity or velocity of propagation. When $a=0$, the profile of the liquid is $y=0$ which is the mean level.

Let $\eta(x,t)$ be the elevation or depression of the surface from the mean position. The maximum value of the disturbance y namely 'a' is called the amplitude of the wave. The points, A_1, A_2 of maximum elevations are known as the Crests and the points $B_1, B_2, \cdots$ of maximum depression are known as throughs.



The function η and its derivatives are small. Distance between successive crests or throughs is called the wave length. If we replace x by $x+\frac{2\pi}{m}$, then (1) remains unchanged, so that the wave profile repeats itself at regular interval $\frac{2\pi}{m}$. The number $\lambda = \frac{2\pi}{m}$ is called wave length.

Again, the nature of the free surface remains the same if we replace t by $t+\frac{2\pi}{n}$. Hence $T=\frac{2\pi}{n}$ is called the period of the wave.

Also, $t = \frac{2\pi}{n} = \frac{2\pi}{m}\cdot\frac{m}{n} = \frac{\lambda}{c}$

The reciprocal of the period i.e. $\frac{1}{T} = \frac{n}{2\pi}$ is defined as

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Water Waves

Introduction:

When a pebble is thrown into a pond, some disturbance is seen to travel radially over the surface of water, this disturbance is popularly known as water waves. It is also well familiar that sound waves through the room when a piano is played upon. The energy extracted from the sun is transmitted by waves to the earth, these are all examples of wave motion. The practical application of waves have given paramount importance to the study of dynamics of wave motion in physical investigation.

Water waves:

We note that all types of waves have got two distinguished features in common.

(i) Energy is propagated two distinct parts.

(ii) Disturbance travels through the medium without any interference of the medium itself.

In fact, all types of waves motions are governed by a certain differential equation of wave motion whose solution, under suitable boundary condition explain the given problem in its right perspective.

Waves in water:

It is particular class of motion of water under gravity when there is a free surface or density interface present within it. Generally, it represent a continuous transference of the particular form or shape of the surface from one position to the other. If the disturbance which creates the motion, be small in magnitude then the particles

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Water Wave (Inviscid fluid)

Matter

- Solid
- Liquid
- Gas (compressible)
- Ionised Gas

Fluid

- Viscous (shearing stress, or, tangential force and normal stress or pressure)
- Inviscid (Normal stress pressure)

Pressure

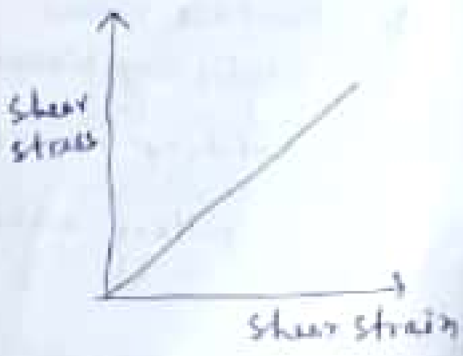
- Newtonian — eg. Water, air, thin oil etc.
- Non-Newtonian — eg. Thick oil, blood, lubricants etc.

flow → Laminar flow
→ Turbulent (Turbulous)

Defn.

fluid → substance
→ deformed
→ under the action of shear stress whatever small it may be.

$\sigma_{ij} \rightarrow i = j$ (normal stress)
$i \neq j$ (shearing stress)



Continuum Mechanics

- Fluid Mechanics
- Solid Mechanics