THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING – THIRD YEAR DEGREE
SECOND SEMESTER EXAMINATION - 2022

CE 324 – COASTAL ENGINEERING

DATE: TUESDAY, 1 NOVEMBER 2022
ROOM: SLT
TIME: 8:20 P.M.
DURATION: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Check that there are 4 different pages of this Examination Paper.
2. You have ten (10) minutes to read this Examination Paper.
3. This paper contains 5 questions. You are only allowed to answer any 4.
4. Write your name, student number and course on the front page of the answer booklet.
5. All answers must be written on the ANSWER SHEET provided. No other written material will be accepted.
6. Mobile phones, notes and notebooks are NOT allowed.

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DO NOT WRITE UNTIL YOU ARE TOLD TO START

Question 1: Wave Basics (10 marks)

A. Briefly discuss the propagation of waves in sea (4 marks).
B. Given a design wave with a period $T = 4\ sec$, in a water depth $d = 5\ m$, and a height $H = 2\ m$. Find the local horizontal velocities at seabed when $\theta = 30°$ (6 marks).

Question 2: Wave Transformation (10 marks)

A. Discuss how wave behave when encountering current (3 marks).
B. A wave in deep water has the following characteristics: $H = 3m$, $T = 8s$ and $\alpha = 30°$ travelling over a sandy seabed of slope 1 in 100. Assuming that the seabed contours are parallel, find the height, depth, celerity and angle of the wave when it breaks. (7 marks).

Question 3: Wave Forces (10 marks)

For a design wave of 2m with period 4 seconds, evaluate the wave load on a vertical pile of diameter $300\ mm$ in a water depth of 5 $meters$ when $\theta = 30°$(10 marks)

Note: $C_D = 1.2;\ C_M = 2;\ \rho = 1027\text{kg}/m^3$.

Question 4: Wind Waves (10 marks)

A. Clearly differentiate fetch limited and duration limited waves (4 marks).
B. Calculate the significant wave height and zero up crossing period using the Jonswap method for a fetch length of 4 km and a wind speed of $U_{10} = 10\ m/s$(6 marks).

Question 5: Tides (10 marks)

A. Briefly discuss Diunal and Semi-diunal variations in Tides (4 marks).
B. Calculate the height through which the sea surface is raised due to the Earth-Sun systems, given that the mass of the Earth, is $5.98 \times 10^{24}\ kg$, the mass of the sun, is $1.989 \times 10^{30}\ kg$, with a distance of $149.6\ million\ km$ from the earth, and the mean radius of the Earth, is $6.37 \times 10^6\ m$ (6 marks).

Table 1: Formula Sheet

$K_s = \frac{H}{H_0} = \sqrt{\frac{n_0 c_0}{nc}} = \sqrt{\frac{1}{2n \tanh kd}}$	$F = \frac{C_d \rho D}{2} \int u\|u\| dz + \frac{C_M \rho \pi D^2}{4} \int a_x dz$
$L = \frac{gT^2}{2\pi} tanh\, kd$	$u = \frac{\pi H}{T} [\frac{\cosh k(z+h)}{\sinh kh}] \cos(\theta)$
$K_r = \sqrt{\frac{b_0}{b}} = \sqrt{\frac{\cos \alpha_0}{\cos \alpha}}$	$U_a = 0.71 U_{10}^{1.23}$
$h_B = 1.28 H_B$	$n(\theta) = \frac{Ms^4}{mr^3} \left(\frac{3cos^2(\theta) - 1}{2} \right)$
$a_x = \frac{2\pi^2 H}{T^2} [\frac{\cosh k(z+h)}{\sinh kh}] \sin(\theta)$	$P = -\rho g z + \rho g \frac{H}{2} \cos(\theta) \frac{\cosh k(z+h)}{\cosh kh}$
$K_s K_r = \frac{H}{H_0}$	$\hat{F} = F * \frac{g}{U_a^2}$
$H_s = \hat{H}_s * \frac{U_a^2}{g} = a\hat{F}^{0.5} * \frac{U_a^2}{g}$	$T_p = \hat{T}_p * \frac{U_{10}}{g} = b\hat{F}^{0.33} * \frac{U_{10}}{g}$

Note: The constants a and b take the values 0.0016 and 0.2857, respectively. The original form, using U_{10}instead of U_a, had values of a and b being 0.00178 and 0.352, respectively.

Table 2: Functions of d/L for increments of d/L_0

d/L_0	d/L	$\frac{2\pi d}{L}$	Tanh kd	n
0.170	0.200	1.257	0.850	0.705
0.200	0.225	1.414	0.888	0.667
0.020	0.057	0.362	0.347	0.958
0.0025	0.020	0.1257	0.1250	0.9948

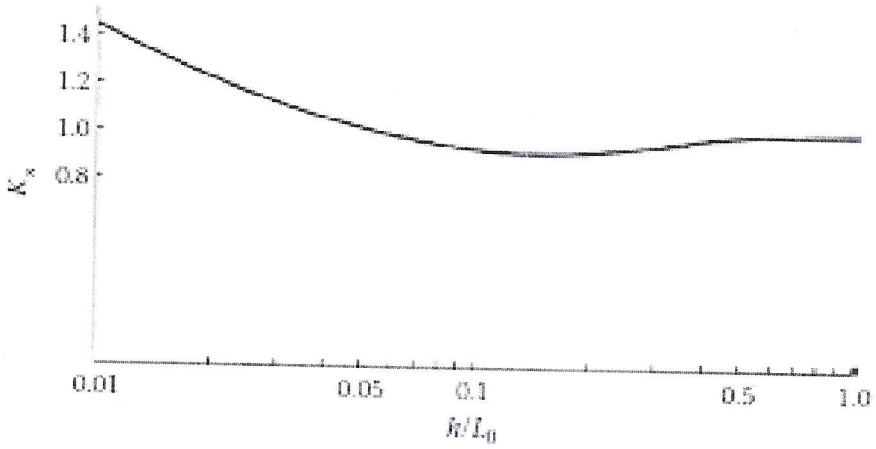

Figure1: variation of shoaling coefficient with depth.

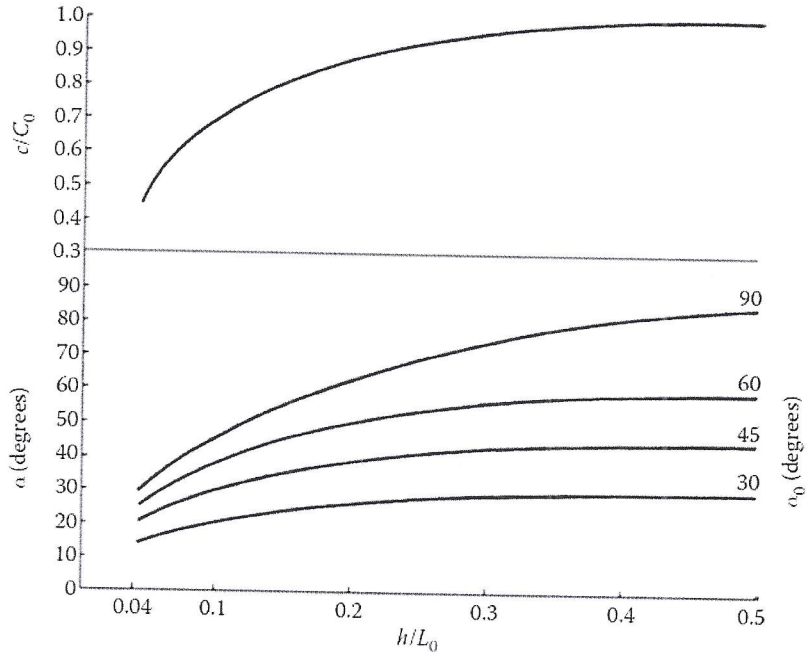

Figure 2: Variation of Waves celerity and angle with depth.