MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2013/2014

THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN EARTH SCIENCE WITH INFORMATION TECHNOLOGY

(MAIN CAMPUS)

NGA 302: GROUNDWATER HYDROLOGY

Date: 10th April, 2014 Time 11.15 a.m. – 1.30 p.m.

INSTRUCTIONS:

- **Answer Question ONE and any other TWO questions.**
- **Sketch maps and diagrams should be used whenever appropriate.**

NGA 302: GROUNDWATER HYDROLOGY

1. a) Explain the importance of specific yield and storage coefficient of aquifers in groundwater studies (6 marks)

   b) Discuss chemical classification of groundwater. (6marks)

   c) The energy in any mass of water consists of three components. Express and explain these energy potentials in the Bernoulli equation (4marks)

   c) Examine groundwater occurrence in the following geological environments;
      i) Crystalline rocks (4 marks)
      ii) Sedimentary rocks (4 marks)

   d) In an unconfined aquifer bounded by a circular boundary of radius R = 1000m, a well is operating in the centre of the aquifer. The discharge of the well is Q = 500m^3/day. The water level along the boundary of the aquifer is 20m. At a distance of 100m from the well the water level is measured to be 18m. What is the permeability of the aquifer? (6 marks)

2. a) Discuss the use of trilinear diagrams in depicting hydrogeochemical analysis of groundwater. (10 marks)

   b) Estimate the average drawdown over an area where 25 million m^3 of water has been pumped through a number of uniformly distributed wells. The area is 150km^2 and the specific yield of the unconfined aquifer is 25%. (10 marks)

3. a) The drawdown data listed in the table below were obtained from a steady state pumping test at some locality with a pumping rate of 761m^3/day.

No. of observation well	Distance from pumped well (m)	Drawdown (m)
1.	10	0.281
2.	30	

3.	60	0.170
4.	90	0.147
5.	120	0.132
6.	400	0.059

i) Plot the drawdown data on single logarithmic paper verses the corresponding distances of observation wells from the pumped well (6 marks)

ii) From the graph determine the transmissivity of the aquifer using the equation;
$Q = 2KD(S_m)/2.30$, where,

Q = discharge of the pumped well in m^3/day
K = hydraulic conductivity of the aquifer (m/day)
D = water bearing thickness of the aquifer (m)
(S_m) = change in maximum drawdown (m) in a piezometer at the distance r(m) from a pumped well. (6 marks)

b) Explain the influence of geological factors on groundwater potential of an area (8 marks)

4. a) Write explanatory notes on the following:
   i) Hydraulic conductivity (4 marks)
   ii) Regional groundwater system (4 marks)
   iii) Artificial groundwater recharge (4 marks)

b) An unconfined aquifer released 500,000m^3 of water for a water table drop of 2m over a horizontal area of 1 km^2. Compute the specific yield if the porosity is 35%. What is the specific retention? (8 marks)

5. a) Explain the characteristics of flownets at:
   i) Impermeable boundary (4 marks)
   ii) Constant head boundary (4 marks)

b) In a confined aquifer of thickness H=10m, a well and a recharge well are operating. The distance of the two wells is 500m. The permeability of the aquifer is K = 5m/d, and the porosity of the soil is 40%. At infinity the groundwater level is 20m above the base of the aquifer. The

discharge of the well is $Q_0 = 200m/d$, and the discharge of the recharge well is $-Q_0$. Calculate the groundwater head and velocity in the middle of the two wells? (12 marks)

6. a) Discuss the role of groundwater in the hydrological cycle (10marks)

b) An unconfined aquifer consists of three horizontal layers, each individually isotropic. The top layer has a thickness of 10m and a hydraulic conductivity of 11.6m/day. The middle layer has a thickness of 4.4m and a hydraulic conductivity of 4.5m/day. The bottom layer has a thickness of 6.2m and a hydraulic conductivity of 2.2m/day. Compute the equivalent horizontal and vertical hydraulic conductivities.

(10 marks)