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Date :- 05/04/202

To.
Principal sir (G.M. Vedak Collage Tala)
subject :- Application for Rechecking of second Link Response

Respected sir
I am Yogesh Gangaram Pardhi studying in T.E. CIVIL. I am writting this Application because First link of Applied hydraulic paper is not recieved in our college due to technical problem. But I have given IInd link paper i.e. (written Paper) So I have requested to check my IInd Paper & on that basis please give me some positive response.
So I am requesting to give me response as early as possible.

Your's faithfully
Pardhi

Paper :- Applied Hydraulic
Seat No :- 12022528
Date :- 12 Jan 2021 .

G.M. Vedak Institute of Technology Tala Raigad

Principal
G.M.Vedak Institute of Technology
Tala, Raigad

APPLIED HYDRAULICS

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Total Marks:- 50

CE - AH Sem-VI Exam JAN 2021

Paper-II

Image title

Q2	Sub question A & B Carries 10 marks each
A	Solve any Two 5 marks each
i.	A centrifugal pump has a 300 mm diameter impeller & an outlet width of 50 mm. It runs at 1000rpm delivering water against a head of 15 meters. The vanes are curved backwards at an angle of 30° with the periphery at outlet. The manometric efficiency of the pump is 92%. Calculate the discharge.
ii.	A 150 mm diameter jet moving at 30 m/s impinges on a series of a vanes moving at 15m/s in the direction of the jet. The jet leaves the vanes at 60° with the direction of motion of the vanes, Calculate the force exerted by the jet in the direction of motion of the vanes & work done by the jet per second
iii.	A 3 m wide rectangular channel conveys 12 cumecs of water at a depth of 2m. Calculate i) Specific energy of flowing fluid; ii) Critical depth, critical velocity and the minimum specific energy; iii) Froude's Number.
B	Solve any One 10 marks each
i.	A 45° reducing bend is connected in a pipeline, the diameters at the inlet & outlet of the bend being 400 mm & 200 mm respectively. If the rate of flow of water is 0.4 cumecs & the pressure intensity at inlet to bend is 100 kPa, find the force exerted by water on the bend.
ii.	The lift force F_l on an air foil depends upon the mass density ρ of the medium, velocity of the flow v. a characteristic length l, the viscosity μ and the angle of attack α. Obtain an expression for the lift force.

Q3	Sub question A & B Carries 10 marks each
A	Solve any Two 5 marks each
i.	A pelton wheel 2.45 m in diameter works under a head of 370 m. Find the power supplied to the turbine and its speed. Assume outlet relative velocity is reduced by 10 %. Peripheral velocity as 40.045 m/s. Coefficient of velocity as 0.98, outlet vane angle as 20°. Jet diameter as 180 mm
ii.	Two geometrically similar pumps are run at the same speed of 1000 rpm. One pump has an impeller diameter of 0.30 m & lifts water at the rate of 20 liters per second against a head of 15 m. Determine the head & impeller diameter of other pump to deliver half the discharge.
iii.	Find the slope at which a circular sewer of 1.50 m diameter should be laid to provide the maximum velocity at a discharge of 0.75 cumecs. Take N =0.015
B	Solve any One 10 marks each
i.	The loss of energy head in a hydraulic jump is 4.25 m. The Froude number just before the jump is 7.50. Find i) discharge per meter width of the channel ii) depths before & after hydraulic jumps iii) Froude number after the jump iv) Percentage loss of energy head due to the jump.
ii.	The inner & outer diameters of an inward flow reaction turbine are 1.25 m & 1.60 m respectively. The vane angle at the inlet is 95°, while the guide blade angle is 22°30'. The axial depth of the wheel of inlet & outlet is 0.50 m. The turbine runs at 150 rpm. Determine i) The discharge of the turbine; ii)The outlet vane angle; iii) Shaft power.

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Q.2) A)

iii) $Q = 12\ m^3/s$

$b = 8m$

$h = 2m$

Ans: $q = Q/b = \frac{12}{8} = 4\ m^2/s$

velocity $v = \frac{Q}{A} = \frac{12}{8\times2} = 2\ m/s$

i) specific energy, $E = h + \frac{v^2}{2g}$

$2 + \frac{2^2}{2g} = 2.20m$

ii) critical depth, $h_c = \left(\frac{q^2}{g}\right)^{1/3}$

$= \left(\frac{4^2}{9.81}\right)^{1/3} = 1.17m$

iv) critical velocity ::

$V_c = \sqrt{g \times h_c} = \sqrt{9.81\times1.17}$

$= 3.38\ m/s$

v) min specific energy ::

$E_{min} = \frac{3h_c}{2} = \frac{3\times1.17}{2} = 1.755m$

vi) froude's no :: $\frac{V_c}{\sqrt{gh_c}}$

$= \frac{3.37}{\sqrt{9.81\times1.17}} = 0.99$ froude's no.

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Q.2.

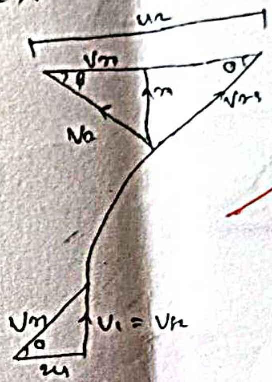
i) $D_2 = 0.8m$

$B_2 = 0.05m$

$N = 1000$ r.p.m

$H_m = 15m$

$\eta_m = 92\%$



$u_2 = \frac{\pi D_2 N}{60} = 15.71\ m/s$

$\eta_m = \frac{H_m \times g}{V_{w2}\times u_2}$

$\frac{15\times9.81}{V_{w2}\times15.71}$

$V_{w2} = 10.18\ m/s$

$\tan\phi = \frac{V_{f2}}{u_2 - V_{w2}}$

$\therefore \tan 80^\circ = \frac{V_{f2}}{15.71 - 10.18}$

$V_{f2} = 0.19\ m/s$

$\therefore Q = \pi \times D_2 \times B_2 \times V_{f2}$

$= \pi \times 0.3 \times 0.05 \times 3.19$

$\boxed{Q = 0.15\ m^3/sec}$

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Q. 3)

ii) The lift force on elemental area

= force due to pressure in the direction perpendicular to the direction of motion + force due to shear stress in the direction perpendicular to the direction of motion.

$= -p\,dA \sin\theta + \tau_0 dA \sin(90^\circ - \theta) = -p\,dA \sin\theta + \tau_0 dA \cos\theta$

Negative sign is taken with pressure force as it is acting in the downward direction while shear force is acting vertically up.

$\therefore$ Total lift, $F_L = \int \tau_0 dA \cos\theta - \int p\,dA \sin\theta$

$= \int \tau_0 \cos\theta\, dA - \int p \sin\theta\, dA$

The drag and lift for a body moving in a fluid of density ρ, at a uniform velocity U are calculated mathematically, as

$F_D = C_D A \frac{\rho U^2}{2}$

$F_L = C_L A \frac{\rho U^2}{2}$

where C_D = co-efficient of drag.

C_L = co-efficient of lift,

A = Area of the body which is the projected area of the body perpendicular to the direction of flow.

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= Largest projected area of the immersed body.

Then resultant force on the body $F_R = \sqrt{F_D^2 + F_L^2}$

The equation and which give the mathematical expression for drag and lift are derived by the method of dimensional analysis.

Q. 3 A)

ii) $D_1 = 0.3\ m$, $Q_1 = 20\ l/s = \frac{20}{1000} = 0.02\ m^3/s$

$H_1 = 15\ m$

$Q_2 = \frac{Q_1}{2} = \left(\frac{0.02}{2}\right) = 0.01\ m^3/s$

i) Head of pump :-

He : for similar pumps, head coefficient $K_H = \frac{H}{D^2 N^2}$ must be equal.

$\frac{H_1}{D_1^2 \cdot N^2} = \frac{H_2}{D_2^2 \cdot N^2} : \frac{H_1}{D_1^2} = \frac{H_2}{D_2^2}$ --- ①

discharge coefficient K_Q

$= \frac{Q}{D^3 N}$ must be equal

$\frac{Q_1}{D_1^3 \cdot N} = \frac{Q_2}{D_2^3 \cdot N}$

i.e. $\frac{Q_1}{D_1^2} = \frac{Q_2}{D_2}$

$\frac{0.02}{(0.3)^3} = \frac{0.01}{D_2^3}$

$D_2 = 0.2381\ m$

from eqn ①

$$H_2 = \left(\frac{D_2}{D_1}\right)^2 \times H_1$$

$$= \left(\frac{0.2981}{0.3}\right)^2 \times 15$$

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$$= 9.449 \text{ m}$$

2. Impeller diameter of pump D_2

from above

$$D_2 = 0.2981 \text{ m}$$

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Q6.

B)

→ i)

1) calculate depth of hydraulic jump

$$h_L = \frac{(d_2 - d_1)^3}{4 d_1 d_2} \qquad d_2 = \frac{d_1}{2}\left[\sqrt{1 + 8 (Fe)_1^2} - 1\right]$$

substitute value of d_2 in h_L

$$h_L = \frac{\left(\frac{d_1}{2}\left[\sqrt{1+8(Fe)_1^2} - 1\right] - d_1\right)^3}{4 d_1 \left[\frac{d_1}{2}\sqrt{(1+8(Fe)_1^2} - 1\right]}$$

$$h_L = \frac{\left(\left[\sqrt{1+8(Fe)_1^2} - 1\right]\frac{d_1}{2} - \frac{d_1}{2}\right)^3}{4 d_1 \left[\frac{d_1}{2}\sqrt{(1+8(Fe)^2} - 1\right]}$$

$$h_L = \frac{\left[\frac{-d_1}{2}\left(\sqrt{1+8(Fe)_1^2} - 1\right]\right.}{4 \times d_1}$$

$$h_L = \frac{\left[\frac{-d_1}{2}\left(\sqrt{1+8(Fe)_1^2}\right]^2\right.}{4 \times d_1}$$

$$4.25 = \frac{\left[\frac{-d_1}{2}\sqrt{1+8(7.5)^2} - 1\right]^2}{4 \times d_1}$$

$$17 d_1 = \left[\frac{-d_1}{2}\sqrt{1+8(Fe)_1^2} - 1\right]^2$$

$$17 d_1 = \left[\frac{-d_1}{2}\sqrt{1+8(Fe)_1^2}\right]^2 + \frac{2}{2} \times d_1\sqrt{0+8(Fe)_1^2} + 1$$

$$0 = \frac{d_1^2}{4}\left[1+8(Fe)^2\right] - 16 d_1\sqrt{(1+8(Fe)_1^2} + 1$$

$$d_1 = 0.500 \text{ m}$$

$$d_2 = 9.65 \text{ m}$$

c) calculate discharge limit width (q)

$d_2 = -\frac{d_1}{2} + \sqrt{\frac{d_1^2}{4} + \frac{2q^2}{g d_1}}$

$8.65 = -\frac{0.502}{2} + \sqrt{\frac{0.502^2}{4} + \frac{2q^2}{9.81 \times 0.502}}$

$q = 6.108 \ m^2/sec.$

e) Frouders No after depth.

$q = Q/b = \frac{V \times a}{b} = V \times b \times d \quad q = V \times d$

$q = V_2 \times d_1 \quad 6.108 = V_2 \times 8.65$

$\boxed{V_2 = 1.673 \ m/sec}$

$(fe)_2 = \frac{V_2}{\sqrt{g d_2}} = \frac{1.673}{\sqrt{9.81 \times 8.65}}$

$(fe)_2 = 0.279$ (sub-critical flow)

4) Calculate length of jump

length of jump = 5-7 times aut. of hydraulic jump

$= 6\,(d_2 - d_1)$

$= 6 \times (8.65 - 0.502)$

$= 18.818 \ m$

5) percentage loss of energy due to jump

$(\text{specific energy})_1 = d_1 + \frac{V_1^2}{2g}$

$(fe)_1 = \frac{V_1}{\sqrt{g d_1}} \quad 7.5 = \frac{V_1}{\sqrt{9.81 \times 0.502}}$

$V_1 = 16.64 \ m/sec$

$(E)_1 = 0.502 + \frac{16.64^2}{2 \times 9.81}$

$(E)_1 = 14.61 \ m$

$(\text{specific energy})_2 = d_2 + \frac{V_2^2}{2g}$

$= 8.65 + \frac{1.673^2}{2 \times 9.81}$

$(E)_2 = 8.79 \ m$

energy loss $\frac{(E)_1 - (E_2)}{(E)_1} \times 100$

$= \frac{14.61 - 8.79}{14.61} \times 100$

$= 74.05\%.$

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