COURSE CODE: 18B11CE 412

COURSE NAME: Fluid Mechanics

MAX. MARKS: 25

COURSE CREDITS: 3

MAX. TIME: 1 Hour 30 Min

Note: All questions are compulsory. Marks are indicated against each question in brackets. This question paper contains two printed pages.

Q1. **(a)** Differentiate between laminar flow and turbulent flow with suitable example. [1]

(b) Prove that equipotential line and stream line are mutually orthogonal. [2]

Q2. The velocity components in a two-dimensional flow field for an incompressible fluid are expressed as:

$$u = \frac{y^3}{3} + 2x - x^2y \quad , \quad v = xy^2 - 2y - \frac{x^3}{3}$$

(a) Is the flow physically possible? If so obtain an expression for the stream function. [1+2]

(b) Find out the angular velocity? is the flow an irrotational flow. [1]

Q3. The diameter of a small piston and a large piston of a hydraulic jack are 2 cm and 10 cm respectively. A force of 60 N is applied on the small piston. Find the load lifted by the large piston? Both pistons are at same level and density of fluid in the jack is 1000 kg/m^3. [3]

Q4. A rectangular box with base 2.5 m x 4.0 m is filled with kerosene oil of specific gravity 0.8 to a depth of 6 m. On which surface of box do you expect more pressure? Determine the resultant pressure and its point of application on the base and on each vertical face of the box. [3]

Q5. A 40 cm diameter pipe, conveying oil (sp. Gravity =0.8), branches into two pipes of diameter 30 cm and 20 cm respectively. If the average velocity in the 40 cm diameter pipe is 3 m/sec, find the discharge and mass rate of flow of oil in this pipe. Also determine the velocity in 20 cm pipe if the average velocity in 30 cm dia pipe is 2 m/sec. [3]

Q6. A pipe converges uniformly from 0.4 m diameter to 0.2 m diameter over a length of 2 m. Discharge through the pipe is 20 litre/sec. Generate the equation for convective acceleration and find the convective acceleration at the middle of pipe.

[4]

Q7. Compute the horizontal and vertical component of total force acting on a gate (curved surface AB), which is in the form of quadrant of a circle of radius 3 m (shown in figure). Take width of gate 2 m.

[5]