

UNIT III- DIMENSIONAL ANALYSIS

PART – A (2 Marks)

01. What is a dimensionally homogenous equation? Give example **(NOV-04)**
02. Give the dimensions for physical quantities: Pressure, Surface tension, Dynamic viscosity, Kinematic viscosity? **(APR-03)**
03. State the Buckingham's π theorem. **(APR-04)**
04. What are the similarities between models and prototype? **(NOV-04)**
05. Submarine is tested in the air tunnel .Identify the model law applicable? **(NOV-03)**

PART-B (16 Marks)

01. Consider force "F" acting on the propeller of an air craft which depends upon variable u, ρ, μ, d and N .Derive the non- dimensional function from $F / \rho u^2 D^2 = f[UD\rho / \mu] \times [ND / U]$ **(APR 03)**
02. The frictional torque T of disc diameter D rotating at a speed N in fluid of viscosity μ and density ρ in a turbulent flow is given by $T= D^5 N^2 \rho \Psi [\mu / D^2 N P]$. Prove it by Buckingham's π theorem. **(NOV-03)**
03. The pressure diff Δp in a pipe of dia D and length L due to viscous flow depends on the velocity V viscosity μ and density ρ using Buckingham's π theorem. Obtain an expression for Δp **(APR-04)**
04. A model of a hydro electric power station tail race is proposed to built by selecting vertical scale 1 in 50 and horizontal scale 1 in 100 if the design pipe has flow rate of $600\text{m}^3/\text{s}$ and the allowable discharge of $800\text{m}^3/\text{s}$. Calculate the corresponding flow rate for the model testing. **(APR – 04)**
05. It is desired to obtain the dynamic similarity between a 30cm dia pipe carrying linseed oil at $0.5\text{m}^3/\text{s}$ and a 5m dia pipe carrying water. What should be the rate of flow of water in LPS? If the pressure loss in the model is $196\text{N}/\text{m}^2$. What is the pressure loss in the proto type pipe? Kinematic viscosities of linseed oil and water are 0.47 and 0.0113 stroke respectively. Specific gravity of linseed oil =0.82 **(APR-03)**
06. Derive an expression showing the relationship between the torque and the variables diameter, rotational speed, viscosity and density by Buckingham's π theorem. **(Nov-04)**
07. A 7.2m high and 15m long spillway discharge $94\text{m}^3/\text{s}$ under a head of 2m. If a 1:9 Scale model of this spillway is to be constructed determine the model law to be used model dimensions , head at spillway and discharge in the model if model experiences a force of 764N, Determine force on prototype. **(NOV-04)**