Exam No: _____

GANPAT UNIVERSITY

B. TECH SEM- 3rd(III) (ME/ME(int)) REGULAR EXAMINATION– NOV-DEC 2015

2ME304: FLUID MECHANICS

TIME: 3 HRS **TOTAL MARKS: 60**

Instructions: (1) This Question paper has two sections. Attempt each section in separate answer book.
(2) Figures on right indicate marks.
(3) Be precise and to the point in answering the descriptive questions.

SECTION: I

Q.1 **(a)** Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.8 m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE. (04

(b) The velocity vector in a fluid flow is given by $V=4x^3\mathbf{i} - 10x^2yj + 2tk$. Find the velocity and acceleration of a fluid particle at (2, 1, 3) at time t = 1. (04

(c) Give the statement for the Bernoulli's. Obtain the Bernoulli's equation from Euler's equation of motion. (02

OR

Q.1 **(a)** Derive continuity equation in three dimensions. (04

(b) A fluid flow is given by, $V = xy^2\boldsymbol{i} - 2yz^2\boldsymbol{j} - \left(zy^2 - \frac{2z^3}{3}\right)\boldsymbol{k}$. Prove that it is a possible case of steady and incompressible flow. Calculate the velocity and acceleration at the point [1, 2, 3]. (04

(c) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of sp. Gr. 0.8. The discharge of oil through venturimeter is 60 litres/s. Find the reading of the oil-mercury differential manometer. Take $C_d = 0.98$. (02

Q.2 **(a)** The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\rho\emptyset\left[\frac{\mu}{D^2N\rho}\right]$ (04

(b) Using Buckingham's π-theorem, show that the discharge Q consumed by an oil ring is given by $Q = Nd^3\emptyset\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{\rho N^2d^3}, \frac{w}{\rho N^2d}\right]$ where d is the internal diameter of the ring, N is rotational speed, ρ is density, μ is viscosity, σ is surface tension and w is the specific weight of oil. (04

(c) How are the repeating variables selected for dimensionless analysis? (02

OR

Q.2 **(a)** The force exerted by a flowing fluid on a stationary body depends upon the length L of the body, velocity V of the fluid, density ρ of fluid, viscosity μ of the fluid and acceleration g due to gravity. Find an expression for the force using dimensionless analysis. (04

(b) Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gh}\,\emptyset\left[\frac{D}{H}, \frac{\mu}{\rho vH}\right]$ where H is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. (04

(c) Give the dimensions of following (i) Surface tension (ii) Kinematic viscosity. (02

Q.3 Attempt any two from the following.

(a) Derive following equation for compressible flow (i) Area-velocity relationship (ii) Velocity of sound in terms of bulk modulus.

(b) A gas with a velocity of 300 m/s is flowing through a horizontal pipe at a section where pressure is 6×10^4 N/m^2 (absolute) and temperature 40 °C. The pipe changes in diameter and at this section the pressure is 9×10^4 N/m^2. Find the velocity of the gas at this section if the flow of the gas is adiabatic. Take R = 287 J/kg K and k = 1.4.

(c) Explain the device which is used to measure the velocity of fluid flowing through the pipe. Also derive its equation to measure the velocity.

SECTION: II

Q.4 (a) Define surface tension. Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by $p=4\sigma/d$. **(10)**

(b) A square plate of size 1 m×1 m and weighing 350N slides down an inclined plane with uniform velocity of 1.5 m/s. The inclined plane is laid on slope of 5 vertical to 12 horizontal and has an oil film 1 mm thickness. Calculate the dynamic viscosity of oil and shear stress.

OR

Q.4 (a) Prove that pressure variation at depth is directly proportional to depth height. **(10)**

(b) A pressure gauge consists of two cylinder bulbs B and C each of 10sq.cm cross sectional area. Which are connected by U-tube with vertical limbs each of 0.25sq.cm cross sectional area. A red liquid of specific gravity 0.9 is filled into C and clear water is filled into B, The surface of separation being in limb attached to C. Find the displacement of surface of separation when the pressure on surface in C is greater than that in B by an amount equal to 1cm head water.

Q.5 (a) Derive equation to determine meta-centric height for analytical method. **(10)**

(b) A block of wood of specific gravity 0.7 floats in water. Determine the meta-centric height of block of if its size is 2 m × 1 m × 0.8 m.

OR

Q.5 (a) Determine Energy correction factor is equal to 2 for fluid flowing through pipe. **(10)**

(b) Calculate (a) the pressure gradient along flow (b) the discharge for and oil of viscosity 0.02Ns/m^2 flowing between two stationary parallel plates 1 m wide maintained 10mm apart. The velocity midway between the plates is 2 m/s.

Q.6 Attempt any four **(10)**

(a)Define following terms

(a) Newtonian fluid (b) Compressibility (c) Kinematic viscosity (d) Capillary (e) Buoyancy

(a) Write condition of equilibrium of a floating body and sub-merged body.

(c) A hydraulic press has a ram of 30 cm diameter and plunger of 4.5 cm diameter. Find the weight lifted by hydraulic press when the force applied at the plunger is 500N.

(d) A shaft 100mm diameter runs in a bearing of length 200mm with a radial clearance of 0.025mm at 30r.p.m. find the velocity of oil , if pressure required to overcome the viscous resistance is 183.94 watts.

(e) Prove pressure intensity remain same in all direction for static fluid.

END OF PAPER