Indian Maritime University

(A Central University, Govt of India)

Supplementary Examinations – September/October 2024

Programme Name: B. Tech (Marine Engineering)

Semester: III

Subject Code: UG11T4302

Subject Name: SOLID MECHANICS

Date: 23.09.2024	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

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

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. Stress is
   (a) External force
   (b) Axial force
   (c) Internal resistive force
   (d) Radial force
2. The ratio of lateral strain to linear strain is known as .....
   (a) modulus of elasticity
   (b) modulus of rigidity
   (c) Poisson's ratio
   (d) elastic limit
3. The radius of Mohr's circle is equals to .....
   (a) σ_x
   (b) τ_{max}
   (c) σ_y

(d) $(\sigma_x + \sigma_y)/2$

4. Angle of twist of a circular shaft under the action of a torsional moment 'T' is given by.....

(a) GJ/TL

(b) TJ/TL

(c) TL/GJ

(d) TG/TL

5. The ratio of the response amplitude of the system in steady-state forced vibration to the excitation amplitude is known as:

(a) Transmissibility

(b) Resonance

(c) Frequency

(d) none of these

6. If a material has identical properties in all directions, it is called

(a) Elastic

(b) Plastic

(c) Isotropic

(d) Homogeneous

7. Maximum shear stress of a solid shaft is given by

(a) 16T/πd

(b) 16T/πd^2

(c) 16T/πd^3

(d) 16T/πd^4

8. In thin cylindrical pressure vessel, hoop stress is _____ the longitudinal stress

(a) Twice

(b) Thrice

(c) One half

(d) Equals to

9. When two dissimilar shafts are connected together, then the shaft is _____

(a) Integrated shafts

(b) Composite shafts

(c) Differential shafts

(d) Combined shafts

10. The planes, which have ..... are known as principal planes.

(a) equal shear and bending stresses

(b) no bending stresses

(c) high shear stresses

(d) no shear stresses

Section B

Five Questions of 02 Marks each

11. The major and minor principal stresses at a point are 3 MPa and -3 MPa respectively. The maximum shear stress at the point is

12. The young's modulus and rigidity modulus of the material are 6 MPa and 2 MPa respectively. Calculate poison's ration of the material.

13. Define the term resonance in vibration.

14. A 500 mm long copper rod is subjected to a torque so that the angle of twist between its ends is 2°. If the permissible shear strain is 0.0006, find the maximum permissible diameter of the rod.

15. Explain the difference between Engineering Stress and True Stress?

Section C

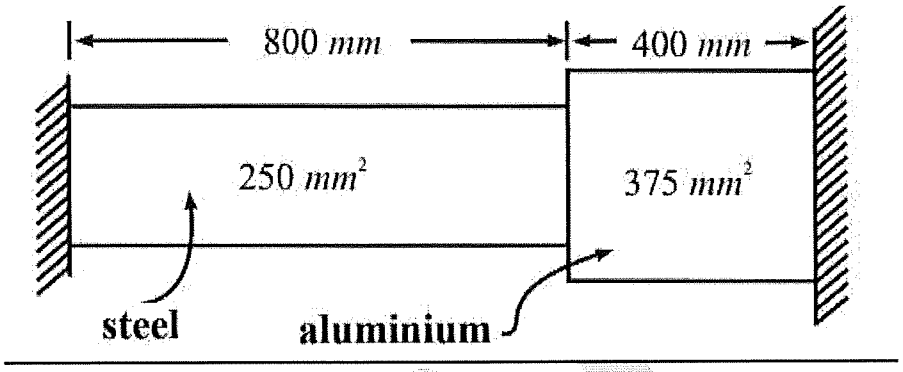
Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. The composite bar consisting of steel and aluminium components as shown in figure 2 is connected to two grips at the ends at a temperature of 60°C. Find the stresses in the two rods when the temperature falls to

20°C, if the ends do not yield. The areas of steel and aluminium bars are 250 mm^2 and 375 mm^2 respectively.

Take $E_{Steel} = 2 \times 10^5$ N/mm^2 and $E_{Aluminium} = 0.7 \times 10^5$ N/mm^2,

$\alpha_{Steel} = 1.17 \times 10^{-5}$ per °C and $\alpha_{Aluminium} = 2.34 \times 10^{-5}$ per °C.



(10 marks)

17. A particle, moving with simple harmonic motion, performs 10 complete oscillation per minute and its speed, is 60% of the maximum speed when it is at a distance of 8 cm from the centre of oscillation. Find amplitude, maximum acceleration of the particle. Also, find speed of the particle, when it is 6 cm far from the centre of oscillation.

(10 marks)

18. a) Explain the longitudinal stress and circumferential stress in a thin cylindrical pressure vessel with the help of the diagram.

b) Derive a relation of change in dimension of a thin cylindrical shell due to an internal pressure.

(03+07 Marks)

19. A helical coil spring is made of round steel wire 6 mm in diameter. The mean radius of helix is 30 mm, number of complete turns are 10; the spring is close-coiled. If G = 84.36 GN/m^2, find

a) pull required to extend the spring by 24 mm
b) stress in the wire
c) spring constant

(10 Marks)

20. At a point in a bracket the stresses on two mutually perpendicular planes are 500 MN/mm2 tensile and 350 MN/mm2 tensile. The shear stress across these planes is 250 MN/mm2. Determine:

a) the magnitude and direction of principal stresses

b) the maximum shear stress?

(7+3 marks)

21. Derive the Torsion equation for a shaft fixed at one end and torque being applied at the other end.

(10 marks)

22. A cylindrical vessel whose ends are closed by means of rigid flange plated, is made steel plate 3 mm thick. The length and the internal diameter of the vessel are 50 cm and 25 cm respectively. Determine the longitudinal and hoop stresses in the cylindrical vessel due to an internal fluid pressure of 3 MN/m^2. Also calculate the increase in length, diameter and volume of the vessel. Take $E=200\ GN/m^2$ and $\mu = 0.3$. (10 marks)