

Indian Maritime University
(A Central University, Govt of India)
End Semester Examinations – December 2022
Programme Name: M. Tech (NAOE)
Semester: I
Subject Code: PG11T2101
Subject Name: Wave Hydrodynamics

Date: 24.12.2022

Max Marks: 60

Duration: 03 Hrs

Pass Marks: 30

General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.
- (iii) Wave tables are permitted

Section A:

10 MCQs of 01 Mark Each = 10 Marks

1. The boundary condition that restrains the splashing of water particles on the free surface
 - (a) Kinematic free surface boundary condition
 - (b) Dynamic free surface boundary condition
 - (c) Mixed free surface boundary condition
 - (d) Linearized free surface boundary condition
2. Which of the following equations represents the dispersion relation
 - (a) $\omega^2 = gk$
 - (b) $T^2 = 2\pi \frac{L}{g}$
 - (c) $c = \frac{g}{\omega}$
 - (d) All the above
3. Which of the following statements is correct
 - (a) Waves are non-dispersive in deep water
 - (b) Waves are dispersive in shallow water
 - (c) Waves are non-dispersive in shallow water
 - (d) The dispersive nature of waves cannot be determined
4. The deep-water wave height of a wave is 2 m and at a certain region near the coast the wave height is 3.5 m. The shoaling coefficient is
 - (a) 0.571
 - (b) 1.75
 - (c) 0.285

- (d) 0.875
5. The surf-similarity parameter holds good in wave
- (a) Refraction
 - (b) Reflection
 - (c) Breaking
 - (d) Shoaling
6. The Keulegan-Carpenter number for an inertia dominated regime will be
- (a) Lesser than 5
 - (b) Greater than 5
 - (c) Lesser than 20
 - (d) Greater than 20
7. Diffraction theory for wave force is applied in the regime where the ratio of diameter of the structure to wavelength is
- (a) Lesser than 0.2
 - (b) Greater than 0.2
 - (c) Equal to 0.5
 - (d) Independent of the structure size
8. Fast Fourier transform (FFT) is used to
- (a) Convert wave data from deep to shallow waters
 - (b) Convert wave data from drag to inertia dominated regimes
 - (c) Convert wave data from time to frequency domains
 - (d) None of the above
9. Which one of the following is not a finite amplitude wave theory
- (a) Airy
 - (b) Cnoidal
 - (c) Trochoidal
 - (d) Stokes
10. The statistical analysis of wave heights follows _____ distribution
- (a) Normal
 - (b) Weibull
 - (c) Poisson
 - (d) Rayleigh

Section B:

5 out of 7 Questions of 8 Marks Each = 40 Marks

11. Derive an expression of velocity potential for a wave following Airy's wave theory.
12. A sea-bed pressure transducer in 9m of water records a sinusoidal signal with amplitude 5.9 kPa and period 7.5 s. Find the wave height, energy density and wave power per meter of crest.
13. A wave in deep water has the following characteristics:

Wave height, $H_0=3.0$ m

Time period, $T_0 =8.0$ sec

Angle of incidence, $\alpha_0=30^\circ$

The wave undergoes refraction and shoaling while moving into water depth of 10m. Find the wave characteristics in this region.

(Use wave tables)

14. Discuss in detail with the help of relevant sketches the wave force regimes and the wave theories used for computing wave loads.
15. What is the significance of diffraction-radiation theory? Give a detailed account of the mathematical formulation and suggest the solution techniques for the total velocity potential.
16. Explain standard spectral families? What are wave parameters analysed from a given wave spectrum?
17. Write short notes on the following wave theories
 - (a) Trochoidal & Stokes [4m]
 - (b) Solitary & Cnoidal [4m]

Section C:

1 out of 3 Questions of 10 Marks Each = 10 Marks

18. What are rogue waves? Present a case-study on ships encountering rogue waves.
19. Explain tsunami waves. Describe their generation and propagation with relevant sketches. Offer comments on the December 2004 tsunami.
20. When do square waves occur in the ocean? Why are they considered dangerous? Give a detailed account.

