

SNS COLLEGE OF TECHNOLOGY, COIMBATORE-35 DEPARTMENT OF MECHANICAL ENGINEERING



Fluid Mechanics and Machinery – **UNIT II DIMENSIONAL ANALYSIS AND SIMILITUDE** Topic - Problems on Dimensional analysis- Buckingham's π theorem method

2. The frictional torque T of a disc diameter Diretating out a Speed N in a flord of viscosity in and density of in a turbulent flow is given by T= D5N2P9 (h Prove if by Buckingham's x-theorem Buckingham's 7-theorem. Solution: The Variables involved in analysis are T, D, N, Mand P The dimensions of each Variable are torque T=ML2T-2 Diameter D=L Speed N=T-1 Viscosity h= ML-1 T-1 Density P= ML-3 The functional relationship Combe worten T= f (D, N, M, P) f, (T, D, N, M, P) =0 The Lotal number of Variables n = 5 Fundamental Variables m=3



SNS COLLEGE OF TECHNOLOGY, COIMBATORE-35 **DEPARTMENT OF MECHANICAL ENGINEERING**



Fluid Mechanics and Machinery – UNIT II DIMENSIONAL ANALYSIS AND SIMILITUDE Topic - Problems on Dimensional analysis- Buckingham's π theorem method

.. The total number of a-terms=n-m

Each Variable has m+1 Variable

So, the functional equation interms of x-terms

 $f_1(x_1, x_2) = 0$ (3)

TI= DaI x NbIX PCIXT

12= D 92 x Nb2 x P C2 x M

TI = Daix Nbix PCIXT

NOW, the dimensionless equation becomes $M^{0}L^{0}T^{0} = L^{\alpha_{1}} \times (T^{-1})^{b_{1}} \times (ML^{-3})^{e_{1}} \times ML^{2}T^{-2}$

Comparing exponents Coefficient

for M:0 = C,+1 -(i)

L:0=91-301+2 +11)

1:0=-b1-2 -(11)

From (1) C1 = -1

(11) $q_1 = 3c, -2 = 3(-1) -2 = -5$

(711) bi= -2

TI = D-5 x N-2 x P-1 x T

 $\vec{\Lambda}_1 = \frac{T}{D5 N^2 P}$



SNS COLLEGE OF TECHNOLOGY, COIMBATORE-35 DEPARTMENT OF MECHANICAL ENGINEERING



Fluid Mechanics and Machinery – **UNIT II DIMENSIONAL ANALYSIS AND SIMILITUDE** Topic - Problems on Dimensional analysis- Buckingham's π theorem method

72 = D92 x Nb2 x P6 x M New, the dimension less equation becomes M° L° T° = L92 x (T-1) 12 x (ML-3) X MITT Comparing enprenents coefficient on both Sides M 0 = C2+1 0= 92-39-1 -0= -b2-1 - vi From (1) cz = -1 (V) 92-362+1=3(-1)+1=-2 (Vi) b2 = -1 T12 = B-2 N-1 P-1 M = D2 NP Substituting values of x, and x2 in (3) f (T N P) =0 T= D5 N2 P & (h
D2 NP) Hence it is Prooved