M.E. (Water Resources & Hydraulic Engineering) Examination (Evening), 2018

(1st Year-2nd Semester)

HYDRAULIC STRUCTURE AND HYDEL POWER ENGINEERING

Time : Three Hours Full Marks : 100

Answer any ***four*** questions.

1. a) How will you use hydropower in the mix of several types of power?
   b) Why is it necessary to predict the future load demand? Name the methods of load forecasting.
   c) A run-of-stream station with an installed capacity of 15,000 kW operates at 15% load factor when it serves as a peak load station. What should be the lowest discharge in the stream so that the station may serve as the base load station? It is given that the plant efficiency is 75% when working under a head of 20 m. Also calculate the maximum load factor of the plant when the discharge in the stream rises to 20 cumec.
   d) What are the difficulties in tidal power generation?
   e) Explain with sketches the Double-Cycle Systems for tidal power generation. What are the advantages and disadvantages of this method?

   2+4+8+4+7 = 25

2. a) What is penstock?
   b) What is banded penstock? What is its utility?
   c) How would you determine the number of penstocks?
   d) Give the analytical approach for determining the economical diameter of penstock.

   2+3+5+15 = 25

3. (a) Define Hydraulic Structure. Describe various types of hydraulic jump stilling basin based on Froude number of the incoming flow?

   (b) A spillway is 12 m wide and discharges 280 m^3/s under design conditions. The reservoir level behind the spillway has a water-surface elevation of 60.0 m, and the river water-surface elevation downstream of the stilling basin is 30.0 m. Assuming a 10% loss of hydraulic head in the flow down the spillway, find the required elevation of the floor of the stilling basin and design the stilling basin. 2+8+15=25

4. (a) 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 m^3/s. The culvert has a slope of 0.5%.

(b) A culvert under a roadway is to be designed for a 100-year peak surface runoff rate of 2.49 m^3/s. The invert elevation at the culvert inlet is 289.56 m, the invert elevation at the outlet is 288.65 m and the length of the culvert is to be 22.9 m. The channel downstream of the culvert has a rectangular cross section with a bottom width of 1.5 m, and a longitudinal slope of 4% and a Manning's n of 0.045. The gravel roadway crossing the culvert has a length of 15.0 m, an elevation of 291.08 m, and a width of 18.3 m. Considering a circular reinforced concrete pipe (RCP) culvert (n= 0.012) with a diameter of 610 mm and an entrance that is mitered to conform to fill the slope, determine the depth of water flowing over the roadway, the flow rate over the roadway, and the flow rate through the culvert.

10+15=25

5. (a) 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.

   (b) What are the different types of flow regimes in culverts and differentiate with sketches. Deduce an expression of flow through culvert with submerged entrance when the outlet is submerged only.

   15+10=25

6. (a) Water is ponded behind a vertical gate to a height of 5 m in a rectangular channel of width 8 m. Calculate the gate opening that will release 50 m^3/s through the gate. How would this discharge be affected by a downstream flow depth of 4 m?

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

   (c) Differentiate between sharp crested weir and broad sharp crested weir. 10+10+5=25

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

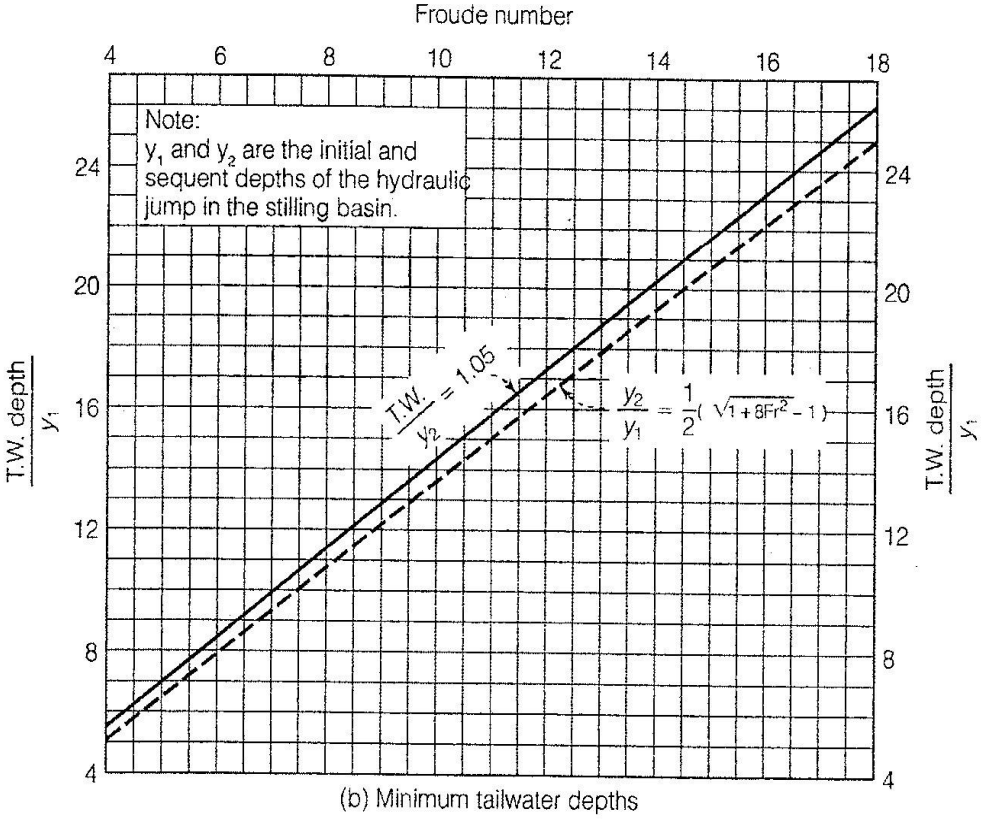
   (b) A contour survey of a reservoir site has been carried out by using a total station and the area is calculated based on different contour values, which vary from 100 m to 140 m at 20 m intervals, and the respective contour areas are found to be 5 ha, 20.5 ha and 42.6 ha respectively ?

   If the capacity of a reservoir up to 100 m elevation is found to be 12.4 ha-m, determine the general equation for the capacity-elevation curve. Also estimate the reservoir capacity at RL 145 m.

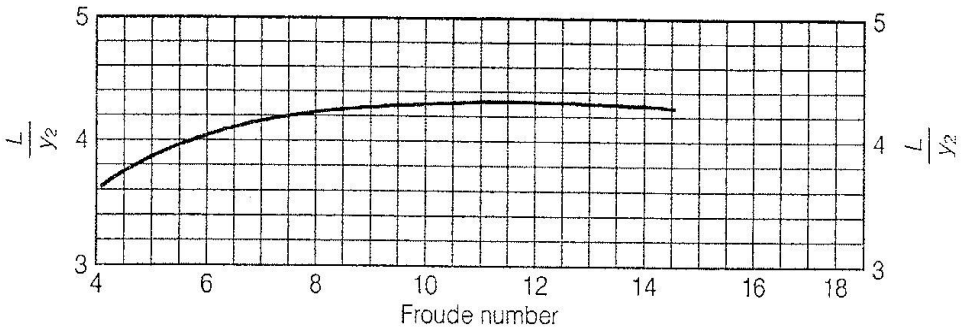
   (c) Differentiate between reservoir and dam. Discuss the classification and purpose of dam.

   8+10+7=25

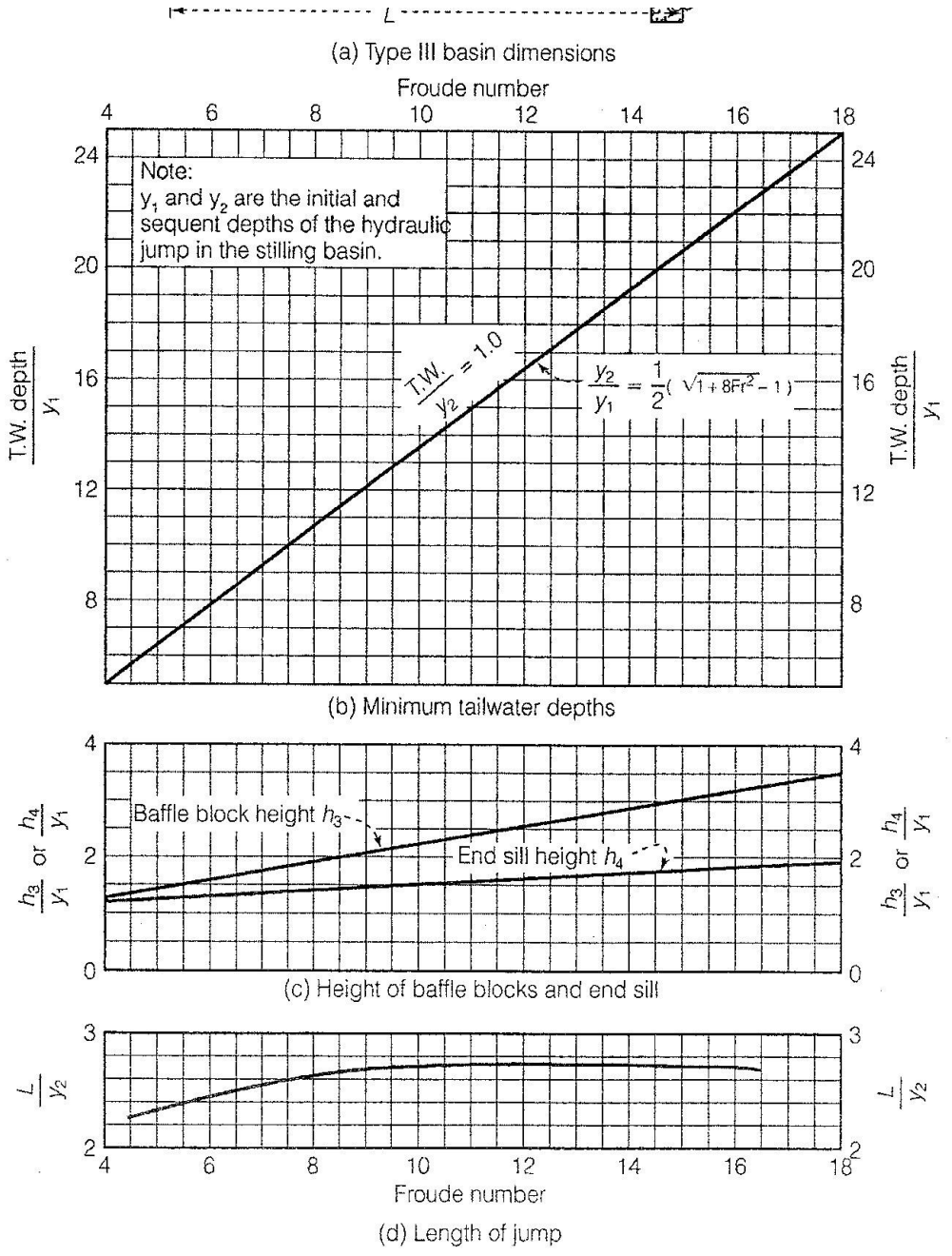
(a) Type II basin dimensions



(b) Minimum tailwater depths



(c) Length of jump



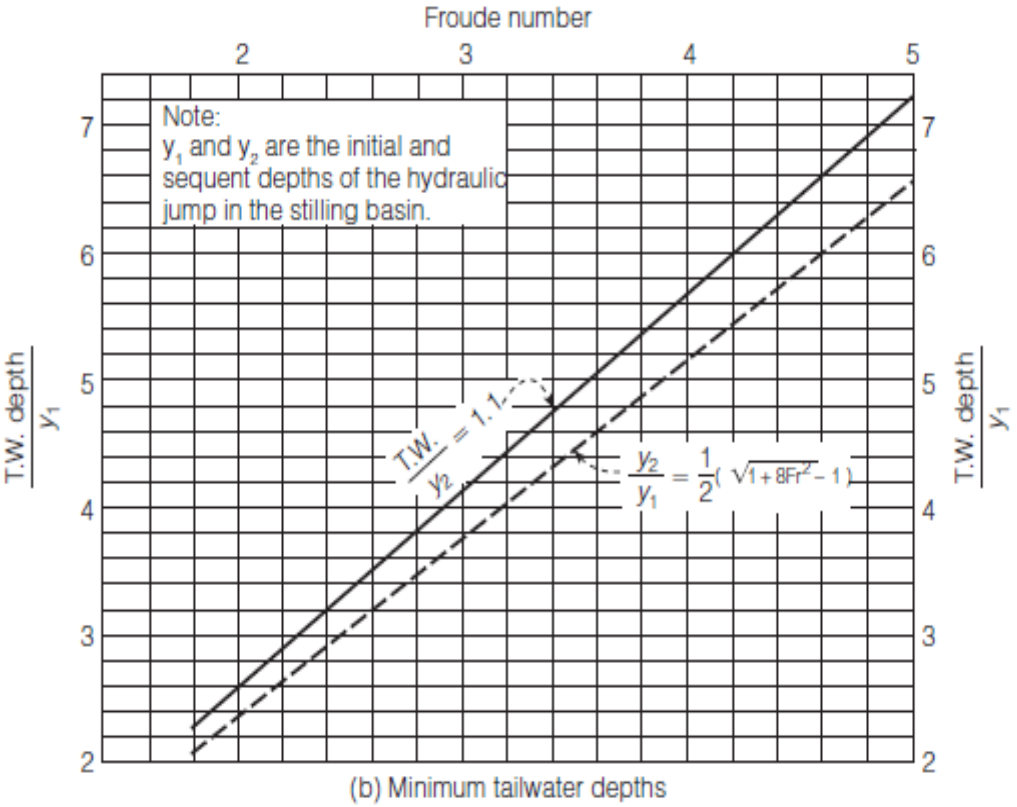
(a) Type III basin dimensions

(b) Minimum tailwater depths

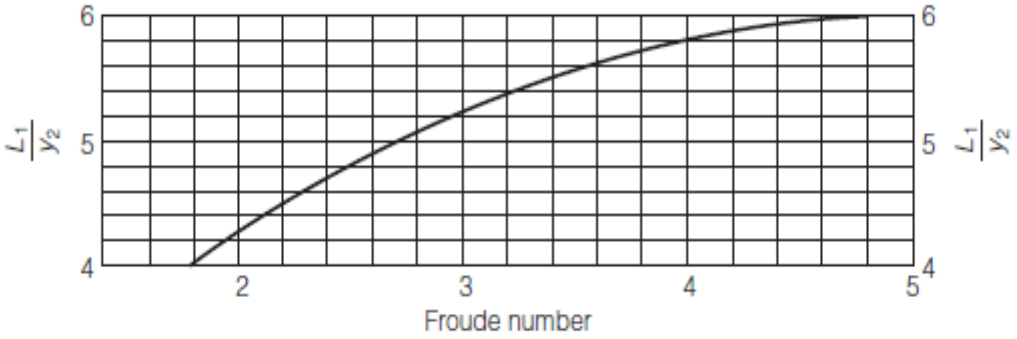
(c) Height of baffle blocks and end sill

(d) Length of jump

(a) Type IV basin dimensions



(b) Minimum tailwater depths



(c) Length of jump