Scheme and Solution: 18CV734/17CV742	
Ground Water Hydraulics	
IAT – 2 Date: 20.12.2021	
1. a) b)	**Darcy's Law**: The flow rate through porous media is proportional to the head loss and inversely proportional to the length of the flow path Figure + Explanation **[05 + 03 Marks]** **Validity** – Darcy's law applies to laminar flow in porous media; Darcy's law is valid for Reynolds Number NR < 1 and does not depart seriously upto 10. This represents an upper limit to the validity of Darcy's law. Most natural underground flow occurs with NR <1. So Darcy's law is applicable. **[2.0 Marks]**
2. a) b)	**Hydraulic Conductivity**: A medium has a unit hydraulic conductivity if it will transmit in unit time a unit volume of groundwater at the prevailing kinematic viscosity through a cross section of unit area, measured at right angles to the direction of flow, under a unit hydraulic gradient. Units are m/day. Has units of velocity **[2.5 Marks]** **Transmissibility**: defined as the rate at which water of prevailing kinematic viscosity is transmitted through a unit width of aquifer under a unit hydraulic gradient. Units are in m^2/day. T = Kb where b is the saturated thickness of the aquifer **[2.5 Marks]** V = K*i = K * h/l (Darcy's Law); 0.00438 = K*0.2/1000; K = 21.9 m/day; T = K*b = 21.9 * 30 = 657 m^2/day (or) m^3/day/m **[05 Marks]**
3.a) b) c)	**Methods**: Laboratory Methods, Auger Hole Tests; Tracer Tests; Pumping Tests of Wells **[02 Marks]** Constant Head Permeability Test – For Coarse Grained Soils - Figure + Explanation **[03 Marks]** K = V*L/A*h*t; K = 5.86*10^{-3} cm/s **[05 Marks]**
4.	a) **Storage Coefficient**: defined as the volume of water that an aquifer releases from or takes into storage per unit surface area of aquifer per unit change in the component of head normal to that surface. For a vertical column of unit area extending through a confined aquifer, the storage coefficient S equals the volume of water released from the aquifer when the piezometric surface declines a unit distance. – dimensionless quantity – volume of water per unit volume of aquifer. S varies directly with aquifer thickness S = 3 x 10^{-6} b where b is the saturated aquifer thickness in meters **[03 Marks]** **Confined aquifers** – 0.00005 < S < 0.005, indicating that large pressure changes over extensive areas are required to produce substantial water yields. The storage coefficient for an **unconfined aquifer** corresponds to its specific yield. **[02 Marks]** Storage coefficient can be determined from – **Pumping tests of wells, groundwater fluctuations in response to atmospheric pressure or ocean tide variations** Explanation - **[05 Marks]**
5.	**Hydrothermal Phenomena of Ground waters**: Thermal Springs – water having temperature in excess of the normal local groundwater – water highly mineralized – meteoric water modified in quality by its passage underground – associated with volcanic rocks – concentrated in regions where large geothermal gradients occur – geyser, mudpot, fumarole **[05 Marks]**

	Groundwater in Permafrost regions – permafrost – perennially frozen ground – unconsolidated deposits or bedrock that continuously have had a temp. < $0^{o}C$ for 2 years to thousands of years Frozen ground – creates impermeable layer that restricts the movement of groundwater, acts as a confining layer, and limits the volume in which liquid water can be stored. In many areas of frozen ground, shallow aquifers are entirely eliminated, thereby requiring that wells be drilled deeper than in similar geologic environments without permafrost. Groundwater can occur above, below, and locally within permafrost. In the continuous – permafrost zone, the best sources of water in unfrozen alluvium beneath large lakes, in major valleys, and adjacent to river beds. In the discontinuous permafrost zone, groundwater can be produced locally from shallow aquifers. **[05 Marks]**