

## **GEOL 5401. Hydrogeology (3 credits)**

### **Unit – 1**

Definitions and differences of - Hydrology, Hydrogeology, Geohydrology and Groundwater hydrology. Hydrologic cycle and processes – Precipitation, Evaporation and transpiration, Runoff, infiltration. Water balance. Origin and types of waters – meteoric, juvenile, magmatic and metamorphic. Groundwater storage – Aquifer, Aquiclude, Aquifuge and Aquitard. Types of aquifers – Confined, Unconfined, Bonded aquifers Sloping Piezometric and Phreatic aquifers. Springs.

Hydrological properties of rocks – Porosity, Permeability, Void ratio Specific yield and Specific retention, Hydraulic conductivity, Transmissivity and Storativity. Elasticity of aquifers, barometric efficiency and barometric tidal efficiency. Geological framework in relation to Hydro geological environment: Rock types and distribution, rock matrix, fractures, weathered hard rocks and superficial materials.

### **Unit – 2**

Groundwater flow-Water table and Piezometric surface- Flow characteristic of water – Head distribution, Laminar and turbulent flow. Darcy's law and its experimental verification. Flow through aquifers. Differential equation governing ground water flow. Hydrological boundaries, flow nets. Groundwater tracers.

Well hydraulics: Aquifer tests, organization and conduct of pumping tests, data analysis of pumping test, Recovery test, drawdown, cone of depression and cone of impression, Steady radial flow to a well in confined and unconfined aquifers – Thiem's equation and Dupuit-Forchheimer equation. Unsteady radial flow to a well in confined and unconfined aquifers – Theis equation – Theis, Chow and Cooper-Jacob methods – Isotropic non-leaky artesian aquifers.

### **Unit – 3**

Groundwater exploration: Geological and Hydrological methods, Surface investigations of groundwater- Geophysical methods, Electrical Resistivity methods – Wenner and Schlumberger methods, Seismic refraction methods, Gravity and magnetic methods. Application of remote sensing and GIS in Groundwater exploration. Mapping methods Remote sensing data, Field reconnaissance and data acquisition.

### **Unit – 4**

Water well designing - Types and mode of construction – Methods of deep well drilling- Cable tool method, Rotary method, Air rotary method, Rotary Percussion method, Reverse Circulation Rotary Method, DTH method – construction design – development and maintenance of wells. Production specification, well production, specific capacity pumps and pumping equipments.

### **Unit – 5**

Quality of Groundwater: Chemical quality- Different chemical parameters and its analysis, Graphical representation of water quality data: various diagrammatic representations – interpretation of hydrochemical analysis data – Hill-Piper Trilinear diagram, Durov's diagram and U.S. Salinity diagram – Sodium Adsorption Ratio (SAR) – Water quality standard for different purposes – Drinking, Domestic, Irrigation and Industrial.

Threats to groundwater quality and reserve: Saline water intrusion in coastal and other aquifers and its prevention – Ghyben-Herzberg relationship. Water management, groundwater system planning. Groundwater development – safe yield, Groundwater provinces of India. Groundwater depletion due to mining.

### References

- Bouwer,H. Groundwater Hydrology,1978.
- Davis,S.N. and Dewiest, R.J.N. Hydrogeology, John Wiley and Sons Inc. New York,1966.
- Karanth.K.R.Groundwater Assessment Development and Management, Tata Mc Graw Hill,1987.
- Linsley,R.K, Kohler, M.A. and Taulhus, J.L.H. Applied Hydrology, Tata Mc Graw Hill,1975.
- Todd,D.K. Groundwater Hydrology, John Wiley and Sons, 1980.
- Walton,W.C. Groundwater Resource Evaluation, Mc Graw Hill Inc,1970.
- Reghunath, H.M. Groundwater.2<sup>nd</sup> Edn.Wiley Eastern Limited. 1992.
- Sharma H.S.Well Hydraulics and Tube Wells.