

Ex/SC/GEOL/UG/CORE/TH/11/2025

BACHELOR OF SCIENCE EXAMINATION, 2025

(3rd Year, 1st Semester)

GEOLOGICAL SCIENCE

PAPER : CORE/TH/11

(HYDROGEOLOGY)

Time : Two Hours

Full Marks : 40

(Use separate answer script for each Part)

PART—I (Marks : 20)

Answer *any four* questions from the following : 5×4=20

1. What do you understand by the term ‘field capacity’ of soil water zone? How is the field capacity related to ‘wilting point’? What is gravitational water? (2+2+1)
2. What is the normal time span required to complete the full rotation of a natural hydrologic cycle? Present a schematic flow chart of hydrologic cycle with global annual average water balance given in the units relative to a value of 100 for the rate of precipitation on land. (1+4)
3. What is ‘hydraulic head’? Why actual velocity of the liquid through interconnected voids of the porous media cannot be measured by applying Darcy’s law? Explain with justifications. Mention the assumptions to be taken for the proper application of Darcy’s law. (1+2+2)

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(2)

4. Calculate the coefficient of permeability (in meter/day unit) of a soil sample 6 cm in height and 50 cm² in cross-sectional area, if a quantity of water equal to 450 ml is passed down in 10 minutes under an effective constant head of 40 cm. On oven drying, the test specimen weighs 495 gm. Taking the specific gravity of soil solids as 2.65, calculate the seepage velocity of water during the test. (5)
5. Select the correct answer for the following questions from the given options : (1×5)
- I. Out of the following, which is **not** a major contributor of the hydrologic cycle?
- (a) Pedosphere
 - (b) Atmosphere
 - (c) Biosphere
 - (d) Lithosphere
- II. Specific yield is the measure of
- (a) porosity of the aquifer
 - (b) effective porosity of the aquifer
 - (c) permeability of the aquifer
 - (d) void ratio of the aquifer

(5)

6. (a) Describe with different cases to illustrate how hydraulic conductivity can be distributed at the broader scale of a geologic formation. (CO5)
- (b) How can a combination of groundwater observation wells and pumping wells be utilized to estimate hydraulic conductivity? (CO5) 2.5+1.5
7. (a) How do redox reactions affect the mobility of iron and arsenic in groundwater? (CO6)
- (b) Explain how various sources and transport mechanisms contribute to the spatio-temporal variability of fluoride contamination in groundwater system. (CO6) 2+2

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(3)

III. Wet weight of a fully saturated sediment core sample is 362 gm. After complete drying it weighs 278 gm. Therefore, the water content of the sediment sample is

- (a) 1.30
- (b) 23.20
- (c) 2.30
- (d) 30.21

IV. For a steady state of well discharge, the increase rate of depth of cone of depression increases

- (a) exponentially and directly with time
- (b) linearly and inversely with time
- (c) exponentially and inversely with time
- (d) linearly and directly with time

V. The coefficient of permeability of two aquifers *A* and *B* are 60 m/day and 40 m/day respectively. Their saturated thicknesses are 30 m and 15 m respectively. Assuming the steady state Darcian flow, the transmissivity of aquifer *A* is _____ times that of aquifer *B*.

- (a) 2
- (b) 3
- (c) 4
- (d) 9

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(4)

PART—II (Marks : 20)

Answer *any five* questions from the following :

1. (a) How do the components of the global water cycle (precipitation, evaporation and runoff) interact with one another to maintain the global water balance? **(CO1)**

(b) Briefly discuss the factors that should be considered for groundwater well site selection. **(CO3) 2.5+1.5**
2. (a) Which type of aquifer, unconfined or confined, is generally less vulnerable to contamination? **(CO6)**
(b) Under what conditions exceptions may occur? **(CO6)**
2+2
3. (a) How does climate change affect the recharge dynamics of unconfined aquifers? **(CO1)**
(b) Discuss the potential consequences of groundwater pumping from confined versus unconfined aquifers. **(CO2) 2+2**
4. In a region with an unconfined aquifer connected to a river, what would be the likely effects of a prolonged drought (characterized by below-normal precipitation) on (a) the aquifer and (b) the river system? **(CO4) 2+2**
5. (a) How is hydraulic head typically distributed in recharge and discharge zones? **(CO4)**
(b) Explain the Ghyben-Herzberg relation and its significance in understanding freshwater-saltwater interfaces. **(CO2) 2.5+1.5**

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