# Model Answer: Summer 2017

**Subject: Geotechnical Engineering** | **Sub. Code: 17420**

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**Important Instructions to examiners:**

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills.)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by the candidate and those in the model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and the model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

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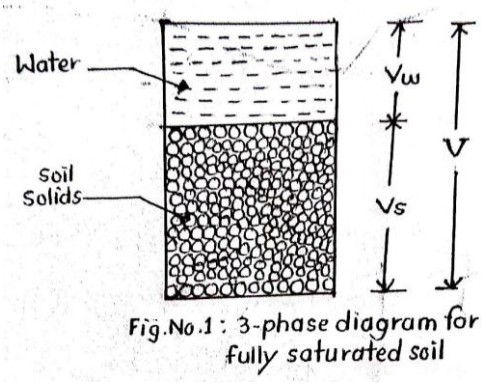
| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.1** | **A** | **Attempt any SIX of the following:** | | **12** |
| | **a) Ans.** | **Explain the use of soil as a foundation material.**<br>Soil is used as foundation material in the form of supporting soil to support various foundations of civil engineering structures. Depending upon the bearing capacity of soil , the type of foundation can be decided as soil carries load of substructure and superstructure. | **2** | **2** |
| | **b) Ans.** | **Define water content and voids ratio of soil.**<br>**Water content-** It is the ratio of weight of water to weight of soil soilds which is measured in percentage called as water content. | **1** | **2** |
| | | **Voids ratio –** It is the ratio of volume of voids to volume of solids called as voids ratio. | **1** | |
| | **c) Ans.** | **Draw 3 – phase diagram for fully saturated soil.**<br>  <br>Fig.No.1 : 3-phase diagram for fully saturated soil | **2** | **2** |

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| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.1** | **d. Ans.** | **State 4 – field applications of Geo – Tech Engg.**<br>**Field applications of Geo – Tech Engg. are as follows-**<br>1. Design of foundation for various structures.<br>2. Design of pavement for various roads.<br>3. Design of earth retaining structures i.e. retaining wall, sheet pile.<br>4. Design of water retaining structures i.e. Dam , weir etc.<br>5. Design of abutments of bridge.<br>6. Design of underground structures i.e. Pipeline, tunnels etc. | **½ mark each (any four)** | **2** |
| | **e. Ans.** | **State any 2 types of fault.**<br>**Types of fault are as follows-**<br>1. Translational fault<br>2. Rotational fault<br>3. Normal or gravity fault<br>4. Reverse or thrust fault<br>5. Dextral fault<br>6. Sinistral fault<br>7. Strike fault<br>8. Dip fault<br>9. Oblique fault<br>10. Radial fault<br>11. Enechelon fault<br>12. Accurate or peripheral fault | **1 mark each (any Two)** | **2** |
| | **f. Ans.** | **Define term porosity.**<br>**Porosity-** It is the ratio of volume of voids to the total volume of soil , measured in percentage is called as porosity. | **2** | **2** |
| | **g. Ans.** | **State the classification of rocks on the basis of their mode of origin.**<br>1. Igneous Rock<br>2. Sedimentary Rock<br>3. Metamorphic Rock | **2** | **2** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.1** | **h.** | **Enlist types of joints.** | | |
| | **Ans.** | **Types of joints are-**<br>1. Strike Joint<br>2. Dip Joint<br>3. Oblique Joint<br>4. Columnar Joint<br>5. Tension Joint<br>6. Shear Joint<br>7. Tight Joint<br>8. Block or Mural Joint<br>9. Sheet Joint | **1 mark each (any Two)** | **2** |
| | **(B)** | **Attempt any <u>TWO</u> of the following:** | | **8** |
| | **(a)** | **Define outcrop, Dip , Strike and fold of Rocks.** | | |
| | **Ans.** | **1.Outcrop –**The exposure of solid rock on the earth surface is known as outcrop.<br>**2.Dip –** It is the inclination of bedding plane of rock with horizontal is called as Dip**.**<br>**3.Strike –** It is the geographic direction in which bed, fault or joint plane of rock occurs called as strike**.**<br>**4.Fold –** It is the bends or curvatures in rock formed due to action of compressive forces on horizontal layers called as fold**.** | **1 mark each** | **4** |
| | **(b)** | **Explain Different types of forms occurring in rock minerals.** | | |
| | **Ans.** | **Types of forms occurring in rock minerals-**<br>**1. Tabular Form-** In this type of form , minerals appears as slabs of uniform thickness e.g. Feldspar.<br>**2. Lamellar Form –**Minerals appears as thin separable layers e.g. Vermiculite.<br>**3. Fibrous Form-** Minerals exists in the form of separable or non separable fine fibres e.g. Asbestos.<br>**4. Bladed Form-** Minerals are of rectangular lath shaped grains eg. Kyanite.<br>**5. Granular Form**- In this , minerals appears in the form of closely packed equal grains e.g. Chromite.<br>**6. Reni Form-** Minerals are available in the form of kidney shaped or sub rounded shape e.g Hematite.<br>**7. Mamillary Form-** Minerals appear with large matually interfering spheroidal surfaces e.g. Malachite. | **1 mark each (any four)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.1** | **b)** | **8. Prismatic form –** Minerals are of independent elongated crystals e.g. Quartz<br>**9. Concretionary Form-** Minerals consist of porous form made of small irregular mass e.g. laterite<br>**10. Nodular Form –** Minerals appears in the form of irregular shaped compact bodies with curved surfaces e.g. Limestone | | |
| | **c)** | **Explain any four field of applications of Geotechnical Engineering Knowledge.** | | |
| | **Ans** | **Field of applications of Geotechnical Engineering Knowledge-**<br>**1. Design of foundation-** The knowledge of bearing capacity of soil is useful to design of foundation for proposed structure. The size , depth and type of foundation depends on type of soil available.<br>**2. Design of pavement-** The flexible or rigid pavement can be designed by knowing C.B.R ,shear strength and permeability of subgrade soil. Geotechnical Engg. knowledge helps to know these properties of soil to avoid future defects in pavement .<br>**3. Design of Earth retaining structures-** The geotech engg knowledge provides information about earth pressure, slope stability , density and moisture content of soil. It is useful to design earth retaining structures like retaining wall and sheet pile.<br>**4. Design of water retaining structure-** The water retaining structure like dams,barrages and weirs requires knowledge of index properties , particle size distribution , flow net, pore pressure of soil Geotechnical Engg. Knowledge is also applicable for complete design of percolation tank, contour bunding etc.<br>**5. Design of abutment-** The abutment for bridges are designed with the help of knowledge of shear strength, compaction, frictional coefficient , angle of repose.<br>**6. Design of underground structures-** Geotechnical Engg. knowledge in the form of density , compaction , permeability and consolidation; requires to design underground structures like pipe lines, tunnel etc | **1 mark each (any four)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.2** | | **Attempt any FOUR of the following:** | | **16** |
| | **(a) Ans.** | **Enlist various types of seismic waves and explain one.**<br>**Types of seismic waves-**<br>1. Primary or Longitudinal Waves<br>2. Secondary or Traverse waves<br>3. Long or surface waves-Rayleigh waves and love waves | **1** | |
| | | **Primary Waves- (P-wave)-** These waves propagates in longitudinal direction and capable to pass through solids, liquid and gases . These are fastest waves among all with speed of travel 8-13 km/s and hence reach first to recording station on ground . These waves gives push or pull or to and fro moment to particles of ground. | | **4** |
| | | **Secondary or Traverse waves (S-wave) –** These waves moves in perpendicular direction to direction of propagation of waves . It passes through only solids . These waves has slow speed about 5 – 7 km/s . When secondary or shear waves moves horizontally during propagation, then it is known as SH waves. But when it moves in vertical plane, then it is SV waves. | **3** | |
| | | **Long waves (L-waves)-**These waves travels along the surface or earths crust to pass through solids and liquids. These surface waves are slower with speed of 4-5 km/s confined to earth layers. These waves gives major destruction during earthquake . these waves are complex in nature having large amplitude.<br>**(Note- Any one of the above explanation should be considered.)** | | |
| | **(b) Ans.** | **Define terms focus and epicenter related to earthquake.**<br>**Focus-** The place or point of origin of an earth quake below ground surface is termed as focus or hypocenter of earthquake. | **2** | **4** |
| | | **Epicentre –**The place or point on ground surface , where seismic waves reaches firstly causing major damage is known as epicenter. | **2** | |
| | **(c) Ans.** | **State the types of earthquake based on their focus and richter scale.**<br>**Types of earthquake based on focus -**<br>1. **Shallow earthquake-** Focus depth less than 60 km is taken as shallow earthquake<br>2. **Intermediate earthquake – O**rigin of earthquake is at a depth in between 60 km to 300 km called as Intermediate earthquake.<br>3. **Deep earthquake –** Focus is at depth in range of 300 km to 700 km such earthquake is considered as deep earthquake. | **1 mark each (any two)** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.2** | **(c)** | **Types of earthquake based on Richter Scale -**<br>1. **Minor or Instrumental Earthquake-** Magnitude < 2 R.S.<br>2. **Slight or feelable earthquake -** Magnitude = 2 R.S. to 5 R.S.<br>3. **Low or mild earthquake-** Magnitude = 5 R.S. to 6 R.S.<br>4. **Moderate or average earthquake-** Magnitude = 6 R.S. to 7 R.S.<br>5. **Strong earthquake-** Magnitude = 7 R.S. to 8 R.S.<br>6. **Disastrous or destructive earthquake-** Magnitude = 8 R.S. to 9 R.S.<br>7. **Catastropic or extreme severe earthquake-** Magnitude > 9 R.S. | **1 mark each (any two)** | **4** |
| | **(d)** | **State the types of consistency limit and define any one.** | | |
| | **Ans.** | **Types of consistency limit-**<br>1. Liquid limit<br>2. Plastic limit<br>3. Shrinkage limit | **2** | **4** |
| | | **Liquid limit-** It is minimum water content at which two separated grooved soil parts mixed together under 25 blows of casagrande's liquid limit apparatus; is called as liquid limit.<br>**Plastic limit –**It is minimum water content at which soil begins to crumble into parts when it is rolled into 3 mm diameter thread; is known as Plastic limit.<br>**Shrinkage limit-** It is maximum water content at which there is no reduction in volume of soil due to further decrease in water content : is termed as shrinkage limit. | **2 (any one)** | |
| | **(e)** | **Enlist two causes and two effects of earthquake.** | | |
| | **Ans.** | **Causes of earthquake-**<br>1. Volcanic eruption<br>2. Technical movements<br>3. Natural disaster like landslide, tsunami<br>4. Massive civil structures like dams, reservoirs<br>5. High water flows<br>6. Manmade explosions | **1 mark each (any two)** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.2** | **(e)** | **Effects of earthquake-**<br>1. Destruction of various Civil Engg. structures<br>2. Formation of irregularities (Unevenness) on ground<br>3. Sudden landslides along hill slopes<br>4. Change in river course<br>5. Formation of new lakes, springs<br>6. Generation of high ocean tidal waves<br>7. Fire exposure due to short circuiting<br>8. Loss of human life and property | **1 mark each (any two)** | **4** |
| | **(f)**<br>**Ans.** | **Explain the procedure of determination of liquid limit of soil.**<br>**Procedure of determination of liquid limit of soil-**<br>1. Take 120 gm air dried soil passing through 425 µ IS sieve. And add 20 ml water in it to prepare homogeneous soil paste<br>2. Fill this paste in brass cup of casagrande's liquid limit apparatus in horizontally leveled manner<br>3. Divide the soil centrally using grooving tool into two equal parts as shown in figure No. 2-a<br>4. Now, rotate the handle at the rate of 2 rev/ s so that brass cup will impact on hard rubber base through 10 mm dropping height<br>5. Count the number of blows ($N_1$) required to mix soil parts together as shown in Fig No 2-b.<br>6. Take some soil from mixed grove and determine its water content($w_1$%) using oven drying method<br>7. Repeat all above steps by increasing water in soil and record number of blows $N_2$, $N_3$, $N_4$, $N_5$and corresponding water content $W_2$, $W_3$, $W_4$, $W_5$.<br>8. Finally draw the graph of no of blows Vs water content as shown Fig No. 2-c from graph , the water content at 25 blows will be liquid limit of given soil. | **3** | **4** |

Fig. No. 2 (a)

Fig. No 2 (b)

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| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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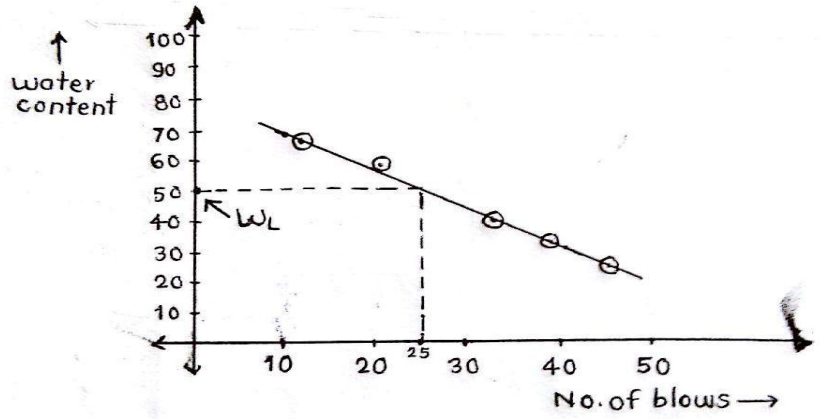
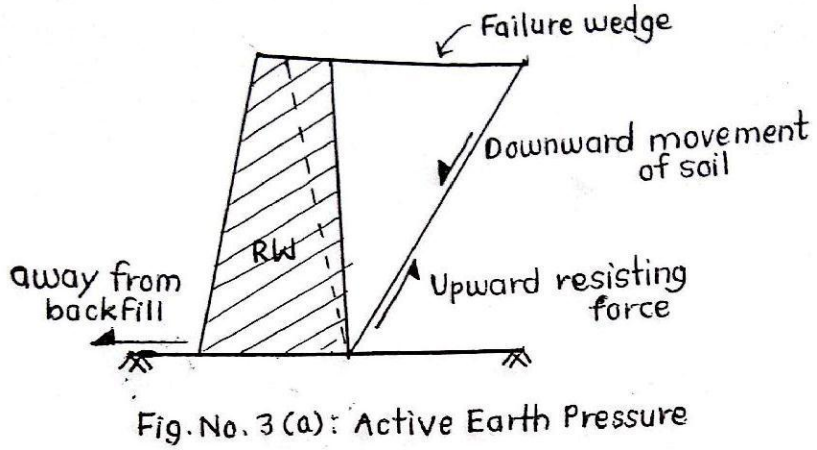
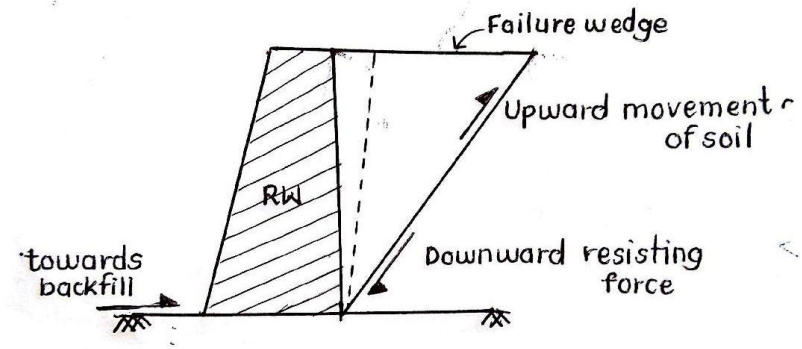
| **Q.2** | |  Fig. No. 2 (c) . Flow Curve ( N Vs. w% ) | **1** | |
| **Q.3** | | **Attempt any <u>FOUR</u> of the following:** | | **16** |
| | **a)** | **Explain step by step procedure for determination of water content of soil by oven dry method.** | | |
| | **Ans.** | **Procedure for determination of water content of soil by oven dry method-**<br>**1.**Take container with lid , measure the empty weight of container with lid as $W_1$ gm.<br>**2.** Put sufficient quantity of moist soil sample in the container and take the weight of container , lid and moist soil as $W_2$ gm.<br>**3.** Keep this assembly in the thermostat oven at a temperature $105^0$c to$110^0$c for 24 hrs. with lid at bottom; so that water should be evaporated completely to give us dry soil .<br>**4.** Take out container from oven and cool it in dessicator .Then take weight of container , lid and dry soil as $W_3$ gm.<br>**5.**Calculate the percentage water content of given soil as-<br>$W = (W_2 - W_3)/( W_3 - W_1) \times 100$<br>**6.**Repeat above steps two more times to determine average water content of given soil sample. | **4** | **4** |
| | **b)** | **State different characteristics of flow net.** | | |
| | **Ans.** | **Characteristics of flow net are as follows-**<br>1. The flow lines and equipotential lines in the flow net intersects each other orthogonally<br>2. The area or field formed due to intersection of these lines is approximately square<br>3. The quantity of water flowing through each channel is almost same.<br>4. Smaller dimensions of the field indicates greater hydraulic gradient and more velocity of flow.<br>5. The potential drop between two adjacent equipotential lines is same. | **1 mark each (any four)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.3** | **c) Ans.** | **Define with sketch active and passive earth pressure.**<br>**Active earth pressure –** The minimum earth pressure on retaining wall which is developed due to movement of wall away from backfill , is called as active earth pressure.<br><br>**Diagram of Active earth pressure-**<br>  <br><br>Fig. No. 3 (a): Active Earth Pressure<br><br>**Passive earth pressure -** The maximum earth pressure on retaining wall which is developed due to movement of wall towards backfill , is called as Passive earth pressure.<br><br>**Diagram of Passive earth pressure –**<br>  <br><br>Fig. No. 3 (b): Passive Earth Pressure | **1**<br><br>**1**<br><br>**1**<br><br>**1** | **4** |
| | **d) Ans.** | **State the advantages of direct shear test and its any two limitations.**<br>**Advantages of direct shear test-**<br>1. The direct shear test is simple and quick as compared to other tests.<br>2. Quick drainage from soil takes place due to lesser thickness of soil. | **2** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.3** | **d)** | **Dis-advantages of direct shear test-**<br>1. The failure of soil along horizontal plane is not realistic in nature.<br>2. The actual field loading condition is not considered in this test<br>3. The coarser particles along failure plane may give wrong results.<br>4. Pore pressure between soil particles cannot be measured which generally affect the results. | **1 mark each (any two)** | **4** |
| | **e)** | **A soil sample was tested in constant head permeameter, dia of sample is 4 cm and length is 10 cm under constant head 15 cm discharge was found to be 70 cc in 10 mins. Find coefficient of permeability.** | | |
| | **Ans.** | **Given ,** **Find ,**<br>D = 4 cm K= ?<br>L = 10 cm<br>H= 15 cm<br>Q = 70 cc<br>T = 10 min = 600 sec<br>**Solution-** | | **4** |
| | | To find coefficient of permeability by constant head method<br>$K = Q.L/(A.h.t)$ | **1** | |
| | | Here, c/s Area of soil sample= $A= \Pi/4\ D^2 = \Pi/4 \times 4^2 = 12.566\ cm^2$ | **1** | |
| | | $K = 70 \times 10/(12.566 \times 15 \times 600)$ | **1** | |
| | | **$K = 6.189 \times 10^{-3}$ cm/sec** | **1** | |
| | **f)** | **Calculate coefficient of uniformity and coefficient of curvature for a soil sample for which $D_{10}$ = 0.430 mm, $D_{30}$ =0.790 and $D_{60}$ =1.300 mm** | | |
| | **Ans.** | **Given,** **To find,**<br>$D_{10}$ = 0.430 mm $C_u$ = ?<br>$D_{30}$ =0.790 mm $C_c$ = ?<br>$D_{60}$ =1.300 mm | | |
| | | $C_u = D_{60}/ D_{10} = 1.300 / 0.430$ | **1** | |
| | | **$C_u = 3.023$** | **1** | **4** |
| | | $C_c = D_{30}^2 / (D_{10} \times D_{60}) = 0.790^2 / (0.430 \times 1.300)$ | **1** | |
| | | **$C_c = 1.116$** | **1** | |

**Q.4** — **Attempt any FOUR of the following:** — **16**

**(a) Enlist assumptions of Terzaghi's bearing capacity theory.** — **4**

**Ans.**

Assumptions of Terzaghi's bearing capacity theory:

1. Soil behave like ideally plastic material.
2. Soil is homogeneous , isotropic and its shear strength is represented by coloumbs equation.
3. The total load on footing is vertical and uniformaly distributed.
4. The footing is long enough with L/B = $\infty$ .
5. The shear strength above base of footing is neglected and taken as uniform surcharge $\gamma_{Df}$ .
6. The elastic zones developed has straight boundaries inclined at $\psi = \phi$ .

**1 mark each (any four)**

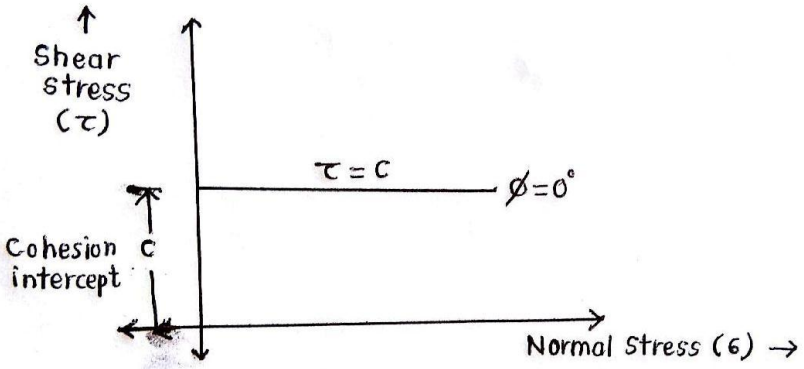
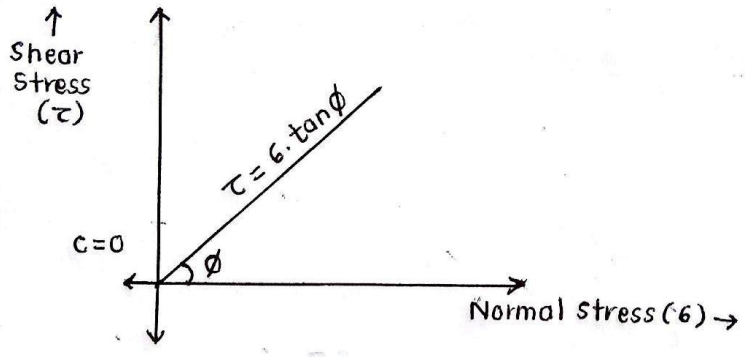
**(b) Differentiate between compaction and consolidation.** — **4**

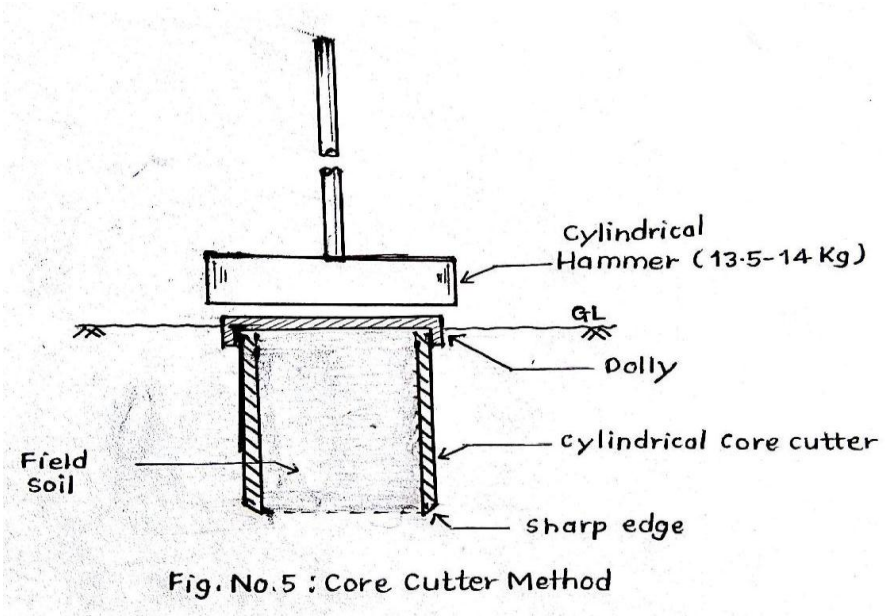
**Ans.**

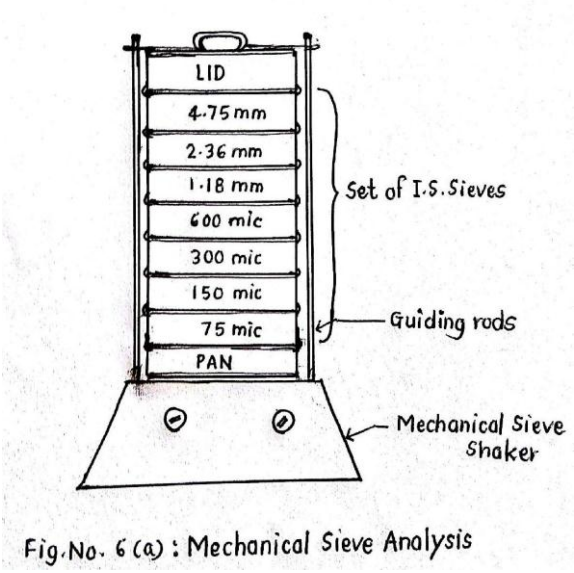
| Sr. No | Compaction | Consolidation |
|---|---|---|
| 1 | Instant compression of soil under dynamic load is called compaction. | Gradual compression of soil under steady load is called consolidation. |
| 2 | It is fast process. | It is very slow process. |
| 3 | It is artificial process. | It is natural process. |
| 4 | It is done to improve soil properties like bearing capacity, shear strength, impermeability etc. | It takes place due to structural load which does not improve soil properties. |
| 5 | Settlement is prevented due to compaction. | Settlement takes place due to compaction. |
| 6 | Compaction is done before construction of structure. | Consolidation takes place after construction of structure. |
| 7 | Pore water pressure is not important in compaction. | Pore water pressure is very important in compaction. |
| 8 | Compaction does not go indefinitely. | Consolidation go indefinitely. |

**1 mark each (any four)**

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.4** | **c) Ans.** | **State effect of water table on bearing of capacity of soil .**<br>**Effect of water table on bearing of capacity of soil –**<br>**1.** When water table is sufficiently well above the bae of footing , the submerged weight of soil should be consider for bearing capacity calculations<br>**2.** When water table is somewhat or at the base of footing , then elastic wedge of partially saturated soil should be consider . The B.C. factor is reduced to half i.e. ½ γ B $N_r$ in terzaghi,s B.C. equations<br>**3.** When water table is at a depth equal to width of footing below the base of footing, then a linear interpolation in reduction factor should be made according to depth of GWT in B.C. calculations.<br>**4.** When water table is at a depth more than width of footing , then no reduction factor should be used.<br>In short , as ground water table rises , accordingly bearing capacity of soil decreases. | **1 mark each** | **4** |
| | **d) Ans.** | **State any four methods of soil stabilization and explain any one.**<br>**Methods of soil stabilization –**<br>1.Mechanical Stabilization 2. Lime Stabilization<br>3. Cement Stabilization 4.Bitumen Stabilization<br>5.Fly ash Stabilization 6.Stabilization by chemicals<br>7.Stabilization by heating 8.Stabilization by grouting | **½ mark each (any four)** | |
| | | **Mechanical Stabilization-** In this method, stabilization of soil is done without adding any chemicals or admixtures . The procedure of mechanical stabilization is described below-<br>**1.** Initially the soil is excavated using excavator and then it is ground to finer particles using pulveriser.<br>**2.** In this pulverized soil , well graded aggregates are spread and mixed till homogeneous mixture will form.<br>**3.** Then water is sprinkled which is optimum moisture content i.e. OMC for getting maximum dry density i.e. MDD<br>**4.** The heavy roller (8-10 tonne capacity ) is used to compact soil 15-20 cm thickness as per type of soil available.<br>**5.** The compacted surface is curved sprinkling water on it , followed by compaction . The curing and compaction is done alternatively for 7 days . Then the stabilized portion is allowed for its further use.<br>(**Note - Explanation of any other method from above should be considered.)** | **3** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.4** | **e) Ans.** | **State necessity of soil exploration.**<br>**Necessity of soil exploration -**<br>1. To know stratification below ground surface<br>2. To determining index properties of soil like bulk density, voids ratio, water content, permeability, bearing capacity, compressibility etc.<br>3. To determine safe bearing capacity for design of foundation of proposed structure<br>4. To control the seepage and rise of ground water below surface<br>5. To decide size , depth and type of foundation for the proposed structure<br>6. To know grain size distribution by sampling undistributed soil sample and classify soil accordingly<br>7. To decide suitability of soil for proposed structure. | **1 mark each (any four)** | **4** |
| | **f) Ans.** | **Draw shear strength envelope for purely cohesive and cohesion less soil with sketch.**<br>**1. purely cohesive soil-**<br>  <br><br>Fig. No. 4(a) : Shear strength envelope for purely cohesive soil<br>**2. Cohesion less soil –**<br>  <br><br>Fig. No. 4(b) : Shear strength envelope for cohesionless soil | **2**<br><br>**2** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.5** | | **Attempt any TWO of the following:** | | **16** |
| | **a)** | **Calculate shrinkage limit for a given soil sample from the following data**<br>**1. Mass of empty container $w_1$ = 13 gm**<br>**2.Mass of container with wet soil $w_2$ = 43 gm**<br>**3.Mass of container with dry soil- $w_3$= 32.3 gm**<br>**4.Vol. of wet soil $v_1$= 20.7 $cm^3$**<br>**5.Vol of dry soil pat $v_2$=10.3 $cm^3$** | | |
| | **Ans.** | **Given-**<br>Mass of empty container $w_1$ = 13 gm<br>Mass of container with wet soil $w_2$ = 43 gm<br>Mass of container with dry soil- $w_3$= 32.3 gm<br>Vol. of wet soil $v_1$= 20.7 $cm^3$<br>Vol of dry soil pat $v_2$=10.3 $cm^3$ | | **8** |
| | | **Find-** Shrinkage limit Ws = ? | | |
| | | **Solution-** | | |
| | | Mass of wet soil = M= $w_2$ - $w_1$ = 43-13 = 30 gm | **1** | |
| | | Mass of dry soil = M= $w_3$ - $w_1$ = 32.3-13 = 19.3 gm | **1** | |
| | | By formula- Ws = {[(M-Md) –(V-Vd) $\gamma_w$] / Md} x 100 | **2** | |
| | | Ws ={[(30-19.3)-(20.7-10.3)x 1]/ 19.3} x 100 | **2** | |
| | | Ws = 0.01554 x 100 | | |
| | | **Ws = 1.554 %** | **2** | |
| | **b)** | **Explain core cutter method with sketch to find dry unit weight of field soil.** | | |
| | **Ans.** |  <br>Fig. No.5 : Core Cutter Method | **2** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.5** | **b)** | **Procedure-**<br>1. Measure the internal dimension of core cutter and calculate its volume V in $cm^3$.<br>2. Take weight of empty core cutter without dolly as $W_1$ gm.<br>3. Clean the ground by removing loose soil if any and keep the core cutter vertically on ground with sharp edge at bottom.<br>4. Now, drive the core cutter into the ground using 13.5 – 14 kg hammer, so that half of dolly will remain above the ground.<br>5. Remove the soil around the core cutter using pick axe and shape take out the core cutter using pick axe and spade and take out the core cutter safely filled with soil<br>6. Remove the dolly and excess soil from top of core cutter<br>7. Take weight of core cutter completely filled with soil as $W_2$ gm<br>8. Calculate the bulk unit weight of field soil as $\gamma = (W_2 - W_1) / V$ in gm /$cm^3$.<br>9. Now, take the soil specimen from the core cutter and determine its water content by oven drying method<br>10. Calculate the dry unit weight of field as $\gamma_d = \gamma / (1+w)$ in gm /$cm^3$.<br>11. Repeat above steps two more times to calculate average dry unit weight of soil. | **3**<br><br><br><br><br><br>**1**<br><br>**1**<br><br>**1** | **8** |
| | **c)**<br><br>**Ans.** | **Draw particle size distribution curve. Explain mechanical sieve analysis for grading of soil with a sketch.**<br>**Mechanical sieve analysis -**The process of analyzing the particle size present in soil by using mechanical means, is known as mechanical sieve Analysis. By performing mechanical sieve analysis, a particle size distribution curve is plotted for grading of soil.<br>  <br><br>Fig. No. 6 (a) : Mechanical Sieve Analysis | **2** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.5** | **c)** | **Procedure-**<br><br>i) Arrange the set of I.S. sieves in descending order i.e. coarser sieve at top and finer sieve at bottom.. The I.S sieve set must include sieves of size 4.75mm, 2.36mm, 1.18mm, 600µ,150µ,75µ.<br>ii) Take 500-1000gm oven dried soil sample and put it on topmost sieve. Keep lid and pan at top and bottom respectively.<br>iii) Now, shake this assembly of sieve on mechanical sieve shaker for 10-15 minutes, so that soil sample will be sieved completely.<br>iv) Take the weight of soil mass retained on each sieve separately in gms.<br><br>v) Calculate % finer for each sieve using following tabular format. | **4** | **8** |

| Sieve size (mm) | Mass retained(gm) | Cumulative mass retained(%) | % Cumulative mass retained (%) | % Finer or passing (%) |
|---|---|---|---|---|
| | | | | |

vi) Finally, plot the particular size distribution curve on a semi log graph paper as sieve size versus % finer of soil to classify soil as shown in Fig.6(b)

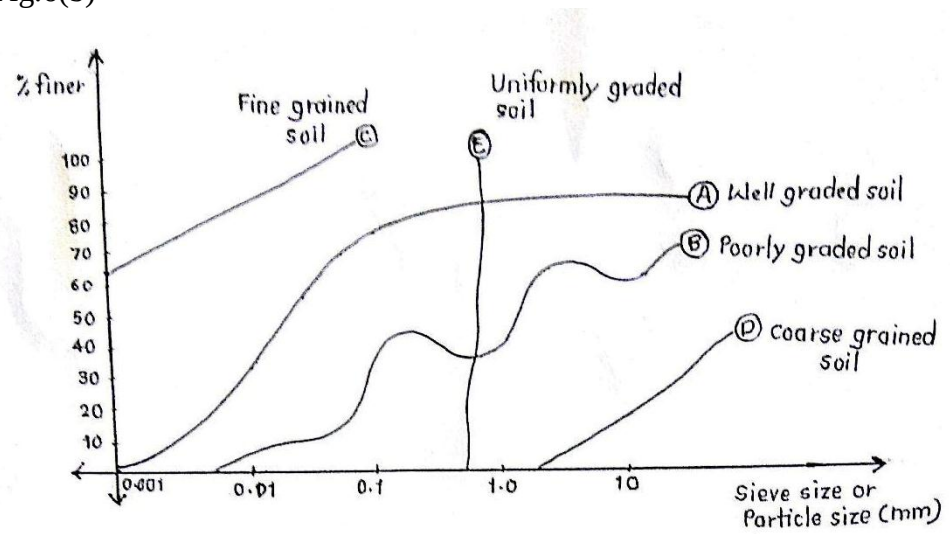



Fig.No. 6-b : Particle Size Distribution Curve

**2**

vii) From above graph, soil is classified based on grading curves as follows-

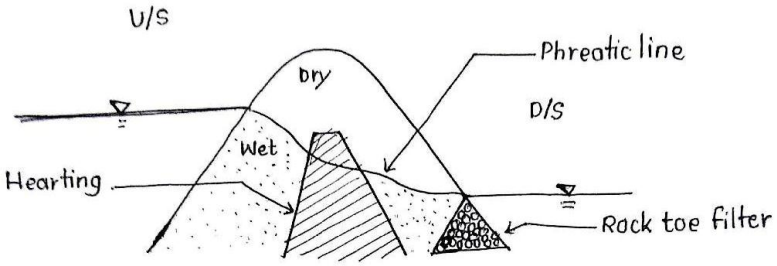
a) Well graded soil

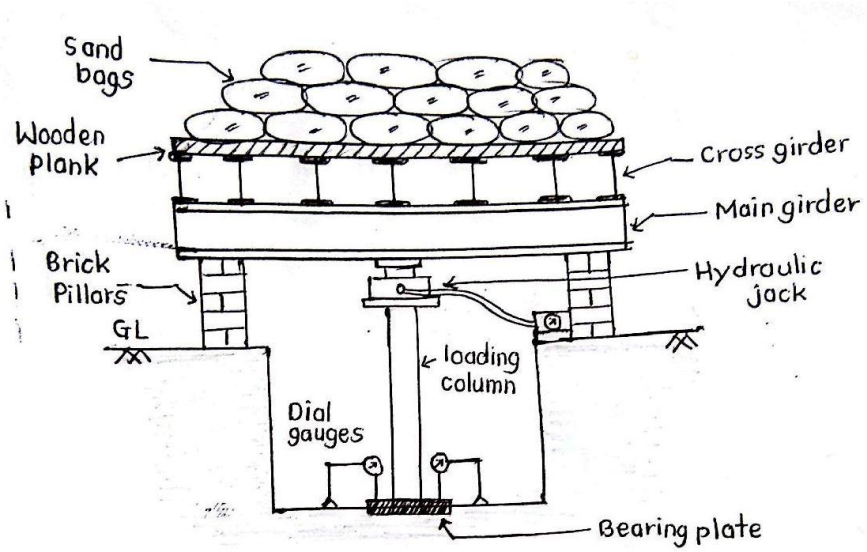
b) Poorly or gap graded soil

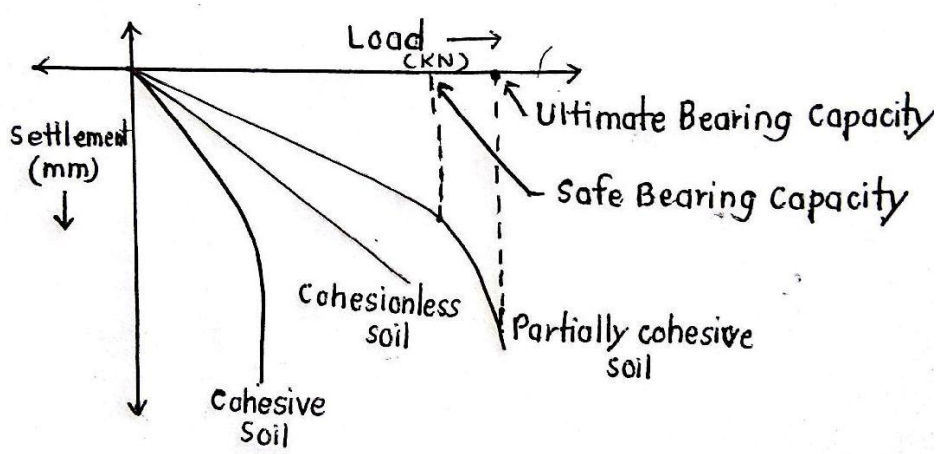
c) Fine grained soil

d) Coarse grained soil

e) Uniformly graded soil

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.6** | **a)** | **Attempt any TWO of the following:** | | **16** |
| | | **i)Explain phreatic line in earthen dam with a sketch.** | | |
| | **Ans.** | **Phreatic line in earthen dam-**<br>1.The line in earthen dam section below which there is positive hydrostatic pressure exists. Phreatic line separates the dry and wet part of earthen dam body as it acts as boundry between them, as shown in Fig.No 7 | | |
| | |  <br>Fig. No. 7 : Phreatic line | **1** | |
| | | 2. Phreatic line indicates zone of seepage through earth dam at which hydrostatic pressure acting is zero. Below phreatic line, soil is always in fully saturated condition.<br>3.When phreatic line ends at down-stream side of earthen dam, then there are chances of hydraulic failure of earthen dam in the form of piping. Therefore, a hearting is provided to break the flow zone of phreatic line.<br>4.When phreatic line ends at toe of earthen dam, then there may be sloughing of toe material. Hence, a rock toe is necessary to avoid removal of toe portion of dam. | **3** | **4** |
| | | **ii)Explain different methods of field compaction of soil.** | | |
| | **Ans.** | **Methods of field compaction of soil-**<br>**i) Rolling-** In this method, soil is compacted by using 6-8 tonne heavy rollers. The rollers are selected as per type of soil. Due to heavy weight, compression of soil takes place.<br>**ii) Ramming or Tamping-** In this method, soil is compacted by using suitable rammers or tampers. Rammers may be flat footed and tampers have spiny projection. It is done manually, which becomes time consuming.<br>**iii) Vibration-** In this method, soil gets compacted under vibrational energy produced by vibratory compactors. Vibrations of large amplitude, rearrange the soil particles together and hence overall compaction takes place. | **2 marks each (any two)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| Q.6 | b) | **A retaining wall with a vertical back of ht = 7.2 m supports cohesionless soil of dry unit wt 18.5 KN/m$^3$ and angle of repose 27$^0$, the surface of soil is horizontal. By Rankine's concept find the thrust per m length of wall then soil is absolutely dry.** | | |
| | Ans. | **Given,**<br>H = 7.2 m<br>$\gamma_d$ = 18.5 kN/m$^3$<br>$\phi = 27^0$<br>**Find ,**<br>Thrust per metre length of wall when soil is absolutely dry, P = ?<br>**Solution,**<br>Here, coefficient of active earth pressure | **1** | **8** |
| | | $K_a = (1-\sin\phi)/(1+\sin\phi)$<br>$K_a = (1-\sin 27^0)/(1+\sin 27^0)$ | **1** | |
| | | **$K_a$ = 0.3755**<br>Therefore total active earth pressure on wall | | |
| | | $P_a = K_a \times \gamma \times H$<br>$P_a = 0.375 \times 18.5 \times 7.2$ | **1** | |
| | | **$P_a$= 49.95 kN/m$^2$**<br>To calculate thrust i.e. active earth pressure per metre length | **2** | |
| | | **P** = ½ x $P_a$ x H x L | **1** | |
| | | **P** = ½ x 49.95 x 7.2 X 1<br>**P= 180.07 kN** | **2** | |
| | c) | **Explain the step by step procedure for determination of plate load test with sketches.** | | |
| | Ans. |  <br>Fig.No.8(a) : Plate Load Test | **2** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.6** | **c.** | **Procedure-**<br>i) Excavate a pit of depth equal to 5 times to that of breath of proposed footing.<br>ii) Keep the suitable bearing plate of specified size (30, 45, 60, 75cm square in plan) on soil. Arrange the loading column on it as shown in fig. no.8. above.<br>iii) Now apply the load on test plate above soil using sand bags or reaction truss loading at a rate of $(1/5)^{th}$ to $(1/10)^{th}$ of total estimated load.<br>iv) Note down the settlements after 1,5,10,20,40,60 minutes at corresponding applied loads.<br>v) Loading should be continued till 25mm total settlement or soil failure, whichever is achieved earlier.<br>vi) Finally plot a graph of load vs. settlement as shown in Fig. No 8(b) to find out load before failure as bearing capacity of soil.<br>  <br><br>Fig. No. 8 (b): Load Settlement Curve | **4**<br><br>**2** | **8** |