

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

CLASS: B.TECH.  
BRANCH: CIVIL

SEMESTER : IV  
SESSION : SP/2025

**SUBJECT: CE418 GROUNDWATER ENGINEERING**

TIME: 3 Hours

FULL MARKS: 50

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- |  |     | CO | BL |
|--|-----|----|----|
| Q.1(a) Determine the volume of water released by lowering the piezometric surface of a confined aquifer by 5 m over an area of 1 km <sup>2</sup> . The aquifer is 35 m thick and has a storage coefficient of $8.3 \times 10^{-3}$ .                                   | [5] | 1  | 3  |
| Q.1(b) Derive the expression for equivalent horizontal hydraulic conductivity for n layers of a stratified material.   | [5] | 1  | 2  |
| Q.2(a) A 30 cm well penetrates 50 m below the static water table. After a long period of pumping at a rate of 1800 lpm, the drawdowns in the wells at 15 and 45 m from the pumped well were 1.7 and 0.8 m respectively. Determine the transmissibility of the aquifer. | [5] | 2  | 3  |
| Q.2(b) Explain the characteristics well losses.  | [5] | 2  | 2  |
| Q.3(a) Discuss the concepts of porous media models.  | [5] | 3  | 2  |
| Q.3(b) Discuss the difference between the finite difference and finite element methods of groundwater modeling.  | [5] | 3  | 4  |
| Q.4(a) Discuss the concepts of Electrical resistivity method for surface geophysical investigations.   | [5] | 4  | 2  |
| Q.4(b) In a refraction shooting, nine geophones were placed along a straight line at distances of 40, 60, 80, 100, 140, 180, 220, 260 and 320 metres from the shot point. The seismic record gave the following data:  | [5] | 4  | 3  |

Geophone	Distance from shot point (m)	Time of first arrival (m/s)
G <sub>1</sub>	40	75
G <sub>2</sub>	60	110
G <sub>3</sub>	80	150
G <sub>4</sub>	100	160
G <sub>5</sub>	140	180
G <sub>6</sub>	180	200
G <sub>7</sub>	220	205
G <sub>8</sub>	260	215
G <sub>9</sub>	320	225

Based on the above data, a time-distance graph has been plotted as shown in Fig. 4.1.

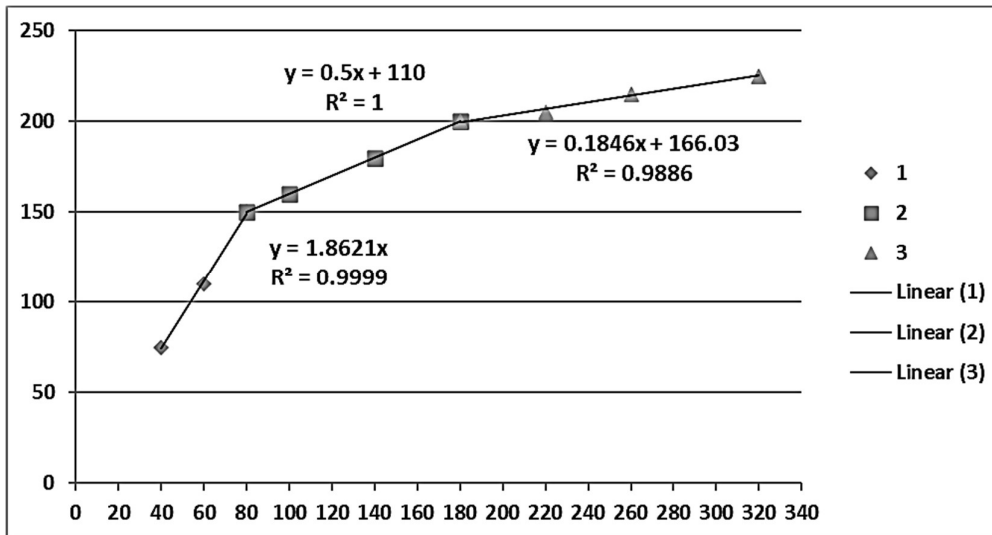


Fig. 4.1: Time-Distance graph

Determine the velocity of the shock wave and thickness of each layer.

Q.5(a) The chemical analysis of a groundwater sample gave the following results. [5] 5 3

Cations : Ca = Mg = Na = 50 mg/L.

Anions :  $\text{HCO}_3 = 138$  mg/L,  $\text{SO}_4 = \text{Cl} = \text{NO}_3 = 100$  mg/L

Report the result qualitatively in terms of Total Hardness (TH), Non-Carbonate Hardness (NCH), Sodium percentage (Na%), Sodium Absorption Ratio (SAR), Residual Carbonates (RC) and Permeability Index (PI).

Q.5(b) Write permissible limits for the following water quality parameters as per IS 10500: 2012 and WHO drinking water standards or guidelines: [5] 5 1

- i. Total Dissolved Solids
- ii. Turbidity
- iii. Calcium
- iv. Magnesium
- v. pH
- vi. Chloride
- vii. Hardness
- viii. Alkalinity
- ix. Sulphate
- x. Nitrate

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