Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III • EXAMINATION – SUMMER 2013

Subject Code: 130602 **Date: 29-05-2013**

Subject Name: Fluid Mechanics

Time: 02.30 pm - 05.00 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) Define 'Fluid' and State its properties. [14]

(b) An open tank contains 1m of water, above which there is an oil of specific gravity 0.8 to a depth of 0.4 m. Find the pressure at (i) the interface (ii) at the bottom of the tank.

(c) Velocity distribution in a viscous flow over a plate is given by $u=4y-y^2$ for $y \leq 2m$. Where u is velocity in m/sec. at distance y from the plate. If coefficient of viscosity is 1.5 Pa. s. determine the shear stress at y=0 and y=2m.

(d) An open cylindrical tank 1 m diameter and 2m high contains water up to a depth of 1.5 m. If the cylinder rotates about its vertical axis, what maximum angular velocity can be attained without water in the tank to spil ?

Q: 2 (a) An inclined rectangular sluice gate AB 1.20 m and 5 m wide at 45 degree to water surface with end B5 m below water surface is installed to control the flow of water. Upper end A of gate is hinged. Find the force F applied normal to the gate at B to open the gate. [6]

(b) (i) Sketch the stability of a floating body. [3]

(ii) A uniform rectangular body 2 m long 1 m wide and 0.8 m deep floats in water, the depth of immersion being 0.6 m. Find (i) the weigth of the body and (ii) check the stability [5]

OR

(b) (i) Describe the terms atmospheric, absolute, gauge and vacuum pressure with a sketch. [3]

(ii) Differentiate between Liquid and gases [5]

Q: 3 (a) Derive continuity equation for 2-D incompressible flow in Cartesian form stating the assumption made and principle involved. [5]

(b) In a 3-D incompressible flow the velocity component in x and y directions are $u = x^2 + 2z^2 + 8$ and $v = 2y^2 + z^2 - 6$. Find the velocity component w in z- direction. [5]

(c) Show that 2-D flow described by $u = 6xy$, $v = 3x^2 - 3y^2$ is continuous and irrotational. [4]

OR

Q : 3 (a) Distinguish between : [5]

(i) Local acceleration and convective acceleration

(ii) Steady, unsteady, uniform and non uniform flow

(iii) Rotational and irrotational flow

(iv) Metacentre and metacentric height

(v) Stream line and stream tube

(b) A 2-D flow is described by $u = 5x^3$ and $v = -15 x^2 y$. Evaluate the stream function and sketch the stream line $\psi = 1$. [5]

(c) Show that ψ- line and Φ – line intersect orthogonally. [4]

Q : 4 (a) classify different types of orifices and write down the equations for hydrantic coefficients used in it. [4]

(b) A tank has two identical orifices in one of its vertical sides. The upper orifice is 1m below the water surface and lower one is 2 m below the water surface. Find the point at which the two jets will intersect if co efficient of velocity is 0.9. The flow being as constant head. [7]

(c) Write down the devices used to measure (i) pressure (ii) velocity and (iii) discharge in a pipe carrying flow of water. [3]

OR

Q :4 (a) State and Prove Euler's equation of motion of a fluid element along a stream line stating the principle used. [5]

(b) A 400 m long pipe tapers uniformly from 1.2 m diameter at high end to 0.6 m diameter at the lower end, the slope of the pipe being 1 in 100 falling. The pipe conveys a discharge of 1.25 cu. m/sec if the pressure at the high end is 75 K pa. find the pressure at the lower end. Ignore losses. [5]

(c) The velocity components in a 2-D flow of an incompressible flow are given by $u = 5x^3$ and $v = -15x^3y$, find the acceleration at (1,2) at t = 1. [4]

Q : 5 (a) An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter of 150 mm and throat diameter of 75 mm. The oil mercury manometer shows a reading of 20 cm. Compute the discharge of oil. Take $C_d = 0.8$ Draw the hydraulic gradient lint for the venturimeter. [5]

(b) Classify briefly different types of notches and weirs. [4]

(c) Water flows over a rectangular weir 1 m wide at a depth of 150 mm and afterwards passes through a triangular right angled weir. Taking C_d for rectangular and triangular weir as 0.62 and 0.59 respectively. Find the depth over the triangular weir. [5]

OR

Q : 5 (a) Derive Darcey weisbatch equation for loss of head due to friction in a pipe line. [4]

(b) Explain (i) Total Pressure and resultant pressure (ii) Specific mass and specific weight [5]

(c) (i) Distinguish between: (A) compressible and incompressible flow

(B) isothermal process and adiabatic process [2]

(ii) For a perfect gas, equation of state is PV = RT with the usual terms. Get the differential equation. [3]

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