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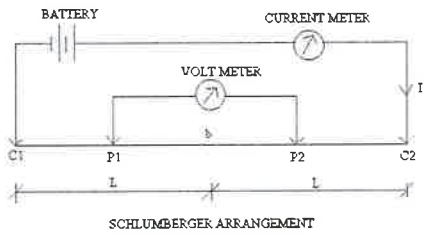
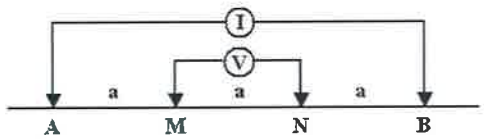
Note: Draw neat diagrams where necessary.

Max. Marks 100
Duration 3 Hrs

1	a	**Fill in the blanks** i) Traverse is a line, or a systems of lines, connecting outcrops or stations where observations are taken. ii) Degrees for direction and strike are read on the outer circular dial. iii) In plane table method directions, horizontal distances and vertical distances are all determined by palne table and alidade. iv) The study of air photographs and maps constructed from such photographs for geologic information is called photogeology. v) Any map that shows the distribution of rocks and the form or distribution of geologic structure is a geologic map. vi) Symbol ⊢ 30° on geological map represents dip. vii) Well defined crack in a rock along which there is no or negligible movement is termed as joint. viii) If a sedimentary deposit represents certain beds which exhibit oblique laminations the structure is termed as cross bedding. ix) Pacing is a common method of measuring distances on the ground. x) Cable drilling, rotary drilling and diamond drilling are subsurface type of geologic surveying	10
	b	**Define the following (all units)** i) Topographic map: it is the one that shows the size shape and distribution of features of the earth's surface. ii) Contour: it is a line drawn through pints having the same altitude. iii) Water table: The level below which the ground is saturated with water iv) Permeability: It is ability of a rock or soil to transmit a fluid. v) Aquifuge: A relatively impermeable formation neither containing nor transmitting water. Example: Solid granite. vi) Strike- in geology, direction of the line formed by the intersection of a fault, bed, or other planar feature and a horizontal plane vii) Lava flow- Lava is the molten rock that comes out of vents and fissures created by volcanic activity. Because of its extremely high temperature (over 2,000 degrees Fahrenheit!), lava stays its molten state and flows along any slope viii) Foliations- Foliation is the result of the parallel arrangement of (micas, etc.) in a plane perpendicular to the maximum principal applied stress ix) Springs- Spring in hydrology, opening at or near the surface of the Earth for the discharge of water from underground sources. A spring is a natural discharge point of subterranean water at the surface of the ground or directly into the bed of a stream, lake, or sea. x) Biological indicators of groundwater- are living organisms such as plants, termite mounds etc indicating presence of groundwater.	10
2		**Answer any two of the following**	
	a	Which are the most likely places for exposures? On field how one can	10

		discriminate between boulders and outcrops? The best place sto look for exposures of rocks are precipices, hilltops, steep hillsides, stram beds, coasts, along railroads and roads and artificial excavations. Don't consider anything smaller that bowlder as bedrock Close observations Correlate it with surroundings. Search for similarities in bedding, joint systems, cleavges etc.	
	b	Give list of equipments needed for any geological field work. Add note on collection and trimming of sample. Map, Haver sac, Measuring tape, Sledge hammer, Chiesel, GPS, Brunton/clinometer compass, Graph papers (12), Litholog tempalate, Zip lock bags, Newspaper, Hand Lance, Survey equipments, dilute acid bottle. Do not collect chips from surface of weathered exposure. Representative samples should be handspeciemns which are trimmed to flat rectangular shape. For trimming use flat end of hammer head. Break the fragment down until its dimentions are half an inch or so greater than they are to be in the complete specimen. Chip off sharp edges. If subsurface samples are collected they sould be carefully wrapped and correctly labelled their depth should be mentioned. Of samples are to be collected for paleontological work same care must be taken.	10
	c	How to measure strike and dip of steeply inclined bed. What advantage Brunton compass has over clinometer when working in steeply inclined strata.	10
	d	Why toposheets are different from contour maps? Add note on Survey Of India maps naming index. In toposheets along with contour other topographic features are also shown which incluids drainage and culture. There are connventional signs employed to designate these features. A key called here as legend of these conventional signs is provided on the map. The scale for toposheets surveyed in the same year will be same. A numbering system has been adopted by survey of India. or the purpose of an international series (within 4° N to 40° N Latitude and 44° E to 124° E Longitude) at the scale of 1: 1,000,000 is considered as a base map. This map is divided into sections of 4° latitude × 4° longitude and designated from 1 to 136 consisting of the segments that cover only land area. Each section is further divided into 16 sections (4 rows and 4 columns) each of 1° latitude × 1° longitude. The sections start from Northwest direction, run column wise and end in Southeast direction. The 1°×1° sheets are further subdivided into four parts, each of 30′ latitude × 30′ longitude. These are identified by the cardinal directions NE, NW, SE and SW. The 1°×1° sheets can also be divided into 16 sections each of 15′ latitude × 15′ longitude and are numbered from 1 to 16 in a columned manner. A 15′×15′ sheet can be divided into 4 sheets, each of 7(1/2)′ and are numbered as NW, NE, SW and SE	10
3		**Answer any two of the following- (unit 2)**	
	a	What is subsurface zonal distribution of groundwater? Groundwater has been divided mainly in two groups: interstitial water and	10

		internal water. The interstitial water is again subdivided into two divisions. They are vadose water present in the zone of aeration and groundwater present in the zone of saturation. The vadose water is further subdivided into three zones, *i.e.*,soil water zone, intermediate zone and capillary zone. Fig. 1.2 shows the classification of groundwater. The soil water zone is adjacent to the ground surface. The intermediate zone is between the lower edge of the soil water zone and the upper edge of the capillary zone. The capillary zone extends from the bottom edge of the intermediate zone to the upper edge of the saturated zone. The thickness of the capillary zone depends on the properties of the soil and also on the homogeneity of the soil. The depth of capillary zone is varying from few centimeters to few meters. In capillary zone, all the pores are field up with water. However, we cannot draw water by inserting a well up to that depth. This is because of the negative pressure developed at this zone due to surface tension effect. Groundwater zone starts from the bottom edge of the capillary zone. In this zone, all the pores of the soil matrix are filled with water. This zone is also known as zone of saturation. The top surface of the zone of saturation or groundwater is known as phreatic surface. This phreatic surface is also known as water table.	
	b	Differentiate between confined aquifer and unconfined aquifer.	10
	c	Explain the controlling factors for the flow of ground water. Add note on flow nets.	10
	d	**Which properties of rock affect ground water?**	10
4		**Answer any two of the following-(unit 3)**	10
	a	Describe methods of surface investigation of ground water Geological methods- Reconnaissance in area will give idea about lithologies exposed , soil moisture contain, structural features Remote sensing- Study of aerial photographs and satellite images can be used to detect the water bodies, soil moisture, structural features. Geophysical methods- Resistivity and seismic surveys. In these methods physical properties of rocks are used to detect the presence of water and lithologies underneath. These methods followed by subsurface drilling methods will give complete picture about the presence of groundwater.	
	b	What is electrical methods of logging for ground water. In this method the different electrical properties that influence electrical fields are primarily the resistivity ρ, the dielectric permeability μ & magnetic permeability ε. • Electrical parameters vary depending upon the lithology & more influenced by the presence, content & quality of water. Resistivity is the resistance in ohm meter of a unit cube of material. There are two common arrangements which are used in this method  SCHLUMBERGER ARRANGEMENT 	10

	c	Which exploration methods are used for groundwater? There are two methods resistivity and Seismic method. The purpose of electrical surveys is to determine the subsurface resistivity distribution by making measurements on the ground surface. From these measurements, the true resistivity of the subsurface can be estimated. The ground resistivity is related to various geological parameters such as the mineral and fluid content, porosity and degree of water saturation in the rock. The resistivity measurements are normally made by injecting current into the ground through two current electrodes (C1 and C2 in Figure 1), and measuring the resulting voltage difference at two potential electrodes (P1 and P2). The electrode arrangement in these investigations are called as arrays. Some of the most common electrode arrays are Wenner, Schlumberger, pole-pole, pole-dipole and dipoledipole array. Seismic prospecting developed from seismology, the science of earth quake- also called applied / exploration seismology. It has its basics in utilizing the propagational time of elastic waves excited at the surface. The energy generated at the source travels as waves & these elastic waves have different transmission times. Most widely used artificial sources of generating elastic waves are explosions – non explosive sources such as mechanical vibrations are also used.	10
	d	Explain basin method of artificial recharge. Why it is most favored method of recharge? In this method, series of earthen dams/basins are constructed on suitable sites for storing of adequate quantity of surface water. The area should be selected in such a way that significant amount of water infiltrates through the bed of the tank and reaches the groundwater table. This method is very effective in alluvial area as well as in areas with hard rock. This method is very useful in providing continuous recharge after the monsoon. In another method Water is distributed over the region using a distribution system. This method can achieve higher rate of infiltration in a region having thin vegetation cover or sand soil cover.	10
5		**Write notes on any four of the following (all units)** i) Unconformable contacts observed in field By observing the relation between the country rock and the overlying sediments the unconformable contacts can be easily detected in field. There are three types of unconformities which can be detected easily on field viz., Angular unconformity, Nonconformity, disconformity. The fourth type of unconformity that is paraconformity is very rarely can be detected on field. ii) Contact aurioles The surrounding zones of rock that become altered or metamorphosed—vary in thickness from several centimetres (around tabular bodies such as dikes and thin sills) to several kilometres (around large granitic intrusions). The contact metamorphic rocks of the aureole zone often lack any obvious schistosity or foliation. iii) Potential logging Spontaneous potential (SP) is one of the oldest logging techniques. It employs very simple equipment to produce a log whose interpretation may be quite complex, particularly in freshwater aquifers. This complexity has led to misuse and misinterpretation of spontaneous potential (SP) logs for groundwater applications. The spontaneous	20

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			potential log (incorrectly called self potential) is a record of potentials or voltages that develop at the contacts between shale or clay beds and a sand aquifer, where they are penetrated by a drill hole.	
		iv)	Temperature logging:	
		v)	Irrigation method of artificial recharge: The land which used for irrigation is flooded with water to incorporate infiltration of water. This is done when the land is without any crop.	
		vi)	Recharge mounds Groundwater mounding is the local rise of the water table above its natural level resulting from a localized source as an infiltration pond. The shape and height of the mound depend on several factors including the recharge rate, hydraulic conductivity and thickness of the aquifer in the area.	
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