

MASTER OF ENGINEERING INCIVIL ENGINEERING EXAMINATION, 2019  
(1<sup>ST</sup> YEAR 2<sup>ND</sup> SEMESTER)

SUBJECT: Ground Improvement Techniques (SMFE)  
(Name in full)

Full Marks: 100

Time: Three hours

No. of Questions	PART I (MARKS 60)	Marks
	<p><u>Answer all questions</u> (Assume reasonable values of data not supplied)</p>	
Q1	<p>A temporary access road using nonwoven geotextile is proposed to be constructed on the bank of river Hooghly to reach a project site by using a layer of gravel over the existing subsoil. The subsoil at the site consists of a deep deposit of dark grey silty clay / clayey silt with bulk density = <math>17.0 \text{ kN/m}^3</math>, undrained cohesion = <math>20 \text{ kN/m}^2</math>, coefficient of volume change = <math>0.00065 \text{ m}^2/\text{kN}</math>.</p> <p>Determine the thickness of gravel over the existing subsoil without and with a layer of geotextile at the interface of subsoil and gravel. Maximum axle load for the dual wheel vehicle is 12 ton; contact area of the wheel is <math>300 \text{ mm} \times 600 \text{ mm}</math>.</p>	7+8 = 15
Q2	<p>A 70 m diameter and 14 m high petroleum storage tank is to be constructed at a site at Budgebudge with subsoil data given below :</p> <p>Depth 0 – 3.0m : Brownish grey silty clay / clayey silt  <math>\gamma = 18.5 \text{ kN/m}^3</math>, <math>C_u = 30 \text{ kN/m}^2</math>, <math>m_v = 0.0005 \text{ m}^2/\text{kN}</math></p> <p>Depth 3.0 – 16.0m : Dark grey silty clay / clayey silt with decomposed wood  <math>\gamma = 17.0 \text{ kN/m}^3</math>, <math>C_u = 20 \text{ kN/m}^2</math>, <math>m_v = 0.00065 \text{ m}^2/\text{kN}</math></p> <p>Depth 16.0 – 20.0m : Stiff / very stiff bluish / mottled brown silty clay / clayey silt with rusty spots  <math>\gamma = 19.0 \text{ kN/m}^3</math>, <math>C_u = 70 \text{ kN/m}^2</math>, <math>m_v = 0.0003 \text{ m}^2/\text{kN}</math></p> <p>Depth &gt;20.0m till 35.0m : Dense / very dense sand  <math>\gamma = 20 \text{ kN/m}^3</math>, <math>\phi = 36^\circ</math></p> <p>It is proposed to do the construction after installing stone column of diameter 800mm at the site.</p> <p>(a) What will be the length of stone columns for the proposed construction?            (b) Calculate the bearing capacity of the stone column reinforced ground and accordingly fix up the spacing of the stone columns            (c) Estimate the maximum settlement of the tank under superimposed load.</p>	3+10+12 = 25
Q3	<p>An embankment of height 15m and top width 30m, side slopes 2.5H:1V is proposed to be constructed over the subsoil deposit as given in Q2. For this purpose stage construction with vertical drains at a regular spacing are to be adopted.</p> <p>Consolidation of top 16 m thick clay layer, drained at top only, is proposed to be accelerated using sand wick installed at a spacing of 2.0m c/c in triangular arrangement. Calculate time required to achieve 95% degree of consolidation after each stage of construction.</p> <p>Also calculate the average degree of consolidation for combined vertical and radial drainage after 100 days of load application.</p> <p>Data given : <math>C_{vr} = 2C_v = 0.04 \text{ m}^2/\text{day}</math>; <math>r_w = 0.04 \text{ m}</math>; <math>m_v = 0.006 \text{ m}^2/\text{ton}</math>            GW is at the ground level.</p> <p>Determine the total consolidation of the clay layer.</p> <p>Use the following expression for <math>U_v = 1 - \exp\{-8T_v / F(n)\}</math>            Where, <math>F(n) = (n^2/(n^2 - 1)) \ln(n) - ((3n^2 - 1)/4n^2)</math></p>	10+10 = 20

**M.E. CIVIL ENGINEERING FIRST YEAR**  
**SECOND SEMESTER EXAM 2019**

**SUBJECT: GROUND IMPROVEMENT TECHNIQUES (SMFE)**

(Name in full)

**PAPER XXXX**

Time: Three hours

Full Marks 40 (for Part-II)

Use a separate Answer-Script for each part

No. of Question	Part - II	Marks
	<ul style="list-style-type: none"> <li>• <i>Maintain neatness.</i></li> <li>• <i>Mobile phone is not allowed with the candidate in any mode during examination</i></li> <li>• <i>Assume reasonable data if it is not supplied.</i></li> <li>• <i>Answer any two questions, All drawings-must be drawn by pencil</i></li> <li>• <i>No code etc. will be needed to answer the questions of this part</i></li> </ul>	
(1)(A)	What are the principle forms of densification? What are the similarities among them? What are the differences among them?	2+3+3=8
(B)	How the ground can be improved using drop hammer?	6
(C)	State how compaction piles may improve the condition of a ground (with less bearing capacity).	6
(2)	Discuss about factors influencing the compaction and procedures of compaction in field and laboratory.	20
(3)(A)	What is meant by grouting? How the condition of a ground (with less bearing capacity) can be improved using grouting techniques?	2+4=6
(B)	What is meant by Groutability ratio?	2
(C)	State the procedure and the applicability of: <ul style="list-style-type: none"> <li>A) Sand-cement grouting.</li> <li>B) Cement Bentonite grouting.</li> </ul>	6+6=12