Q1: Write down the factors affecting the coastal aquifers.
Ans:

Q2: What are the countermeasures available for controlling the saltwater intrusion in coastal aquifers?
Ans:
The available countermeasures are listed below
- Demand Management
- Non-potable Water Reuse
- Modified Pumping Rates
- Pumping Caps
- Well Relocation
- Conjunctive Use
- Aquifer Storage and Recovery
Q3: Explain the Bodon Ghyben-Herzberg Principle using simple sketches.
Ans:

\[ \rho_s g H = \rho_f g (h + H) \]

\[ h = \frac{\rho_s - \rho_f}{\rho_f} H \]

\[ \Delta h = 40 \Delta H \]

Q4: Write down the classification of Hydraulic management strategies.
Ans:
Hydraulic Management
- Embedding Approach
  - Finite Difference or Finite Element based discretization of governing equation as constraints of management model
- Linked Simulation Optimization Approach
  - Externally linked simulation model as binding constraint
- Meta-Model Based Approach
  - Response Matrix Approach-Linear Model as constraints of management model
  - Soft Computing Models (Artificial Neural Network, Support Vector Machine) as constraints of management model

Q5: Define Monitoring Network Design. Write down the types of long-term monitoring network design approaches.
Ans: Monitoring Network Design is the method for selection of sampling schedule under budgetary limitation.

Types of long-term monitoring network design approaches
- Ambient monitoring
Regional, annual monitoring for water safety.

- Detection monitoring
  - Watch a dangerous spot
- Compliance monitoring
  - Evaluate the progress of a management policy
- Research monitoring
  - Monitoring for a specific research purpose

Q6: Write down the governing equations for combined surface-subsurface modeling.

Rainfall

- Surface Flow (1-D)
- Ground Surface

Infiltration

Subsurface Flow (2-D)

Governing equation for 1-D Surface Flow
\[
\frac{\partial U}{\partial t} + \frac{\partial F}{\partial x} = S
\]
with
\[
U = \left\{ \frac{h}{q} \right\}, 
F = \left\{ \frac{q^2}{h} + \frac{gh^2}{2} \right\}, 
S = \left\{ \frac{R - I}{gh(S_0 - S_f)} \right\}
\]
Where,
- \( h \) = flow depth,
- \( q \) = discharge per unit width,
- \( g \) = acceleration due to gravity,
- \( R \) = volumetric rainfall per unit surface area,
- \( I \) = volumetric infiltration per unit area,
- \( S_0 \) = bottom slope in the direction of flow,
- \( S_f \) = friction slope.
Governing equation for 2-D subsurface flow (Richards equation):
\[
\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial x} \left[ K(\psi) \frac{\partial \psi}{\partial x} \right] + \frac{\partial}{\partial z} \left[ K(\psi) \left( \frac{\partial \psi}{\partial z} - 1 \right) \right]
\]

Where
\( \theta \) = volumetric moisture content,
\( \psi \) = pressure head,
\( K(\psi) \) = unsaturated hydraulic conductivity

Reference: