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

CLASS: BE **SEMESTER : IV**
BRANCH: CIVIL **SESSION : SP/19**

SUBJECT: CE4007 FLUID MECHANICS - I

TIME: 3 Hours **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
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) Differentiate between viscosity and kinematic viscosity. [2]
Q.1(b) Derive the expression for internal pressure inside a liquid droplet. [4]
Q.1(c) What is capillarity? Derive the expression for capillary rise in a glass tube when it is partially immersed in a liquid. [6]

Q.2(a) What is Archimedes principle? [2]
Q.2(b) Describe briefly the measurement of pressure at a point using a U-tube simple manometer. [4]
Q.2(c) A 3.6 m X 1.5 m wide rectangular gate MN is vertical and is hinged at point 0.15 m below the centre of gravity of the gate. The total depth of water is 6 m. What horizontal force must be applied at the bottom to keep the gate closed? [6]

Q.3(a) What is a flownet? [2]
Q.3(b) Define the velocity potential function and show that it satisfies the Laplace equation. [4]
Q.3(c) For the following flow, find the equation of the streamline passing through (1, 1). [6]

$$V = 3xi - 3yj$$

Q.4(a) What is a pitot tube? Where is it used? [2]
Q.4(b) Discuss briefly about the kinetic energy correction factor. [4]
Q.4(c) A pipeline is 15 cm in diameter and is at an elevation of 100.00 m at Section – A. At Section – B it is at an elevation of 107.00 m and has a diameter of 30 cm. When a discharge of 50 lit/s of water is passed through this pipe, the pressure at Section – A is observed to be 30 kPa. The energy loss in the pipe is 2 m. Calculate the pressure at B when the flow is from (i) A to B (ii) B to A. [6]

Q.5(a) What is Reynold's experiment? [2]
Q.5(b) Discuss briefly about the laminar flow through porous media. What is Darcy's law? [4]
Q.5(c) Two parallel plates kept 0.1 m apart have laminar flow of oil between them with a maximum velocity of 1.5 m/s. Calculate the discharge per metre width, shear stress at plates, the difference in pressure between two points 20 m apart, velocity gradient at the plates, and velocity at 0.02 m from the plate. Assume viscosity of oil as 2.45 N-s/m^2. [6]

Q.6(a) Why is the golf ball dented? [2]
Q.6(b) Discuss briefly the formation of boundary layer over a long flat plate. [4]
Q.6(c) The velocity distribution in boundary layer is given as [6]

$$\frac{v}{V} = \frac{3}{2}\eta - \frac{1}{2}\eta^2$$

Where, $\eta = \frac{y}{\delta}$

Compute $\frac{\delta^*}{\delta}$ and $\frac{\theta}{\delta}$

Q.7(a) What are the applications of dimensional analysis? [2]
Q.7(b) Describe briefly the Buckingham π method of dimensional analysis. [4]
Q.7(c) Calculate total drag, shear drag, and pressure drag exerted on 1 m length of an infinite circular cylinder which has a diameter equal to 3 cm. Air of density 1.236 kg/m^3 is flowing past the cylinder with a velocity of 3.6 m per minute. Assume total drag coefficient as 1.4 and shear drag coefficient as 0.185. [6]

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