

Indian Maritime University
(A Central University, Govt of India)
End Semester Examinations – December 2023
Programme Name: M Tech (NAOE)
Semester: I
Subject Code: PG11T2101
Subject Name: Wave Hydrodynamics

Date : 20-12-2023

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) Use of wave tables is permitted

Section A:

10 MCQs of 01 Mark Each = 10 Marks

1. When viscous, gravity and pressure forces are predominant and the flow is rotational, the equation of motion is known as _____ equation of motion.
 - (a) Euler's
 - (b) Bernoulli's
 - (c) Reynolds's
 - (d) Navier-Stokes's
2. Which of the following is an assumption in Airy's wave theory ?
 - (a) Fluid is viscous
 - (b) Fluid is rotational
 - (c) Fluid is incompressible
 - (d) Fluid is heterogeneous
3. Mathematically the representation of a flat, horizontal and impermeable seabed at a depth "d" from the mean sea level is
 - (a) $\left. \frac{\partial \phi}{\partial z} \right|_{z=-d} = 0$
 - (b) $\left. \frac{\partial \phi}{\partial z} \right|_{z=d} = 0$
 - (c) $\left. \frac{\partial \phi}{\partial z} \right|_{z=-d} \neq 0$
 - (d) $\left. \frac{\partial \phi}{\partial z} \right|_{z=d} \neq 0$

4. Water particles follow _____ orbits during vertical motions in deep water.
- elliptical
 - parabolic
 - circular
 - hyperbolic
5. Snell's law holds good in the case of wave
- reflection
 - refraction
 - breaking
 - shoaling
6. The relationship between group velocity, " C_g " and phase velocity, " C_p " in deep water is
- $C_g = C_p$
 - $C_g = \frac{1}{4} C_p$
 - $C_g = \frac{1}{2} C_p$
 - $C_g = 2C_p$
7. Which wave load estimation theory was developed for floating cylinders in inertia dominated regimes with the ratio of diameter to wave length greater than 0.2.
- Morison's approach
 - Froude-Krylov theory
 - Diffraction theory
 - Diffraction-radiation theory
8. The surf similarity parameter is highest in value for _____ wave breaker.
- plunging
 - spilling
 - collapsing
 - surging
9. CEM and SMB methods are used in
- Wave force estimation
 - Estimation of velocity potential
 - Wave forecasting
 - Determining spectral density function
10. Wave heights are normally modelled following a _____ distribution.
- Normal
 - Rayleigh
 - Weibull
 - Poisson

Section B:

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

11. (a) Explain in detail the classification of fluid flow. (4 marks)
- (b) Determine the stream function if the velocity potential of a two-dimensional flow field is given by
$$\phi = 5(x^2 - y^2)$$
 (4 marks)
12. Derive an expression for velocity potential of a small amplitude regular wave explaining various boundary conditions.
13. A pressure sensor is located 0.6 m above the sea bed in a water depth $d = 12$ m. The pressure fluctuates with period 15 s. A maximum gauge pressure of 124 kPa is recorded. Determine
- (a) Wave height (4 marks)
- (b) Maximum horizontal and vertical velocities at the surface (4 marks)
14. Under what conditions does the diffraction-radiation theory become applicable? Formulate a typical diffraction-radiation problem and propose solutions.
15. Define the following
- (a) Snell's law of wave refraction (4 marks)
- (b) Wave breaking (4 marks)
16. What do you understand by non-linear wave theories? Using a neat sketch explain their application with varying wave non-linearities. Explain two such theories.
17. Explain the role of spectral analysis and any two standard spectral families with respect to random waves.

Section C:

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

18. Determine the speed of propagation and wavelength of a tsunami wave whose period is 15 min, height 0.6 m and propagating in a depth of 3800 m. Assume suitable conditions and justify the answers.
19. What are rogue waves? Explain with a case study on how ships encounter them.

20. Why are break waters constructed near the coast? What are the various wave transformations observed near a break water?