Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – December 2022

Programme Name: B Tech (ME)

Semester: III

Subject Code: UG11T4302

Subject Name: Solid Mechanics

Date: 12.12.2022	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. If for a given material E = 2G, then the bulk modulus K will be
   a. E
   b. E/2
   c. E/3
   d. E/4

2. The value of corresponding to force on whose removal deformation disappears is known as
   a. Proportional Limit
   b. Elastic Limit
   c. Yield Point
   d. Fracture

3. Which of the following relation represents the Torsional Flexibility?
   a. GJ
   b. GL
   c. GJ/L
   d. L/GJ

4. Which of the following options correctly define Proof Resilience?
   a. The maximum value of strain energy upto elastic limit
   b. The minimum value of strain energy beyond the elastic limit
   c. The maximum value of kinetic energy
   d. The Minimum value of strain energy

5. When a bar is subjected to a change of temperature and its deformation is prevented, which of the following stresses is induced?
   a. Shear Stress
   b. Thermal Stress
   c. Tensile Stress
   d. Compressive Strain

6. Hydrostatic stress results in the following
   a. Linear Strain
   b. Shear Strain
   c. Both Linear and Shear Strain
   d. None

7. A ratio of the uniform pressure intensity to volumetric strain is called
   a. Shear Modulus
   b. Poisson's Ratio
   c. Young's Modulus
   d. Bulk Modulus

8. In thin cylindrical pressure vessel, hoop stress is _____ the longitudinal stress
   a. Twice
   b. Thrice
   c. One half
   d. Equals to

9. The rim of the flywheel is subjected to
   a. Torsional shear stress and bending stress
   b. Direct tensile stress and bending stress
   c. Compressive stress and Bending stress
   d. Direct shear stress and bending stress

10. If a spring has plain ends then number of inactive coils is?
    a. 1
    b. 2
    c. 3
    d. 0

Section B

Five Questions of 02 Marks each

11. Why Wahl's Correction factor is required in the springs?

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

13. Define periodic time and frequency? What is relation between periodic time and frequency.

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. Define Resilience and Modulus of Resilience?

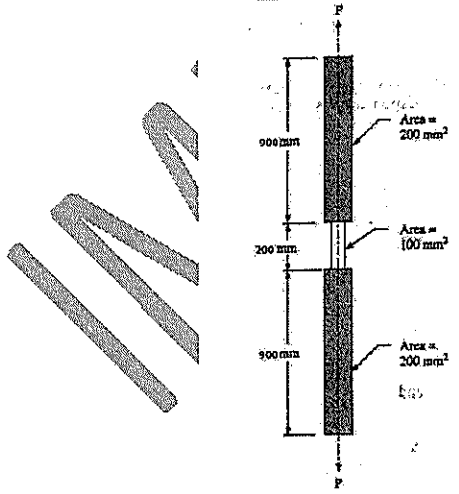
Section C

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

16. A load of 400 kN is applied on a short concrete column 250 mm x 250 mm. The column is reinforced by steel bars of total area 4800 mm^2.
    a. If the modulus of elasticity for steel is 15 times that of concrete, find the stress in concrete and steel?
    b. If the stress in concrete should not exceed 4 N/mm^2, find the area of steel required so that the column may support a load of 600 kN?

(5+5 Marks)

17. A bar 2 meter in length is subjected to a pull such that the maximum stress is equal to 150 N/mm^2. Its area of cross section is 200 mm^2 over a length of 1800 mm and for the middle 200 mm length, the sectional area is 100 mm^2. If E = 2 x 10^5 N/mm^2, calculate the strain energy stored in the bar?



(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.

(3+7 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/mm^2 tensile and 350 MN/mm^2 tensile. The shear stress across these planes is 250 MN/mm^2. Determine
    a. the magnitude and direction of principal stresses?
    b. the maximum shear stress?

(7+3 marks)

21. Derive the Torsion equation?

(10 Marks)

22. A 1800 mm long shaft ABCD of diameter 60 mm over half its length AB and 40 mm diameter for the remaining half length BD, is subjected to a torque of 900 Nm at a section C midway between B and D. Determine the following:
    a. Reacting torque at the supports?
    b. Maximum shear stress in the shaft?

    Take the Modulus of Rigidity (G) = 7 x 10^4 N/mm^2

(7+3 Marks)