HYDROGEOLOGY

Time Allowed : Three Hours

Maximum Marks : 200

Question Paper Specific Instructions

Please read each of the following instructions carefully before attempting questions :

There are **NINE** questions divided under **FIVE** sections.

Candidate has to attempt **FIVE** questions in all.

The **ONLY** question in Section A is **compulsory**.

Out of the remaining **EIGHT** questions, the candidate has to attempt **FOUR**, choosing **ONE** from each of the other Sections B, C, D and E.

The number of marks carried by a question / part is indicated against it.

Symbols, abbreviations and notations have their usual standard meanings.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly.

Answers must be written in **ENGLISH** only.

Neat sketches are to be drawn to illustrate answers, wherever required.

Wherever required, graphs / tables are to be drawn on the Question-cum-Answer Booklet itself.

Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.

SECTION A
(Compulsory Section)

Q1. **Write notes on the following in not more than 5 sentences each :**   *5×8=40*

    (a)   Transmissivity of Aquifers   *5*

    (b)   Vadose Zone   *5*

    (c)   Spatial Resolution in Remote Sensing   *5*

    (d)   Piezometer   *5*

    (e)   Reynolds Number   *5*

    (f)   Cone of Depression   *5*

    (g)   GRACE Satellite Data-finding for Groundwater Status   *5*

    (h)   Check Dams   *5*

SECTION B
(Attempt any one question)

Q2. (a) Describe the role of vadose zone in water balance equation. *15*

(b) What are aquifers ? Explain the different types of aquifers and their characteristics with suitable diagrams. *10*

(c) Describe the salient features of different groundwater provinces of India. *15*

Q3. (a) Define the origin of Sambhar Lake and its relation with surrounding aquifers. *10*

(b) How are the groundwater levels affected by tides and weather fluctuation ? *15*

(c) Classify the rocks based on their water-bearing properties. *15*

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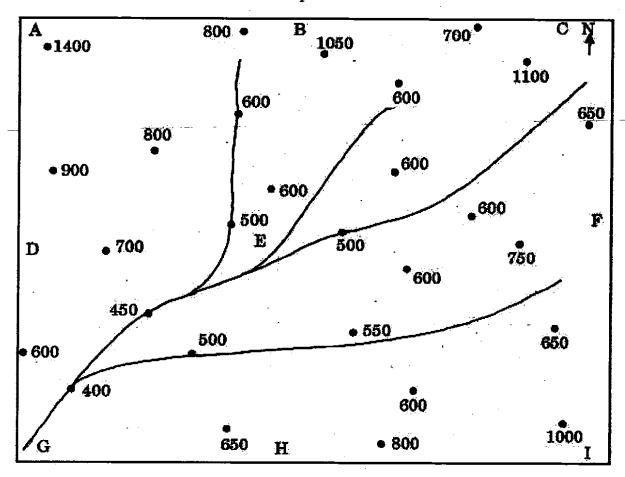**Q4.** (a) The water table elevations (in m above mean sea level) measured from observation wells of an area are shown in Map 1. After drawing the water table contours, discuss about the groundwater flow directions and significances. *15*

Map 1

(b) Define hydraulic conductivity. Explain the field methods of determining the hydraulic conductivity of aquifer media. *15*

(c) What is meant by Porosity ? Explain the types of porosities encountered in various rock types. Add a note on the two aquifer properties involved in porosity. *10*

Q5. **(a)** Explain the factors controlling groundwater flow. Highlight the types of flows encountered in different kinds of aquifers. *10*

(b) Pumping tests were conducted in a set of four wells designated as A, B, C and D, with a pumping rate of 100 cu.m./day, in each well. The semi-log plot of drawdown versus time has shown the following drawdown-per-log cycle (Δs) values as output :

Well	A	B	C	D
Δs	0·25	0·75	0·50	0·15

After calculating the aquifer transmissivities using Jacob's straight line equation, compare the nature of aquifers in these wells. Find out the best performing well. *15*

(c) What are groundwater models ? Give an account on the protocols of groundwater models, available for water resources evaluation. *15*

SECTION D

(Attempt any one question)

Q6. (a) What are the elements of interpretation adopted in Satellite Images ? Give an account on the role of Remote Sensing in groundwater exploration. *10*

(b) Write notes on the following : *15*

    (i) Principles of Seismic Refraction Method

    (ii) Bouguer Anomalies

    (iii) Proton Precession Magnetometer

(c) What are the basic principles involved in Electrical Resistivity Method ? Give an account on the types of surface electrical resistivity methods employed in groundwater exploration. *15*

Q7. (a) What are water wells ? Give an account on the methods adopted in design, development and maintenance of various types of tube wells. *15*

(b) Explain the water well drilling methods employed in the groundwater exploration of hard rock terrains. *10*

(c) What are the basic principles involved in well logging ? Give an account on the methods of subsurface geophysical logging employed for hydrogeological interpretations. *15*

Q8. (a) How do the following parameters affect the use of groundwater ?   *15*

     (i) Hardness

     (ii) pH

     (iii) EC

     (iv) SAR

     (v) Fluoride

(b) Name various graphical representation techniques of groundwater hydrochemical data. Explain the one which is used for the classification of groundwater into various facies.   *15*

(c) What is Radon ? Explain its implications in hydrogeology.   *10*

Q9. (a) Discuss the major challenges in implementation of groundwater related regulatory measures in India.   *15*

(b) Explain the following pertaining to the groundwater management :   *15*

     (i) Supply side measures

     (ii) Demand side measures

(c) Calculate the total annual rainfall runoff available from a roof top area of 2080 sq.m. with surface runoff coefficient 0·8 and average annual rainfall of 600 mm.   *10*