Time: 3 hours Marks: 80

N. B.: 1. Question **No. 1** is compulsory.
2. Attempt any **Three** from remaining questions.
3. Figures to the right indicate full marks.
4. Assume suitable data whenever necessary.

Q.1 Attempt **any Four**: **(4x5 = 20)**

a) Explain in brief efficiencies of a centrifugal pump.

b) Obtain the equation to the streamlines for the velocity field given as:

$$V = 2x^3i - 6x^2j$$

c) The diameter of pipe at the section 1-1 and 2- 2 are 200 mm and 300 mm respectively. If the velocity of water flowing through the pipe at section 1-1 is 4 m/s, find (i) discharge through the pipe and (ii) velocity of water at section 2-2.

d) A geometrically similar model of an air duct is built to 1:25 scale and tested with water which is 50 times more viscous and 800 times denser than air. When tested under dynamically similar conditions, the pressure drop is 2 bar in the model. Find the corresponding pressure drop in the full scale prototype.

e) Oil of absolute viscosity 1.5 poise and density 848.3 kg /m^3 flow through a 30 cm I.D. pipe. If the head loss in 3000 m length of pipe is 20 m, assuming laminar flow, determine (i) the velocity (ii) Reynolds number and (iii) Friction factor.

Q.2

a) Find an expression for the head lost due to friction in suction and delivery pipes. **(07)**

b) Explain the terms buoyancy and centre of buoyancy. **(05)**

c) A 45° reducing bend is connected in a pipe line, diameter at the inlet and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 N/cm^2 and rate of flow of water is 600 Litres/s. **(08)**

Q3

a) Two fixed parallel plates kept 8 cm apart have laminar flow of oil between them with a maximum velocity 1.5 m/s.Taking dynamic viscosity of oil to be μ = 2.0 Ns/m^2, compute: (i) the discharge per metre width (ii) the shear stress at the plates (iii) the pressure difference between two points 25 m apart (iv) velocity at 2 cm from the plate (v) the velocity gradient at the plates end. **(08)**

b) A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 cumec. If the efficiency is 90 % determine: (i) Specific speed of Machines, (ii) power generated. **(04)**

c) An outward flow reaction turbine has internal and external diameter of the runner as 0.5 m and 1.0 m respectively. The guide blade angle is 15 ° and velocity of flow through the runner is constant and equal to 4 m/s. If the speed of the turbine is 250 r.p.m., head on the turbine is 10 m and the discharge at outlet is radial, determine: (i) The runner vane angle at inlet and outlet,(ii) work done by the water on the runner per second per unit weight of water striking per second,(iii) Hydraulic efficiency. **(08)**

Q.4

a) Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity ω, speed of advance V,diameter D,dynamic viscosity μ, mass density ρ ,elasticity of the fluid medium which can be denoted by the speed of sound in the medium C. **(12)**

b) Derive an expression for the velocity distribution of viscous fluid flow through an conduits. **(08)**

Q.5

a) The following data relate to a pelton wheel: **(10)**

Head	... 72 m
Speed of turbine	...240 r.p.m
Shaft power of the wheel	...115 Kw
Speed ratio	...0.45
Co-efficient of velocity	...0.98
overall efficiency	...85%

Design the Pelton wheel.

b) A horizontal venturi-meter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of sp.gr.0.8.The discharge of the oil through venturi-meter is 60 litres/s. Find the reading of the oil- mercury differential manometer. Take $C_d = 0.98$ **(06)**

c) Differentiate between: **(04)**

(i) Compressible and incompressible flow and

(ii) Stream line and Streak line.

Q.6

a) A single acting reciprocating pump having plunger diameter 12.5m and stroke length 30cm is drawing water from a depth of 4 m from the axis of the cylinder at 30rpm and delivers to a height of 22m from the axis of the cylinder. the length and diameter of suction pipe is 9m and 7.5cm respectively. the length and diameter of delivery pipe is 30m and 7.5cm respectively. Determine (i) the pressure head on the piston at the beginning and end of the both suction and delivery strokes. (ii) the power required to drive the pump. Take atmospheric pressure as 10.3m of water. **(10)**

b) Derive an expression for the meta centric height of a floating body. **(10)**

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