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Printed Pages : 4 **CH-302**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 9002 Roll No.

B. Tech.

(SEM. III) EXAMINATION, 2007-08

CHEMICAL ENGG AND FLUID MECHANICS

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt **all** questions.*

1 Attempt any **two** parts of the following :

(a) What is bulk stress? What is the axiam relating bulk stress and pressure? **9**

(b) A rectangular gate 0.2 m × 1.0 m is in position by its own weight. Find the minimum weight of the gate necessary for the situation shown : **9**

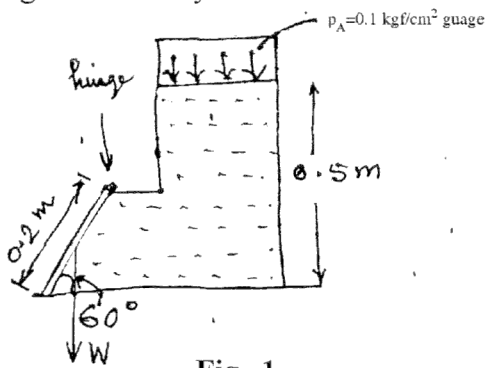

Fig. 1

(c) Under what condition Euler equation is applicable? What is the surface force in this equation? **9**

2 (a) Attempt any **two** parts of the following : 9

(i) Under what condition a gas can be treated as incompressible?

(ii) What is the difference between a barometer and a manometer?

(b) A box whose lower face (of 0.5 m^2 area) is parallel to the xy plane, has a force of 10 kgf acting on it as shown. The projection of the force on the xy plane makes an angle of 45^0 with the x axis. What are average stress acting on this face? 9

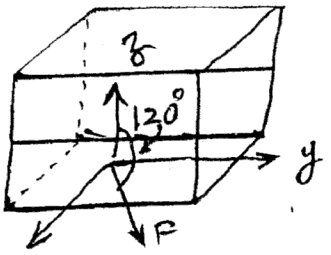

Fig. 2

(c) A cream separator is a cylindrical vessel which is rotated about a verticle axis through the centre. If the vessel is of 1m diameter and contains 750 liters of milk, find the smallest height the vessel should have so that it can be rotated at 100 rpm without spilling. What is the pressure at 0.25m and 0.5 m from the centre at the base of the vessel? Sp.gr. of milk is 1.08. 9

3 Do any **four** parts of the following :

(a) For the radial flow of water between the two circular discs shown, prove that the velocity Ur in proportional to $1/r$ 8

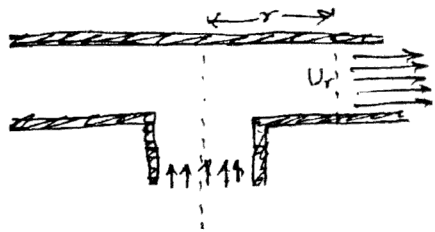

Fig. 3

(b) Can a rotameter be used horizontally? Give reason of your answer. **8**

(c) A firehose has a conical nozzle at its end. If the inlet and exit areas are A_1 and A_2 respectively ($A_1 > A_2$), find the direction in which a fireman will feel a force while holding the nozzle by the handle. Assme 'M' to be the mass flow rate of water flowing out which remains constant. **8**

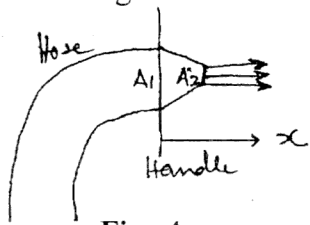

Fig. 4

(d) A cylindrical bucket of diameter 30 cm and height 45 cm is ascending from rest in the vertical direction at a constant acceleration of 1.4 m/s^2. A sand chute of diameter 2.5 cm directly above the bucket feeds sand at a constant velocity of 2 m/s into the bucket. Find the time required to fill the bucket. **8**

(e) For the velocity field $\vec{U} = 2y\vec{i} + \vec{j}$ find the equation of the stream line passing through the origin. Show that in this case the acceleration of a fluid element does not change with position and remains always in the same direction. **8**

(f) A venturimeter is to be installed in a schedule 40, 10 cm line to measure the flow of water. The maximum flow rate is expected to be 1230 liters/min at 16°C. The 127 cm manometer used to measure the differential pressure is to be filled with mercury and water is to fill the leads above the mercury surfaces. The water temperature is to be 16° C throughout. What throat diameter should be specified for the venturi, to the nearest 0.5 cm and what will be the power required to run the meter at full load? Sp. gr. of mercury is 13.6. **8**

4 Do any **four** parts of the following :

(a) The pressure just at the discharge of a centrifugal pump is 15 kgf/cm^2 guage. The discharge rate is 200 liter/min. The discharge pipe is vertical and has a diameter of 5cm. If the pump delivers water into the atmosphere, find the height to which the water can be lifted when the pipe is smooth. **8**

(b) What is priming of a centrifugal pump? How this type of problem is overcome? **8**

(c) Explain the principle and working of a centrifugal pump with the help of a neat sketch. **8**

(d) What is Stoke's law and in what range of Reynold's number it is valid? **8**

(e) Describe static bed, boiling bed and continuous fluidization. **8**

(f) Explain, why fluidized bed reactors are preferred over fixed bed reactors for heterogeneous reactions. **8**