The National University of Lesotho

B.Sc. Examination

PG 2401 : Principles of Hydrology

Jan, 2024	Marks: 100	3 Hours

Instructions:

- Answer any **four (4)** questions.
- Where applicable illustrate your answer with equations and diagrams
- Each question carries 25 marks.

Question 1

With the help of appropriate diagrams explain what you understand by the following terms:

(a) Sublimation
(b) Surface runoff
(c) Steady flow
(d) Recharge area
(e) Confined aquifer   (5 each)

[25]

Question 2

(a) About 97% of the world's water is stored in oceans. Describe the natural physical processes involved in the translation of the oceanic water to an upland stream.   (13)

(b) A hydrologist is required to assess the quantity of water available in a particular catchment in the in the lowlands of Lesotho.

   (i) What phases of the hydrological cycle would he/she have to consider and why?
   (7)

   (ii) What measurements would you recommend him/her to make?   (5)

[25]

Question 3

(a) Explain the importance of solar radiation in driving the hydrological processes   (8)

(b)   Sketch a diagram of the hydrological cycle showing all the processes that can take place. Also write short notes explaining the conditions under which each process takes place.   (17)

[25]

Question 4

(a)   Explain the following terms as used in the study of evaporation

      i.   Open water evaporation   (3)

      ii.   Actual evapotranspiration   (3)

     iii.   Potential evapotranspiration   (3)

(b)   A practical realisation of the vapour flow equation ($E_o = f(u)(e_s - e_d)$) for open water evaporation incorporates the area of the lake/reservoir as follows;

$$E_0 = 0.291A^{-0.05}U(e_s - e_d)$$

      Where E_o is in $mm\,day^{-1}$, A is in m^2, U is in $m\,s^{-1}$ and e_s and e_d are in mb.

Calculate the volume of water lost from a lake of surface area 10.86 km^2 over the summer months (October-March), given that the mean wind speed is $4.64ms^{-1}$ and the values of e_s and e_d are 15.3 and 11.2 mb, respectively.   (16)

[25]

Question 5

In a given year, a watershed/catchment with an area of 50 km^2 receives a total precipitation of 1800 mm. A dam build at the outlet of the watershed supplies $6.7 x10^7\,m^3$ of water to the nearby village during this period while an average discharge of 0.1 $m^3\,s^{-1}$ is maintained downstream of the dam.

  (a)   Assuming the watershed to be water-tight, estimate the average daily evapotranspiration from the watershed.   (15)

  (b)   What is the importance of the assumption made in (a)?   (3)

  (c)   Would the amount of evaporation be different if the watershed was not water-tight? Explain.   (7)

[25]

Question 6

(a)   Briefly describe how to carry a discharge measurement using a current meter. Itemise the instruments required and the necessary precautions you would take to ensure accuracy.   (10)

  (c) Current meter measurements were taken at a cross-section in a river as shown in table 6.1 below. Expand the table and calculate the discharge using the <u>mean-section method</u>.

      Table 6.1

Distance (m)	Depth (m)	Velocity (ms^{-1})
5	0	0
10	1.8	0.1
20	3.7	0.2
30	9.0	0.6
35	12.6	1.1
40	10.1	0.8
45	5.3	0.5
47	0	0

(15)

[25]