B.E. (Aeronautical Engineering) Semester Third (C.B.S.)

Fluid Mechanics & Machinery

Paper - III

P. Pages : 3 **KNT/KW/16/7260**

Time : Three Hours * 0 9 3 6 * Max. Marks : 80

Notes : 1. All questions carry marks as indicated.

1. a) Explain Newton's law of viscosity and give examples of its application. Explain importance of viscosity in fluid motion. **6**

b) An oil film thickness 1.5 mm is used for lubrication between a square plate of size 0.9 m x 0.9 m and an inclined plane having an angle of inclination 20º. The weight of the square plate is 390 N and it slides down the plane with a uniform velocity of 0.2 m/s Find the dynamic viscosity of the oil. **7**

OR

2. a) State Pascal law and hydrostatic law. Distinguish between manometer and mechanical gauges. **6**

b) A differential manometer is connected at the two points A and B as shown in fig. 1 At B air pressure is 7.848 N/cm^2 (abs) Find the absolute pressure at A. **7**

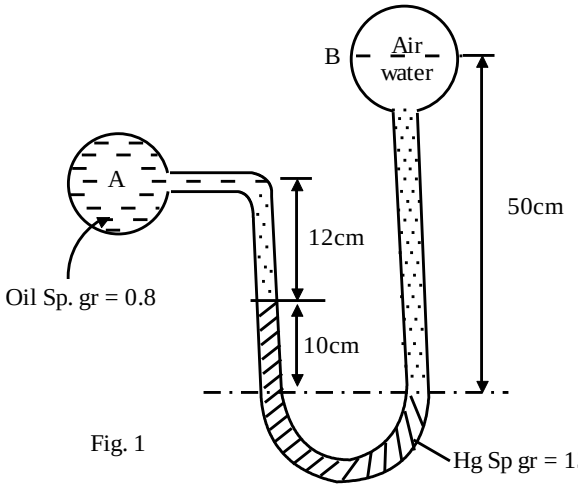

Fig. 1

3. a) Differentiate between : **6**

i) Stream function and velocity potential function

ii) Stream line and streak line and

iii) Rotational and irrotational flows.

b) The velocity vector in a fluid flow is given by **7**

$V = 2x^3\hat{i} - 5x^2y\hat{j} + 4t\,k$

Find the velocity and acceleration of a fluid particle at (1, 2, 3) at time t = 1.

OR

4. a) Derive Bernoulli's equation for the flow of an incompressible fluid. Derive equation of flow through venturimeter from it. **7**

b) A pipe line carrying oil of specific gravity 0.8, changes in diameter from 300 mm at a position A to 500 mm diameter to a position B which is at a 5 m higher level. It the pressure at A and B are 19.62 N/cm^2 and 14.91 N/cm^2 respectively, and the discharge is 150 litres/s, determine the loss of head and direction of flow. **6**

5. a) Distinguish between laminar flow and turbulent flow. Prove that loss of pressure head in laminar flow through a pipe is directly proportion to velocity. **7**

b) Water is flowing between two large parallel plates which are 2 mm apart. Determine : **7**
i) maximum velocity
ii) the pressure drop per unit length and
iii) the shear stress at the walls of the plate if the average velocity is 0.4 m/s
Take viscosity of water as 0.01 poise.

OR

6. a) Explain the phenomena of boundary layer formation. Define the following terms : **7**
i) Laminar boundary layer
ii) Turbulent boundary layer
iii) Boundary layer thickness
iv) Laminar sublayer

b) A jet plane which weight 29.43 kN and having a wing area of 20 m^2 flies at a velocity of 950 km/hr, when the engine delivers 7500 kw power. 65% of the power overcomes the drag resistance of the wing. Calculate the coefficients of lift and drag for the wing. The density of the atmospheric air is 1.21 kg/m^3. **7**

7. a) Differentiate between : **6**
i) The impulse and reaction turbines
ii) Radial and axial flow turbines
iii) Kaplan and propeller turbines

b) A pelton wheel is having a mean bucket diameter of 0.8 m and is running at 1000 rpm. The net head on the Pelton wheel is 400 m. If the side clearance angle is 15º and discharge through nozzle is 150 litres/s. **7**
Find :
i) Power available at the nozzle and
ii) Hydraulic efficiency of the turbine.

OR

8. a) Describe governing mechanism of pelton turbine with help of a neat sketch. **5**

b) A 137 mm diameter jet of water issuing from a nozzle impinges on the buckets of a pelton wheel and the jet is deflected through an angle of 165º by the buckets. The head available at the nozzle is 400 m. Assuming co-efficient of velocity as 0.97, speed ratio as 0.46 and reduction in relative velocity while passing through buckets as 15%. **8**
Find :
i) The force exerted by the jet on the bucket in tangential direction
ii) The power developed.

9. a) Describe with the help of neat sketch, why draft tube used in reaction turbine. **4**

b) The inward flow reaction turbine has external and internal diameters as 0.9 m and 0.45 respectively. The turbine is running at 200 rpm and width of turbine at inlet is 200 mm. The velocity of flow through the runner is constant and is equal to 1.8 m/s. The guide blades make an angle of 10º to the tangent of the wheel and the discharge at the outlet of the turbine is radial. Draw the velocity triangles and determine : **9**

i) Power developed by the turbine
ii) Hydraulic efficiency of the turbine.

10. a) Explain with help of neat sketch, the working of Kaplan turbine and also draw the velocity triangles. **5**

b) A Kaplan turbine of runner diameter of 4.5 m is running at 40 rpm. The guide blade angle at inlet is 145º and runner blade angle at outlet is 25º to the direction of vane. The axial flow area of water through runner is 25 m^2. If the runner blade angle at inlet is radial. **8**
Determine :

i) Hydraulic efficiency of the turbine
ii) Discharge through turbine
iii) Power developed by the runner and
iv) Specific speed of the turbine

11. a) Differentiate between the volute casing and vertex casing for centrifugal pump. **4**

b) What is the minimum speed for starting the centrifugal pump ? **2**

c) A centrifugal pump is running at 1000 rpm. The outlet vane angle of the impeller is 30º and velocity of flow at outlet is 3 m/s. The pump is working against a total head of 30 m and the discharge through the pump is 0.3 m^3/s. If the manometric efficiency of the pump is 75%, determine : **8**

i) the diameter of the impeller, and
ii) the width of the impeller at outlet

OR

12. Write a short on the following **any three.** **14**

a) Gear pump

b) Sliding vane pumps

c) Mixed flow pumps

d) Selection of pump

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