UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	GEOTECHNIC II
COURSE CODE	:	BFC 35403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) Flow net is a convenient graphical tool to compute hydraulic properties such as the amount of water flow, and water pressure on flow boundaries. With your knowledge of water flow, explain the boundary water pressure of pore water pressure in Geotechnical engineering.

(5 marks)

(b) Construct a diagram of water flow based on the following situation:

(i) Uplift water pressure flow under a dam

(3 marks)

(ii) Unbalance water pressure flow against sheet pile

(3 marks)

(c) Seepage analysis is used to assess the impact of groundwater flow on the stability, safety, and performance of structures. Determine the engineering applications that consider seepage analysis.

(14 marks)

Q2 (a) Two classic lateral earth pressure theories (Coulomb and Rankine) at failed stage in backfill soils is always used by practicing geotechnical engineers. Explain **THREE (3)** the differences between Coulomb theory and Rankine theory.

(9 marks)

(b) By referring to **Figure Q2.1**, calculate the change in vertical stress, $\Delta\sigma v$;

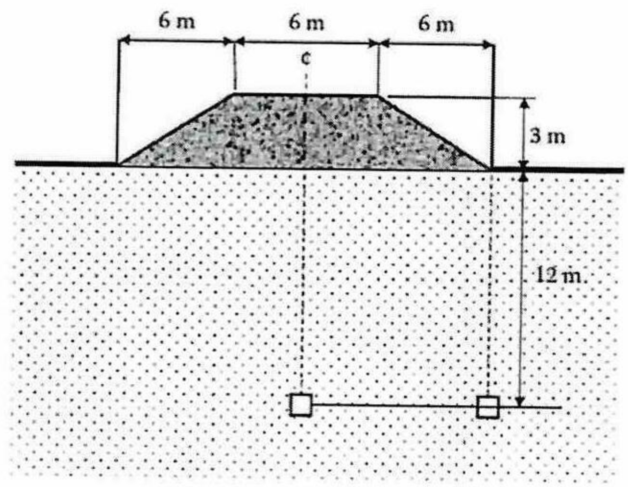

Figure Q2.1 An Embankment

(i) At directly below the centreline of the embankment. Please refer to **Figure APPENDIX A.1**. (Consider the total unit weight of embankment as γt = 19.5 kN/m^3 and z = 12 m below the ground surface).

(7 marks)

(ii) At directly under the toe of the embankment. Please refer to **Figure APPENDIX A.1** and **Table APPENDIX A.2**. (Consider the total unit weight of embankment as γt = 19.5 kN/m^3 and z = 12 m below the ground surface).

(6 marks)

(c) Support the embankment's change in superposition by incorporating a diagram redrawn from **Figure Q2.1**.

(3 marks)

Q3 (a) In a laboratory consolidation test, 12.7 mm (1/2 in.) thick clay specimen was tested with top and bottom drained condition, and 90% consolidation was accomplished in 15.8 minutes (t90 = 15.8 min). In the field, the same clay material with the thickness of 6.5 m is sandwiched by top sand and bottom gravel layers for drainage. Determine the period that the field clay takes to accomplish 50% and 90% consolidation. Please refer to **Table APPENDIX B.1**.

(12 marks)

(b) A clay layer has a thickness of 4.5 m. After 6 months, it settled to 30% of the total settlement, and 50 mm of the settlement was observed. Assume that the top of the clay layer is a drainage layer, and the bottom is an impervious layer for both 4.5 m and 20 m thick clay layers. For a similarclay layer and loading condition, if the thickness of clay is 20 m, determinethe settlement occurs at the end of 3 years. Please refer to **Table APPENDIX B.1**.

(13 marks)

Q4 (a) The slope can be natural or man-made.

(i) Classify the slope failures into **FIVE (5)** categories.

(5 marks)

(ii) Illustrate with the diagrams the mode of slope failures classified in **Q4(a)(i)**.

(10 marks)

(b) A cut slope was excavated in saturated clay. The slope made an angle of 40 degree with the horizontal. Slope failure occurred when the cut reached a depth of 6.1 m. Previous soil explorations showed that a rock layer was located at a depth of 9.15 m below the ground surface. Assuming an undrained condition and $\gamma sat = 17.29$ kN/m^3.

(i) Compute the undrained cohesion of the clay. Please refer to **Figure APPENDIX C.1**.

(6 marks)

(ii) Determine the position of the critical circle as either full point, mid-point, or non-point.

(1 marks)

(iii) Determine the distance surface of slide intersect the bottom of the excavation. Please refer to **Figure APPENDIX C.2**.

(3 marks)

- END OF QUESTIONS -

APPENDIX A: Design Chart and Table

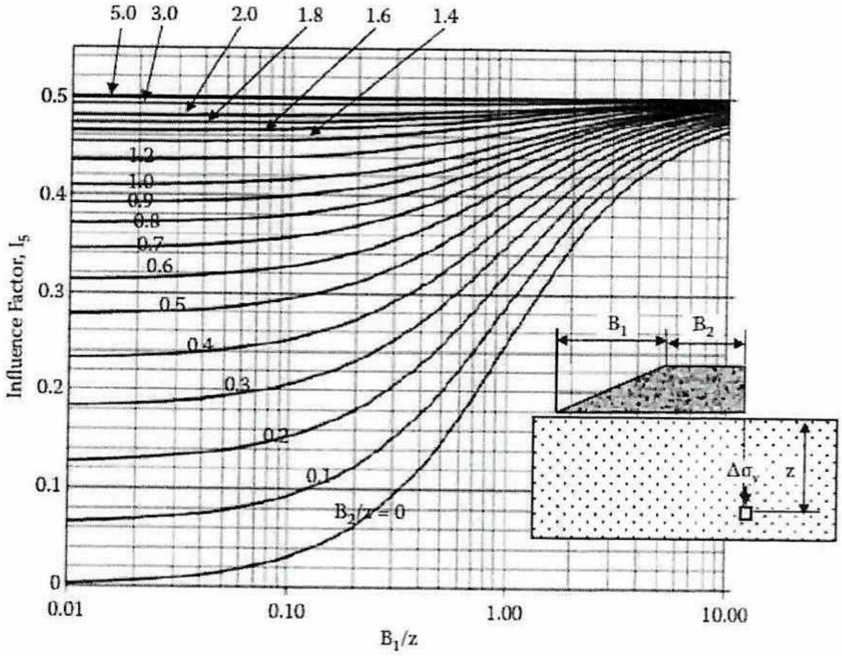

Figure APPENDIX A.1 Influence factor I_5

Table APPENDIX A.2 Influence Factor I_5 (Half Embankment Load)

	B_1/z													
B_2/z	0.01	0.02	0.04	0.06	0.1	0.2	0.4	0.6	0.8	1	2	4	6	8	10
0	0.003	0.006	0.013	0.019	0.032	0.063	0.121	0.172	0.215	0.250	0.352	0.422	0.447	0.460	0.468
0.1	0.066	0.069	0.076	0.082	0.094	0.123	0.176	0.221	0.258	0.288	0.375	0.434	0.455	0.466	0.473
0.2	0.127	0.130	0.136	0.141	0.153	0.179	0.227	0.265	0.297	0.322	0.394	0.444	0.462	0.471	0.477
0.3	0.183	0.186	0.191	0.196	0.206	0.230	0.271	0.303	0.330	0.351	0.411	0.452	0.468	0.476	0.480
0.4	0.233	0.235	0.240	0.245	0.253	0.274	0.308	0.336	0.358	0.375	0.425	0.459	0.472	0.479	0.483
0.5	0.277	0.279	0.283	0.287	0.294	0.311	0.340	0.363	0.381	0.395	0.437	0.466	0.477	0.482	0.486
0.6	0.314	0.316	0.319	0.322	0.329	0.343	0.367	0.386	0.400	0.412	0.446	0.471	0.480	0.485	0.488
0.7	0.345	0.347	0.349	0.352	0.357	0.369	0.389	0.404	0.416	0.426	0.454	0.475	0.483	0.487	0.489
0.8	0.371	0.372	0.375	0.377	0.381	0.391	0.407	0.419	0.429	0.437	0.461	0.478	0.485	0.489	0.491
0.9	0.392	0.393	0.395	0.397	0.401	0.408	0.422	0.432	0.440	0.447	0.467	0.481	0.487	0.490	0.492
1	0.410	0.411	0.412	0.414	0.416	0.423	0.434	0.442	0.449	0.455	0.471	0.484	0.489	0.491	0.493
1.2	0.436	0.436	0.437	0.438	0.440	0.445	0.452	0.458	0.463	0.466	0.478	0.488	0.491	0.493	0.495
1.4	0.453	0.454	0.454	0.455	0.456	0.459	0.464	0.469	0.472	0.475	0.483	0.490	0.493	0.495	0.496
1.6	0.465	0.466	0.466	0.467	0.467	0.470	0.473	0.476	0.478	0.480	0.487	0.492	0.495	0.496	0.497
1.8	0.474	0.474	0.474	0.475	0.475	0.477	0.479	0.481	0.483	0.485	0.489	0.494	0.496	0.497	0.497
2	0.480	0.480	0.480	0.480	0.481	0.482	0.484	0.485	0.487	0.488	0.491	0.495	0.496	0.497	0.498
3	0.493	0.493	0.493	0.493	0.493	0.494	0.494	0.494	0.495	0.495	0.496	0.498	0.498	0.499	0.499
5	0.498	0.498	0.498	0.498	0.498	0.498	0.498	0.498	0.499	0.499	0.499	0.499	0.499	0.499	0.499

APPENDIX B: Design Table

Table APPENDIX B.1 Relationship between U and T_v

U (%)	T_v	U (%)	T_v
0	0	3.751	0.001
5	0.00196	5.665	0.0025
10	0.00785	7.980	0.005
15	0.0177	9.772	0.0075
20	0.0314	11.28	0.01
25	0.0491	17.84	0.025
30	0.0707	25.23	0.05
35	0.0962	30.90	0.075
40	0.126	35.68	0.1
45	0.159	56.22	0.25
50	**0.197**	76.40	0.5
55	0.239	87.26	0.75
60	0.286	93.13	1
65	0.340	99.83	2.5
70	0.403	100	5
75	0.477	100	7.5
80	0.567	100	9.5
85	0.684		
90	**0.848**		
95	1.129		
100	∞		

APPENDIX C: Design Chart and Figure

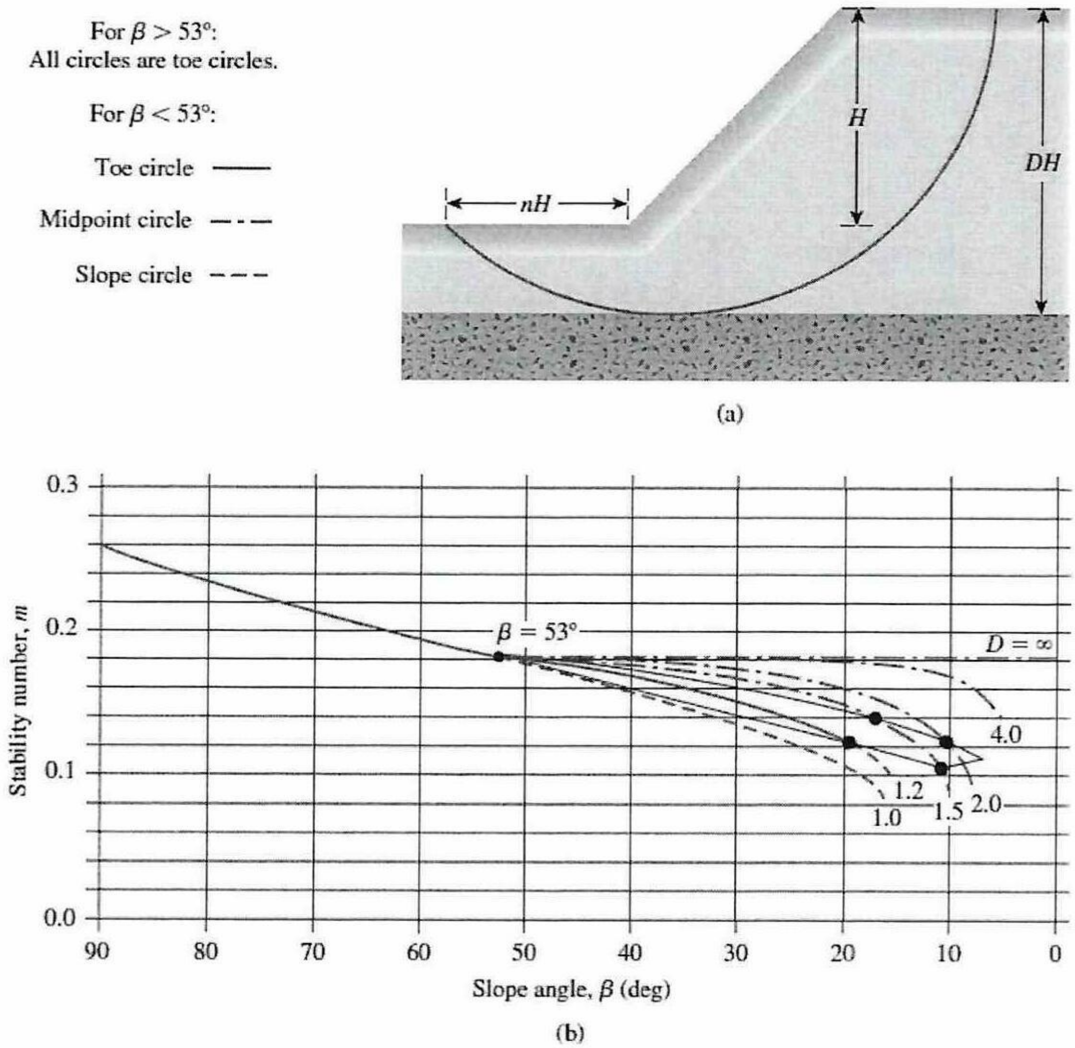

Figure APPENDIX C.1 (a) Definition of parameters for midpoint circle type of failure, (b) Plot of stability number against slope angle

APPENDIX C: Design Chart

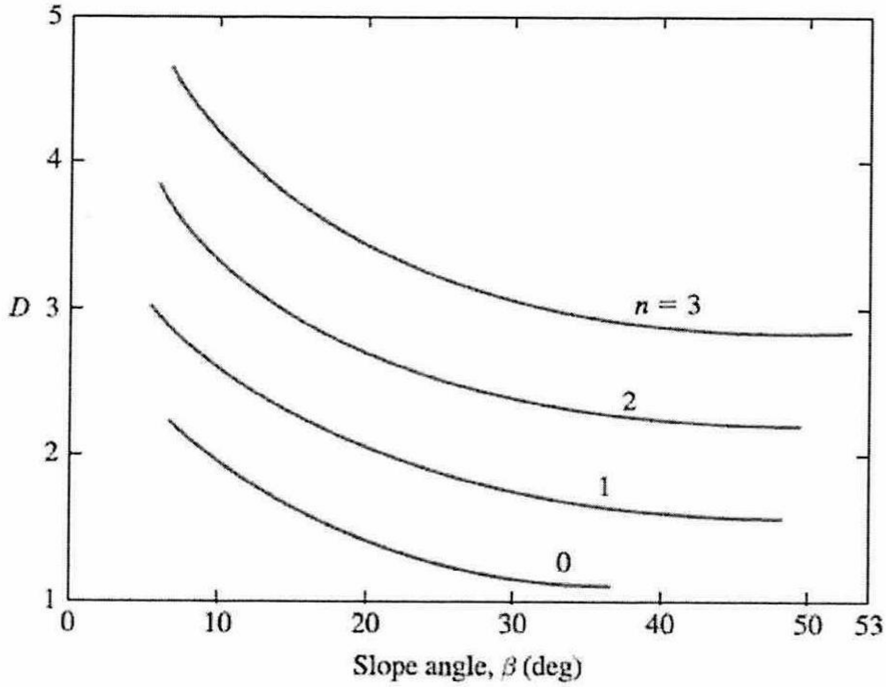

Figure APPENDIX C.2 Location of midpoint circle

APPENDIX D: Formulas

$$\Delta\sigma_v = \frac{q}{\pi}\left[\frac{B_1 + B_2}{B_1}(\alpha_1 + \alpha_2) - \frac{B_2}{B_1}\alpha_2\right] = q\, I_5$$

$$q = \gamma_t H$$

$$\Delta\sigma_v = 2 \times q \times I_5$$

$$T_v = \frac{C_v t}{H^2}$$

$$H_{cr} = C_u / \gamma_m$$