IQRA National University, Peshawar **Name:** _____
Department of Electrical Engineering
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Power Generation

Terminal Examination *course Instructor: Engr.Sanaullah Ahmad*

Note: Attempt all Questions & Draw diagrams where necessary.

Question No 1 **20**

A. With the help of a diagram show different Elements of a Hydropower Plant? CLO 1
B. Water for a small hydroelectric station is to be made available from a pondage with a volume of $5 \times 10^5 m^3$ located at a height uphill to provide water at a head of 100m at a hydraulic efficiency of 85% If the electrical efficiency is 94% and the water supply is available for 8 hours daily, determine the capacity of the generator to be installed at the power station. CLO 2

Question No 2 **20**

A. Classify different hydropower turbines, what are the parameters required for the selection of hydropower turbines? CLO1
B. Select a suitable turbine for a hydropower scheme with available head height of 190m and rated discharge of 2.2 m^3/s with overall efficiency of 85%? Also determine turbine diameter and jet diameter? Specific speed $Ns = 85.49/(h)^{0.243}$. *Diameter* $= 38.56\sqrt{h}/n$. *Jet Diameter* $q = (\prod/4)dj^2 Vj$ *where* $Vj = \sqrt{2gh}$ CLO 2

Question No 3 **10**

Explain different stages of Nuclear Fuel Cycle? CLO 1

GOOD LUCK

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Q2.

Ans:

History of hydro plant

- Hydro power or water power is power derived from the energy of falling water or runing water.
- first used by Greeks for grinding wheat.
- Earlier water wheels were used to turn machinery
- These water wheels powered Textile and Industrial mills
- Hydro power is conventional but renewble energy source.

- In 1753 french engineer Bernard forest first give Idea about the use of hydro power.

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- in 1848 James B. Francis while working as head engineer of Lowell's locks and Canals Company created first turbine from water wheel with 90% effeciency
- By the late 19th Century the electrical generator was devalped.

Hydro electricity

Hydro electricity is the Term refrerring to electricity generated by hydropower
- The production of electrical power Through the use of the grivitational force of falling or flowing water.

- about 16-18% of global electicity generation
- Total Insttaled hydropower Capaccity is about 630 GW
- China is the largest hydro electricity producer (721 Terawatt-hourse)

Hydro Types:

- Conventional hydroelectric refering to hydro electric dam (potinial energy)
- run of the river hydro electricity which captures the (kinetic energy) in rivers or streams with out the use of Dams.

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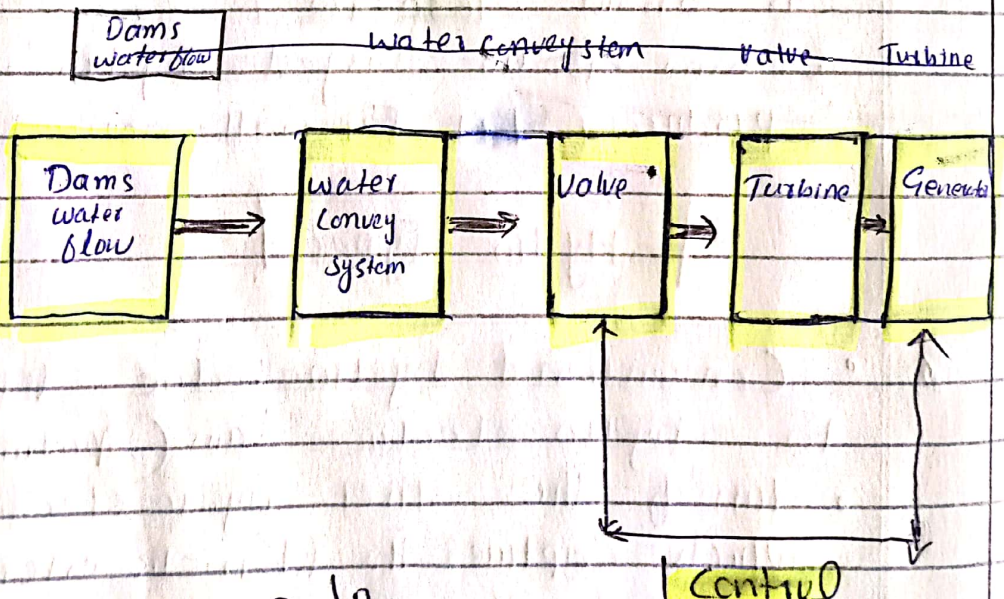
- **Small hydro projects:** are 10 MWatts or less and often have no artificial reservoirs.

  micro hydro projects. Provide a few Kilowatts to a few 100 Kilowatts to Isolated homes, villages or Small Industries.

- **Pumped – storage hydroelectricity** Store watter pumped during periods of low demond to be released for generation when demond is high.

Hydro electric General Layout



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Side Consideration for hydro Power plant

Two factor

→ amount of water flow per unit Time

- Vertical Height that water can be made fall (head)

- For reaction Turbines the gross head h_0 is the vertical distance b/w the water Surface level at the intake and the Tailtace, while Impuls Turbine it is taken from the water Intake level to nozzel level.

• Effective head height can be Calculated by Simpaly Subtracting the head losses along path. Head losses are due to frictions within the System (Pipes, Penstock, Tunnels etc)

$$H = h_0 - h_2 - h_1$$

$$H = h_0 - h_g - h_1$$

H, used to determine the effective potintial energy avaliable.

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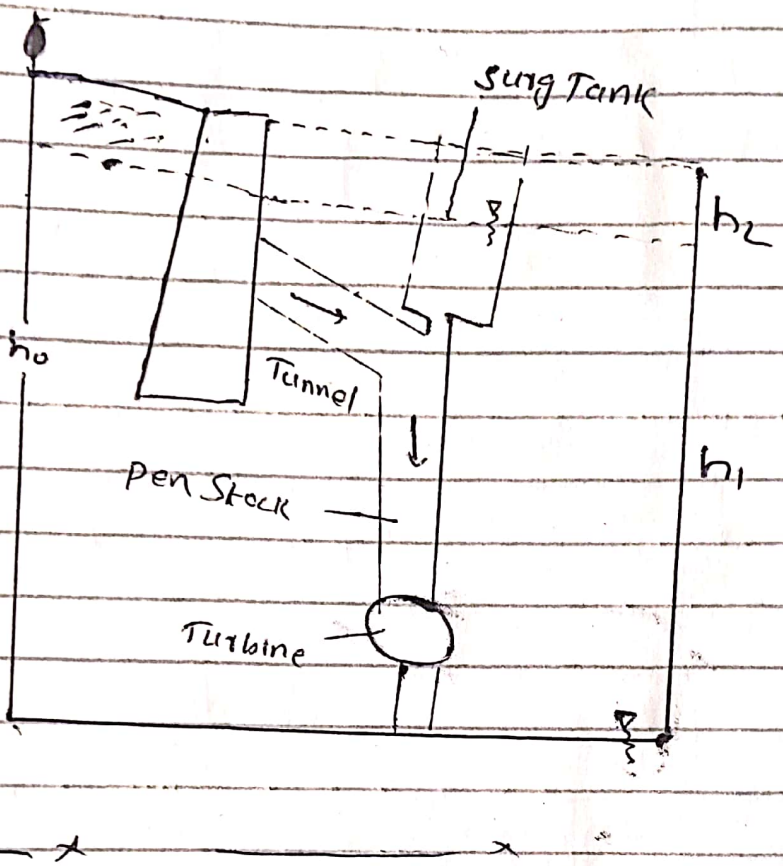

Sit Consideration

- water Sources
- hydrology
- Catchment area
- Geographical condition
- Seismic activity
- Strong foundation for dam.

Purpose classification

Singal Purpose
- Ittigation

Multi purpose.
→ water supply
- flood control
→ Soil erosion
→ Environmental managment
→ Hydro electric Power generation
→ Nevegation
→ Recreation
→ Irrigation.

Q1: Part(b)

Given Data:

avaliable Volume at pondag $V = 5 \times 10^5 m^3$

avaliable head : $n = 100 m$

Hydralic effiency = 85% = 0.85

Electrical effeciency = 95% → 0.95

over All effeciency = $0.85 \times 0.95 = 0.80$

Required

Cappacity of generator $E = ?$

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

$E = 0.8 \times 1000 \times 9.81 \times 100 \times 5 \times 10^5$

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

Q2 Part (a)

what is Turbine:

Ans:

it is a rotary mechine 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 types of hydro power Turbine.

i) Impuls Turbine:
ii) Reaction Turbine:

1) Impuls Turbine

The Impulse Turbine generally uses the velocity of the water to move The runn and discharg to atmospharic Presur. the water stream hits each bucket on the runner. There is no suction on the down side of the Turbine and the water flows

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out the bottom of the Turbine housing after hitting the runner

it is generally suitable for high head Low flow appliances.

ii) Reaction Turbine

A reaction Turbines 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 Then Stricking each Individually.

Reaction Turbines are generally used for sites with Lower head and higher compared with the Impuls Turbines.

Following are the Paramaters of the selection of hydro power Turbines.

1) Total ~~hei~~ height of the water Head
2) water flow
3) Total volume of the watter
4) Deepness of the Turbine Instalation
5) Efficiency
6) Cost effectiveness.

Q2

Part b

Given Data:

Head $h = 190m$

Discharge $Q = 2.2 m^3/s$

over all effeciency $= \eta = 85\%$ or 0.85

Using the formulla to calculate Specific Speed

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

$$n_2 = \frac{85.49}{(190)^{0.243}}$$

$$n_2 = \frac{85.49}{(190)^{0.243}} = 23.88 \text{ rpm}$$

Using $P = \eta \rho g Q h$ to obtain Power output.

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

$$= 3485.5 \text{ kW}$$

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

$$= 985.32 \text{ rpm}$$

0.40

The number of Poles are Computed by

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

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

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

We will select 24 Poles which will rotate at 250rpm at 50Hz so the Turbine will all have diameter which can be calculated by.

$$D = 38.567 \frac{\sqrt{H}}{n} = 38.567 \frac{\sqrt{190}}{250}$$

$$D = 2.12 \text{ m}$$

For Calculating Jet diameter.

$$q = \pi d_j^2 (C_v)$$

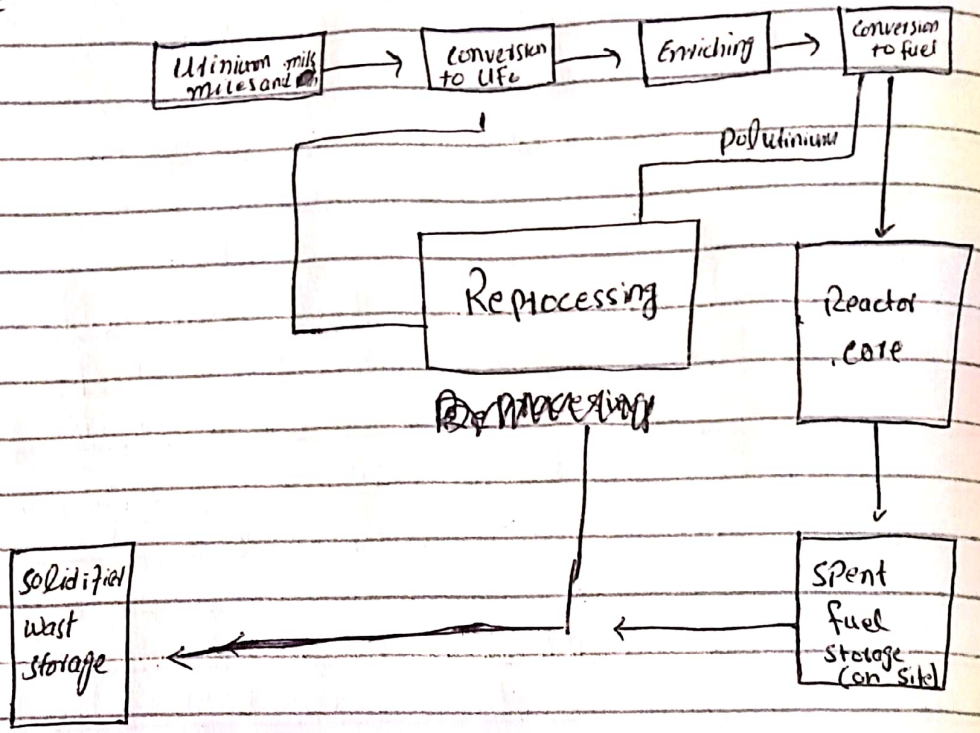
$$V_j = \sqrt{2gH} = \sqrt{2 \cdot 9.8 \times 190} = 61.05 \text{ m/sec}$$

Therefore Jet diameter will b

$$d_j = \sqrt{\frac{4q}{\pi V_j}} = \sqrt{\frac{4 \times 2^2}{3.14 \times 61.05}} = 0.714\text{m}$$

$$\Rightarrow d_j = 21.4\text{cm}$$

Q3:



1) Mining and Miling:

Utinium is a usally mined be either Surface or under ground mining Techniques defending on the depth at which the ore body is found. from these the mined Utinium is set to a mill which is usually located close to the mine At the mill the ore is crushed and ground to a fine Sulray which is leached in sulfuric acid to allow the Separation of uranium from the wast rock. it is then recoverd from Sallution as Uranium oxide (U_3O_8) concentrate Some time is known as "yellow cake"

ii) **Conversion:**

Because Uranium needs to be in the form of a gas before it can be enriched, The U_3O_8 is converted in to the gas Uranium hexafluoride (UF_6) at a conversion plant

iii) **Enriching**

Need to enrich Uranium to at least 3% for a power plant

Two methods of enriching

→ UF_6 (hexafluoride) gase heated

- U-238 is heavier Than U-235

→ hexafluoride gas can be Sepreated in to two streams

→ Low velocity U-238

→ high velocity U-235

iii) **Centrifuged Method**

Gas Spun in ~~Centrifuge~~ centrifuge Lighter U-235 will seprate from heavier U-238

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(iv)

Fuel conversion

- Enriched Uranium Transported to a fuel fabrication Plant where it is converted to Uranium dioxide (UO_2) Powder and Ptessed into Small Pellets. These Pellets are Inserted in to Thin tubes usually of a ~~Zirlo~~ Zirconium alloy or stainless steel to form fuel rods.

→ The rods are Then Sealed and Assembled in Clusters to form fuel [redacted] assemblies for us in the core of the neucler reactor.

(v)

The rector Core

The rector core Consist of a fuel rods and Control rods

fuel rods Containd enriched Uranium

Control rods are Inserted b/w the fuel rods to absorb neutrons and slow the chain reaction.

Control rods are made of Cadmium which absorb neutrons effectively.