BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : III**
BRANCH: CIVIL **SESSION : MO/19**

SUBJECT: CE203 FLUID MECHANICS

TIME: 3 HOURS **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

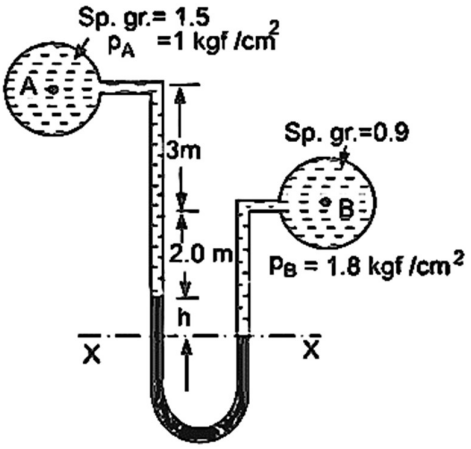
Q.1(a) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 metre per sec requires a force of 98.1 N to maintain the speed. Determine: [3]
(i) The dynamic viscosity of the oil in poise, and
(ii) The kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95.

Q.1(b) Calculate the capillary rise in a glass tube of 3.0 mm diameter when immersed vertically in (i) water, and (ii) mercury. Take surface tensions for mercury and water as 0.0725 N/m and 0.52 N/m respectively in contact with air. Specific gravity for mercury is given as 13.6. [3]

Q.1(c) A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.1 cm. Both cylinders are 25 cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. if a torque of 12.0 Nm is required to rotate the inner cylinder at 100 rpm, determine the viscosity of the fluid. [4]

Q.2(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 are 4 m and 1.5 m respectively. The circular plate has a concentric circular hole of diameter 1.5 m. Determine the total pressure on one face of the plate and position of the centre of pressure. [3]

Q.2(b) A differential manometer is connected at the two points A and B of two pipes as shown in figure. The pipe A contains a liquid of specific gravity = 1.5 while pipe B contains a liquid of specific gravity = 0.9. The pressures at A and B are 1 kgf/cm^2 and 1.80 kgf/cm^2 respectively. Find the difference in mercury level in the differential manometer. [3]



Q.2(c) A fluid flow field is given by V = $x^2yi + y^2zj - (2xyz + yz^2)k$. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2, 1, 3). [4]

Q.3(a) A nozzle of diameter 20 mm is fitted to a pipe of diameter 40 mm. Find the force exerted by the nozzle on the water which is flowing through the pipe at the rate of 1.2 m^3/minute. [2]

Q.3(b) Derive equation of motion for vortex flow. Also derive equations of motion for both free and forced vortex flow. [4]

Q.3(c) The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness k. Using Buckingham's π-theorem, obtain an expression for Δp. [4]

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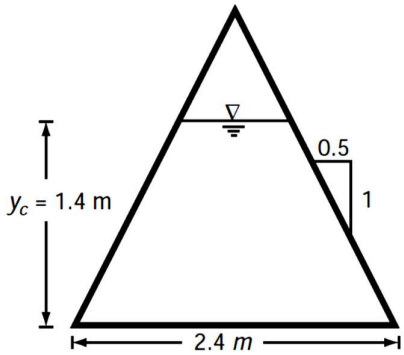
Q.4(a) Water flows in a Δ shaped channel as shown below. Critical depth is known to occur at a section in this channel. Estimate the discharge and specific energy corresponding to an observed critical depth of 1.4 m. [2]



Q.4(b) What are different classifications of water surface profiles? Show them with neat sketches. [4]

Q.4(c) Derive the expressions for the parameters of a most efficient trapezoidal channel section. Hence determine the normal depth, bed width and sides slopes of a most efficient trapezoidal channel section to carry a discharge of 25 m^3/s. The longitudinal slope of the channel is to be 0.0009 and Manning's n is equal to 0.015. [4]

Q.5(a) A three stage centrifugal pump has impellers 40 cm in diameter and 2 cm wide at outlet. The vanes are curved back at the outlet at 45° and reduce the circumferential area by 10%. The manometric efficiency is 90% and the overall efficiency is 80%. Determine the head generated by the pump when running at 1000 rpm delivering 50 litres per second. What should be the shaft horse power? [5]

Q.5(b) Define the specific speed of a turbine? Derive an expression for the specific speed. What is the significance of the specific speed? [5]

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