Date:

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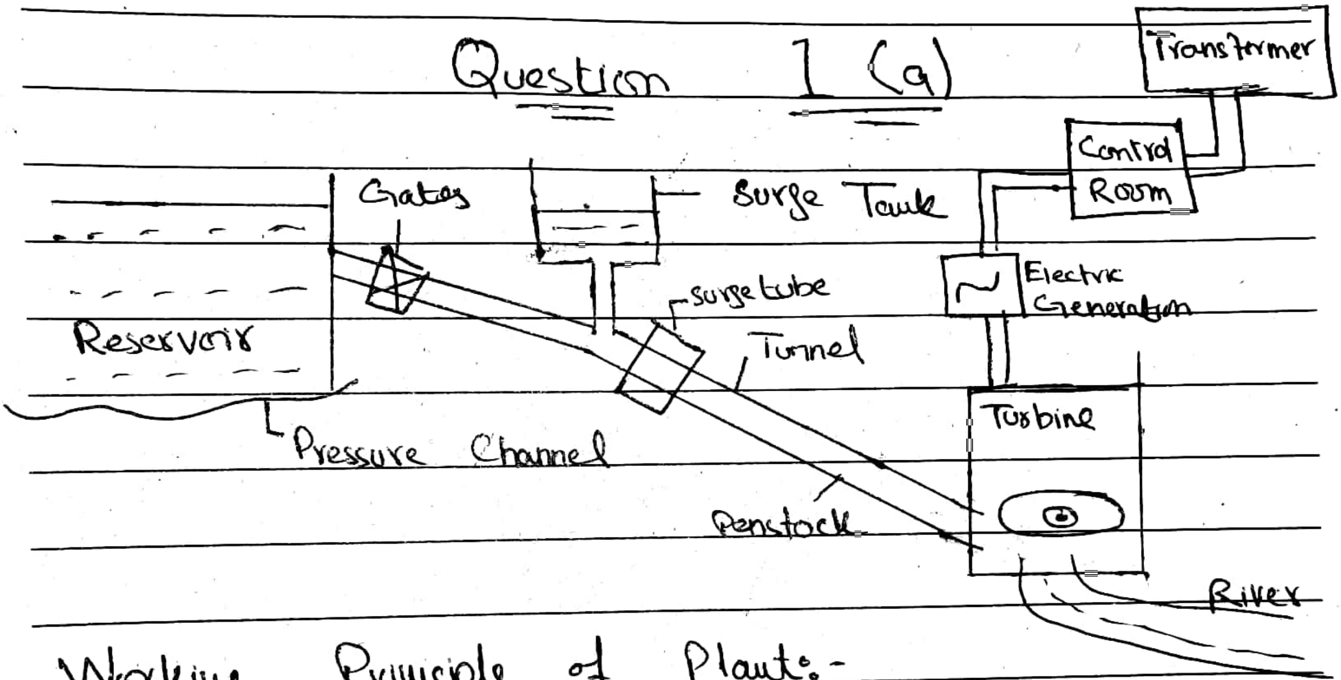
Subject :- Power Generation.

Question 1 (a)



Working Principle of Plant :-

The principle of hydropower is that the potential energy of the water stored at great heights in the dam is converted into Kinetic energy by allowing the water to flow at high speed. Then the kinetic energy of flowing water used to generate electricity.

16% - 18% of global electricity generation due to this. The total Hydro-Power capacity is about 630GW.

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General Layout of Hydro-Electric :-

Dams Water Flow → Water Convey System → Valve → Turbine → Generator

Elements :-

1) Storage Reservoir 2) Dam 3) Forebay
4) Spilling Way 5) Intake 6) Surge Tank
7) Penstock 8) Valves 9) Gates
10) Draft tubes 11) Water turbines.

Question 1 (b)

Sol :-

Given Data :-

Efficiency = 85% or 0.85

Avb volume = V = $5 \times 10^5 \, m^3$

Avb head = h = 100m

Electrical Efficiency = 95% or 0.95

Overall Efficiency = $0.85 \times 0.95 = 0.80$

Using the Following Formula

$E = \eta \rho g h V$

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

$E = 392000 \times 10^5 = 3.92 \times 10^{11}$ W.S

So Capacity of head power plant is 3.92×10^{11} W.S

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Question 2 (a)

Ans) **What is turbine :-**

It is a rotary mechanical device that extracts energy from a fluid flow and converts it into useful work. The work produced by a turbine can be used for generating electrical power when combined with a generator.

There are two main types of hydropower turbines.

1) **Impulse Turbine :-**

The impulse turbine generally uses the velocity of the water to move the runner and discharge to atmospheric pressure. The water stream hits each bucket on the runner. There is no suction on the down side of the turbine and the water flows out the bottom of the turbine housing after hitting the runner.

It is generally suitable for high head low flow appliances.

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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 impulse turbines.

Following are the parameters of the selection of hydropower turbines.

1) Total Height of the water Head.
2) Water Flow
3) Total Volume of the water
4) Deepness of the turbine installation.
5) Efficiency.
6) Cost Effectiveness.

x————x————x

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Question 2 (b)

Sol:-

Given Data:-

Head $= h = 190\ m$

Discharge $= q = 2.2\ m^2/s$

Overall Efficiency $= \eta = 85\%$ or 0.85

Using the formula to calculate specific speed.

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

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

Using "$P = \eta \rho q g h$" to obtain power output

$$P = 0.85 \times 1000 \times 2.2 \times 9.81 \times 190$$

$$= 3485.5\ KW$$

$$n = n_s = 23.88 \times \frac{(190)^{3/4}}{\sqrt{3485.5}}$$

$$= 285.32\ rpm$$

The Number of poles required are computed by

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

$$P = \frac{120 \times 50}{285.32}$$

$$P = 21.02 \text{ poles}$$

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We will select 24 poles which will rotate at 250 rpm at 50 Hz. so The turbine will also have diameter which can be calculated by.

$$D = 38.567 \frac{\sqrt{H}}{n} = 38.567 \frac{\sqrt{190}}{250} = 2.12\,m.$$

For calculating Jet diameter

$$q = \pi d_j^2 (v_j)/4$$

Jet velocity $= V_j = \sqrt{2gh} = \sqrt{2 \cdot 9.8 \times 190}$
$= 61.05$ m/sec

Therefore Jet diameter will be

$$d_j = \sqrt{\frac{4q}{\pi v_j}} = \sqrt{\frac{4 \times 2.2}{3.14 \times 61.05}}$$

$= 0.214$ m

$d_j = 21.4$ cm

x ——————— x ——————— x

Question 3

Ans:

The nuclear fuel cycle represents the progression of nuclear fuel from creation to disposal.

Mixed oxide is another type of nuclear fuel. The nuclear fuel typically includes the following stages.

1) Uranium recovery to extract or mine urainium ore. From the ore they produce uranium ore concentrate. They are sometimes called "U_3O_8".

2) In the next step the Uranium ore concentrate is converted into Uranium hexaflouride (UF_6)

3) In the next Step the Uranium is enriched to increase the concentration of Uranium which is at last becomes 235 (U^{235}) in UF^6.

4) In the next step Deconversation is done to reduce the hazards associated with the depleted Uranium hexa flouride (DUF_6) produced in the earlier stages of fuel cycle.

5) In the next Fuel fabrication is done to convert natural and enriched UF_6 into UO_2 or uranium metal alloys for use as fuel for nuclear reactors. This also includes mixed oxide fuel fabrication.

6) In the step use of the fuel in reactors. C nuclear power, research.

7) Interim storage of spent nuclear fuel.

8) After that Reprocessing of high level waste.

9) Final disposition (disposal of used fuel or high level waste.

Nuclear Fuel Cycle