**Practical No. 08**

**Object:** Experimental study of Reynolds’s number and observing Laminar, Transitional and Turbulent Flow

**APPARATUS:**

1. Hydraulic Bench
2. Visualization
3. Outlet control
4. Needle
5. Reservoir
6. Marble glasses( kanchi ) for smoothness of flow
7. Starter
8. Overflow pipe
9. Inlet pipe
10. Dye reservoir
11. Bil mouth
12. Dye control valve

**THEORY:**

**Laminar flow** is the type of low in which the particles move in a straight line in the form of thin parallel sheets is known as the Laminar flow.

**Turbulent flow**  is the type of flow in which the particles move in a zigzag pattern is known as the turbulent flow.

**Transitional flow**  is the type of flow when when the flow is changing from laminar to turbulent .

**Open Channel flow:**  When flow is exposed to the environment whether in pipes or open then it is scales the open channel flow.

**Closed channel flow**  is that when flow is not directly exposed to the environment then tits is called as the closed or pipe flow.

Flow can be categorized by

1. By visualization
2. By calculation

**Forces**  acting on a flowing liquid are

1. Inertial force
2. Gravitational force
3. Viscous force

**Reynolds number** can be defined for a number of different situations where a fluid is in relative motion to a surface (the definition of the Reynolds number is not to be confused with the Reynolds Equation or lubrication equation). These definitions generally include the fluid properties of density and viscosity, plus a velocity and a characteristic length or *characteristic dimension*. This dimension is a matter of convention – for example a radius or diameter are equally valid for spheres or circles, but one is chosen by convention. For aircraft or ships, the length or width can be used. For flow in a pipe or a sphere moving in a fluid the internal diameter is generally used today. Other shapes (such as rectangular pipes or non-spherical objects) have an *equivalent diameter* defined. For fluids of variable density (e.g. compressible gases) or variable viscosity ([non-Newtonian fluids](http://en.wikipedia.org/wiki/Non-Newtonian_fluid)) special rules apply. The velocity may also be a matter of convention in some circumstances, notably stirred vessels.

 \mathrm{Re} = {{\rho {\bold \mathrm v} L} \over {\mu}} = {{{\bold \mathrm v} L} \over {\nu}}[4]

where:

* {\bold \mathrm v}is the mean velocity of the object relative to the fluid (SI units: m/s)
* *L* is a characteristic linear dimension, (travelled length of the fluid; [hydraulic diameter](http://en.wikipedia.org/wiki/Hydraulic_diameter) when dealing with river systems) (m)
* μ is the dynamic viscosity of the [fluid](http://en.wikipedia.org/wiki/Fluid) (Pa·s or N·s/m² or kg/(m·s))
* ν is the [kinematic viscosity](http://en.wikipedia.org/wiki/Kinematic_viscosity) (ν = μ / *ρ*) (m²/s)
* {\rho}\,is the [density](http://en.wikipedia.org/wiki/Density) of the fluid (kg/m³)

If

Rn = 0- 2000 the flow is laminar Rn = 2000-2800 The flow will be transitional

Rn = greater than 2800 The flow is turbulent.

**Procedure:**

* Filled the reservoir with dye.
* Positioned the apparatus on the bench and connected the inlet pipe to the bench feet.
* The lowered the dye injector until it was just above the bell mouth inlet.
* Opened the bench inlet valve and slowly filled head tank to the overflow level , the closed the inlet valve.
* Then opened and closed the flow control valve to admit after to the flow visualization pipe
* Opened the inlet valve slightly until water traveled from the outlet pipe.
* Fractionally opened the control valve and adjusted dye control vale until slow flow with dye indication is achieved.
* At low flow rates the dye was drawn through the center of pipe
* Increased the flow rate that produce eddies in the dye until the dye completely dispersed into the water.
* Visually observed the three types of flow.
* When the dye was looking like a line then categorized it as Laminar flow.
* When the dye was looking dispersed categorized it as Turbulent flow.
* When the dye looking like a line at some instant and dispersed at some categorized it as Transitional flow.

**Observation:**

 \mathrm{Re} = {{\rho {\bold \mathrm v} L} \over {\mu}} = {{{\bold \mathrm v} L} \over {\nu}}

Here V= kinematic velocity

d=diameter v= viscosity of water 20 ͦC = 0.0101 poise (P) d=0.025

V= 0.025 a= π/2 (d²)

Q=0.55 l/s

Q=a.v

v=

v=1131.2 m/s

Renold’s number will be

Rn=

=2800

Q=0.475 l/s

Q=a.v

v=

v=369.6 m/s

Renold’s number will be

Rn=

=2400

Q=0.395 l/s

Q= a.v

v=

Renold’s number will be

Rn=

Rn = 2000

**Result**:

When Rn is 2000, it is laminar lfow

When Rn is 2400 it is transitional flow.

When Rn is 2800, it is turbulent flow