4E1233

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B. Tech. IV - Sem. (Main) Exam., May - 2019
PCC Automobile Engineering
4AE4 – 05 Fluid Mechanics and Fluid Machines
AE, ME

Time: 3 Hours **Maximum Marks: 160**

Instructions to Candidates:

Attempt all ten questions from Part A, five questions out of seven questions from Part B and four questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×3=30]**

All questions are compulsory

Q.1 What do we mean by Newtonian Fluid? Explain Newton's Law of Viscosity.

Q.2 What will be the effect of Temperature and pressure on the viscosity of the liquid and gas? Also give reason for the effect.

Q.3 What is the cause of Surface Tension? If P is the pressure within a spherical droplet, what will be the gauge pressure within a bubble of the same size and same fluid?

Q.4 On which different basic laws of science continuity equation, Euler's equation and Bernoulli's equation are based.

Q.5 A garden hose of 30mm diameter then determine limiting average velocity or laminar flow.

Q.6 What do you understand by the terms major energy losses and minor energy losses in a pipe? https://www.rtuonline.com

Q.7 Explain the use of foot valve in a centrifugal pump.

Q.8 Explain different heads of a centrifugal pump.

Q.9 State physical significance of Reynolds number.

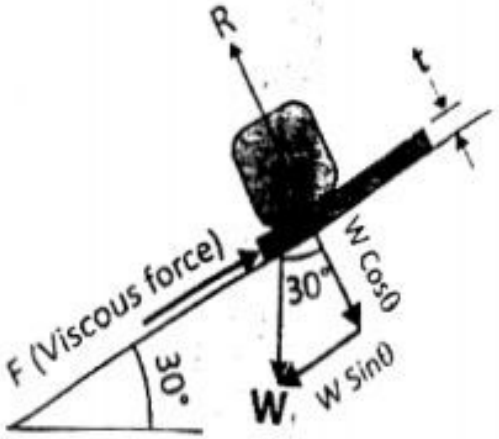
Q.10 What are the advantages and disadvantages of Francis turbine over a pelton wheel?

PART – B

(Analytical/Problem solving questions) **[5×10=50]**

Attempt any five questions

Q.1 A square block weighing 1kN and 100mm on an edge slides down an incline on a film of oil 5.0μm thick. Assuming a linear velocity profile in the oil, what is the terminal speed of the block? The viscosity of the oil is 5×10^{-3} (N – s/m^2). [10]



Q.2 (a) What will be the necessary and sufficient condition of floating body to be stable? [5]

(b) Explain center of pressure and center of gravity, for a body immersed in liquid. [5]

Q.3 In case of pressure force acting on vertical submerged surface, the centre of pressure, point C, always lies below the centroid of the area, G. Explain analytically. [10]

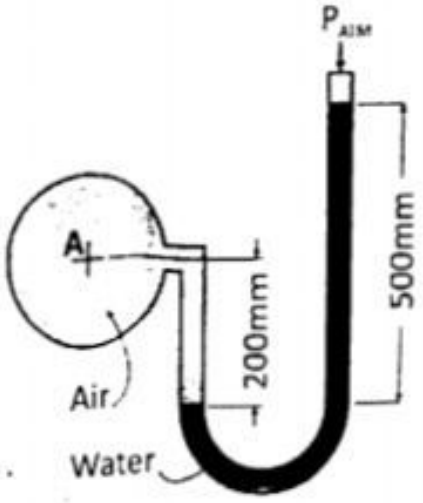
Q.4 (a) Derive expression for hydrostatic law for variation of pressure with depth. [5]

(b) In the figure shown below, air is contained in the pipe and water is the manometer liquid. Find pressure at 'A' in [5]

(1) m of water

(2) Pascal

(3) Absolute



Q.5 (a) What is Dimensional Homogeneity? Check Dimensional Homogeneity of Bernoulli relation $p_0 = p + \frac{1}{2}\rho V^2 + \rho gz$ where [5]

p_0 = stagnation pressure

p = pressure in moving fluid

V = velocity

ρ = density

Z = altitude

g = gravitational acceleration

(b) What will be the expression for the power P, developed by a pump when P depends upon the head H, the discharge Q and specific weight w of the fluid? [5]

Q.6 A jet of water 10cm in dia, velocity 20m/s strike a stationary flat plate which is 30° incline to the axis of the stream. [10]

(1) Find force by jet on plate.

(2) Flow rate of water

(3) Ratio of discharge

Q.7 (a) What is meant by the term unit quantities for a turbine? Define and derive the relation for [5]

(1) Unit speed

(2) Unit discharge

(3) Unit power

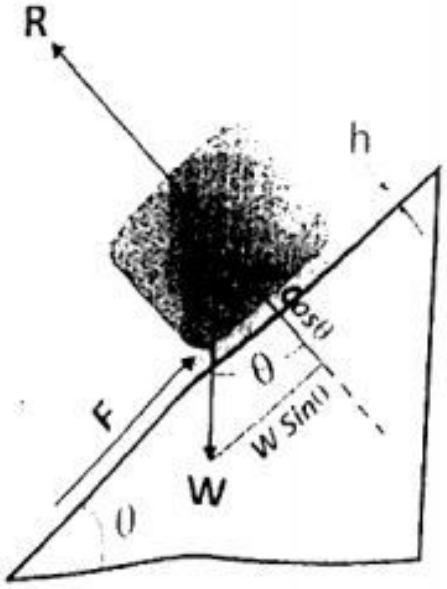
(b) A turbine develops 10,000kW power when running at 10rpm under the head of 30m. if the head of turbine is reduced to 15 meter, what will be the speed and power developed by the turbine. [5]

PART – C

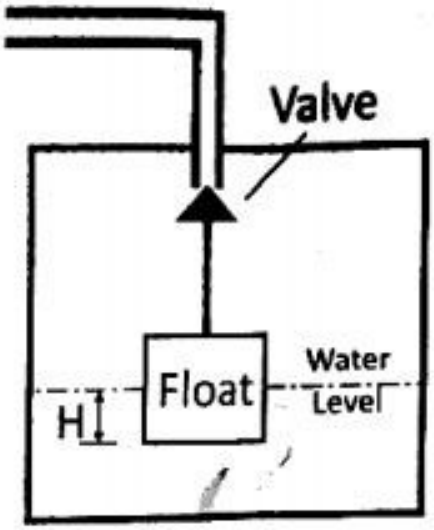
(Descriptive/Analytical/Problem Solving/Design Questions) **[4×20=80]**

Attempt any four questions

Q.1 (a) A block of weight W slides down an inclined planer (θ) while lubricated by a thin film of oil (viscosity = μ), as in Fig. below. The film contact area with box is A and its thickness is h. Assuming a linear distribution in the film, derive an expression for the "terminal" (zero – acceleration) velocity V of the block. [10]



(b) A float of cubical shape has sides of 10cm. The float valve just touches the valve seat to have a flow area of 0.5cm^2 as shown in the given figure. If the pressure of water in the pipeline is 1 bar, the rise of water level h in the tank to just stop the water flow will be : [10]



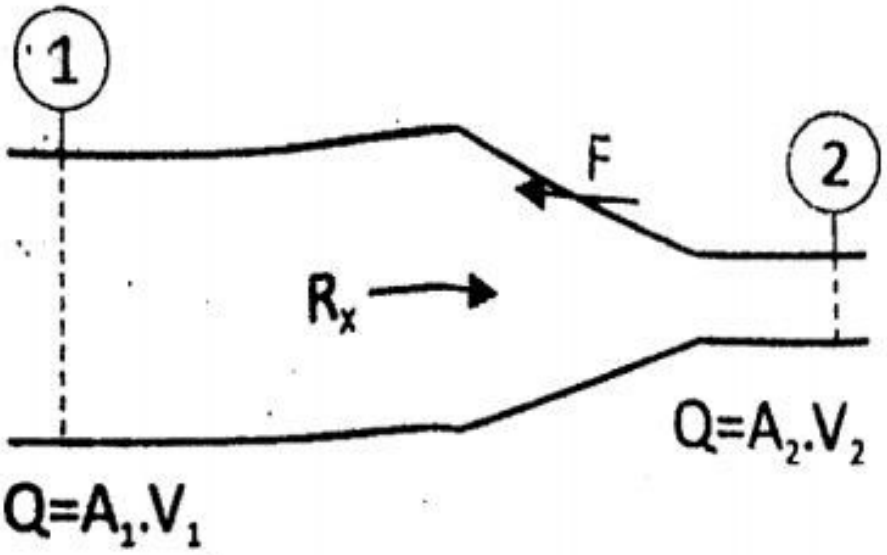
Q.2 (a) What is buoyant force and differentiate center of buoyancy from center of gravity? [5]

(b) Explain vapor pressure and cavitation, and how they both are related, also tell that how cavitation can be harmful to hydraulic machines. [5]

(c) A tapered section in a horizontal pipeline reduces the diameter from 600mm to 450mm in the direction of flow. If the flow rate is 750 L/s and the upstream pressure is 300kN/m^2, calculate : [10]

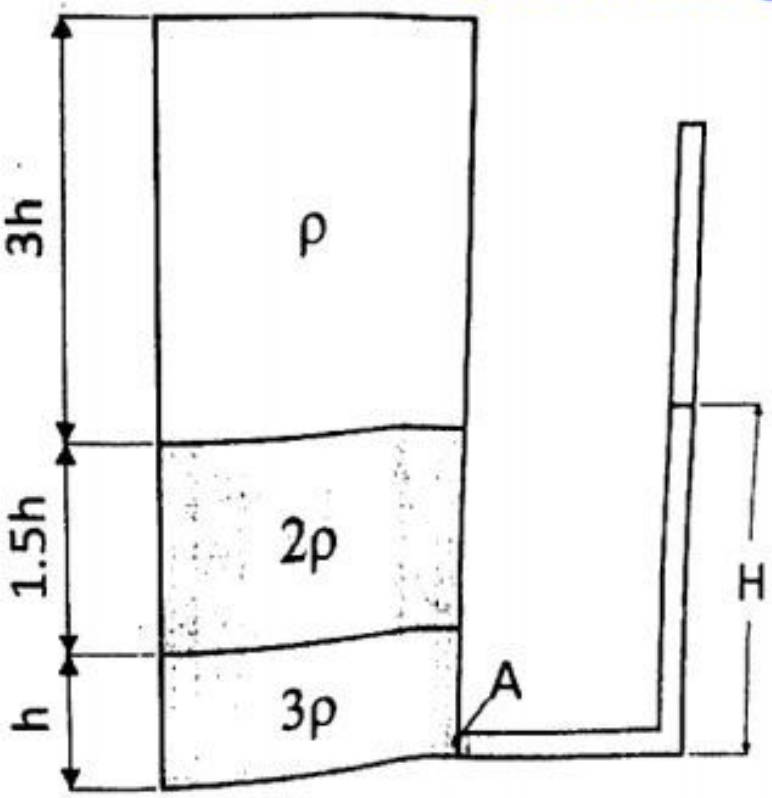
(i) The downstream pressure

(ii) The magnitude and direction of the force on the taper



Q.3 (a) Explain the Euler's equation of motion, and how we can derive Bernoulli's equation from it. https://www.rtuonline.com [10]

(b) Three immiscible liquids of specific densities ρ, 2ρ and 3ρ are kept in a jar. The height of the liquids in the jar and at the piezometer fitted to the bottom of the jar is as shown in the given figure. The ratio H/h is? [10]



Q.4 (a) For the flow through pipes, derive the expression for Darcy Weisbanch formula to calculate Major Losses. [10]

(b) Find the head lost due friction in a pipe of diameter 300mm and length 50m, water velocity in the pipe is 3m/s., kinematic viscosity $\nu = 0.01$ stoke, using Darcy Weisbach formula. [10]

Q.5 (a) What is the difference between model and prototype, and how similarity is established between them? [8]

(b) State Froude's Model Law. [6]

(c) In the model test of a spillway the discharge and velocity of flow over the model were $2m^3/s$ and 1.5m/s respectively. Calculate the velocity and discharge over the prototype which is 36 times the model size. [6]
