Ref. No. **Ex/PG/CIV/PE/T/124D/2025**

MASTER OF CIVIL ENGINEERING EXAMINATION 2025

(First Year, Second Semester)

OFFSHORE GEOTECHNICS

Time: Three Hours

Full Marks: 100
(PART I: 60 Marks & PART II: 40 Marks)

Use a separate Answer-Script for each part

No. of questions		PART I (**60 MARKS**)	Marks
		Answer any THREE questions from this part. Assume suitable values for the parameters if not supplied	
1	(a)	Draw a neat sketch of general profile of 'Coastal Zone' and indicate all labels.	8
	(b)	What are the different types of natural shore protections? Indicate the equivalent artificial shore protection.	8
	(c)	Discuss the utility and disadvantages of seawall and groin as coastal structures.	4
2	(a)	What is called wave motion? How many types of wave motions can be seen in the ocean? Explain briefly.	2+3=5
	(b)	Define: (i) Group wave celerity; (ii) Wave steepness; (iii) Significant wave height	3x1=3
	(c)	In a wave measurements programme, the wave height and period was measured at a water depth of 9.0m as follows:	12
		Wave Height (m): 1.70, 1.69, 1.68, 1.62, 1.57, 1.60, 1.63, 1.69, 1.59, 1.48, 1.60, 1.62 Wave period (sec): 12, 11, 11, 12, 10, 10, 10, 11, 10, 9, 10, 11	
		Find the following: (i) Significant wave height; (ii) Wave celerity and group wave celerity; (iii) Wave power and energy; (iv) Wave length; (v) Breaker height and length, if breaker depth is 2.0m.	
3	(a)	What is littoral drift in ocean? What are the parameters on which littoral drift depends?	2+4=6
	(b)	Define: Point source and sink, Line source and sink, Littoral cell, Balanced littoral cell.	4x1=4
	(c)	Draw a schematic diagram of the coastal cell for its sediment budgeting.	4
	(d)	What are the steps involved for coastal sediment budgeting? Explain briefly.	6
4	(a)	What are the basic data required for sediment budgeting of a coastal stretch? Explain briefly.	8
	(b)	In a coastal stretch the average elevation of the sea beach was found to be 0.50m RL. Design a seawall in three layers for HTL=3.50m RL in that coastal stretch and wave height=1.50m. Provide a detail neat sketch of the designed section. Assume freeboard 2.5m and combined value of composite slope factor and friction factor 0.8. Also assume that the stability coefficient (KD) = 2.2 and layer coefficient (KΔ) = 1.15. Given that Unit weight of armour material is 2700 kg/m3.	12

[Turn over

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M.E. CIVIL ENGINEERING FIRST YEAR SECOND SEMESTER – 2025
SUBJECT : OFFSHORE GEOTECHNICS
Time : 3 HOURS Full Marks : 40
PART II
Use Separate Answer scripts for each PART
Assume reasonable values of data not supplied

1(a) What are the possible mechanism of incomplete consolidation of marine deposits? Discuss each of them with neat sketches. 2+6=8

(b) Derive the expressions for normalized undrained shear strength in terms of effective stress parameters, coefficient of earth pressure at rest, pore water pressure parameter at failure, A_f, and also other soil parameters for a normally consolidated clay deposit.
Discuss the purpose of using these expressions. 5+2=7

2. Using the following equation for pore pressure generation plot the increase in normalised undrained pore water pressure (u_N) with normalised increase in number of load cycles (N/N_l) at 2.5m, 5.0m, 7.5m and 10m depth of deep sand deposit. Take bulk unit weight 18kN/m^3 and ground water table at ground surface.
$u_N / \sigma_0' = (2/\pi)\, Sin^{-1}(N/N_l)^{1/2\theta}$, where θ is a soil parameter, take, 0.70.
N_l = number of stress cycles to produce a pore water pressure ratio of 100% = 30
Prepare a Table of (u_N) vs. (N) and plot the same. 7

3. Use the following equation to determine residual pore water pressure ratio (u_r / σ_c') for a soft clay deposit with the soil parameters given below.
$u_r / \sigma_c' = \beta\, [\, \log (\gamma_c / (A_1 (OCR-1) + B_1))\,]$
Where, γ_c = single amplitude maximum cyclic shear strain = $\pm$ 1%
β= 0.45, OCR = 2, $A_1 = 1.1 \times 10^{-3}$, $B_1 = 1.2 \times 10^{-3}$
Use the above value of residual pore pressure ratio to determine post cyclic shear strength (cohesion) of a soil deposit with initial cohesion of 40 kPa using the expression
$Suc / Su = (1 - u_r / \sigma_c')^{(\kappa/\lambda)}$, where, $\kappa = 0.04$, $\lambda = 0.13$ 4+4 = 8

4. Determine ultimate bearing capacity of a spud can foundation with the following data.
Cohesion = 25kPa
Diameter = 20m
Volume below seafloor = 880 cum
Depth of foundation = 4.0m
Take effective unit weight of soil = 8 kN/m^3
What will be the ultimate bearing capacity if eccentricity of foundation loading is 2m? 10