B.Tech-3rd(Chem Engg)
Fluid Mechanics

Full Marks : 50

Time : 2:30 hours

Answer **all** questions.

The figures in the right-hand margin indicate marks.

Symbols carry usual meaning.

Any supplementary materials to be provided.

1. Answer *all* questions: 2 × 5

(*a*) Differentiate between dynamic and kinematic viscosity of fluid. State their units of measurement.

(*b*) Write down the assumptions of Bernoulli's theorem.

(*c*) Name the different forces present in a fluid flow. For the Euler's equation of motion, which forces are taken into consideration ?

(*d*) Differentiate between free settling and hindered settling of solid particles flowing through the fluid.

(*e*) What is cavitation and what are its causes ? How will you prevent the cavitation ?

2. (*a*) Discuss briefly about different types of pressure with suitable figure. 4

(*b*) What are the gauge pressure and absolute pressure at a point 3 m below the free surface of a liquid having a density of 1.53×10^3 kg/m^3 if the atmospheric pressure is equivalent to 750 mm of mercury ? The specific gravity of mercury is 13.6 and density of water is 1000 kg/m^3. 4

Free Settling: Fall of particles don't get affected by molecules

Hindered: Fall of particles get affected by molecules present

Or

(*a*) Discuss briefly about different types of fluids with suitable example. 4

(*b*) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m/sec requires a force of 98.1N to maintain the speed. Determine. 4

(*i*) The dynamic viscosity of the oil in poise.

(*ii*) The kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95.

3. (*a*) Show that the rate of increase of pressure in a vertical direction is equal to weight density of the fluid at that point. 4

(*b*) An open tank contains water up to a depth of 2 m and above in an oil of sp.gr. 0.9 for a depth pf 1 m. Find the pressure intensity (*i*) at the interface of the two liquids and (*ii*) at the bottom of the tank. 4

Or

(*a*) What is the difference between U-tube differential manometers and inverted U-tube differential manometers ? Where are they used ? 4

(*b*) A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of sp. Gravity 0.9 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of the mercury level in the two limbs is 40 cm and the height of the fluid in the left limb from center of the pipe is 15 cm below. 4

4. (*a*) Derive the expression of Bernoulli's equation with suitable assumptions. 4

(*b*) The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 liters/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. 4

Or

(*a*) Derive the expression of discharge when a fluid is flowing through a venturimeter. 4

(*b*) A 20 cm ×10 cm venturimeter is inserted in a vertical pipe carrying oil of specific gravity 0.8,the flow of oil is in upward direction. The difference of levels between the throat and the inlet section is 50 cm. The oil mercury differential manometer gives a reading of 30 cm of mercury. Find the discharge of oil. Neglect the losses. 4

5. (*a*) Show that the ratio of maximum velocity to average velocity equals 2 when a viscous fluid flows through a circular pipe. 4

(*b*) Calculate (*i*) the pressure gradient along flow (*ii*) the average velocity, and (*iii*) the discharge for an oil of viscosity 0.02 Ns/m^2 flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/s. 4

Or

(*a*) What do you mean by fluidization ? Discuss briefly about different types of fluidizations and write their advantages and disadvantages. 4

(*b*) Water is flowing through a 200 mm diameter pipe with coefficient of friction f = 0.04. The shear stress at a point 40 mm from the pipe axis is 0.00981 N/cm^2. Calculate the shear stress at the pipe wall. 4

6. (*a*) What do you mean by centrifugal pump ? Explain briefly about different parts of centrifugal pump with its working principle. 4

(*b*) The internal and external diameters of the impeller of centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 rpm. The vane angles of the impeller at the inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water. 4

Or

(*a*) Discuss briefly about the different type of efficiencies of a centrifugal pump. 4

(*b*) A centrifugal pump is to discharge 0.118 m3/s at a speed of 1450 rpm against a head 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75 %. Determine the vane angle at the outer periphery of the impeller. 4