Name Majid Mahmood.

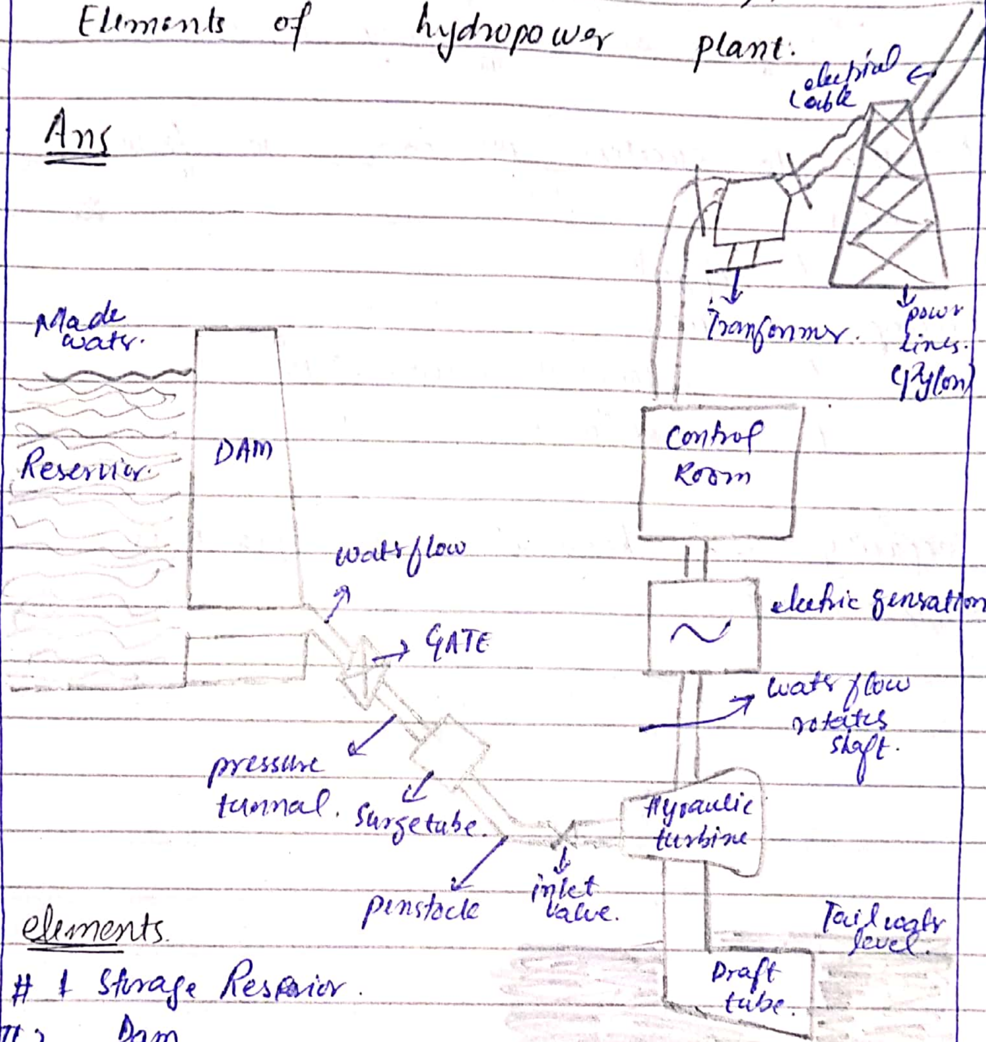
ID 13876.

Subject power Generation.

Question No 1 (a).

Elements of hydropower plant.

Ans



elements.

- #1 Storage Reservoir.
- #2 Dam
- #3 Forebay
- #4. Spillway.
- #5. intake
- #6. Surge tank.
- #7. Penstock
- #8. Valve and Gates.
- #9. Trash Racks.
- #10. Tailrace
- #11 Draft tube
- #12 Prime movers or water turbine.

Question no 1 (b)

Solution

Given that.

avaiable Volume: $V = 5 \times 10^{5} m^3$.

Available head: $h = 100m$

Hydraulic efficiency = 85% or 0.85

Electrical efficiency = 0.94.

Therefore overall efficiency = $0.85 \times 0.94 = 0.80$.

According to question we can use following formula.

$E = \eta \rho g h V$.

putting Values.

$E = 0.8 \times 1000 \times 9.8 \times 100 \times 5 \times 10^{5}$

$E = 3.92 \times 10^{11}$ W-s

Capacity of head of power plant is 3.92×10^{11} W-s.

———x ———x ———x ———x ——— x.

Question 2 (a)

Answer

Turbine

Turbine is a rotatory mechinical device that extracts energy from a fluid flow and convert it into useful work.

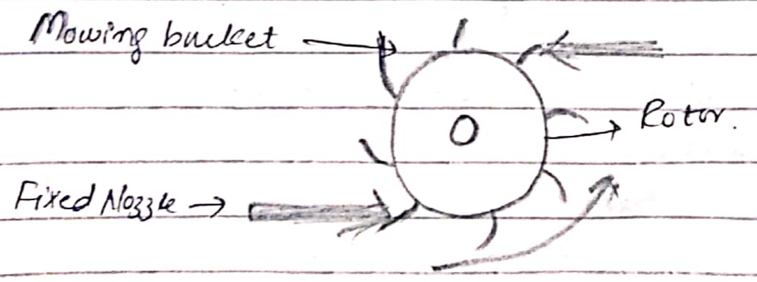
Types.

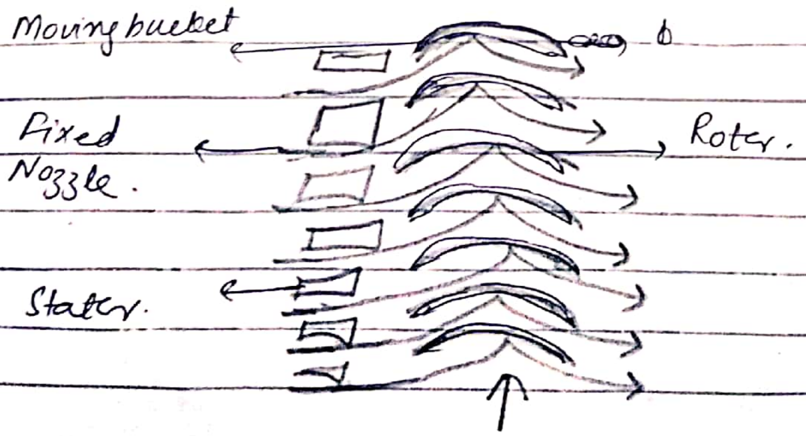
(1) Impluse Turbine.

The impluse turbine generally uses the velocity of the water to move the runner. The water stream hits each bucket on the runner.

An Implus turbine is generally suitable for high head low flow applications.

In implse turbine, at inlet only kinetic energy available. But in reaction turbine at inlet kinetic energy as well as pressure energy both are aviable.

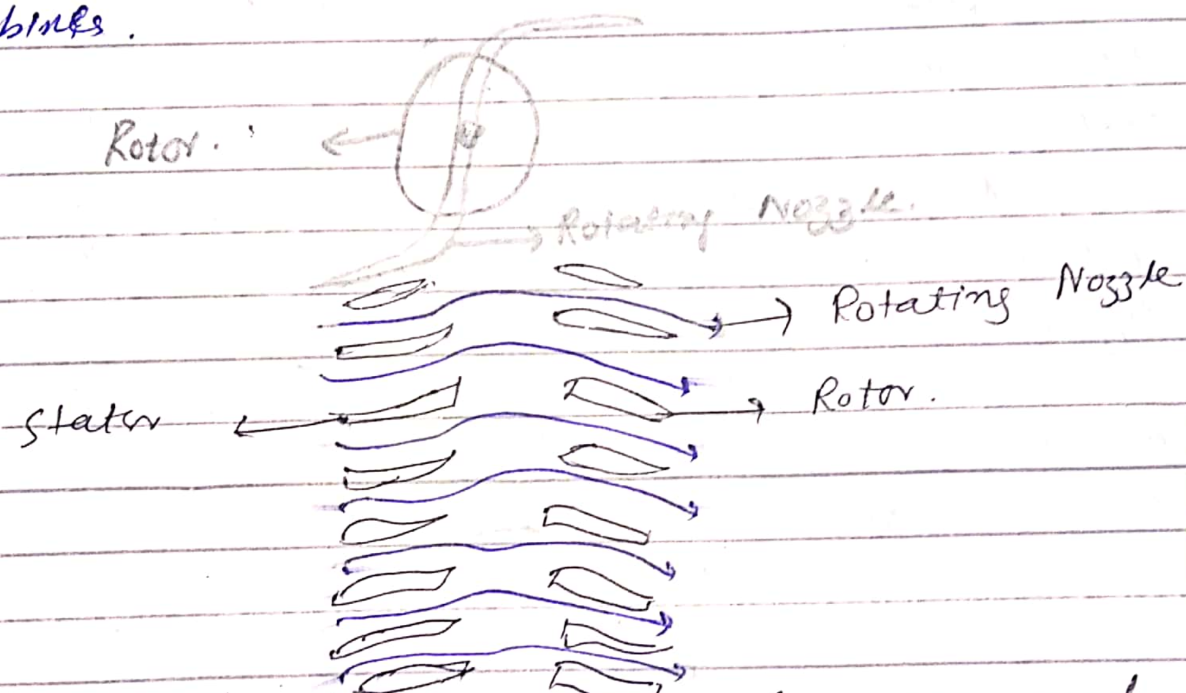




Reaction Turbine

A reaction turbine develops power from the combined action of pressure and moving water. The runner is placed directly in the water stream flowing over the blades rather than striking each individually.

Reaction turbines are generally used for sites with lower head and higher flows than compared with the impluse turbines.



Parameters: The following Parameters are used for Hydropower plant:

1. Height of standing water "Head"
2. Flow of water.
3. Volume of water.
4. How deep the turbine must be set.
5. Efficiency.
6. Cost.

Question 2(b)

Given that.

Head = h = 190m

Discharge: q = 2.2 m^3/s

overall efficiency = η = 85% 0.85.

At a head of 190m, a single jet pelton wheel turbine seems most suitable. So we can use following formula for calculated specific speed.

$$n_s = \frac{85.49}{(h)^{0.243}}$$

$$n_s = \frac{85.49}{(190)^{0.243}} = 23.88 \text{ rpm}$$

The output power can be obtained by using.

$P = \eta \rho q g h$ watts.

$P = 0.85 \times 1000 \times 2.2 \times 9.81 \times 190 = 3485.5 \text{ kW}$.

$$n = \frac{n_s \, h^{5/4}}{\sqrt{P}} = \frac{23.88 \times (190)^{5/4}}{\sqrt{3485.5}} = 285.32 \text{ rpm}$$

An alternator rated at 50Hz frequency with synchronous speed approaching 285.32 rpm but not greater is to be selected. The no of poles required are computed by using.

$$N_s = \frac{120f}{P}$$

or.

$$P = \frac{120 \times 50}{285.32} = 21.02 \text{ poles}.$$

Slecting 24 poles alternator will rotate at 250rpm at 50Hz seems just right. The turbine will have diameter which can be determined by using equation.

$$D = 38.567 \frac{\sqrt{4}}{\eta} = 38.567 \frac{\sqrt{190}}{250} = 2.12m.$$

The jet diameter can be calculed by using equation.

$$q = \pi d_g^2 (v_g)/4.$$

The jet velocity: $V_j = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 190}$

$= 61.05 m/sec.$

therefore jet diameter will.

$$d_j = \sqrt{\frac{4q}{\pi V_j}} = \sqrt{\frac{4 \times 2.2}{3.14 \times 61.05}} = 0.214m$$

$d_j = 21.4cm.$

x ——— x ——— x ——— x ———

Tha

Question No 3 (B).

Ans.

Stages of the Nuclear Fuel Cycle.

The nuclear fuel cycle represents the progression of nuclear fuel from creation to disposal. Mixed oxide is the another type of nuclear fuel. The nuclear fuel typically include the following stages.

→ Uranium recovery to extract (or mine) uranium ore, and concentrate (or mill) the ore to to produce a uranium ore concentrate; Sometime called U_3O_8 or "yellowcake"

→ Conversion of Uranium ore Concentrate into Uranium hexafluoride (UF_6).

→ Enrichment to increase the conc; of Uranium 235 (U^{235}) in UF_6.

→ Deconversation to reduce the hazards associated with the depleted Uranium hexaflluoride (DUF_6) or "tailings" produced in earlier stages of fuel cycle.

→ Fuel fabrication to convert natural and enriched UF_6 into UO_2 or Uranium metal alloys for use as fuel for nuclear reactors. This step also include mixed oxide fuel fabrication.

→ Use of the fuel in reactors. (nuclear power, research or naval population).

→ Interim storage of spent nuclear fuel.

→ Reprocessing (or recycling) of high-level waste.
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→ Final disposition (disposal of used fuel or high-level waste.