Ref No.– **Ex/PG/CE/T/112C/2018**

MASTER OF ENGINEERING IN CIVIL ENGINEERING EXAMINATION, 2018

(1ST YEAR 1ST SEMESTER)

(1st / 2nd-Semester/~~Repeat/ Supplementary/Spl. Supplementary/Old/ Annual/ Biannual~~)

SUBJECT: ADVANCED THEORY OF SOIL MECHANICS

(Name in full)

Time: ~~Two hours~~/Three hours/~~Four hours/ Six hours~~ Full Marks : 100

No. of Questions	PART I (60 marks)	Marks
	Answer all questions	
Q1	(a) What are stress invariants? Derive the expression for stress invariants using cauchy's stress formula.	10
	(b) The state of stress at a point is such that $\sigma_x = \sigma_y = \sigma_z = \tau_{xy} = \tau_{yz} = \tau_{zx} = \rho$ Determine the principal stresses and their directions.	5
Q2	(a) The displacement field is given by, $u_x = k(x^2+2z)$, $u_y = k(4x+2y^2+z)$, $u_z = 4kz^2$, where is a very small constant. What are the strains at (2,2,3) in directions (i) $n_x = 0, n_y = 1/2, n_z = 1/2$ (ii) $n_x = 1, n_y = n_z = 0$ (iii) $n_x = 0.6, n_y = 0, n_z = 0.8$	8
	(b) For the state of strain matrix as derived in Q(a)(i), determine the principal strains and direction of maximum and minimum principal strains.	7
Q3	For the state of strain matrix as derived in Q(a) calculate the stress matrix with the following data : $E = 207 \times 10^6$ kPa $G = 80 \times 10^6$ kPa	10
Q4	A shallow foundation with a column load of 600 kN is to be placed at a depth of 1.0 m in the subsoil deposit given below: Stratum I : Depth 0 – 3.0m : Brownish grey silty clay / clayey silt γ 18.6 kN/m^3, C_u = 40 kN/m^2, $C_c/1+e_0 = 0.11$, p_c = 70kN/m^2, $C_c'/1+e_0 = 0.04$ Stratum II : Depth 4.0 – 15.0m : Dark grey silty clay / clayey silt with decomposed wood γ = 16.5 kN/m^3, C_u = 15 kN/m^2, $Cc/1+e_0 = 0.15$ Stratum III : Depth 15.0 – 18.0m : Stiff / very stiff bluish / mottled brown silty clay / clayey silt with rusty spots γ = 19.5 kN/m^3, C_u = 75 kN/m^2, $C_c/1+e_0 = 0.09$ Stratum IV : Depth > 18.0m till 35.0m : Dense / very dense sand γ = 20 kN/m^3, $\varphi = 36^0$ Using Newmark's chart given below, determine vertical stress distribution over the horizontal planes through the centre of strata I, II and III.	20

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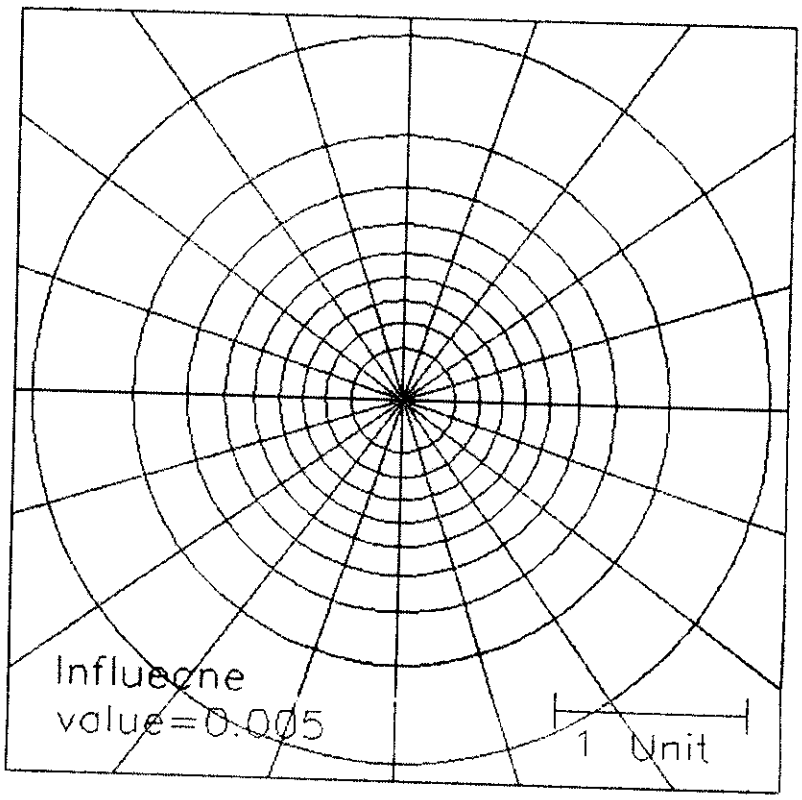
(Name in full)

Time: ~~Two hours~~/Three hours/~~Four hours/ Six hours~~

Full Marks ~~60~~ 100

No. of Questions	PART I (60 marks)	M



M.E. CIVIL ENGINEERING FIRST YEAR FIRST SEMESTER - 2018

ADVANCED THEORY OF SOIL MECHANICS (SMFE)

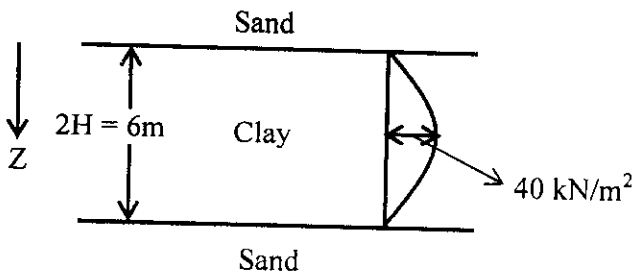
PART-II

Time: Three Hours

Full Marks 100
(40 marks for this part)

Use a separate Answer-Script for each part

[Answer all the question & Assume data reasonably wherever necessary]

Question No.	(Answer all the questions)	Marks
1.	A clay layer exists between two sandy soil layers as shown in the following figure. The initial excess pore water pressure in the clay layer after the application of a certain loading follows a sinusoidal pattern with an equation $u_t = 40\ sin(\pi z/2H)\ kN/m^2$. Calculate the excess pore water pressure at $z = H$ of the clay layer for $T_v = 0.3, 0.5, 0.7\ and\ 0.9$. 	10
2. (a)	Derive a finite difference equation for the one-dimensional consolidation equation. Extend the formulation for impermeable boundary condition as well.	8
(b)	A 4m thick clay layer is drained on its top surface. The coefficient of consolidation of clay is 0.09 m^2/month. Using finite difference technique obtain the distribution of excess pore water pressure 25 months after the commencement of consolidation. Also find out the average degree of consolidation of the clay layer within this time period. [Assume uniform initial excess pore water pressure]	12
3.	Write short note on the followings: (a) Logarithm of Time Fitting Method (b) Preloading	[5+5]