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

CLASS: BE **SEMESTER: IV**
BRANCH: BIOTECHNOLOGY **SESSION : SP/2019**

SUBJECT : BT4021 CHEMICAL ENGINEERING II

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

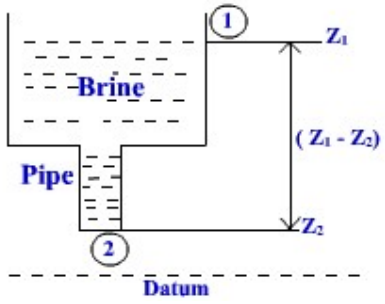
Q1 (a) Water is flowing through a pipe of 1.5 km long with a velocity of 1.5 m/s. What should be the diameter of the pipe, if the loss of head due to friction is 10 m. Take coefficient of friction as f=0.01. [2]

(b) A fluid of viscosity 8 poise and specific gravity 1.2 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is 210 N/m^2. Find (i) The pressure gradient (ii) The average velocity (iii) Reynold's number of the flow. [3]

Q2 Water is pumped at a rate of 36 m^3/h from a tank 2 m below the pump to an overhead pressurized vessel 10m above the pump. The pressure values at the point of suction from the bottom tank and at the discharge point to an overhead vessel are 120 kPa and 240 kPa. All pipes in the system have same diameter. Neglecting frictional losses, What is the power required (Kw) to deliver the fluid? [5]

Q3 (a) A pipe carrying water experiences a sudden reduction in area. The area at point (1) is 0.002 m^2 and at point (2) it is 0.001 m^2 . The pressure at point (2) is 500 kPa and the velocity is 8 m/s. The loss coefficient K is 0.4. The density of water is 1000 kg/m^3 . Calculate the following. i. The mass flow rate. ii. The pressure at point (1) [2]

(b) Brine is to be drained from the bottom of a large tank through a pipe. The drawn pipe ends at a point 10m below the surface of the brine in the tank. Considering a streamline starting at the surface of the brine in the tank and passing through the centre of the drain line to the point of discharge, calculate the velocity of flow along the streamline at the point of discharge from the pipe. [3]



Q4 (a) Compare Hagen-Poiseuille and Darcy- Weisbach equation. [2]

(b) At a point in the pipeline the diameter is 300 mm, the velocity of water is 3 m/s and the pressure is 420 kN/m^2. At a point 16m downstream the diameter gradually reduces to 150 mm. Neglecting the losses find the pressure at this point, if the pipe is (i) Horizontal (ii) Vertical with flow downward. [3]

Q5 (a) Determine the Mach number when an aeroplane is flying is at 1000 km/hr through still air having pressure of 70 kPa and temperature -15 C. Determine also the pressure and temperature at the stagnation point on the nose of the aeroplane. [2]

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(b) A gas is flowing through a horizontal pipe at a temperature of 4 C. The diameter of the pipe is 8 cm and the pressure is 40.3×10^4 N/m^2. The diameter of the pipe changes from 8cm to 4 cm at another end of the pipe where the pressure is 30.3×10^4 N/m^2. Find the velocities of the gas at these two different sections assuming as isothermal process. R = 287.14 Nm/ kg K. [3]

Q6 (a) Write about lift and drag force. [2]

(b) A flat plate 2m x 2m moves at 40 km/hr in a stationary air of density 1.2 $kg/m^{3.}$ If the coefficient of drag and lift are 0.1 and 0.5 respectively, [3]
i. The lift force ii. The drag force iii. The resultant force iv. The power required to keep the plate in motion

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