VIT

Reg. No. :

Final Assessment Test (FAT) - APRIL/MAY 2023

Programme	**B.Tech**	Semester	**Winter Semester 2022-23**
Course Title	**FLUID MECHANICS AND MACHINES**	Course Code	**BMEE204L**
Faculty Name	**Prof. Vinayagamurthy G**	Slot	**D2+TD2**
		Class Nbr	**CH2022235002422**
Time	**3 Hours**	Max. Marks	**100**

Section A (10 X 10 Marks)
Answer any 10 questions

01. If the velocity profile of a fluid over a plate is parabolic with the vertex *30 cm* from the plate, where the velocity is *60 cm/sec*. Calculate the velocity gradient and shear stress at the distance of *5, 15, 30 cm* from the plate, if the viscosity of the fluid is *7.5 poise*. [Hint: Assume the parabolic distribution for velocity profile $u = c\,y^2 + by + a$]. Also draw a schematic sketch of the velocity profile above the flat plate. **[10]**

02. (a) Find out the differential reading '*h*' of an inverted U-tube manometer containing oil of specific gravity *0.7* as the manometric fluid when connected across pipes A and B as shown in Figure below, conveying liquids of specific gravities *1.2* and *1.0* are immiscible with manometric fluid. Pipes A and B are located at the same level and assume pressures at A and B to be equal. [7 Marks] **[10]**

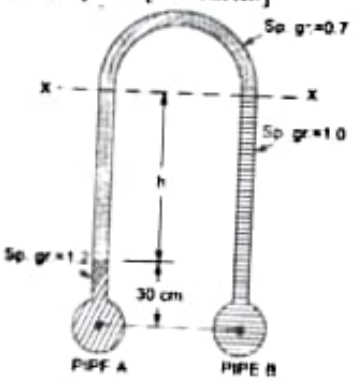

Figure 1

(b) Discuss the stability of a submerged body and a floating body whose center of gravity is above the center of buoyancy. [3 Marks]

03. (a) A fluid flow field is given by $V = x^2y\,i + y^2z\,j - (2xyz + yz^2)\,k$. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point *(2,1,3)*. [7 Marks] **[10]**

(b) Differentiate between steady and unsteady flow with appropriate examples. [3 Marks]

04. A Venturimeter of inlet diameter 300 mm and throat diameter 150 mm is fixed in a vertical pipe line. A liquid of specific gravity 0.8 is flowing upward through the pipe line. A differential manometer containing mercury gives a reading of 100 mm when connected at inlet and throat. The elevation difference between the inlet and throat is 500 mm. If the value of C_d = 0.98, then determine the (i) rate of flow of liquid in liters per second and (ii) differential pressure between the inlet and throat in N/m^2 **[10]**

05. A 45° bend reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being *600 mm and 300 mm* respectively. Find the Magnitude and direction of force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 *N/cm²* and rate of flow of water is 600 *litres/s*. [10]

06. Three pipes of *400 mm, 200 mm and 300 mm* diameters have lengths of *400 m, 200 m and 300 m* respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with tanks whose difference of water levels is *16m*. If coefficient of friction for these pipes is same and equal to *0.005*, determine the discharge through the compound pipe neglecting first the minor losses and then including them. [10]

07. The pressure drop, Δp along a straight pipe of diameter D has been experimentally studied, and it is observed that for laminar flow of a given fluid and pipe, the pressure drop varies directly with the distance, l, between pressure taps. Assume that Δp is a function of D and l, the velocity, V, and the fluid viscosity, μ. Use dimensional analysis to deduce how the pressure drop varies with pipe diameter. [10]

08. (a) A jet plane which weights *29.43 kN* and having a wing area of *20 m²* flies at a velocity of *1100 km/hr*, when the entire plane delivers *7357.5 kW* power. It is to be noted that *65%* of the power is used to overcome the drag resistance of the wing. Calculate the coefficients of lift and drag for the wing. Assume the density of the atmospheric air is *1.15 kg/m³*. [7 Marks] [10]

(b) Differentiate streamlined body from a bluff body in the view of aerodynamics. Draw the flow pattern and mark the stagnation and separation points for any four bluff bodies with its Drag coefficient. [3 Marks]

09. Define a centrifugal pump. Explain the working of a single stage centrifugal pump with neat sketches. [10]

10. Draw the schematic view of a Kaplan turbine and explain it construction and working. [10]

11. (a) Consider steady flow of water through an axisymmetric garden hose nozzle (refer Figure below). Along the centerline of the nozzle, the water speed increases from $u_{entrance}$ to u_{exit} as sketched. Measurements reveal that the centerline water speed increases parabolically through the nozzle. Write an equation for centerline speed $u(x)$, based on the parameters given below, from $x=0$ to $x=L$. *[5 Marks]* [10]

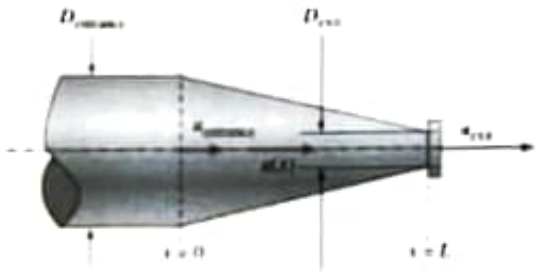

Figure 2

(b) What do you mean by Boundary layer separation. Also discuss any three methods to avoid boundary layer separation. *[5 Marks]*

12. (a) Water at 10 C (ρ=999.7 *kg/m3* and μ=1.307 ×10-3 *kg/m·s*) is flowing steadily in a *0.12 cm* diameter, *15 m* long pipe at an average velocity of *0.9 m/s*. Determine (i) the pressure drop, (ii) the head loss, and (iii) the pumping power requirement to overcome this pressure drop. *[5 Marks]* [10]

(b) What are various kinds of Similitude? Discuss the importance of Dimensional analysis with appropriate examples. *[5 Marks]*