

Hydropower Plants: Generating and Pumping Units

Mock exam – part 1

Duration : 45 minutes;

To indicate your answer, cross the corresponding box. Each question has **only one correct answer**.

Exam evaluation: Every correct answer gives you +1 point. A blank answer gives you 0 point, a wrong one -0.25 point. If in one question you cross more than one box, it will be considered as blank answer: 0 point.

Maximum total score: 20 points

- 1) What is the main difference between storage hydropower plants and run of river power plants?
 - Run of river power plants have a limited storage capacity and, therefore, offer a restricted flexibility to the power system in respect to storage hydropower plants.
 - Run of river power plants can be equipped only with Kaplan turbines while storage hydropower plants only with Pelton.
 - Storage hydropower plants are off-river as they don't have a natural inflow.
- 2) Which parameters are important to compute the specific energy losses in the penstock by knowing the local loss coefficient?
 - The diameter, the length and the flow the velocity in the penstock.
 - The static pressure in the penstock.
 - The discharge and the area of the penstock.
- 3) According to the energy and discharge balance, which of the following sentence is correct?
 - The specific energy of the flow at the headwater and tailwater reservoir are the same.
 - The flow discharge from the headwater to the tailwater reservoir is the same if we neglect the volumetric losses.
 - The specific energy of the flow increases linearly with the discharge.
- 4) Why it is important to include the number of poles of the synchronous generator in the design of the hydroelectric unit?
 - Because it defines the rotational speed of the unit.
 - Because it defines the runaway condition of the unit.
 - Because it allows defining the range of the variable speed of the unit with an asynchronous motor.

- 5) The hydraulic power in a hydropower plant operating in pumping mode is:
- Always positive.
 - Always negative and the absolute value is greater than the pump power input.
 - Always negative and the absolute value is smaller than the pump power input.
- 6) The power transferred by a hydraulic turbine can be computed by knowing:
- The rotational speed and the driving torque.
 - Only the absolute flow velocity at the inlet and outlet section of the hydraulic machine.
 - The traversing discharge and the gross head.
- 7) Which is the hydraulic machine which reach the highest efficiency at the BEP for generating units?
- Francis turbine.
 - Pelton turbine.
 - Kaplan turbine.
- 8) If you have a plant with a very high head (> 1000 m), you will choose for a new storage hydropower plant:
- Multiple Francis turbines.
 - One or multiple Pelton turbine.
 - One Kaplan turbine.
- 9) The absolute flow velocity:
- Only depends on the discharge in all sections of the hydropower plants.
 - Is given by the sum of the tangential velocity and the relative velocity of the flow.
 - It does not depend on the specific energy losses.
- 10) Why Pelton turbines are defined as impulse turbines?
- Because they handle very large discharge values.
 - Because the rotational speed depends on the flow velocity of the jets.
 - Because the transferred energy is given by the difference in kinetic energy between the inlet and outlet section of the bucket.
- 11) The jet hits the bucket:
- Perpendicularly, i.e. absolute, relative and tangential velocity are aligned at the inlet section of the bucket.
 - With an incidence which corresponds to a positive relative flow angle at the inlet section of the bucket.
 - With an incidence which corresponds to a negative relative flow angle at the inlet section of the bucket.

- 12) How can you regulate the power output in a hydropower plant equipped with a Francis turbine?
- The power output cannot be regulated.
 - By changing the guide vanes opening angle.
 - By changing the blades pitch angle position.
- 13) What is the role of the draft tube in a Francis turbine?
- To recover the kinetic energy by decreasing the axial velocity of the flow.
 - To increase the static pressure at the runner outlet.
 - To have an uniform flow velocity at the runner outlet.
- 14) What is the phenomenon affecting Francis turbines operation which appears exclusively at partial load condition?
- Fatigue of the mechanical components.
 - Development of cavitation on the runner blades.
 - Development of a precession vortex rope.
- 15) For which site conditions you will likely select a bulb turbine?
- In case of very high head (> 1000 m).
 - In case of low head conditions (< 5 m).
 - In case of very large discharge. ($> 250 \text{ m}^3 \text{ s}^{-1}$)
- 16) In a generating unit equipped with a Kaplan turbine, in which conditions you will have the best efficiency?
- If the flow at the exit of the runner is fully axial, i.e. $C_u = 0$.
 - If the tangential velocity is double the tangential component of the absolute velocity at the outlet section of the turbine.
 - If the pitch of the blades is positioned at its maximum opening angle.
- 17) In a run of river power plant there is an important variation of the flow discharge during the year. Why a Kaplan runner is likely to be the best choice?
- Because it is a run of river power plant and the head will be the one in the range of Kaplan turbine.
 - Because with a large discharge variation a Kaplan turbine is particularly suitable as it is possible to adjust guides vanes and blade angle to have good performance in the operating range.
 - Because it allows avoiding cavitation for all range of flow discharge.
- 18) What is a ternary group?
- A generating and pumping group where the electrical machine, the turbine and the pump are on the same shaft.
 - A generating and pumping group with three pump-turbines in parallel.
 - A generating and pumping group with one electrical machine and two pump-turbines in series.

- 19) How is the required setting level of the hydraulic machine computed in a hydropower plant?
- By knowing the minimum Net Positive Suction Head (NPSH).
 - By measuring the minimum pressure in the hydraulic machine.
 - By measuring the maximum discharge traversing the hydraulic machine.
- 20) If a pumping unit needs to provide frequency regulation through hydraulic bypass, how can the power input be modified at plant level?
- By shutting off the pump.
 - By changing the opening of the Pelton injector if it is a ternary group.
 - By changing the blade position of the pump impeller.