B.E./B.Tech (Full Time) DEGREE END SEMESTER EXAMINATION, NOVEMBER 2011

AGRICULTURAL AND IRRIGATION ENGINEERING BRANCH
FIFTH SEMESTER – (REGULATIONS 2008)

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. An undisturbed cylindrical core sample of sandstone 20 cm high and 10 cm in diameter weighs 2800 g. Calculate the porosity, given that the particle mass density of constituent grains is 2.65 g/cm^3.
2. Write the Dupuit's equation for a one dimensional steady groundwater flow? State its assumption.
3. The coefficient of storage of an artesian aquifer is $3 * 10^{-4}$. If the thickness of the aquifer is 50 m and the porosity 30%, estimate the fraction of the coefficient of storage attributable to expansibility of water and that attributable to the compressibility of the aquifer skeleton. $K_w = 2.1$ GN/m^2.
4. How transmissivity and storage coefficient are estimated using Theis Method.
5. Define Law of Times. Where is it used?
6. Explain upconing of saltwater beneath a pumped well in a coastal aquifers.
7. Write short note on groundwater prospecting.
8. What is the pupose of using geophones during geophysical method?
9. Why do modeling studies are needed? Write classification of models and its application.
10. What is the average life of tubewells and what are the reasons for their failure?

PART – B [5 * 16 = 80 marks]

11. Pump test data on a 60 cm well is given in table 1.The well is pumped at the rate of 900 lpm. Determine the aquifer constants T and S. Comment on the hydraulic boundary condition if any. Determine also the distance between the boundary and the pumping well.

Table - 1

Time t (min)	10	20	30	40	50	60	80	100	120	150	250	350
s (m)	3.55	3.72	3.82	3.88	3.95	4.00	4.09	4.14	4.18	4.22	4.35	4.44.
Time t (min)	500	600	800	1000	1300	1600	2000	2500	3000	4000	5000	
s(m)	4.50	4.55	4.59	4.62	4.65	4.69	4.72	4.75	4.77	4.80	4.85	

12a. The following readings were obtained from an NGRI resistivity meter while conducting a resistivity depth probe by Schlumberger method. Draw the resistivity curve and make interpretations for water well drilling. (10)

Distance of potential electordes MN/2 (m)	Distance of Current electrodes AB/2 (m)	Meter Readings	
		Voltage (mv)	Current (ma)
0.15	1.5	46	25
	2.1	9	12
	3.0	3	9
	4.5	4	26
0.75	4.5	15	26
	6.0	3	9
	9.0	2	11
	15.0	1	14
	21.0	1	17
3.0	15.0	8	17
	21.0	3	11
	30.0	2	12
	45.0	1	16
7.5	45.0	3	16
	60.0	2	16
	90.0	1	17
15.0	90.0	2	17

12b. Draw a flow chart to identify the suitable sites for artificial recharge zones using Remote Sensing and GIS technology. (06)

(or)

12c. A 25 cm well penetrates an artesian aquifer of 10 m thick. After 10 hours of pumping at the rate of 1100 lpm the drawdown in the well is 2.6 m and after 48 hours the drawdown is 2.85 m. Determine the T and S of the aquifer. What is the permeability of the aquifer material? After what time the drawdown will be 4.1 m?

12d. A 30 cm well 75 m deep is proposed in an aquifer having a transmissibility of $1.5*10^5$ lpd/m and a coefficient of storage 0.004. The static water level is expected to be 20 m below ground level. Assuming a pumping rate of 2000 lpm. What will be the drawdown in the well after one year and two years? (8)

13a. Under what circumstances can a radial collector well be most advantageously used? How do you determine the length and number of laterals for a proposed radial collector well? (08)

13b. Describe briefly the image well theory. An aquifer is bounded by two converging boundaries at an angle of 45° , one being a barrier boundary and the other a recharge boundary. Compute the number of image wells and mark them neatly in a sketch. (08)

(or)

13c. 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

14a. Enumerate the different methods which are used for drilling the tube wells. Discuss any one of these methods in detail with a neat sketch.

(or)

14b. Explain Well Development and its objectives. Discuss the commonly adopted well development methods. (10)

14c. Explain various stages of well completion. (06)

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

15b. Explain the artificial recharge methods that is in practice to recharge shallow aquifers. (06)

(or)

15c. By conductivity measurements in a well in a coastal aquifer extending 4 km along the shore, the interface was located at a depth of 20 m below msl at 100 m from the shore, inland. The depth of the homogeneous aquifer is 30 m below m.s.l and has a permeability of 50 m/day. What is the rate of freshwater flow into the sea and the width of gap at the shore bottom through which it escapes into the sea? What is the position of the toe of the saltwater wedge? Use Glover's method. If due to groundwater exploitation, the freshwater flow into the sea is reduced by 80% how far the toe will eventually move?