MADE EASY

Civil Engineering

Toppers Handwritten Notes

Hydrolics Mechinenary

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HYDRAULIC MACHINE -

1) Impact of jets (Dynamic action of fluid)

2) Turbine
   - Pelton
   - francis
   - Kaplan.

ESE obj - 6 Q obj marks.

ESE conv. - 20-40

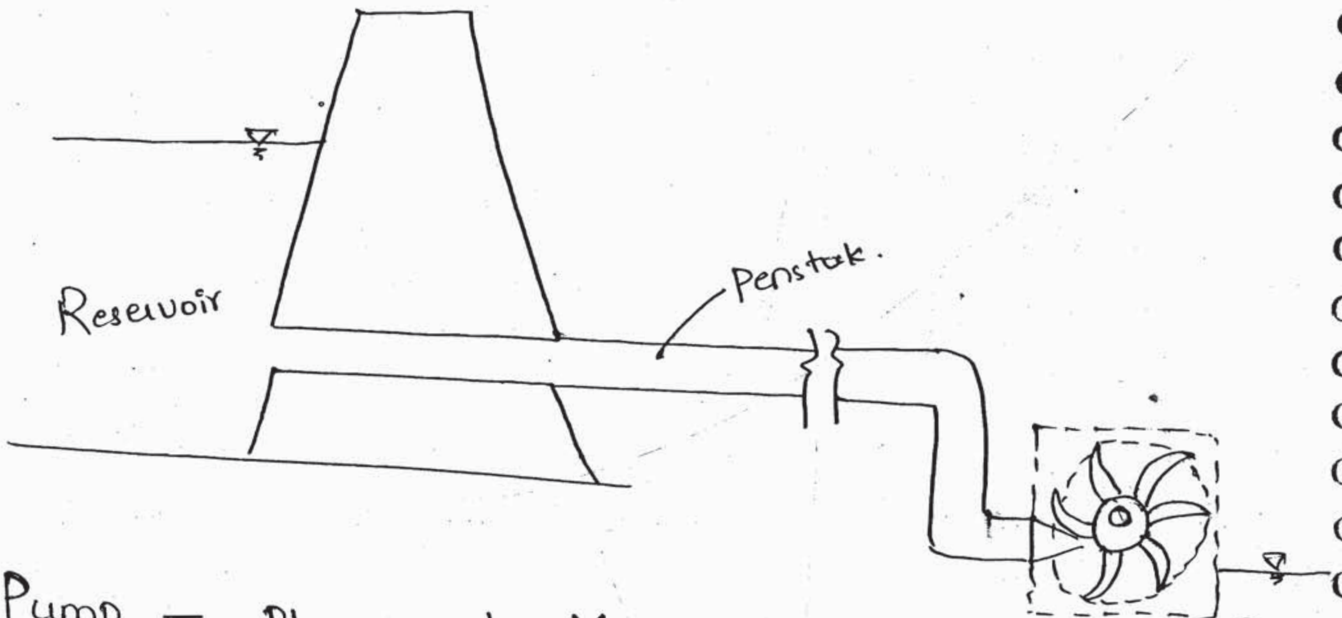
GATE - 2-4 marks

3) Pumps
   - centrifugal.
   - Reciprocating.

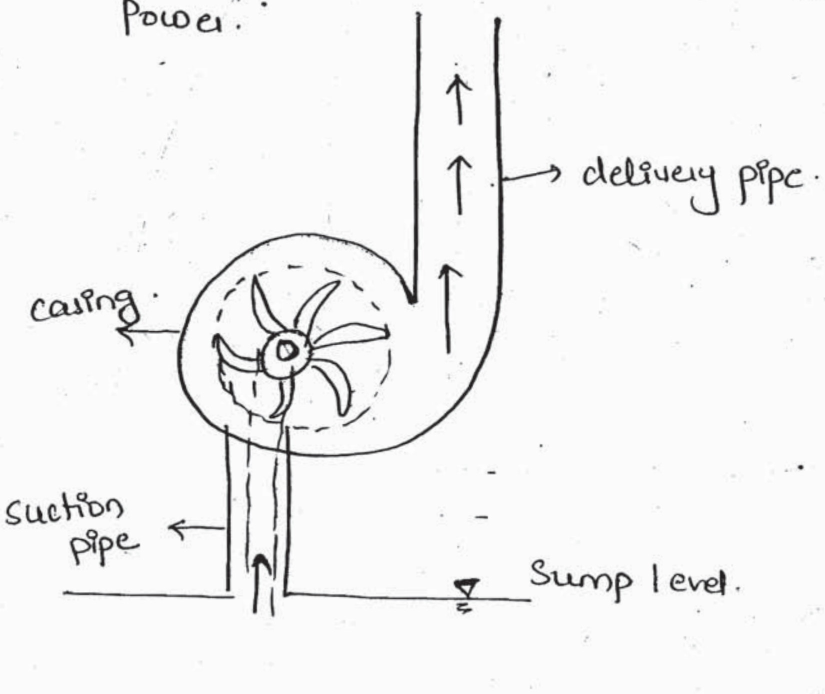
Turbine - It converts hydraulic power or water power into mechanical power.

Introduction –

* Turbine : It converts hydraulic power or water power into mechanical power.



* Pump – It converts Mechanical Power to Hydraulic Power.



Impact Of Jet – (Dynamic Action of fluid)

FORCE CONCEPT –

(1) Impulse Momentum Theorem :

Impulse – suddenly applied force
By applicatn of force the momentum will be change
Ex– slap in cheek.

Impulse = Change in momentum.

$$\boxed{F \cdot dt = mV_2 - mV_1} \quad \text{——— (1)}$$

In case of water we have to consider.

Mass of flow rate $\left(\frac{dM}{dt} = \dot{M} \right) = \rho Q$ (kg/s)

By differentiating equation (1),

$$F = \frac{d}{dt}\left(mV_2 - mV_1 \right)$$

$$= \frac{d}{dt} m V_2 - \frac{d}{dt} m V_1$$

$$= \frac{dM}{dt} \cdot V_2 - \frac{dM}{dt} \cdot V_1$$

$$\boxed{F = \dot{M} V_2 - \dot{M} V_1}$$

force equal to rate of change of Momentum.

$$F_{(external\,|\,Vanes\,|\,Blades)} = \dot{m}V_2 - \dot{m}V_1.$$

$$F_{water\ jet} = -F_{vane}$$

$$= -(\dot{m}V_2 - \dot{m}V_1)$$

$$\boxed{F_{jet} = \dot{m}V_1 - \dot{m}V_2}$$

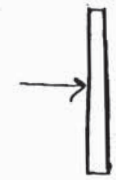
Energy CONCEPT -

Energy (solid body)	Energy / sec (Power)	$\frac{(\text{Power or Workdone/sec})}{\dot{m}g}$ (Head)
$\frac{1}{2}mv^2$ (KE)	$\frac{1}{2}\dot{m}V^2$	$\frac{\frac{1}{2}\cancel{\dot{m}}V^2}{\cancel{\dot{m}}g} = \frac{V^2}{2g}$
mgh (PE)	$\dot{m}gh$	$\frac{\cancel{\dot{m}}gh}{\cancel{\dot{m}}g} = h$
$F\cdot x$ (WD)	$F\cdot v$ $v \rightarrow$ velocity of body jisme force lagega	$\frac{F\cdot v}{\dot{m}g}$

* Types Of Vanes -

1) Flat plates -

- Normal flat plates

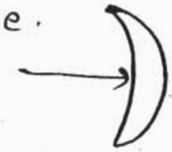


- Inclinced flat plates

2) Curved Plates -

- Curved Vane with Central Splitter.

- Normal curved vane.



* Assumptions :

1) At entry point section is assumed as 1 - 1.
At exit point section is assumed as 2 - 2.

2) Pressure at 1 = Pressure at 2 = P_{atm}.

3) $Z_1 \simeq Z_2$.

4) Their is no friction loss over the Vanes.

5) Theirs is no Impact loss (No - Shock condition)

Note - (No shock condition)-

* To achiere no shock condition the entry and exit

Parallely.

of water over the vanes should be (tangentially) to the vanes, hence water entry angle should be equal to inlet vane angle and exit angle of water should be equal to exit vane angle.

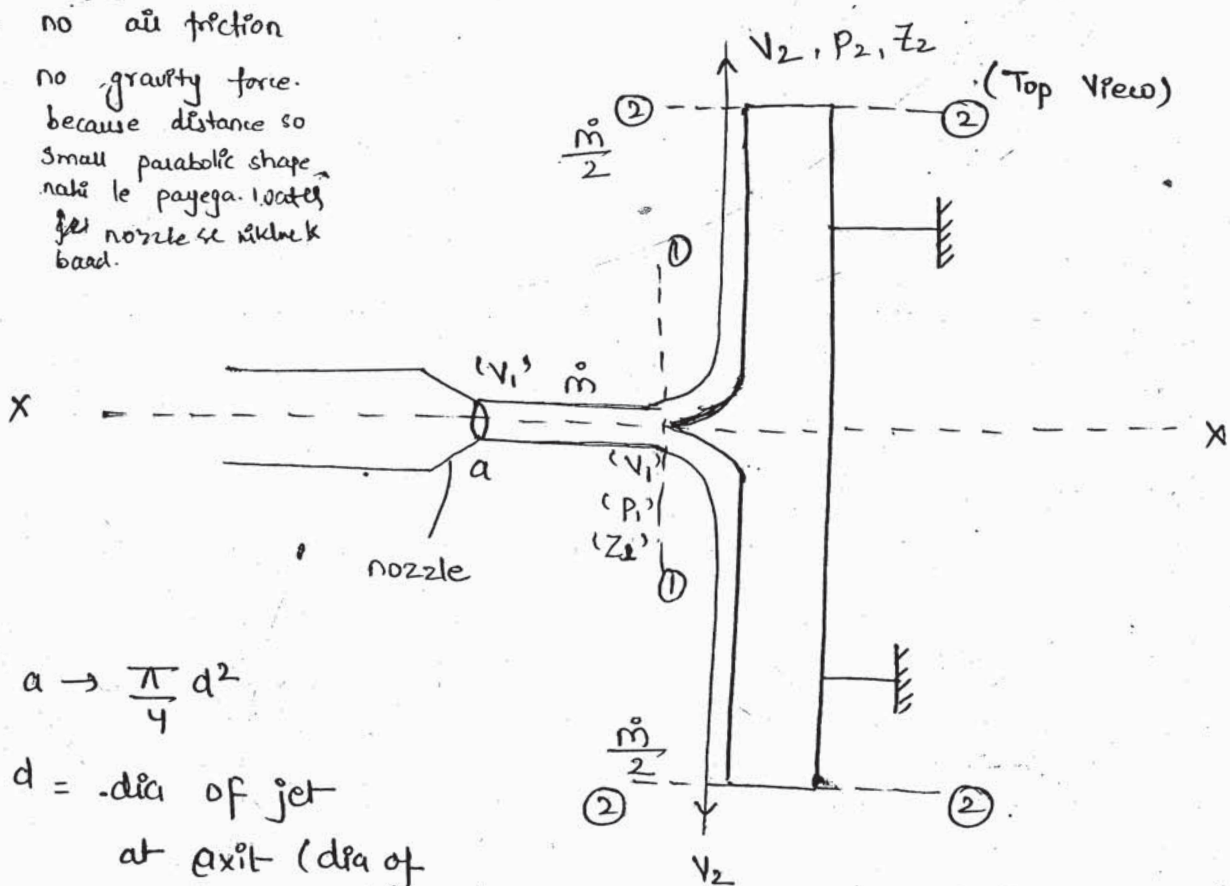
at starting shock hota h
at exit shock hota h
to starting me parallely move karna hota h for no shock

* Impact of jet on Stationary Vanes -

case-1 Impact on flat Plate held normal -

(for analysis)

* no air friction
* no gravity force. because distance so small parabolic shape nahi le payega. water jet nozzle se nikalne k baad.



$a \to \frac{\pi}{4} d^2$

d = dia of jet at exit (dia of nozzle)

Mass of flow rate Impacting the value -

$$\boxed{\dot{m} = \rho Q}$$

$$= \rho a v.$$

Applying Bernoullis equation at 1 & 2. (4)

$$\frac{P_1^2}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2 + 0$$

$$P_1 = P_2$$

$$Z_1 = Z_2$$

$$\boxed{V_1 = V_2}$$

$$F_{jet}\ (\text{x-direct}^n \text{ or Normal direct}^n) = \dot{m}V_1 - \left(\frac{\dot{m}}{2}\times 0 + \frac{\dot{m}}{2}\times 0\right)$$

$$= \dot{m}V_1$$

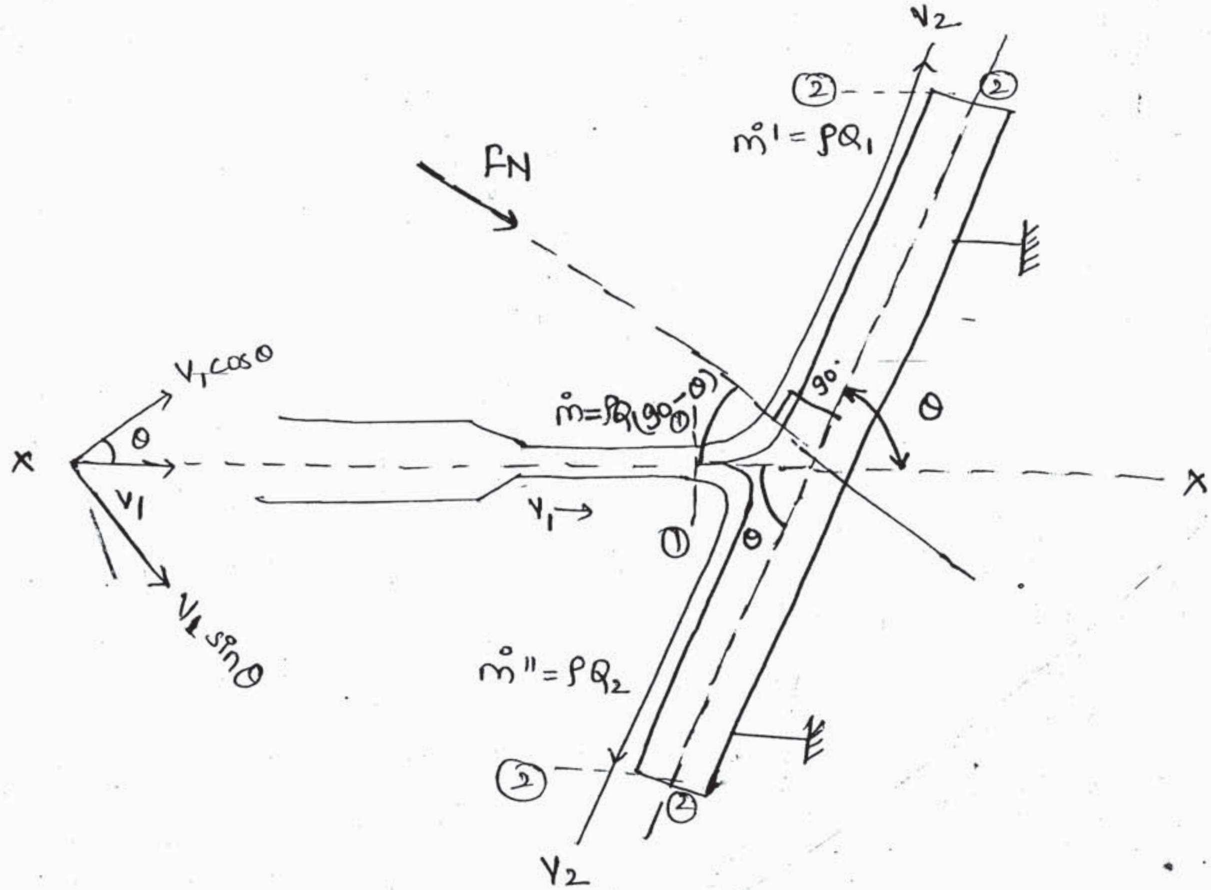
$$\boxed{F_x \text{ or } F_{normal} = \rho a V_1^2}$$

$$F_{jet}\ (\text{y-direct}^n \text{ or Tangential}) = \dot{m}\times 0 - \left(\frac{\dot{m}}{2}\times V_2 + \frac{\dot{m}}{2}(-V_2)\right)$$

$$= 0$$

Note. The force in tangential direction is zero. because water is flowing in two opposite direction in such a way that momentum is balanced.

Case-2) Impact over a Inclined flat plate -



$$F_N = \mathring{m} V_1 \sin\theta - (\rho Q_1 \times 0 + \rho Q_2 \times 0)$$

$$F_N = \mathring{m} V_1 \sin\theta$$

$$F_N = \rho a v_1^2 \sin\theta$$

$$F_x = F_N \cos(90-\theta) = F_N \sin\theta = \rho a v_1^2 \sin^2\theta$$

$$F_y = F_N \sin(90-\theta) = F_N \cos\theta = \rho a V_1^2 \sin\theta \cos\theta$$

$$F_T = \mathring{m} V_1 \cos\theta - \left(\rho Q_1 V_2 + \rho Q_2 (-V_2)\right)$$

$$F_T = \mathring{m} V_1 \cos\theta - (\rho Q_1 V_2 - \rho Q_2 V_2)$$