AI 9302 – GROUNDWATER AND WELL ENGINEERING

Time : 3 hr   Max. Mark   : 100

Instructions : Question Number 11 is compulsory

PART – A [10 * 2 = 20 marks]

1. Explain briefly the three types of soil moisture associated in the zone of aeration.

2. Write five generalized approaches in groundwater modeling.

3. State Darcy's Law and its limitations.

4. What are the factors responsible for permeability and write the expression for the coefficient of permeability.

5. Explain steps followed in estimating the aquifer parameters using the Theis Method.

6. The draw down is 2 m in an observation well 20 m away from the pumping well after 15 min of pumping. At what time the same draw down will occur in another well 40 m away?

7. Draw a sketch for a pumping well between recharge boundary (3 cm) on the left and barrier boundary (2 cm) on the right using method of images.

8. Write short notes on well revitalization.

9. What do you mean by vulnerability index with respect to aquifer pollution? Explain briefly.

10. What is the simplified freshwater-seawater relation which is universally used?

PART – B [5 * 16 = 80 marks]

11 A 20 cm pumping well is discharging 1,150 lpm which is 12.3 m from an observation well whose draw down is given below. Find the aquifer parameters T and S. What will be the draw down at the end of 180 days (a) in the observation well and (b) in the pumped well.

Time (min)	2	3	5	7	9	12	15	20	40	60	90	120
Drawdown (m)	2.42	2.46	2.52	2.58	2.61	2.63	2.67	2.71	2.79	2.85	2.91	2.94

1

12a(i) Why do modeling studies are needed? Write classification of models and its application (6)

(ii) Explain Model Domain, Spacially and time varying inputs, Initial and Boundary conditions in the groundwater modeling. (10)

(or)

12b Write the procedure to delineate and to characterize the groundwater potential zone in the hard rock terrain using remote sensing and GIS technique with flow chart.

13a Explain the Wenner and Schlumberger electrode arrangement with appropriate electrode connections. What are its various application to groundwater studies?

(or)

13b An Aquifer of aerial extent of 100 km^2 is overlain by four strata given below:

Strata	Thickness (m)	K_x (m/day)	K_y (m/day)
1 (top)	1	1	0.25
2	3	2	0.3
3	2	1.5	0.2
4	4	0.025	0.005

i. If a 4 hour storm occurs producing a total rainfall 100 mm, estimate the recharge into the aquifer, assuming that the piezometric surface in the aquifer is at the bottom of layer and that all layers are saturated.

ii. If the four layers are underlain by an impermeable strata instead of the aquifer, estimate the lateral flow per unit width through the layers, assuming that the layer dip by 0.1%.

14a. The results of sieve analysis test carried out on a 500 gm sample of underground aquifer, proposed to be tapped for installation of a tube well, are given in the table below. Design all the components of the water well both for naturally developed and artificially gravel packed cases.

Sl. No.	Size of Sieve in mm	Wt. of material retained in gm
1	> 2.54	0.0
2	1.80	6.0
3	0.30	15.0
4	0.25	320.0
5	0.21	5.0
6	0.16	50.0
7	0.12	34.0

8	< 0.12	70.0
	Total	500 gm

(or)

14b Explain both the hydraulic rotary method which used for drilling the well with neat sketch. List the advantages of direct circulation and reverse circulation method.

15a(i) Explain any two types of pumps used in lifting the water.   (10)

(ii) Explain the artificial recharge methods that is in practice to recharge shallow aquifers.   (06)

(or)

15b(i) Why do groundwater legislation needed. What are various aspects of the bill of legislation?   (06)

(ii) The loss of freshwater from a coastal aquifer extending 6 km along the shore has been estimated to be 30000 m³/day. The aquifer is underlain by an impervious layer at a depth of 50 m below msl. Permeability of the aquifer is 40 m/day. Determine the i. depth of the interface below msl at 90 m from the shore inland, ii. The location of the toe of the saltwater wedge, iii. The width of the gap at the shore bottom through which the freshwater escapes into the sea and (iv) how far the toe of the wedge will move if the loss of freshwater is reduced by 80% by groundwater exploitation in the coastal aquifer?   (10)