Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER – III • EXAMINATION – WINTER 2012

Subject code: X 31901 **Date: 26/12/2012**

Subject Name: Fluid Mechanics

Time: 10.30 am - 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** i) Distinguish the following. **04**
1) Liquid and Gas
2) Newtonian fluid and Non- Newtonian fluid

ii) Define surface tension. List some examples of surface tension. Why the concept of surface tension is not applied to gases? **03**

(b) Define dynamic and kinematic viscosity of fluid and solve the following: **07**
A piston 796mm diameter and 200mm long works in a cylinder of 800mm diameter. If the annular space is filled with lubricating oils of viscosity 5cp (centi poise), Calculate speed of descent of piston in vertical position. Consider weight of piston and axial load are 9.8N.

Q.2 **(a)** Define Center of Buoyancy. Discuss conditions of equilibrium of a floating body and a submerged body? **07**

(b) i) State and prove Pascal's Law. **04**

ii) The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The center of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm. **03**

OR

(b) What is meta-centric height? Derive an expression for meta-centric height of a floating body. **07**

Q.3 **(a)** A circular plate 3.0 m diameter is immersed in water in such a way that its greatest and least depth below the free surface is 4 m and 1.5 m respectively. Determine the total pressure on face of the plate and position of center of pressure. **07**

(b) i) Derive Bernoulli's equation for the fluid flow from Euler's equation of motion. Mention the assumptions made in it. **03**

ii) Draw venturimeter and manometer arrangement, apply the steady flow energy equation and derive an expression for the actual flow rate of an incompressible fluid. **04**

OR

Q.3 **(a)** i) Define the following hydraulic co-efficients: **03**
1) Co-efficient of discharge

2) Co-efficient of velocity
3) Co-efficient of contraction

ii) Mention the advantages of triangular notch over rectangular notch and find the discharge of water flowing over a rectangular notch of 2 m length when the constant head over the notch is 300 mm. Take C_d= 0.60 **04**

(b) i) Explain different types of fluid flow with suitable examples. **05**

ii) Define stream function and velocity potential function. **02**

Q.4 **(a)** Define streamline, streakline and pathline. For velocity field given by $q(x,y,z,t) = 10xyi + 5x^2j + (t^2x + z)k$ find velocity and acceleration of fluid particle at position $r(x,y,z) = i + 2j + 3k$ at t=1 unit. **07**

(b) The efficiency η of a fan depends on density ρ , dynamic viscosity of the fluid μ , angular velocity ω, diameter of rotor D and discharge Q. Perform dimensional analysis using Buckingham's Pi-Theorem. **07**

OR

Q.4 **(a)** What is the dimensional analysis? How is this analysis related to the theory of similarity? A 2.5m ship model was tested in fresh water (ρ=1000kg/m^3) and measurements indicated that there was a resistance of 45N when the model was moved at 2m/s. Calculate the velocity of 40m prototype. Also calculate the fore required to drive the prototype at this speed through sea water (ρ=1025 kg/m^3). **07**

(b) Explain dimensionless numbers with their significance and applications. **07**

Q.5 **(a)** Explain the nature of propagation of disturbance in compressible flow when mach number less than one, is equal to one and is more than one. **07**

(b) Explain methods for measurement of fluid viscosity. **07**

OR

Q.5 **(a)** i) Define Mach angle and find the velocity of bullet fired in air if the mach angle is 40^0. Take R=287.14 J/kg K and k = 1.4 for air. Assume temperature as 15^0C. **04**

ii) Find the head lost due to friction in a pipe of diameter 0.30 m and length 50 m , through which water is flowing at a velocity of 3 m/s using 1) Darcy formula and 2) Chezy's formula for which C= 60. Take Co-efficient of friction (f) = 0.00256 **03**

(b) Explain various flow losses in pipes. **07**

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