Hydropower Overview and Schemes

1. What percentage of the world's electricity is currently provided by hydropower?
2. Which countries rely most heavily on hydropower for electricity generation, and what percentages do they contribute?
3. What are the three categories of hydropower schemes based on "head," and how are they differentiated?
4. Define "run-of-river" hydropower schemes. How do they differ from conventional dam-based hydropower systems?

Hydropower System Components

5. What is the function of a **forebay** in a hydropower scheme, and where is it located?
6. Define the terms **penstock** and **tailrace** in the context of hydropower systems.
7. What role does a **fish ladder** play in a hydropower project, and why is it necessary?

Types of Hydropower Turbines

8. What are the main differences between **impulse turbines** and **reaction turbines**?
9. Give examples of impulse turbines and describe how they generate power.
10. Give examples of reaction turbines and explain how they differ from impulse turbines in the way they generate power.

Fundamentals of Hydraulic Engineering

11. Explain the concept of "head" in hydropower and how it relates to gravitational potential energy.
12. What is **Bernoulli's equation**, and how is it used to describe water flow in pipes?
13. Differentiate between **laminar flow** and **turbulent flow**. What factors determine whether flow is laminar or turbulent?
14. What is the **Reynolds number**, and how does it influence the classification of water flow as laminar or turbulent?

Hydropower Calculations

15. How do you calculate the power output of a hydropower system? Write the formula and explain each variable.
16. Using the following data, calculate the power output of a hydropower system:

- Flow rate (Q) = 25 m^3/s
- Head (h) = 50 m
- Efficiency (η) = 80%

17. What is the **Manning equation**, and how is it used to calculate water flow in open channels?

Stream Flow and Discharge Measurement

18. Describe the **velocity-area method** used to measure stream discharge. What are the key steps involved?
19. Explain the **float method** of measuring water velocity. How can this method be used to estimate stream discharge?
20. What is a **rating curve**, and how does it help estimate river discharge?

Head Loss and Efficiency

21. How do **friction factor** and **roughness height** affect the flow of water through a pipe?
22. What factors contribute to **minor head loss** in hydropower systems, and how can these losses be minimized?
23. Explain how the **Moody Diagram** is used to calculate the friction factor for different types of water flow.