5. Attempt any TWO parts of the following :— (10×2)

(a) Explain the following recharge methods along with its design, relative merits, demerits and neat sketch :—
   (i) Dug Well Recharge
   (ii) Inter Watershed Transfer.

(b) What are the various methods used for controlling the saline water intrusion? Explain briefly.

(c) How GIS and remote sensing is very much useful in artificial recharge of ground water?

1. Attempt any four parts of the following :— (5×4)

(a) List the major activities in which hydrological studies are important. Describe briefly the sources of hydrological data in India.

(b) Discuss briefly any five properties of rock which affect the quality of ground water.

(c) Define the following terms in brief:
   * Aquifer*, *Well loss*, *Specific capacity*, *Specific yield* and *Efficiency of a well*.

(d) An aquifer sample of 30 m$^3$ having all its pores interconnected, was saturated with water and then drained under the influence of gravity. The sample yielded 3 m$^3$ of water and retained 4.5 m$^3$ of water. Determine porosity of sample.
(e) What do you mean by the contamination of groundwater? Write in brief; the various measures to control the groundwater pollution.

(f) Write about the assessment of the surface water resources in India. Also explain in brief the intra basin development concept.

2. Attempt any two parts of the following: — (10×2=20)
   (a) During hydrogeological investigation of two potential aquifers 32 km apart, were, located, one being 5000 years and the other 25000 years old. They were found to be connected by a water bearing stratum of 30 m thickness running inclined at 20 m/km. From few observation wells, the hydraulic gradient was found to be 0.2 m/km. Determine the transmissibility of the water bearing stratum.

   (b) Discuss and show the utility of various mathematical equations governing the three dimensional ground water flows.

   (c) What is the significance of ground water flow contours? Also discuss the various applications of these contours.

3. Attempt any TWO parts of the following: — (10×2)
   (a) What are the differences between confined and unconfined aquifers for the determination of discharge with steady flow condition?

      A well penetrates into an unconfined aquifer having a saturated depth of 100 m. The discharge is 250 litres per minute at 12 m drawdown. Assuming equilibrium flow conditions and a homogeneous aquifer, estimate the discharge at 18 m drawdown. The distance from the well where the drawdown influences are not appreciable may be taken equal for both cases.

   (b) What are the assumptions given in the linear leakage model by Jacob? Discuss any one of the mathematical solution showing the non equilibrium equations for the unsteady flow towards a well. Also draw a definition sketch of a nonpenetrating well in a leaky confined aquifer.

   (c) What do you mean by pumping test of a well? Discuss its importance in well design.

      A 30 cm diameter well fully penetrates a confined aquifer 30 m deep. After a long period of pumping at a rate of 1.2 m³/minute, the drawdown in the observation wells at 20 m and 45 m from the pumping well were 2.2 m and 1.8 m, respectively. Determine the transmissivity of the aquifer and drawdown in the pumped well.

4. Attempt any two parts of the following: — (10×2)
   (a) What is the utility of seismic reflection and seismic refraction methods in the surface ground water investigation? Also write the comparative merits and demerits of these two methods.

   (b) How will you investigate the subsurface ground water by the resistivity logging method?

   (c) What do you mean by the aerial photogrammetry technique? How this technique is very much useful in subsurface investigation?