



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

HYDRAULIC DESIGN II

TCW 5201

Supplementary Examination Paper

August 2015

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: NONE

Examiner's Name: ENG. A CHINYAMA

INSTRUCTIONS

1. Answer ALL questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
TOTAL	100

QUESTION 1

- a. The inflow to reservoir has an average sediment concentration of 800ppm. If the volume of the reservoir is $100 \times 10^6 \text{ m}^3$ and the annual flow of the river is $900 \times 10^6 \text{ m}^3$, determine the approximate 'half-life' of the reservoir. Assume that average porosity of the settled sediment over this period is 0.4. (15 marks)
- b. Describe the effects of sedimentation on reservoirs and measures that can be taken to minimize sediment input to a reservoir. (10 marks)

[25 marks]

QUESTION 2

- a. With aid of neatly labeled sketches describe how the venturimeter is used to measure flow in an open channel. (10 marks)
- b. A suppressed rectangular weir is being used to measure flows in an irrigation canal. The weir is 5m wide and 2m high and under flood conditions, the upstream and downstream depths are measured as 2.5m and 2.3m respectively. Use all applicable formulae to estimate the range of possible flows over the weir under these conditions. Assess the reliability of your flow estimate. How can a more precise estimate of the flow rate be obtained? (15 marks)

[25 marks]

QUESTION 3

- a. Describe the types of spillways and indicate where they are most suitable. (5marks)
- b. The maximum design discharge over a spillway 12m wide is $280 \text{ m}^3/\text{s}$ into a stilling basin of the same width. The reservoir behind the spillway has a surface elevation of 60.00m and the river water-surface elevation downstream of the stilling basin is 30.00m. Assuming a 10% energy loss in the flow down the spillway, find the invert elevation of the floor of the stilling basin so that the hydraulic jump forms in the basin. (20 marks)

[25 marks]

QUESTION 4

- a. Describe the middle third rule and explain its application in the design of concrete gravity dams. (5 marks)
- b. A culvert under a roadway is to be designed to accommodate a 100-year peak flow of $2.49\text{m}^3/\text{s}$. The invert elevation at the culvert inlet is 289.56m, the invert elevation at the outlet is 288.65m and the length of the culvert is 22.9m. The channel downstream the culvert has a rectangular cross section with a bottom width of 1.5m, slope of 4% and a Manning $n = 0.045$. The paved roadway crossing the culvert has a length of 15.2m, an elevation of 291.08m and a width of 18.3m. Considering a circular reinforced concrete pipe culvert with a diameter of 610mm and a conventional square-edge inlet and headwall, determine the depth of water flowing over the roadway, the flow over the roadway, and the flow through the culvert. (20 marks)

[25 marks]