NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART V FIRST SEMESTER EXAMINATION – APRIL 2009
GROUNDWATER HYDRAULICS AND MODELLING – TCW 5001

INSTRUCTIONS:

Answer ALL questions. All questions carry equal marks.

Time : 3 hours
Totals Marks: 100

QUESTION 1

(a) An unconfined aquifer has a hydraulic conductivity of 1.8 m/day and a porosity of 0.3. The aquifer is a bed of sand of uniform thickness of 35 m. Two observation wells A and B, separated by a distance of 200 m, indicate water levels of 22.5 m and 24 m below the land surface, respectively. Determine
(i) the steady discharge per unit width
(ii) the average pore velocity, and
(iii) the water table elevation midway between the two wells (11 marks)

(b)A long canal was constructed running parallel to a river 1.5 km away. Both fully penetrate a sand aquifer with hydraulic conductivity of 1.2 m/d. The area is subject to a rainfall of 1.8 m/year and evaporation of 1.3 m/year. The elevation of water in the river is 33 m and in the canal it is 28 m. Determine
(i) the water divide (where specific discharge is zero)
(ii) the maximum water table elevation
(iii) the steady discharge per kilometer into the canal, and
(iv) the steady discharge per kilometer into the river (14 marks)

QUESTION 2

(a) In the face of low rainfall, artificial recharge becomes a good management tool. What are its merits and demerits? How is it implemented? (10 marks)

(b) Define the following terms as used in groundwater development and management:
(i). maximum sustained yield, (ii) maximum mining yield, (iii) developmental overdraft, (iv) seasonal or cyclical overdraft, and (v) long-run overdraft. (10 marks)

(c) Outline the information required for the assessment of the groundwater development potential of an aquifer. (5 marks)

QUESTION 3

(a) A well completed in a confined aquifer is pumped at a rate of 200 m^3/d, and the drawdown is measured in 2 monitoring wells located at distances r_1 = 10 m and r_2 = 25 m from the pumping well. After a period of pumping, the observed heads in the monitoring wells stabilize with the measured values h_1 = 86 m and h_2 = 88 m. What is the aquifer transmissivity? (6 marks)

(b) 2 wells, one of diameter 450 mm and the other of diameter 250 mm, are sunk 80 m apart and they fully penetrate a confined medium of thickness, b = 12 m. After pumping both wells for a long time with the larger diameter well being pumped at a constant rate of 2 m^3/min and the other at a rate 0.8m^3/min, the drawdown in the larger diameter well is 4 m. Determine the coefficients of transmissivity and conductivity of the aquifer. Assume the radius of influence of the larger diameter well is 600 m, while that of the smaller diameter well is 400 m. Estimate the drawdown in the smaller diameter well. (13 marks)

(c) What is a flownet? Under what conditions can it be used? (6 marks)

QUESTION 4

(a) A well penetrating a confined aquifer is pumped at a uniform rate of 2,500 m^3/d. Drawdowns during the pumping period are measured in an observation well 60 m away; observation of *t* and *s* are listed in Table Q4. Using the Thesis method determine T and S for this aquifer. (25 marks)

Table Q4

t (min)	s (m)	r^2/t	t (min)	s (m)	r^2/t
0	0	∞	18	0.67	200
1	0.20	3,600	24	0.72	150
1.5	0.27	2,400	30	0.76	120
2	0.30	1,800	40	0.81	90
2.5	0.34	1,440	50	0.85	72
3	0.37	1,200	60	0.90	60
4	0.41	900	80	0.93	45
5	0.45	720	100	0.96	36
6	0.48	600	120	1.00	30
8	0.53	450	150	1.04	24
10	0.57	360	180	1.07	20
12	0.60	300	210	1.10	17
14	0.63	257	240	1.112	15