Code No: RT31011 **R13** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2016
GEOTECHNICAL ENGINEERING – I
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1 a) List any two types of field compaction equipment. Also list any two types of soil structures [4M]
b) What are the corrections to be applied to hydrometer test readings [3M]
c) Write the formula to determine height of capillary rise in a soil and mention what each term of the formula stands for? [4M]
d) What is an Isobar? [3M]
e) Define normally consolidated clay? Write the formula to determine the compression index in terms of liquid limit. [3M]
f) Define shear strength of a soil. What are the names of shear tests based on drainage conditions? [5M]

PART -B

2 a) Write short notes on texture and structure of soils. [8M]
b) Explain about transported soils and soil formation. [8M]

3 a) What are the limitations of hydrometer test? [8M]
b) The following results were recorded in a shrinkage limit test using mercury [8M]
Mass of container =17.0g
Mass of wet soil and container =72.30g
Mass of dish =132.40g
Mass of dish and displaced mercury =486.10g
Mass of dry soil and container =58.20g
Volume of wet soil =32.4 cm^3
Determine the shrinkage limit, the linear shrinkage and the shrinkage ratio. The density of mercury is 13.6g/cm^3.

4 a) Write notes on soil water [8M]
b) A falling head permeability test is to be performed on a soil sample whose coefficient of permeability is $3x10^{-5}$ cm/s. What diameter of the standpipe should be used if the head is to drop from 27.5cm to 20.0cm in 5 minutes and if the cross-sectional area and length of the sample are respectively 15cm^2 and 8.5cm? [8M]
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5 a) With a sketch explain the construction of a Newmark's chart? [8M]

b) **i**) A long strip footing of width 2m transmits a pressure of 200kPa to the underlying soil. Using 2 : 1 dispersion method, compute the approximate value of the vertical stress at a depth of 5m below the footing. [8M]

ii) A line load of 100kN/m run extends to a long distance. Determine the intensity of vertical stress at a point 2m below the surface at a distance of 2m perpendicular to the line load. Use Boussinesq's theory

6 a) Explain briefly the laboratory consolidation test [8M]

b) In a consolidation test the pressure on a sample was increased from 150 to 300kN/m^2. The void ratio after 100% consolidation under 150kN/m^2 was 0.945, and that under 300kN/m^2 was 0.812. The coefficient of permeability of the soil was 25 x 10^{-6} mm/s and the initial height of the sample was 20mm. Determine [8M]

(**i**) the coefficient of compressibility, (**ii**) the coefficient of volume compressibility

7 a) Write a note on the laboratory box shear test. [8M]

b) The following results were obtained from a triaxial test on two soil specimens. [8M]

Sample No.	Confining Pressure(kPa)	Deviator Stress at failure(kPa)	Pore water pressure(kPa)
1	200	244	55
2	300	314	107

Determine the shear strength parameters of the soil terms of (i) total stresses ii) effective stresses

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Code No: RT31011 **R13** SET - 2

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(Civil Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1 a) List the names of three important clay minerals [3M]
b) Define a sand particle as per IS classification system. Write the formula to determine the coefficient of uniformity of a soil. [4M]
c) Write the relationship between discharge velocity and seepage velocity and also state Darcy's law [3M]
d) List the assumptions of Boussinesq's theory [4M]
e) Write Terzaghi's one-dimensional consolidation equation and mention what each term of the formula stands for. [4M]
f) What is the name of the test used to determine quickly the un drained shear strength of soft clay? Write the formula to determine the sensitivity of a clay. [4M]

PART -B

2 a) What are the two basic structural units of clay minerals? Explain them [8M]
b) Write a short note about diffuse double layer and base exchange capacity. [8M]

3 a) What is meant by consistency of soils? Define all the Atterberg limits [8M]
b) The following data refer to a sample of soil: [8M]
Percent passing 4.75 mm IS Sieve = 64
Percent passing 75-μ IS Sieve = 6,
Uniformity Coefficient = 7.5
Coefficient of Curvature = 2.7, Plasticity index = 2.5%
Classify the soil as per IS soil classification.

4 a) Derive the formula to compute the height of capillary rise in soils. [8M]
b) Determine the average horizontal and vertical permeability coefficients of a soil deposit made up of three horizontal strata, each 1m thick, if the coefficients of permeability are $1x10^{-1}$ mm/s, $3x10^{-2}$mm/s and $8x10^{-3}$mm/s respectively for the three layers. [8M]

5 a) Write a note on 2:1 stress distribution method. [8M]
b) A ring foundation of 10m external diameter and 9m internal diameter carries a uniformly distributed load of 150kPa. Determine the vertical stress due to the load at a depth of 6m below the centre of the foundation. [8M]
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6 a) Explain Casagrande's method to determine the coefficient of consolidation [8M]

b) In a consolidation test the pressure on a sample was increased from 140 to 280kN/m^2. The void ratio after 100% consolidation under 140kN/m^2 was 0.95, and that under 280kN/m^2 was 0.82. The coefficient of permeability of the soil was 20×10^{-6} mm/s and the initial height of the sample was 20mm. Determine (**i**) the coefficient of consolidation, and (**ii**) the time taken in days for 90% consolidation of the layer of this clay, 0.5mm thick in the field, sandwiched between an impervious layer beneath and the pervious layer on top. [8M]

7 a) Write a note on the laboratory triaxial shear test. [8M]

b) The following results were obtained from a direct shear test on a sandy clay sample. [8M]

Normal load (N)	Shear load proving ring reading (divisions)
360	13
720	19
1080	26
1440	26

If the shear box is 60mm square and the proving ring constant is 20N per division, estimate the shear strength parameters of the soil. Would failure occur on a plane within this soil at a point where the normal stress is 320kN/m^2 and the corresponding shear stress is 138kN/m^2?

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Code No: RT31011 **R13** SET - 3

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2016
GEOTECHNICAL ENGINEERING – I
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1 a) Define degree of compaction. What is zero air voids line and it significance [4M]

b) Define a gap graded soil. Also write the equation of the A-line and mention what each term of the equation stands for. [5M]

c) What is quick sand condition? [3M]

d) When is New mark's influence chart applicable? What are the differences between Boussinesq's and Westergaard's theories [4M]

e) List the two methods used for finding the coefficient of consolidation. [3M]

f) Define Critical Void Ratio and explain in which state sand can have cohesion. [3M]

PART -B

2 a) Derive the relationship between bulk unit weight of a soil, specific gravity and degree of saturation. [8M]

b) Write about the factors affecting the compaction properties of a soil. [8M]

3 a) Write a short note on the corrections to be applied to hydrometer test readings [6M]

b) The undisturbed soil at a pit has a water content of 15%, void ratio 0.60 and specific gravity of 2.70. The soil from the pit is to be used to construct a rolled fill having a finished volume of 35000m^3. The soil is to be transported from the pit to the construction site by trucks having a net carrying capacity of 6tons. After completion, the fill soil has a water content of 18% and dry density of 1.70 g/cm^3. Calculate the total number of trips the truck will have to make to construct the rolled fill. [10M]

4 a) With the help of a sketch of a flow net, derive the formula to determine the quantity of seepage through an earth dam. [8M]

b) A soil profile consists of a surface layer of sand 3m thick (γ=16kN/m^3), an intermediate clay layer 2m thick (γ_{sat}=19.25kN/m^3), and a bottom layer of gravel 4m thick (γ_{sat}=19kN/m^3). The water table is at the top of the clay layer. Determine the effective stress at various interfaces. There is a surcharge of 50kN/m^2 on the ground surface. [8M]
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5 a) With a sketch explain the construction of a Newmark's chart? [8M]

b) Two point loads P and Q act on the ground surface 8m apart. The magnitude of P is 100kN and that of Q is 80kN. Point A is at a depth of 6m directly below P and point B is at a depth of 5m directly below Q. Point C is between P and Q and it is at a distance of 4m from P. Point C lies at a depth of 3m below the ground surface. Calculate the increase in vertical stresses at A, B and C due to the point loads. [8M]

6 a) Explain Taylor's method to determine the coefficient of consolidation [8M]

b) A consolidation test was performed on a 20mm thick undisturbed clay sample. 50% consolidation occurred in 5 minutes. The sample was drained both at the top and at the bottom. In the field, the clay layer is 2.4m thick and is underlain by an impervious rock. Drainage is possible only at the top surface. (**i**) Determine the coefficient of consolidation and (**ii**) calculate the time in days for 50% and 90% consolidation to take place in the field deposit. [8M]

7 a) Explain the shear characteristics of sand? [8M]

b) In an unconfined compression test, a sample of sandy clay 8cm long and 4cm in diameter fails under a load of 120N at 10% strain. Compute the shearing resistance taking into account the effect of change in cross-section of the sample. [8M]

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Code No: RT31011 **R13** SET - 4

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2016
GEOTECHNICAL ENGINEERING – I
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1 a) List any four factors affecting the compaction of a soil [4M]
b) Define consistency of a soil and liquid limit of soil [4M]
c) Define equipotential line. What is the name of the topmost flow line of an earth dam [3M]
d) What is the increase in vertical stress at a point 5m below a point load of 100kN, using Boussinesq's theory? [3M]
e) Write the formula to determine the time factor, when the degree of consolidation is more than 60%. Define over-consolidation ratio [4M]
f) What is usual length to diameter ratio of a lab triaxial test sample? What is the formula of additional axial stress and what is another name for additional axial stress [4M]

PART -B

2 a) Write a short note on adsorbed water and relative density. [8M]
b) How is compaction control achieved in the field? [8M]

3 a) Draw neatly the IS plasticity chart and label it. [8M]
b) In a hydrometer test, the initial reading is 1.08. After one hour, the corrected hydrometer reading is 1.03 and the corresponding effective depth is 12cm. Find the initial weight of soil placed in 1000cc suspension, the particle size corresponding to the 15min reading, and the percentage of particles finer than this size. Take G =2.65, and μ=0.1 poise. [8M]

4 a) Derive the expression to determine the average coefficient of permeability in the horizontal direction for a stratified soil deposit. [8M]
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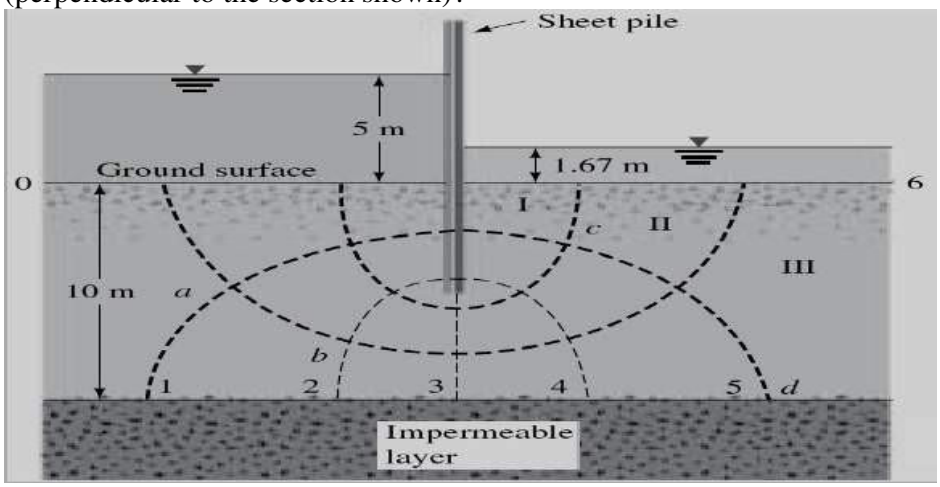
b) A flow net for flow around a single row of sheet piles in a permeable soil layer is shown in Figure. Given that [8M]
$k_x=k_z=k=5x10^{-3}$ cm/s
i) How high (above the ground surface) will the water rise, if piezometers are placed at points **a** and **d**?
ii) What is the rate of seepage through flow channel II per unit length (perpendicular to the section shown)?



5 a) Write a note on 2:1 stress distribution method [6M]
b) A three-legged tower forms an equilateral triangle of side 4m in plan. If the total weight of the tower is 450kN and is equally carried by all the legs, compute the vertical stress increase caused in the soil by the tower at a depth of 4m directly below one of the legs and also at the same depth below the centroid of the triangle. [10M]

6 a) Describe Casagrande's method of geometrical construction to find the pre-consolidation pressure. [8M]
b) The settlement analysis of a proposed structure indicated that 5cm of settlement will occur in three years and the total settlement will be 150mm. The analysis was based on the assumption that the compressible layer is drained only at the top surface. However further investigations showed that there will be drainage both at the bottom and the top of the layer. For the case of double drainage, calculate [8M]
(i) ultimate total settlement, **(ii)** time required for 50mm of settlement.

7 a) Explain the stress-strain behaviour of clays. [8M]
b) In a direct shear test on a specimen of clean dry sand, a normal stress of 180kPa was applied and failure occurred at a shear stress of 100kPa. Determine analytically the angle of shearing resistance, the principal stresses during failure, and directions of the principal planes with respect to the direction of the plane of shearing. [8M]

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3. Answer any **THREE** Questions from **Part-B**
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PART –A

1	a)	Explain different types of soil structures with neat figures.	[3M]
	b)	What is a flow curve? Explain with a neat sketch.	[4M]
	c)	What are the factors affecting permeability?	[4M]
	d)	What are differences between Bossiness's and Westergaard's theories?	[4M]
	e)	Define over consolidated, under consolidated and normally consolidated clays.	[3M]
	f)	Explain the basic mechanism of shear strength of soils.	[4M]

PART -B

2	a)	What is compaction and how it is different from consolidation?	[4M]
	b)	Explain in detail about three clay minerals.	[8M]
	c)	One cubic metre of wet soil weighs 19.80 kN. If the specific gravity of soil particles is 2.70 and water content is 11%, find the void ratio, dry density and degree of saturation.	[4M]
3	a)	Define three consistency limits.	[3M]
	b)	Explain IS soil classification.	[8M]
	c)	What are the different hydrometer corrections? Explain.	[5M]
4	a)	Derive expression for calculating average permeability of layered soil systems.	[8M]
	b)	What are the uses of flow nets?	[4M]
	c)	In order to compute the seepage loss through the foundation of a cofferdam, flownets were constructed. The result of the flownet study gave Nf= 6, Nd = 16. The head of water lost during seepage was 19.68m. If the hydraulic conductivity of the soil is k = 13.12 x 10^{-5} m/s, compute the seepage loss per metre length of dam per day.	[4M]
5	a)	Explain Newmark's influence chart preparation and usage.	[8M]
	b)	Explain 2:1 stress distribution method.	[3M]
	c)	A ring footing of external diameter 8 m and internal diameter 4 m rests at a depth 2 m below the ground surface. It carries a load intensity 150 kN/m^2. Find the vertical stress at depths of 2, 4 and 8 m along the axis of the footing below the footing base. Neglect the effect of the excavation on the stress.	[5M]

6 a) Explain concept of consolidation using Spring Analogy. [5M]

b) Explain the procedure for determining pre consolidated pressure. [5M]

c) An oedometer test is performed on a 2 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long time would the same degree of consolidation is achieved in the field where the clay layer is 3.70 m thick? Assume the sample and the clay layers have the same drainage boundary conditions (double drainage). [6M]

7 a) Explain Mohr Coulomb's shear failure theory. [4M]

b) Explain three drainage conditions for conducting shear testing of soils. [4M]

c) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters: [8M]

$\sigma 3$	100 kN/m^2	200 kN/m^2
$(\sigma 1 - \sigma 3)$	150 kN/m^2	192 kN/m^2
uf	60 kN/m^2	140 kN/m^2.

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Code No: RT31011 **R13** SET - 2

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GEOTECHNICAL ENGINEERING – I
(Civil Engineering)

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3. Answer any **THREE** Questions from **Part-B**
******

PART –A

1	a)	What are the effects of compaction on soil properties?	[3M]
	b)	Explain with neat figure about plasticity chart and label it clearly.	[4M]
	c)	What quick sand condition?	[4M]
	d)	What is the use of New mark's influence chart?	[3M]
	e)	Define initial, primary and secondary consolidation of soils.	[4M]
	f)	How soils attain their shear strength?	[4M]

PART -B

2	a)	What is compactive effort?	[4M]
	b)	Write a relationship between void ratio, degree of saturation, unit weight of soil, unit weight of water and specific gravity of soil solids.	[6M]
	c)	The soil in a borrow pit has a void ratio of 0.90. A fill-in-place volume of 20,000 m^3 is to be constructed with an in-place dry density 18.84 kN/m^3. If the owner of borrow area is to be compensated at Rs. 1.50 per cubic metre of the excavation, determine the cost of compensation.	[6M]
3	a)	Draw a grain size distribution curves for different grades of soils and name them.	[6M]
	b)	What are the different Atterberg limts? Explain them.	[6M]
	c)	The natural moisture content of an excavated soil is 32%. Its liquid limit is 60% and plastic limit is 27%. Determine the plasticity index of the soil and comment about the nature of the soil.	[4M]
4	a)	Derive an equation, for determining soil permeability using variable head permeability test.	[8M]
	b)	A concrete dam is constructed across a river over a permeable stratum of soil of limited thickness. The water heads are upstream side 16m and 2m on the downstream side. The flow net constructed under the dam gives Nf= 4 and Nd=l2. Calculate the seepage loss through the subsoil if the average value of the hydraulic conductivity is 6 x 10^{-3} cm/sec horizontally and 3 x 10^{-4} cm/ sec vertically. Calculate the exit gradient if the average length of the last field is 0.9 m. Assuming e = 0.56, and Gs = 2.65, determine the critical gradient. Comment on the stability of the river bed on the downstream side.	[8M]

5 a) Derive an equation for determining the stress intensity at a given on the axis of loading due to the uniformly loaded circular area. [8M]

b) What is an isobar? What is a pressure bulb? [3M]

c) A ring footing of external diameter 8 m and internal diameter 4 m rests at a depth 2 m below the ground surface. It carries a load intensity 200 kN/m^2. Find the vertical stress at depths of 2, 4 and 8 m along the axis of the footing below the footing base. Neglect the effect of the excavation on the stress. [5M]

6 a) Explain coefficient of volume compressibility, coefficient of consolidation. [6M]

b) How do you determine the consolidated settlement of a foundation? [4M]

c) An oedometer test is performed on a 4 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation is achieved in the field where the clay layer is 8 m thick? Assume the sample and the clay layer has the same drainage boundary conditions (double drainage). [6M]

7 a) Explain the limitations of shear box test. [4M]

b) Name different lab shear tests on soils. [4M]

c) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters: [8M]

$\sigma 3$	100 kN/m^2	200 kN/m^2
$(\sigma 1 - \sigma 3)$	157 kN/m^2	199 kN/m^2
uf	57 kN/m^2	136 kN/m^2.

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GEOTECHNICAL ENGINEERING – I
(Civil Engineering)

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******

PART –A

1	a)	What is compaction control? Explain.	[4M]
	b)	Explain $C_{U,}$ C_C.	[4M]
	c)	What is Capillarity? Derive an equation to find its rise in soils.	[4M]
	d)	What is the use of New mark's influence chart?	[3M]
	e)	What is degree of consolidation and what is it's relation with time factor?	[3M]
	f)	Explain different drainage conditions for shear testing of soils.	[4M]

PART -B

2	a)	Explain the difference between IS light and heavy compactions.	[6M]
	b)	Write a relationship between water content, void ration, degree of saturation and specific gravity of soil solids.	[4M]
	c)	A dry soil has a void ratio of 0.65 and its grain specific gravity is = 2.80. (i) What is its unit weight? (ii) Water is added to the sample so that its degree of saturation is 60% without any change in void ratio. Determine the water content and unit weight. (iii) The sample is next placed below water. Determine the true unit weight (not considering buoyancy) if the degree of saturation is 95% and 100% respectively.	[6M]
3	a)	Show IS soil classification based on grain size.	[4M]
	b)	Explain Total, neutral and effective stresses.	[6M]
	c)	The laboratory tests on a sample of soil gave the following results: *wn* - 24%, w, = 62%, *wp* = 28%, percentage of particles less than 2 microns is- 23%. Determine: (i) The liquidity index, (ii) activity, (iii) consistency and nature of soil.	[6M]
4	a)	Derive an equation for quicksand condition.	[6M]
	b)	Explain Total, Neutral and Effective Stresses.	[6M]
	c)	In order to compute the seepage loss through the foundation of a cofferdam, flownets were constructed. The result of the flownet study gave *N,*= 6, *Nd* = 16. The head of water lost during seepage was 19.68m. If the hydraulic conductivity of the soil is k = 13.12 x 10^{-5} m/s, compute the seepage loss per metre length of dam per day.	[4M]

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5 a) Explain New mark's influence chart preparation and usage. [8M]
b) What is an isobar? What is a pressure bulb? [3M]
c) A ring footing of external diameter 8 m and internal diameter 4 m rests at a depth 2 m below the ground surface. It carries a load intensity 250 kN/m^2. Find the vertical stress at depths of 2, 4 and 8 m along the axis of the footing below the footing base. Neglect the effect of the excavation on the stress. [5M]

6 a) What are the assumptions in Terzaghi's 1-D Consolidation theory? [6M]
b) Explain consolidation concept. [4M]
c) An oedometer test is performed on a 3 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation is achieved in the field where the clay layer is 6 m thick? Assume the sample and the clay layers have the same drainage boundary conditions (double drainage). [6M]

7 a) How soils attain their shear strength? [4M]
b) Explain soil strength envelop. [4M]
c) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters: [8M]

$\sigma 3$	99 kN/m^2	201 kN/m^2
$(\sigma 1 - \sigma 3)$	155 kN/m^2	197 kN/m^2
uf	58 kN/m^2	138 kN/m^2.

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Code No: RT31011 **R13** SET - 4

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GEOTECHNICAL ENGINEERING – I
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******

PART –A

1	a)	What are factors that affect compaction?	[4M]
	b)	Explain $C_{U,}$ C_C.	[4M]
	c)	What is quick sand condition?	[3M]
	d)	What is 2:1 stress distribution method?	[4M]
	e)	Define coefficient of consolidation and give its relations with other soil parameters.	[3M]
	f)	Explain different drainage conditions for shear testing of soils.	[4M]

PART -B

2	a)	What are various field compaction methods?	[4M]
	b)	Write a relationship between void ratio, degree of saturation, unit weight of soil, unit weight of water and specific gravity of soil solids.	[6M]
	c)	A soil has bulk density of 20.1 kN/m^3 and water content of 15%. Calculate the water content if the soil partially dries to a density of 19.4 kN/m^3 and the void ratio remains unchanged.	[6M]
3	a)	Draw a grain size distribution curves for different grades of soils and name them.	[5M]
	b)	What are the corrections required in hydrometer analysis?	[5M]
	c)	The laboratory tests on a sample of soil gave the following results: *wn* - 24%, w, = 62%, *wp* = 28%, percentage of particles less than 2 microns is-23%. Determine: (i) The liquidity index, (ii) activity (iii) consistency and nature of soil.	[6M]
4	a)	What is capillarity? Derive an equation to find its rise in soils.	[4M]
	b)	Explain Flow nets, their Characteristics and Uses.	[6M]
	c)	A concrete dam is constructed across a river over a permeable stratum of soil of limited thickness. The water heads are upstream side 16m and 2 m on the downstream side. The flow net constructed under the dam gives Nf= 4 and Nd=l2. Calculate the seepage loss through the subsoil if the average value of the hydraulic conductivity is 6 x 10^{-3} cm/sec horizontally and 3 x 10^{-4} cm/ sec vertically. Calculate the exit gradient if the average length of the last field is 0.9 m. Assuming e = 0.56, and G = 2.65.	[6M]

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Code No: RT31011 **R13** SET - 4

5 a) Explain Newmark's influence chart. [8M]

b) What is an isobar? What is a pressure bulb? [3M]

c) A ring footing of external diameter 8 m and internal diameter 4 m rests at a depth 2 m below the ground surface. It carries a load intensity 300 kN/m^2. Find the vertical stress at depths of 2, 4 and 8 m along the axis of the footing below the footing base. Neglect the effect of the excavation on the stress. [5M]

6 a) Explain Compression Index and Swelling Index. [6M]

b) How do you determine the consolidation settlement of a foundation [4M]

c) An oedometer test is performed on a 3 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation is achieved in the field where the clay layer is 5 m thick? Assume the sample and the clay layers have the same drainage boundary conditions (double drainage). [6M]

7 a) Explain shear box test with neat figure. [8M]

b) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters: [8M]

$\sigma 3$	100 kN/m^2	200 kN/m^2
$(\sigma 1 - \sigma 3)$	156 kN/m^2	198 kN/m^2
uf	58 kN/m^2	138 kN/m^2.

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