M.E. (Water Resources & Hydraulic Engineering) Examination, 2019

(Evening) (1st Year-2nd Semester)

HYDRAULIC STRUCTURE AND HYDEL POWER ENGINEERING

(Paper - III)

Time : Three Hours

Full Marks : 100

Answer any *four* questions.

1. (a) State the difference between dam and reservoir with sketches

(b) Deduce a general expression of storage against the height of the water surface in the reservoir above any assumed datum.

(c) A contour survey of a reservoir site has been carried out by using a total station and the area is calculated based on different contour values, which vary from 100 m to 150 m at 25 m intervals, and the respective contour areas are found to be 6 ha, 22.5 ha and 46.6 ha respectively ?

If the capacity of a reservoir up to 100 m elevation is found to be 12.8 ha-m, determine the general equation for the capacity-elevation curve. Also estimate the reservoir capacity at RL 160 m.

$$5+10+10=25$$

2. (a) Deduce the expression of normal and critical depths for analyzing of culvert flows and also highlight explicit equation to find out the exact solution for critical depth.

(b) Define Hydraulic Structure

(c) Determine the normal and critical depths of flow in a concrete culvert with a diameter of 1220 mm and a design flow rate of 2.5 m³/s. The culvert has a slope of 0.5%. (Assume n= 0.013).

$$12+3+10=25$$

3. (a) What is spillway?

b) State the function of spillways?

c) Design an overflow spillway with an effective crest length of 60 m that will discharge at a design flow rate of 1500 m³/s at a maximum allowable pool elevation of 400m. The bottom elevation behind the spillway is 350 m, the upstream face of the spillway is vertical and the spillway chute is to have a slope of 1:2 (H:V).

$$(2+3+20)$$

4. (a) Deduce an expression of flow under a sluice gate having low tail water in an open channel.

(b) Water is released from a sluice gate at 0.65 m depth having a discharge of 6.5 m³/s per m width. Estimate the upstream water level, where the flow rate is negligible. Estimate the maximum discharge per unit width that could be delivered through the sluice gate?

(c) A spillway with crest height of 25 m above the stream bed is designed for an energy head of 3.5 m. If a minimum pressure head of 5.0 m below atmosphere is allowed, what is the discharge intensity over the spillway?

$8+9+8=25$

5. (a) Deduce an expression of flow through culvert with free entrance when the normal depth of flow in the culvert is larger than the culvert height.

(b) A 500-mm-diameter concrete drainage culvert (n =0.013) is to be placed under a roadway. During the design storm, it is expected that water will pond behind the culvert to a height 20 cm above the crown of the culvert. If the culvert entrance is to be well rounded (k_e = 0.05, C_d = 0.95), the slope of the culvert is 2%, the length of the culvert is 20 m, and the exit is not submerged, estimate the discharge through the culvert.

$10+15=25$

6. a) What do you mean by "mean potential power"?
   b) Define (i) Plant Factor, (ii) Pondage Factor and (iii) Secondary Power
   c) Define "Diversion Canal Plants" and "High Head Diversion Plants". Give examples of both the types with brief description and neat sketches.
   d) Explain with sketches the Cooperating Double Basin System for tidal power generation. What are the limitations of this method?
   e) Estimate the energy and power that could be available for a tidal power plant.

$3+4½+8+7+2½ = 25$

7. a) What is banded penstock?
   b) Prove that following relationship for the most economical penstock diameter.

$$D = \left(\frac{5K_1}{2K_2} \right)^{1/7}$$

   c) Typical weekly and daily releases of water from an upstream reservoir on a river are as given below. Estimate the pondage capacity to operate a run-of-river plant at a downstream location so that a steady uniform power output is available from the plant. Sunday is an idle day.

   Weekly Release Pattern

Day	Average daily release rate, m^3/s
Monday	45
Tuesday	50
Wednesday	60
Thursday	50
Friday	42
Saturday	35

   Daily Release Pattern

Time	Volume released, %
12 MN – 6 AM	10
6 AM – 12 Noon	35
12 Noon – 6 PM	40
6 PM – 12 MN	15

$2+14+9 = 25$