Code No: 07A80102 **R07** **Set No. 2**

IV B.Tech II Semester Examinations,APRIL 2011
GROUND WATER DEVELOPMENT AND MANAGEMENT
Civil Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. Explain along with a case study how Remote sensing is useful for assessment of groundwater studies. [16]

2. Find an expression relating the length of the interface with freshwater out flow to the sea in a confined aquifer. Draw diagrams to show that the expression is valied when
   (a) The top of a confined aquifer is at mean sea level.
   (b) The top of the confined aquifer is at a level higher than mean sea level.
   (c) The top of the confined aquifer is at a level lower than mean sea level. [16]

3. (a) Define the principle of the seismic refraction method. How is this method applied to assess the presence of an aquifer?
   (b) In the seismic refraction method, distinguish between the intercept time and cross over distance methods for estimating the thickness of an aquifer. Derive the relevant equations for these determinations. [8+8]

4. (a) Give the water balance equation for an inland-drainage basin in an arid region.
   (b) Give the transient hydrologic-budget equation for the saturated portion of a ground-water basin. [8+8]

5. The aquifer properties S and T of a confined aquifer in which a well is driven are known. Explain a procedure to calculate the draw down at a location away from the well at any instant after the pump has started. [16]

6. A 20 cm diameter tube well taps an artesian aquifer. Find the yield for a drawdown of 3.0 m at the well. The length of the strainer is 30 m and the coefficient of permeability of the aquifer is 35 m/day. Assume the radius of influence as 300 m. If the other conditions remain same, find the percentage change in yield under the following cases:
   (a) The diameter of the well is 40 cm,
   (b) The drawdown is 6.0 m,
   (c) The permeability is 17.5 m/day. [16]

7. (a) The discharge from a fully penetrating well operating well operating under steady state in a confined aquifer of 35 m thickness is 3000 1pm. Values of drawdown at two observation wells 12 and 120 m away from the well are 3.0 and 0.30 m respectively. Determine the permeability of the aquifer.

(b) Determine the yield from a 30 cm well fully penetrating an unconfined aquifer of 30m thickness and permeability of 12 m/day. The drawdown in the well is 4m and rainfall penetration is 1 mm/hr. Assume recharge is within the radius of influence. [8+8]

8. Determine the effective size, mean size, and the uniformity coefficient of the aquifer material from the following data from a sieve analysis: [16]

Sieve opening (mm)	Percentage finer by weight
4	95.5
2	92.3
1.4	86.0
1.0	78.0
0.5	57.8
0.25	25.5
0.125	12.4
0.075	5.4

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1. List out various methods for determination of permeability and explain any one in detail along with a neat sketch. [16]

2. What are the various requirements for assessing the suitability to carry out an artificial recharge project in a particular area? [16]

3. (a) Explain the concept of safe yield and alternative yields.
   (b) Describe the role of conjunctive use in water resources management. [8+8]

4. In an unconfined aquifer of hydraulic conductivity $k_f = 77.76m/d(9\times10^{-4}m/s)$ the fresh water flows in the aquifer to the sea at the rate of 0.02592 $m^3/d\,(3\times10^{-4}1/s)$ per meter width of the aquifer. Estimate the depth of fresh water (below ground level) in an observation well located 150 m from the coast line (ground elevation 3m). If water is pumped from the well at a very low rate so as to lower the water table at the well by 0.5 cm, what will happen to the interface?
   $\rho_s = 1025kg/m^3, \rho_f = 1000kg/m^3$. Height of mean sea level above datum = 2.5 m. [16]

5. (a) A artesian aquifer 30m thick has a porosity of 25% and bulk modulus of compression of 2000kg/cm^2. Estimate the storage coefficient of the aquifer. What fraction of this is attributable to the expansibility of water?
   (b) A 30 cm well penetrates an aquifer of transmissibility of 2×10^5 lpd/m and a storage coefficient of 0.005.What pumping rate could be adopted so that the drawdown will not exceed 10m within the subsequent two years of drought? [8+8]

6. Following are the data obtained in a refraction shooting. Determine the depth to the water table: [16]

Geophone (no.)	Geophone (no.)	Time of first arrival (m/sec)
1	20	100
2	40	200
3	60	300
4	80	400
5	100	500
6	120	590
7	140	620
8	160	660
9	180	700

7. At a certain point in an unconfined aquifer of $3km^2$ area, the water table was at an elevation of 102.00m. Due to natural recharge in a wet season, its level rose to 103.20m. A volume of $1.5Mm^3$ of water was then pumped out of the aquifer causing the water table to reach a level of 101.20m.Assuming the water table in the entire aquifer to respond in a similar way, estimate

   (a) The specific yield of the aquifer and

   (b) The volume of recharge during the wet season. [16]

8. Tabulated below are the data on an observation well 12.3m from a 20 cm well which is pumped for test at the rate of 1,150 lpm. Find the transmissibility and storage coefficient of the aquifer. What will be the drawdown at the end of 180days

   (a) in the observation well and

   (b) in the pumped well, Use the modified Thesis method ;under what conditions is this method valid? [16]

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

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Code No: 07A80102 **R07** **Set No. 1**

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1. Derive the discharge equation for steady state artesian flow along with a neat sketch and assumptions adopted. [16]

2. Discuss the various aspects of technical feasibility and economic viability of a real world artificial recharge project. [16]

3. Derive the equation to establish the relationship between the length of the interface and outflow to the sea in unconfined coastal aquifer. What are the assumptions involved? [16]

4. A field test for permeability consists min observing the time required for a tracer to travel between two observations wells. A tracer was found to take 10h to travel between two wells 50m apart when the difference in the water-surface elevation in them was 0.5m.the mean particle size of the aquifer was 2mm and the porosity of the medium 0.3.If ϑ=0.01cm^2/s estimate:

   (a) The coefficient of permeability and intrinsic permeability of the aquifer

   (b) The Reynolds number of the flow. [16]

5. The coefficient of transmissivity and storage of a nonleaky confined aquifer infinite in aerial extent are 1241.9 m^2/day and 3×10^{-4} respectively. A fully penetrating production well has been discharging water at a constant rate of 5450 m^3/d for a period of one year. Compute the drawdown at a distance of 3.048 kms from the production well for pumping periods of 10 days, 50 days and 1 year. [16]

6. In a confined aquifer, lowering of the piezometric head by 5 m eventually causes aquifer compaction by 11 mm. If the porosity of the aquifer is 40% and the compressibility of groundwater and the aquifer are 5×10^{-10} and 2×10^{-08} m^2/N respectively, find

   (a) the storage coefficient of the aquifer

   (b) the intergranular stress before and after the decline in the piezometric head.

   (c) the change in aquifer porosity and groundwater density due to this decline It is given that the initial aquifer thickness of the overburden = 7m, specific weight of saturated clay, $\rho g = 3 \times 10^4$N/m^3 and initial piezometric head = 15m. [16]

7. In figure 1 shows the location of 4 geophones placed on an undulating topography for a seismic refraction investigation. The actual first arrival times recorded at A,

B, C and D are 15 ms, 29 ms, 40 ms and 50 ms respectively, whereas the corrected times for these geophones to project on a datum plane at 400 amsl are 7.74 ms, 25.37 ms, 42.42 ms and 54.357 ms respectively. If the over burden and seismic velocity of the aquifer are assumed as 400 m/s and 1.6 km/s respectively, compute the elevations of geophones A, B, C and D above mean sea level. [16]

Figure 1:

8. Two identical wells of 0.20 m diameter are proposed to the constructed screening a confined aquifer, such that there is no mutual interference. Determine the minimum distance to be maintained between the wells, given that the pumpage from each will be 4320 m^3/day, equilibrium drawdown to be maintained is 7.02 m and transmissivity of the aquifer is 775 m^2/day. Assume that the well will be 100 percent efficient. [16]

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Code No: 07A80102 **R07** **Set No. 3**

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Answer any FIVE Questions
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1. What is the necessity of artificially recharging confined and unconfined aquifers? Discuss some specific advantages of practicing artificial recharge techniques. [16]

2. (a) Explain general variation pattern of porosity specific retention and specific yield.
   (b) In an area of 100 ha, the water table dropped by 4.5 m, the porosity is 30 %, and specific retention is 10 %. Compute the change in groundwater storage. [8+8]

3. Discuss the Ghyben-Herzberg (G-H) theory of sea water intrusion in coastal aquifers. Draw neat diagrams to show the G-H and actual interface between sea and fresh water (assuming a sharp interface). How can the interface angle be determined in terms of the velocities of sea and freshwater along the sharp interface? [16]

4. (a) A 25cm well, located at a distance of 1.5 km from a recharge boundary, has been discharging at a constant rate from a water table aquifer. The coefficients of transmissibility and storage of the aquifer are 1.8×10^5 lpd/m and 0.2 respectively. Compute the time that must elapse the water level in the well stabilize.
   (b) The barometric efficiency of a well in an aquifer infinite in areal extent is 70%. If the thickness of the aquifer is 50 m and the porosity is 25%. Estimate the coefficient of storage of the aquifer. [8+8]

5. The following data were obtained from a seismic refraction shooting: [16]

Geophone no. Distance from	1	2	3	4	5	6	7	8	9
Shot point, (m) First arrival	4	8	12	16	20	24	28	32	36
Time, (millisec) Estimate the depth to water table	21	42	63	84	105	117	124	132	140

6. The cropping pattern during the rabi season and irrigation requirement of a 2 ha. Farm in Maharashtra, supplied with water from a dug well pumping for 4 h a day, are given below. Determine the required discharge. [16]

Crop	Area (ha.)	No. of irrigations	Irrigation interval (days)	Depth of irrigation (cm)
Sugarcane	1.2	12	12	9.0
Wheat	1.8	6	20	7.5
Cotton	1.4	9	30	7.5
Gram	1.6	3	30	7.5

7. Solve the governing equation
$\frac{\partial^2 h}{\partial r^2} + \frac{1}{r}\frac{\partial h}{\partial r} = \frac{S}{T}\frac{\partial h}{\partial t}$
With the boundary conditions h as for and $Lim r \rightarrow 0 \left(r\frac{\partial h}{\partial r}\right) = \frac{Q_w}{2\pi T} at$ t> 0 i.e.; at a vanishingly small radius the discharge is constant and is uniformly distributed at the well face. The initial condition is $h_(r, 0) = h_o$ for $t \leq 0$. [16]

8. It was observed in a field test that 3 hr 20 min was required for a tracer to travel from one well to another 20m apart , and the difference in their water surface elevation was 0.5m. Samples of the aquifer between the wells indicated a porosity of 15%. Determine permeability of aquifer, seepage velocity, and the Reynolds number for the flow, assuming an average grain size of 1 mm and water at 27^o C = 0.008 stroke. [16]

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