NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
BACHELOR OF CIVIL AND WATER ENGINEERING (HONS) DEGREE
PART V FIRST SEMESTER EXAMINATIONS – JANUARY 2011

GROUNDWATER HYDRAULICS AND MODELLING– TCW 5001

Instructions:
Answerany 4 questions. All questions carry equal marks

Time: 3 Hours Total marks: 100

Question 1

a. A fully penetrating well is abstracted at a constant at a 400 m3/hr over a considerable period of time from a homogeneneous, isotropic confined aquifer of constant thickness of 40 m. Two observation wells, one at a distance of 25 m shows a water level of 85.3 m and the other at 75 m shows a steady water level at 89.6 m. Determine the aquifer transmissivity and hydraulic conductivity. (10 marks)

b. Two wells, one of 450 mm diameter and the other of 250 mm diameter, are sunk 80 m apart and 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 m3/min and the other at a rate 0.8 m3/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 diameter well. (15 marks)

Question 2

a. The nature and distribution of aquifers in a geologic system are controlled by the lithology, stratigraphy and structure of the geologic deposits and formations. Outline the geological occurrence of groundwater in relation to aquifers, possible groundwater quality problems and abstraction. (25 marks)

Question 3

a. Groundwater is a hidden but valuable resource which is often not properly managed in many developing economies. What are your reactions to this statement with respect to the Matabeleland region, in general, and Bulawayo, in particular. Clearly indicate how you will go about putting into place a management policy for groundwater exploitation. Be methodological by indicating possible objectives, decision variables, state variables, and constraints that can be examined. (10 marks)

b. What is your understanding of the following terms:(i) soil water zone, (ii) vadose water zone, (iii) capillary fringe, (iv) isotropy and anisotropy, (v) homogeneous and nonhomogeneous medium. (5 marks)

c. Describe the mechanisms responsible for storage of water in confined and unconfined aquifers. How do these mechanisms differ for the two types of aquifers? (5 marks)

d. Define the storativity for confined and unconfined aquifers. A volume of water of 40 x $10^6 m^3$ has been pumped from a phreatic aquifer through wells that are more or less, uniformly distributed over an area of $100km^2$ of the aquifer. If the aquifer's specific yield is 0.2, determine the average drawdown of the water table over the area. (5 marks)

Question 4

a. A 0.5 m diameter well, 200 m from a river is pumping at an unknown rate from a confined aquifer. The aquifer properties are T = 432 m2/day and S = 4.0 x 10-4. After 8 hours of pumping, the drawdown in the observation well (60 m from the river) is 0.8 m. Compute the rate of pumping and the drawdown in the pumped well. What is the effect of the river on drawdown in the observation well and in the pumped? (15 marks)

b. A well is pumping near a barrier boundary at a rate of 0.03 m3/s from a confined aquifer 20 m thick. The hydraulic conductivity of the aquifer is 27.65 m/day and its storativity is 3x10-5. Determine the drawdown in the observation well after 10 hours of continouos pumping. What is the fraction of the drawdown attributable to the barrier boundary? (10 marks)

Question 5

a. Explain why numerical techniques are frequently used in groundwater flow and transport. (5 marks)

b. Briefly describe the types of groundwater models (8 marks)

c. Outline the steps involved in the development of a groundwater model. (12 marks)