Important Instruction to Examiners:-

1) The answers should be examined by key words & not as word to word as given in the model answers scheme.

2) The model answers & answers written by the candidate may vary but the examiner may try to access the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance.

4) While assessing figures, examiners, may give credit for principle components indicated in the figure.

5) The figures drawn by candidate & model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credit may be given step wise for numerical problems. In some cases, the assumed contact values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding.

7) For programming language papers, credit may be given to any other programme based on equivalent concept.

<table>
<tr><th>Q .NO</th><th>SOLUTION</th><th>MARKS</th></tr>
<tr><td>1 a)</td><td>Attempt any six of the following</td><td>12 M</td></tr>
<tr><td>i)</td><td>Define geology and state any one importance in Civil Engineering.
Geology: is the science that deals with the study of the earth as a planet. Thus, it includes essence of scientific studies dealing with the origin, age and structure of the earth.
1. It is used to study different properties of rocks.
2. For any heavy construction project study of geology is required.</td><td>1 M
Any One
1 M</td></tr>
<tr><td>ii)</td><td>State classification of rocks based on their genesis : i) Igneous rock ii) Sedimentary rock iii) Metamorphic rock</td><td>2 M</td></tr>
<tr><td>iii)</td><td>Define Faults and state any two types of it.
Define Fault : The fractures along which there has been relative movements of the blocks past each other are termed as faults.
Types of Fault: - a) Normal Fault b) Reverse Fault.</td><td>1 M
1M</td></tr>
<tr><td>iv)</td><td>State importance of structural geology.
i) Geology provides a systematic knowledge of construction materials, their structure and properties.
ii) The knowledge of erosion, transportation and deposition of surface water helps in soil conservation, river control, coastal and harbor works.
iii) The knowledge about the nature of the rocks is very necessary in tunneling, constructing roads and in determining the stability of cuts and slopes.
iv) The foundation problems of dams, bridges and buildings are directly related with geology of the area where they are to be built.</td><td>2 M
(any two)</td></tr>
<tr><td>v)</td><td>Define a) Void Ratio b) Porosity.
Void ratio: The ratio of volume of voids (Vv) to the volume of solids (Vs) in soil mass is called as void ratio .
Porosity: The ratio of volume of voids (Vv) to the total volume of soil (V) is called as Porosity.</td><td>1 M
1 M</td></tr>
<tr><td>vi)</td><td>State field application of Geotechnical Engineering
In foundation design
ii) In pavement design
iii) In earth retaining structures
iv) In design of earthen dams
i) In design of embankments
ii) In design of underground structures</td><td>2 M
For any Two points</td></tr>
<tr><td>vii)</td><td>State silent features for any one dam in Maharashtra state.
<table>
<tr><th>Sr. No.</th><th>Features</th><th>Panset</th><th>Chaskaman</th></tr>
<tr><td>1</td><td>Length of dam</td><td>1039 m</td><td>1045 m</td></tr>
<tr><td>2</td><td>Volume content of Dam (10^3 m^3)</td><td>4190</td><td>2903</td></tr>
<tr><td>3</td><td>Gross Storage capacity (10^3 m^3)</td><td>303000</td><td>318.17</td></tr>
<tr><td>4</td><td>Reservoir area (10^3 m^3)</td><td>15645</td><td>18218</td></tr>
<tr><td>5</td><td>Effcetive storage capacity (10^3 m^3)</td><td>294000</td><td>210.99</td></tr>
<tr><td>6</td><td>Purpose</td><td>Irrigation and water supply</td><td>Irrigation and power generation</td></tr>
<tr><td>7</td><td>Designed spillway capacity (m^3/sec)</td><td>1162</td><td>3962</td></tr>
</table></td><td>2
Marks</td></tr>
</table>

(Note: Student may Wright any appropriate explanation so credit may be given accordingly.)

<table>
<tr><th>Q .NO</th><th>SOLUTION</th><th>MARKS</th></tr>
<tr><td>Q.1) viii)</td><td>State any four Method to find water content of soil sample.
1. Oven Drying Method
2. Alcohol Method.
3. Calcium Carbide Method
4. Pychnometer Method
5. Sand bath Method</td><td>1/ 2 M each for any four</td></tr>
<tr><td>Q.1) b)</td><td>Attempt any two of the following</td><td>08</td></tr>
<tr><td>i)</td><td>State any four types of Minerals with properties depending on the light and state of aggregation.
<table>
<tr><th></th><th>Minerals</th><th>Gypsum</th><th>Kyanite</th><th>Talc</th><th>Quartz</th></tr>
<tr><td rowspan="3">State of Aggregation</td><td>Colour</td><td>White, Yellow, Dark Grey</td><td>White, Pale, Blue, Grey</td><td>Brown, White, Green</td><td>Red, Green Blue, Colourless</td></tr>
<tr><td>Luster</td><td>Vitreous, Silky</td><td>Vitreous</td><td>Greasy, Pearly</td><td>Vitreous</td></tr>
<tr><td>Fracture</td><td>Conchoidal</td><td>Uneven</td><td>Uneven</td><td>Conchoidal</td></tr>
<tr><td>Light</td><td>Streak</td><td>White</td><td>White</td><td>White</td><td>White</td></tr>
</table></td><td>4 Marks (1M each)</td></tr>
<tr><td>ii)</td><td>Define a) OutCrop b) Dip c) Strike d) Fold.
1. Outcrop: - The dip and strike of beds can be easily measured in the field from their exposures called outcrops
2. Dip: - Dip is an angle between the horizontal plane and the inclined plane measured perpendicular to the direction of strike.
3. Strike: - The horizontal distance perpendicular to the fault plane is called as strike.
4. Folds: - Folds may be defined as undulations or bends that are developed in the rock of the Earth’s crust, as a result of stresses (commonly lateral compression) to which these rock have been subjected to, from time to time in the past history of the Earth.</td><td>1 M
1M
1M
1M</td></tr>
<tr><td>iii)</td><td>State the importance of soil as construction material in civil engineering.
1. Soil is more suitable in embankment fills and retaining pond beds after their construction.
2. Soil is also suitable for foundation but require compactions as without compaction structure may collapse.
3. Soil provides the moderate support for all types of foundations.
4. Improper study of soil may lead to failure of structure.
5. For plinth filling soil can be used as a construction material.
6. Soil cement mixture can be used for sub grades.
7. Pervious and impervious soil can be used in earthen dams.
8. For Water bound macadam roads soil is used as a binder material.</td><td>Any four points (1M each)</td></tr>
</table>

<table>
<tr><th>Q .NO</th><th>SOLUTION</th><th>MARKS</th></tr>
<tr><td>**Q. 2**</td><td>**Attempt any four of the following**</td><td>**16 Marks**</td></tr>
<tr><td>**a)**</td><td>**State formation and classification of soil.**
Soils are formed by numerous process of weathering both physical and chemical. A boulder pried loose from the side of mountain by rapidly flowing water of river and came along with the water ay has result of abrasive impact forces converted into sandy soil similarly due to other physical weathering process and environmental conditions.

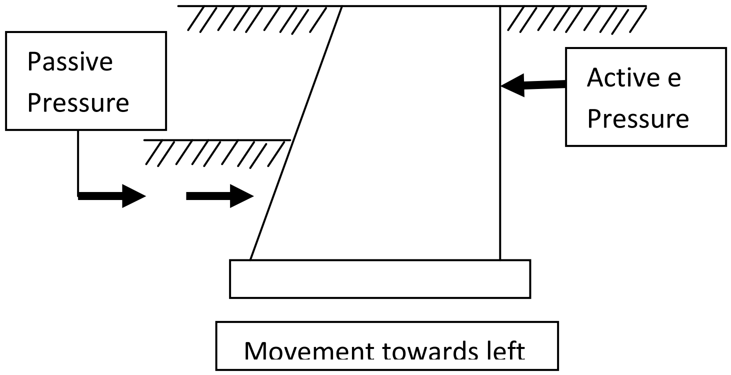
Classification of Soil
<table>
<tr><th>Soil</th><th></th><th></th></tr>
<tr><td rowspan="4">**Coarse Grained Soil:**</td><td rowspan="2">Gravels</td><td>Clean Gravel</td></tr>
<tr><td>Gravel with fines</td></tr>
<tr><td rowspan="2">Sand</td><td>Clean Sand</td></tr>
<tr><td>Sand with fines</td></tr>
<tr><td rowspan="6">**Fine Grained Soil**</td><td rowspan="3">Silts</td><td>Low Compressibility</td></tr>
<tr><td>Medium Compressibility</td></tr>
<tr><td>High Compressibility</td></tr>
<tr><td rowspan="3">Clay</td><td>Low Compressibility</td></tr>
<tr><td>Medium Compressibility</td></tr>
<tr><td>High Compressibility</td></tr>
<tr><td>**Highly Grained Soil**</td><td></td><td></td></tr>
</table>
</td><td>2M

2M</td></tr>
<tr><td>**b)**</td><td>**Classify Earthquakes on the basis of Focus and origin**
Earthquakes based on focus distributed in three general depth ranges:
i) Shallow earthquakes originate within about 60 kilometers of the surfaces
ii) Intermediate earthquakes have foci between 60 to 300 kilometers down
iii) Deep seated earthquakes originate at depths below 300 kilometers.
Earthquakes based on Origin distributed as follows:-
1. Movements of tectonic plates
2. Volcanic eruptions
3. Removal of natural gas from subsurface deposit.
4. Injection and extraction of fluids from earth’s crust.</td><td>2M for any two points

2 marks for any two points.</td></tr>
<tr><td>**c)**</td><td>**State Method of Construction of Earthquake Resisting Structure.**
Methods of Construction of Earthquake Resisting Structure: -
1. The foundation should be provided over the hard rock with no sign of faults.
2. The building should be symmetrical and rectangular in plan.
3. Minimum 16mm diameter reinforcement bar should be provided in all structural members of RCC building.
4. Ductile material should be used to construct the structure.
5. The beam column joint must be designed to resist earthquake effect.
6. Short RCC and Steel column should be designed.
7. Load bearing structures should be avoided.</td><td>1 M each (for any four points)</td></tr>
</table>

Q .NO	SOLUTION	MARKS
Q.2 d)	**Explain four causes and two effects of earthquake** **Causes of earthquake:** i) Movement of tectonic plates ii) Volcanic eruptions iii) Anthropogenic sources iv) Dams v) Use of explosives vi) Injection and Extraction of fluids. **Effects of earthquake :** i) Shaking and ground rupture ii) Landslides and avalances iii) Fires iv) soil liquefaction v) Tsunamis vi) Human impact vii) River water	(Explain any four 1/2M each) (Explain any two 1M each)
e)	**Explain any two types of weathering: -** **1. Mechanical Weathering** **2. Chemical Weathering** **3. Biological Weathering.** **4. Spheroidal Weathering.** **1. Mechanical Weathering: -** **a)** In mechanical weathering the rock surface is broken into smaller pieces without any chemical change. **b)** In mechanical weathering the smaller broken smaller rock pieces are deposited and over that parent rock is accumulated. **c)** It is the slow process due to atmosphere temperature and accumulation of organic matter. **d)** Mechanical weathering is generally seen where significant change in temperature is observed. 2. **Chemical Weathering: -** **a)** In chemical weathering the rocks are broken into smaller pieces by chemical decay of minerals. b) By chemical decay new rocks are formed and whose chemical composition if different than the original rock. c) The main factor that affects chemical weathering are hydration, carbonizations, oxidation.	2 M Any two points 2 M Any two points
f)	**Define – Atterberg's limit of consistency** **Atterbergs limits**: The water content at which the soil changes from one state to another are known as Consistency limits or Atterbergs limits. **Liquid Limit:** The water content at which the soil changes from the liquid state to plastic state is known as liquid limit (LL, w_L). In other wards the liquid limit is the water content at which the soil ceases to be liquid. **Plastic Limit:** The water content at which the soil becomes semisolid is known as the plastic limit. (PL, wp).The plastic limit is the water content at which the soil just fails to behave plastically. Soil begins to crumble when rolled into a thread of 3 mm diameter. The numerical difference between the liquid limit and the plastic limit is known as plasticity index. (PI, Ip), PI = LL – PL. **Shrinkage limit:** The water content at which the soil changes from a semisolid state to the solid state is known as the shrinkage limit (SL, w_S). Shrinkage limit is the smallest water content at which a reduction in water content will not cause a decrease in the volume of the soil mass. At this water content the shrinkage ceases.	2M each for any two definition

Q .NO	SOLUTION	MARKS
Q. 3	**Attempt any four of the following**	16
3.a)	Find coefficient of Uniformity & coefficient of curvature for soil particle.	
	Coefficient of Uniformity $= C_u = \dfrac{(D_{60})}{(D_{10})}$	
	Coefficient of Uniformity $= C_u = \dfrac{(1.30)}{(0.430)} = 3.023$	2 M
	Coefficient of curvature $= C_c = \dfrac{(D_{30})^2}{(D_{10}) \times (D_{60})}$	
	Coefficient of curvature $= C_c = \dfrac{(0.790)^2}{(0.430) \times (1.30)} = \dfrac{0.6241}{0.559} = 1.11$	2 M
3.b	**Factors affecting Permeability of Soil:-** **1. Grain Size: -** Permeability varies approximately as the square of the grain size. The permeability of coarse grain soil is more than fine grained soil. The permeability can be expressed as $k=CD_{10}^2$. Where 'k' is coefficient of permeability in (cm/sec)& D_{10} is the effective grain size of soil. **2. Effect of properties of Pore Fluids:-** The permeability is directly proportional to unit weight of water and inversely proportional to its viscosity. The unit weight of water does not change much with change in temperature but viscosity changes with change in temperature. **3. Effect of void ratio:-** Increase in void ratio increases the area available for flow hence permeability increases for critical condition.. **4. Effect of structural arrangement of particles and stratification: -** The structural arrangement of particle may vary at the same void ratio depending upon the method of compacting of soil mass. The structure may be entirely different for a disturbed sample as compared to undisturbed sample. **5. Effect of Degree of Saturation:** - The permeability is reduced if air is entrapped in the voids thus reducing its degree of saturation. Organic foreign matter has a tendency to move towards critical flow channel and choke them up thus decreasing the permeability. **6. Effect of absorbed water:-**The absorbed water surrounding the fine soil particles is not free to move and reduces the effective pore spaces available for the passage of water.	4M (1 M each for any four points.)
3.c	**Find Coefficient of permeability =?** Diameter of sample = 4 cm hence $A = \pi/4\ (4)^2 = 12.56\ cm^2$ Length of sample = 15 cm Constant head = 20 cm Quantity of discharge = 75 cc Time period = 10 minutes = 10 x 60 = 600 seconds	1 M

Q .NO	SOLUTION	MARKS
3.c	K = (Q/t) x (1/A) x (L/h) K = [75/ 600] x [1/12.56] x [15/20] K= 0.125x 0.0796x 0.75 K = 7.46 x 10^{-3} cm/sec	1 M 1 M 1M
3.d	**Advantages of Direct Shear Test:-** **1.** The direct shear test is a simple test. **2.** The relatively thin thickness of sample permits quick drainage. **3.** The relatively thin thickness of sample permits quick dissipation of pore pressure developed during the test. **Disadvantage of Direct Shear Test:-** **1.** As the test progress the area under shear gradually decreases, the corrected area at the failure should be used in determining the value of 'σ' & 'τ'. **2.** The stress condition across the soil sample is very complex, the distribution of normal stress and shearing stress over the potential surface of sliding in not very uniform. **3.** The stress is more at the edges and less in the center, due to this there is progressive failure of the specimen. **4.** There is effect of lateral restraint by the side walls of the shear box.	2M (1M each for any Two Points) 2M (1M each for any Two Points)
3.e	**Characteristic of flow net** i) In a flow net, flow lines and equipotential lines intersect each other at right angles. ii) The quantity of water flowing through each flow channel is the same. iii) The drop of head, or the potential drop between any two successive equipotential lines is the same. iv) The fields are approximately squares. v) The flow net is representative of the flow pattern and dissipation of the hydraulic head.	4M Any four points (1M-each)
3.f	**Active Earth Pressure: -** It is pressure exerted on retaining wall resulting from slight movement of wall away from filling. **Passive Earth Pressure: -** when the movement of the retaining wall is such that the soil tends to compress horizontally.  	1 M 1M 2 M (fig)

Q No | SOLUTION | MARKS

Q.4 Attempt any four of the following **16**

4.a

Factors affecting bearing capacity of soil : -

1. Type of soil and its physical properties such as density, shear strength etc.
2. Amount of allowable total and different settlement
3. Position of water table.
4. Physical features of the foundation such as
   a) Type of foundation b) Size and shape of foundation c) Rigidity of structures

4M (1mark each)

4.b

Assumptions of Rankine's Theory: -

1. The soil is semi infinite, homogenous, dry and cohesion less.
2. The soil element is in the state of plastic equilibrium.
3. The ground surface is plane which may be horizontal.
4. The back of is vertical and smooth.
5. The wall yield about the base thus satisfies deformation condition for plastic equilibrium.

4M (1mark each)

4.c

Explain Methods of Soil Stabilization: -

a) Mechanical soil Stabilization: Mechanical stabilization means stabilization without adding any chemicals or admixtures. It involves addition or removal of soil components

i) Basic properties are retained
ii) Economical
iii) Simple to carry out
iv) Rapid construction can be immediately started
v) Causes considerable improvement in soil properties
vi) Effective only up to certain extent
vii) Not suitable for all type of soils
viii) Requires special equipments

2 M

b) Cement soil Stabilization: - The soil stabilized with cement is called as soil cement stabilization.

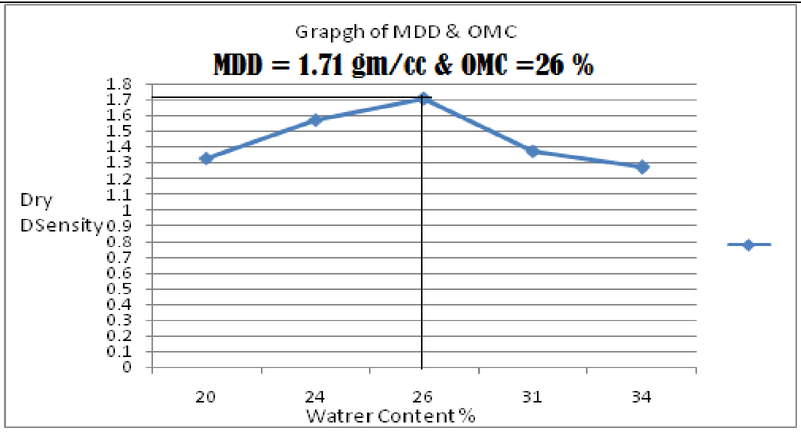
1. When Cement stabilization is used there is large increase in strength.
2. Cement stabilization is used for loose soil and non-cohesive soil.
3. Cement stabilization is not useful for clay, organic soil and expansive soil.
4. Permanent solution
5. Not useful for clays , organic soils and expansive soils
6. Costly
7. Complicated procedure

2M

4.d

By using graph Determine MDD & OMC

Sr. No.	Bulk Density (gm/cc)	Water Content (%)	Dry Density
1	1.6	20	1.33
2	1.95	24	1.57
3	2.15	26	1.71
4	1.8	31	1.37
5	1.7	34	1.27

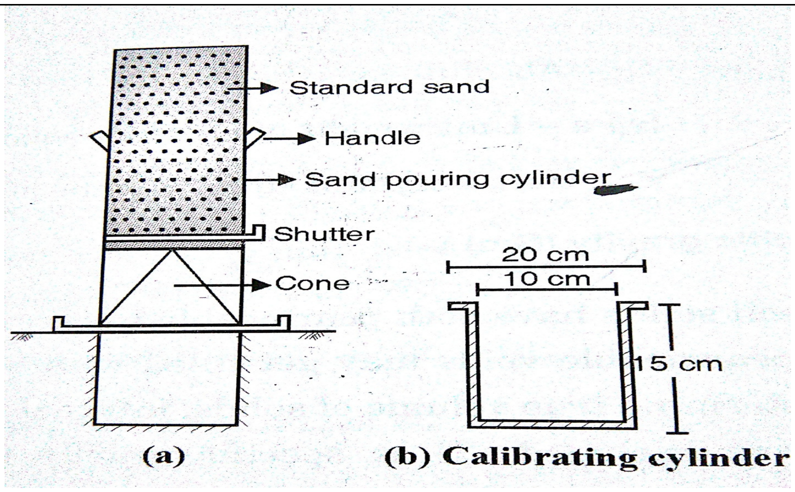


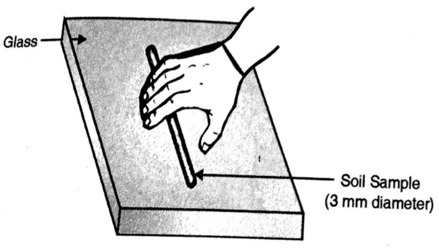
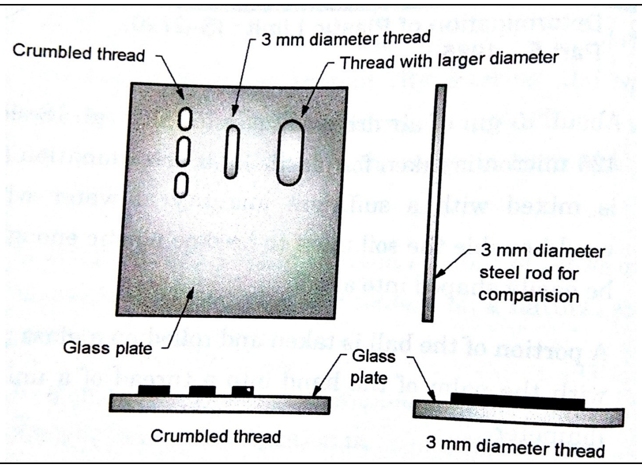
4 M

(2:MDD

2 :OMC)

Q .NO	SOLUTION	MARKS
4.e	**CBR Definition** : CBR is define as the ratio of test load to the standard load, Express in percentage, for a given penetration of the plunger. $CBR = \frac{\text{Test Load}}{\text{Standard Load}} \times 100$	2 M
	Application of CBR Test : - CBR test is considered to be one of the most commonly used and widely accepted test. - - This test is use for the analysis of existing pavements, layers by layer in respect of their strength and load carrying capacity. - It also helps in identifying the courses of failure of road pavements. **-** The CBR values are usually calculated for penetration of 2.5mm and 5mm. Generally the CBR value at 2.5mm penetration will be greater than5mm penetration and in such a case former value is taken as the CBR value for Design purpose. - If the CBR value corresponding to a penetration of 5 mm exceeds that for 2.5mm the test is repeated.	2 M (1/2 mark each)
4.f	**Field Identification test on soil:-** 1) Dry Strength Test 2) Dilatancy Test 3) Toughness Test 4) Organic content and colour test 5) Visual examination. 6) Other identification test.	2M
	a) Dry Strength Test: - 1. The sample is prepared by completely drying in sun or by air drying. It strength is tested by breaking lumps between the fingers. 2. If the dry samples can easily powered it is said to have low dry strength. 3. If considerable finger pressure is required to break the lump the sample has medium strength. 4. If the lump cannot be powered by fingers it has high dry strength. 5. Inorganic silts have very less dry strength. 6. Fine sand and silts possess low dry strength 7. Dry strength test is also known as crushing resistance test.	2M (Explanation)

Q .NO	SOLUTION	MARKS
Q.5	**Attempt any two of the following**	16
a)	**Explain with neat sketch stepwise procedure to determine bulk density by sand replacement method.**	
Q.5 a)	 (a) (b) Calibrating cylinder	2
	i) A flat area, approximately 450sq.mm of the soil to be tested should be exposed and trimmed down to a level surface, preferably with the aid of the scraper tool.	1/2
	ii) The metal tray with a central hole should be laid on the prepared surface of the soil with the hole over the portion of the soil to be tested. The hole in the soil should then be excavated using the hole in the tray as a pattern, to the depth of the layer to be tested upto a maximum of 150mm. The excavated soil should be carefully collected, leaving no loose material in the hole and weighed to the nearest gram(W_w). The metal tray should be removed before the pouring cylinder is placed in position over the excavated hole.	1/2
	iii) The water content (w) of the excavated soil should be determined as discussed in earlier posts. Alternatively, the whole of the excavated soil should be dried and weighed (W_d).	1/2
	iv) The pouring cylinder, filled to the constant weight (W_1) should be so placed that the base of the cylinder covers the hole concentrically. The shutter should then be opened and sand allowed to runout into the hole.The pouring cylinder and the surrounding area should not be vibrated during this period. When no further movement of sand takes place, the shutter should be closed. The cylinder should be removed and weighed to the nearest gram (W_4).	1/2
	v) The internal volume (V) in ml of the calibrating container should be determined from the weight of water contained in the container when filled to the brim. The volume may also be calculated from the measured internal dimensions of the container.	1/2
	vi) The pouring cylinder should be placed concentrically on the top of the calibrating container after being filled to the constant weight (W_1).	1/2
	vii)The shutter of the pouring cylinder should be closed during the operation. The shutter should be opened and sand allowed to runout. When no further movement of sand takes place in the cylinder, the shutter should be closed. The pouring cylinder should be removed and weighed to the nearest gram. These measurements should be repeated at least thrice and the mean weight (W_3) taken.	1/2

Q .NO	SOLUTION	MARKS
Q.5 a)	**CALCULATIONS**	
	i) The weight of sand (W_a) in gram, required to fill the calibrating container should be calculated from the formula: $W_a = W_1 - W_3 - W_2$	1/2
	ii) The bulk density of the sand (γ_s) in kg/m³ should be calculated from the formula: $\gamma_s = \frac{W_a}{V} \times 1000$	1/2
	iii) The weight of sand (W_b) in gram, required to fill the excavated hole should be calculated from the formula: $W_b = W_1 - W_4 - W_2$	1/2
	iv) The bulk density (γ_b), that is, the weight of the wet soil per cubic meter should be calculated from the formula: $\gamma_b = \frac{W_w}{W_b} \times \gamma_s$ kg/m³	1/2
	v) The dry density (γ_d), that is, the weight of dry soil per cubic meter should be calculated from the formula: $\gamma_d = \frac{100\gamma_b}{100+w}$ kg/m³ $\gamma_d = \frac{W_d}{W_b} \times \gamma_s$ kg/m³	1/2
Q.5 b)	**Explain in steps laboratory method to determine plastic limit of soil sample as per IS 2720.**	
	 	2M (1 mark for each diag.)

Q .NO	SOLUTION	MARKS
Q.5 b)	i) The plastic limit of fine-grained soil is the water content of the soil below which it ceases to be plastic. It begins to crumble when rolled into threads of 3mm dia.	1
	ii) Apparatus: Porcelain evaporating dish about 120mm dia., Spatula, Container to determine moisture content, Oven,Ground glass plate – 20cm x 15cm,Rod – 3mm dia. and about 10cm long	1
	PREPARATION OF SAMPLE ii) Take out 30g of air-dried soil from a thoroughly mixed sample of the soil passing through 425µm IS Sieve. Mix the soil with distilled water in an evaporating dish and leave the soil mass for naturing. This period may be upto 24hrs.	1
	Procedure iii) Take about 8g of the soil and roll it with fingers on a glass plate. The rate of rolling should be between 80 to 90 strokes per minute to form a 3mm dia.	1
	iv) If the dia. of the threads can be reduced to less than 3mm, without any cracks appearing, it means that the water content is more than its plastic limit. Knead the soil to reduce the water content and roll it into a thread again. Repeat the process of alternate rolling and kneading until the thread crumbles.	1
	v) Collect and keep the pieces of crumbled soil thread in the container used to determine the moisture content. Repeat the process at least twice more with fresh samples of plastic soil each time.	1
Q.5 c)	**Define**	**8**
i)	**Coefficient of curvature:** It represents the shape of particle size distribution curve. It is given by $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$	1
	where D_{60} is the grain diameter at 60% passing, D_{30} is the grain diameter at 30% passing, and D_{10} is the grain diameter at 10% passing C_c = 1 to 3 for well graded soil C_c = 4 for well graded gravel C_c = well graded sand	1
ii)	**Uniformity coefficient (Cu):**Is define as the ratio of D_{60} size to D_{10} size for given soil. $C_u = \frac{D_{60}}{D_{10}}$	1
	where D_{60} is the grain diameter at 60% passing and D_{10} is the grain diameter at 10% passing	1

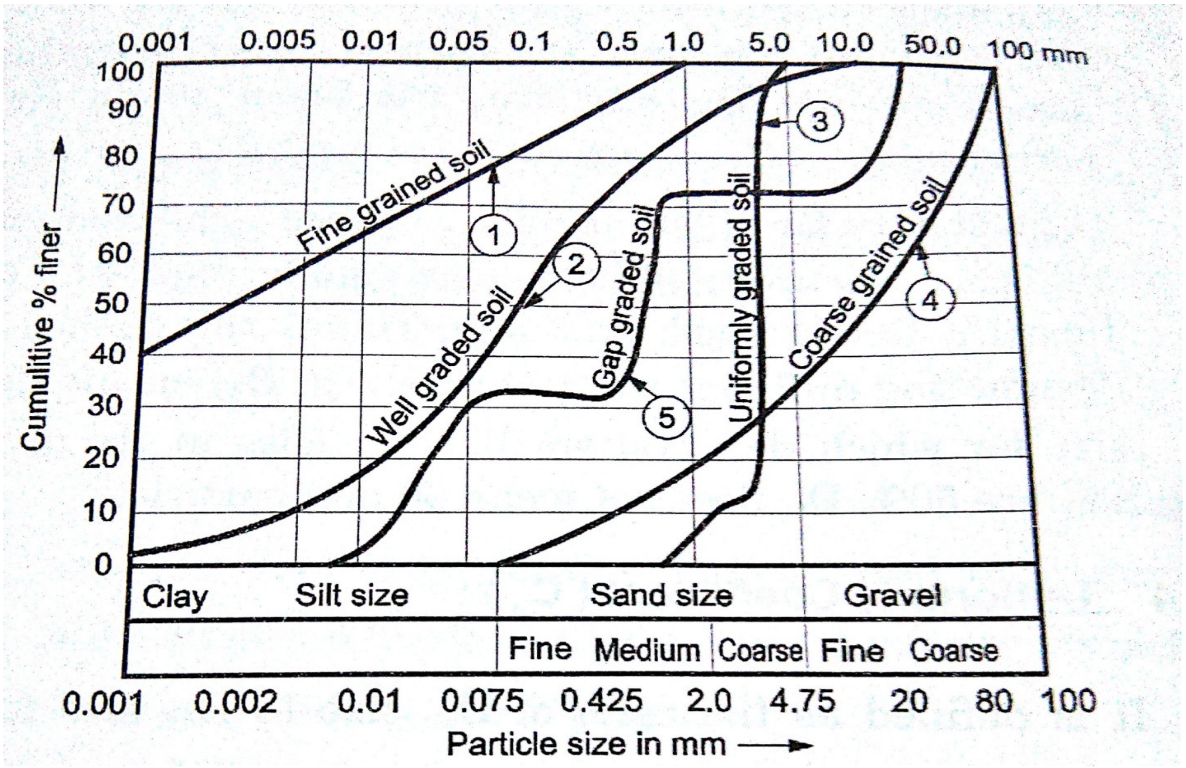
<table>
<tr><th>Q .NO</th><th>SOLUTION</th><th>MARKS</th></tr>
<tr><td>Q.5 c) iii)</td><td>

Effective size of soil: Since soil contains particles of many different diameters, it is necessary to choose some diameter as representative of the soil. This diameter is called as effective diameter or effective size.

The diameter d_{10}which represents the size for which the given soil contains 10% particles finer than this size .D_{10} does not mean 10mm size particle.

</td><td>1
1</td></tr>
<tr><td>iv)</td><td>

Well graded and Uniform graded soil with the help of particle size distribution curve:



i)If a soil contains grains of all sizes in significant amount, then it is called as Well-graded soil. Such a soil will give a particle size distribution curve which is S-shaped.

ii)A uniformly graded soil contains particles almost of only one size. Because of this, the compacted density that can be achieved is much lower for this type of soil. Uniformly graded soil is also called poorly graded soil.

</td><td>1
1/2
1/2</td></tr>
<tr><td>Q.6</td><td>Attempt any <u>TWO</u> of the following.</td><td>16</td></tr>
<tr><td>a</td><td>

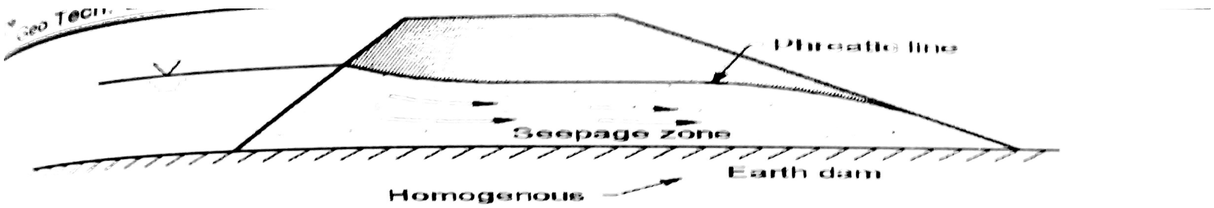
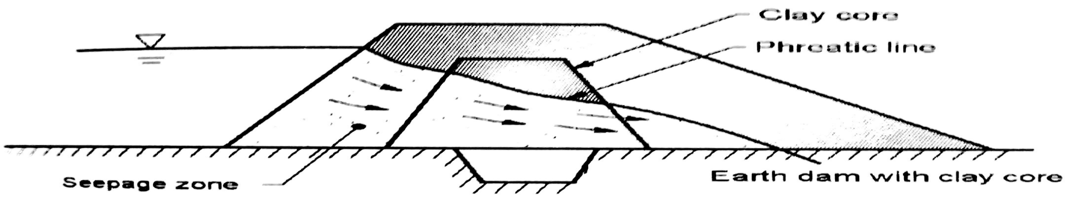
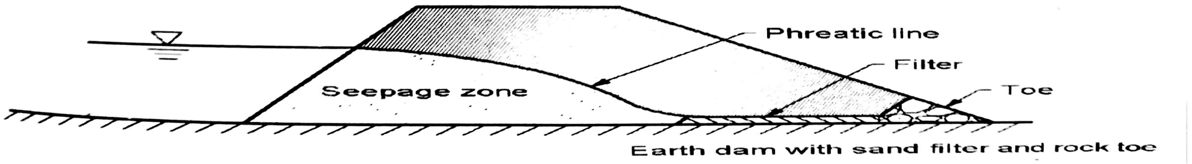
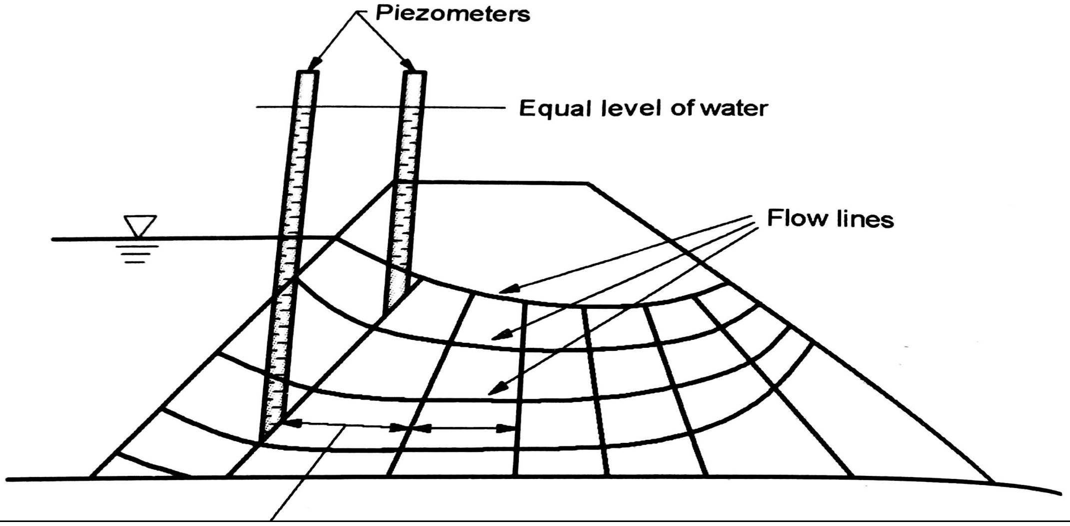
Explain with neat sketch phreatic line in earthen dam with pressure head at different point and show construction points of this line.

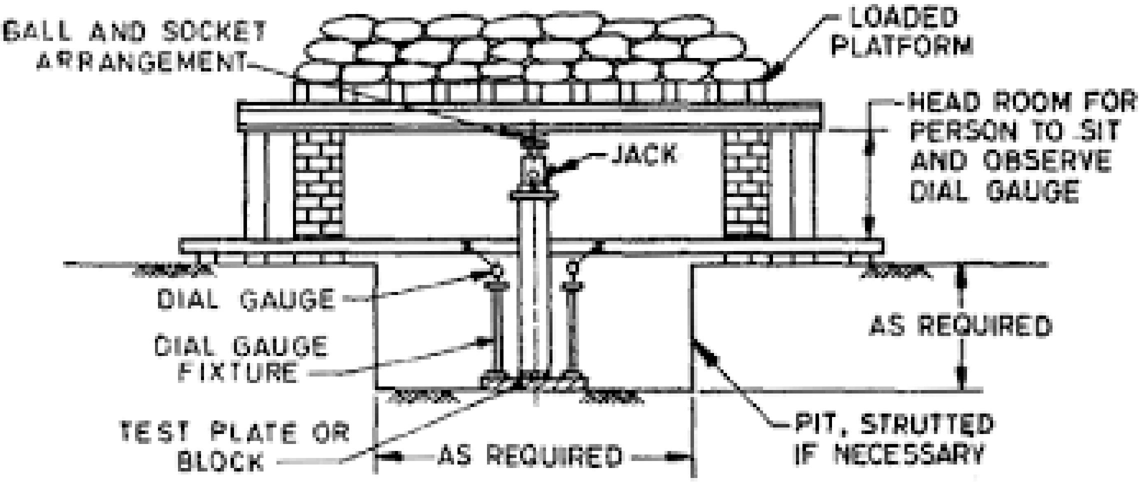
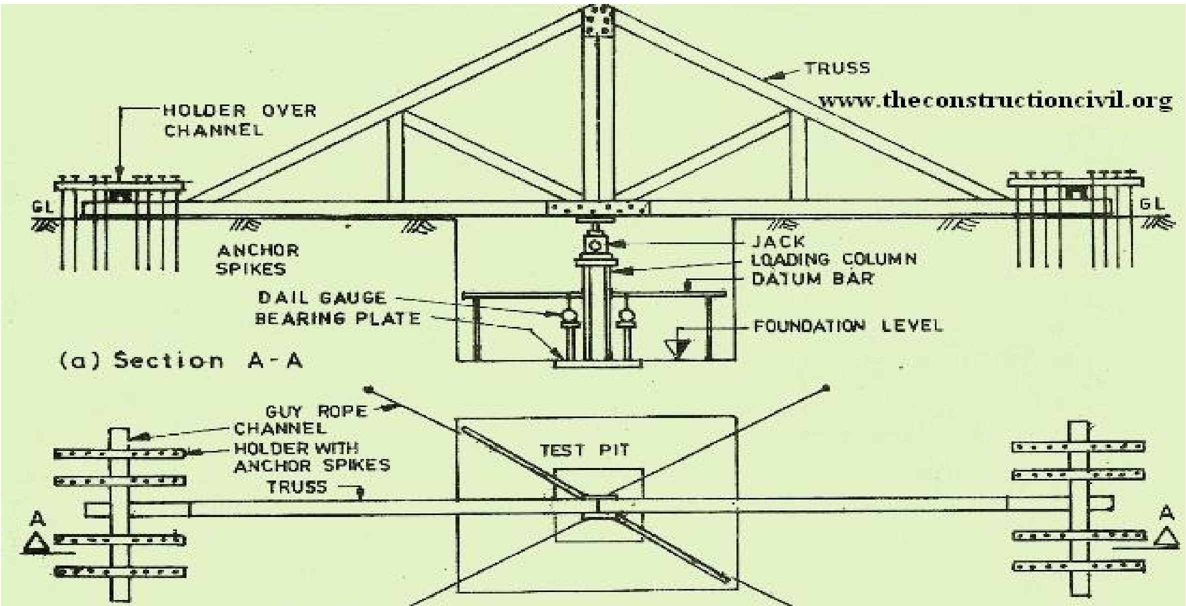
i) When flow of water occurs through soil, the top surface of the flow zone is called the phreatic surface, and in section, the top line of flow zone is called the phreatic line.

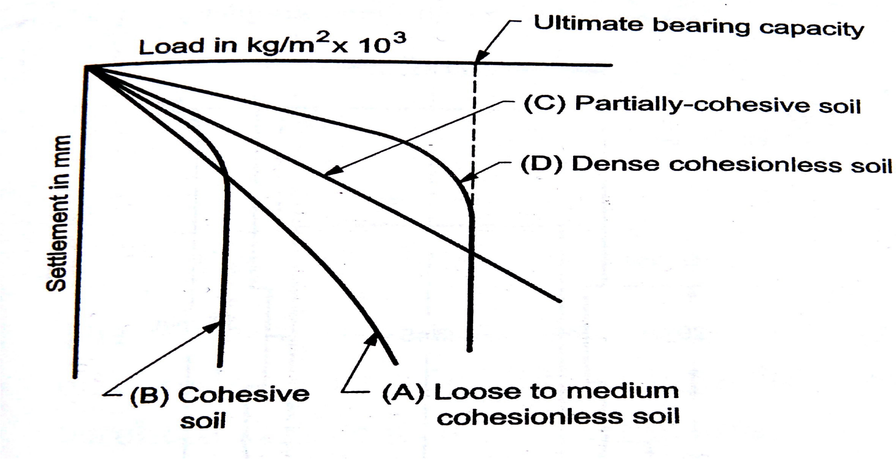
ii) In earth retaining structures, the flow due to seepage will cause the phreatic line.

iii) All points on the phreatic line have equal seepage pressure and it can be taken as atmospheric pressure.

</td><td>1
1/2
1/2</td></tr>
</table>

Q .NO	SOLUTION	MARKS
Q.6. a)	iv) Phreatic or seepage line is the line within a dam section below which there is positive hydrostatic pressure exist in dam and it is atmospheric on it.	1
		1
		1
		1
	v) Pressure head: The pressure at any point is given as the total head minus elevation head $H_p = H_t-(-H_e)$ $H_p= H_t+H_e$ Where $H_{P=}$ pressure head H_t= total head H_e= elevation head	1
		1

Q .NO	SOLUTION	MARKS
Q.6.b)	**Explain with neat sketch plate load test as per IS 1888 with two limitations of this test.**	
	 Gravity loading	1
	 Fig. Plate Load Test - Reaction by Truss Loading	1
	Procedure:	
	i) The site where testing is to be done is selected. A test pit, at least 5 times the diameter or width of the plate, and upto the depth of proposed foundation level, is dug.	1/2
	ii) The plate is seated firmly at the centre of the pit. The dead load of all equipment ball and socket, steel plate loading column, jackets is recorded before applying the load increments.	1/2
	iii) A minimum seating pressure of 70 gm/cm^2 is applied and removed before starting the load test. A minimum load is applied to soil, in cumulative increment upto 1kg/cm^2 or 1/5th of the estimated ultimate bearing capacity, which ever is lower	1/2

Q .NO	SOLUTION	MARKS
Q.6.b)	iv) The settlement is observed after each load increment at 1,2.25,4,6.25,9,16,30 minutes and thereafter at hourly intervals, and is is recorded.	1/2
	v) The recording is stopped when the increase in settlement is only 0.02mm. The procedure is repeated after every increment in load	1/2
	vi) The observation are plotted on a log –log scale. The settlement in mm is plotted on X-axis and in kg/m^2 is plotted on Y-axis	1/2
		1/2
	vii) From this plot, the ultimate bearing capacity is determined. The plate load tast setup is for gravity type of loading. The load increment can either be applied through gravity method or by reaction of truss method .	1/2
	Limitations of plate load test:	
	i) size effect: The actual settlement may vary from the plate weather same pressure is applied.	2 Marks (1 Marks each)
	ii) Time effect: As duration of test is small it does not give the ultimate settlement with respect long time.	
	iii) Layer effect: If foundation is large accurate result can not be obtained by test.	

Q .NO	SOLUTION	MARKS
Q.6.c)	**Differentiate between compaction and consolidation and state any four factors affecting compaction.**	

Compaction	Consolidation	
i) Instant compression of soil under dynamic load is called compaction.	i) Gradual compression under a steady load is called consolidation	1/2
ii) Takes place before building of structure	ii) Takes place after building of structure.	1/2
iii) Fast process.	iii) Very slow process.	1/2
iv) Carry out for improving soil property.	iv) Occurs naturally due to load of structure. Does not improve soil property.	1/2
v) Settlement is prevented due to compaction.	v) Settlement takes place due to consolidation.	1/2
vi) Artificial process.	vi) Natural process.	1/2
vii) Pore water pressure not very important.	vii) Pore water pressure very important.	1/2
viii) Does not go on indefinitely.	viii) Goes on indefinitely.	1/2

Factors affecting compaction:

i) **Type of soil**: For the same compactive effort, a well graded soil can be compacted to higher MDD than a uniformly graded soil. As the grain size decreases the OMC values goes on increasing and the MDD goes on decreasing. 1

ii) **Amount of compaction** : If the compactive effort is increased, MDD increases and OMC decreases. But the increase in MDD is not linear with increase in energy. 1

iii) **Water content** : As is evident, if water content goes on increasing the maximum density of compacted soil goes on increasing upto a certain water content. If water content is further increased, the density goes on decreasing. 1

iv) **Admixtures** : Various admixtures like lime, calcium chloride, aggregate in various proportion etc. are used to improve the compaction properties of soil. Lime can increase the dry density by about 5to 10% 1