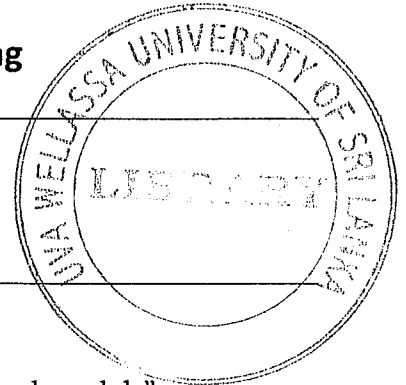


MRT 386-3 Groundwater Flow Modeling

Number of questions: Six (06)
Answer **five (05)** questions only
Time allocation: Three (03) hours
Mark allocation: 100



1.
 - (a) Distinguish between “Data-driven models” and “Process-based models”.

(05 marks)
 - (b) Briefly describe the three scenarios of mathematical groundwater modeling where purpose-specific models are employed. State the limitations of mathematical groundwater models.

(15 marks)

2.
 - (a) Explain why a “conceptual model” is needed as an initial step in any groundwater modeling exercise.

(05 marks)
 - (b) Discuss the components of a conceptual model used in groundwater modeling. Elaborate with examples.

(15 marks)

3.
 - (a) Describe the advantage of numerical methods over analytical solutions in modeling groundwater flow.

(05 marks)
 - (b) The hydraulic head h , at a node (i,j) in a 2-dimensional finite difference grid can be expressed as $h_{i,j} = (h_{i-1,j} + h_{i+1,j} + h_{i,j-1} + h_{i,j+1})/4$ for steady-state groundwater flow in an isotropic aquifer where there are no sinks or sources. Briefly describe two iterative techniques to solve this equation.

(15 marks)

4.

If an aquifer with a uniform saturated thickness of b and hydraulic conductivity of K is recharged at a rate of R through its top surface, show that the fluid continuity equation under steady state conditions takes the following form where h is the hydraulic head.

$$\frac{\partial^2 h}{\partial x^2} + \frac{\partial^2 h}{\partial y^2} = -\frac{R(x, y)}{Kb}$$

(20 marks)

5.

(a) Explain how the changes in hydraulic head with time can release water from aquifer storage, or take water into storage.

(10 marks)

(b) The time-dependent 2-dimensional fluid continuity equation is given by

$$\frac{\partial^2 h}{\partial x^2} + \frac{\partial^2 h}{\partial y^2} = \frac{S}{T} \left(\frac{\partial h}{\partial t} \right) - \frac{R(x, y, t)}{T}$$

where S is the storage coefficient and T is the transmissivity of the aquifer. $R(x, y, t)$ indicates the recharge/discharge in space and time while h is the hydraulic head. Describe the groundwater flow environment presented in the above equation.

[Note: Derivation of the equation is not required]

(10 marks)

Question 6 is based on the Computer Programming Fundamentals Section

6.

(a) Develop an algorithm by drawing a flow chart for the following scenario.

Colombo City Centre (CCC) maintains a parking area as a service for the customers. They have their own method of calculating the parking rate for each vehicle as mentioned below.

- If the duration of parking is less than or equal to one (01) hour, Rs. 100.00 will be charged.
- After the first hour Rs. 50.00 will be charged per hour up to eight (08) hours.
- If the duration exceeds more than eight (08) hours, Rs.500.00 will be charged which is the rate for twenty-four (24) hours.
- Parking will not be allowed more than twenty-four 24 hours for any vehicle.

(10 marks)

(b) Briefly explain the memory allocation of variables in C programming with suitable examples.

(10 marks)

