

Indian Maritime University
(A Central University, Govt. of India)
End Semester Examinations – June 2023
Programme Name: B.Tech (NAOE)
Semester: 4
Subject Code: UG12T2406
Subject Name: Basic Structural Analysis

Date: 07.06.2023

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 sections.

Section A

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

1. A simply supported beam with an extra roller support at the center has a degree of indeterminacy equal to _____,
 - a) Zero
 - b) One
 - c) Two
 - d) Depends on the type of loading
2. In an S-N curve plot, the endurance limit line is:
 - a) Parallel to x-axis
 - b) Parallel to y-axis
 - c) Has a slope depending on the material
 - d) Depends on the type of loading
3. The term endurance limit is used in context of:
 - a. Fracture mechanics
 - b. Bending theory
 - c. Fatigue analysis
 - d. Buckling theory
4. In continuous beams, Force method can be used for calculating the :

- a. Unknown shear force
 - b. Unknown slope
 - c. Unknown deflection
 - d. Unknown support reaction
5. The stiffness "k" for a bar member of length, L, Young's modulus, E and cross-sectional area, A equals:
- a. $k = A \cdot L / E$
 - b. $k = E \cdot L / A$
 - c. $k = L / (A \cdot E)$
 - d. $k = A \cdot E / L$
6. Assembly of all the element stiffness matrices as per the proper procedure gives the:
- a. Local stiffness matrix
 - b. Global stiffness matrix
 - c. Identity matrix
 - d. Upper triangular matrix
7. The stiffness matrix is always:
- a. Upper triangular.
 - b. Square and non-singular.
 - c. Square and singular.
 - d. An identity matrix
8. Portal frames are frequently used in a building to:
- a. Transfer vertical forces
 - b. Transfer horizontal forces
 - c. Transfer moments
 - d. None of the above
9. Which support is not used in portal frames?
- a. roller
 - b. fixed
 - c. pin
 - d. none of the above
10. The stiffness matrix of a 1-D bar element with total DOF=2 is of the size:
- a. 1 X 1
 - b. 2 X 2
 - c. 3 X 3
 - d. Depends on the bar geometry and material

Section B

Five Questions of 02 Marks each

11. Highlight any four assumptions in the Euler-Bernoulli simple beam bending theory.
12. What is the significance of the Three Moment Method?
13. What is meant by stress-controlled fatigue?
14. Write the assumptions made in the portal frame analysis.
15. Discuss Eigen value problems in structural analysis

Section C

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

16. Consider a component being subjected to fatigue loading. For the data provided in Table A.

- a. Find the cumulative damage caused due to fatigue. (7 marks)

Table A. Sl No.	Load in Newton	No. of cycles of load applied	No. of cycles for failure
1	100	500000	5000000
2	500	800000	2000000
3	2000	30000	100000
4	3000	200	40000
5	5000	50	10000
6	10000	10	2000

- b. If, to the above Table A, a new load block is introduced and appended as given below with serial no. 7, Find the value of "N" so that the cumulative damage is equal to 0.95 (3 marks)

7	20000	N	400
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17. For the continuous beam with loading as given Fig.1, evaluate all the support reactions using the Three Moment method. (10 marks)

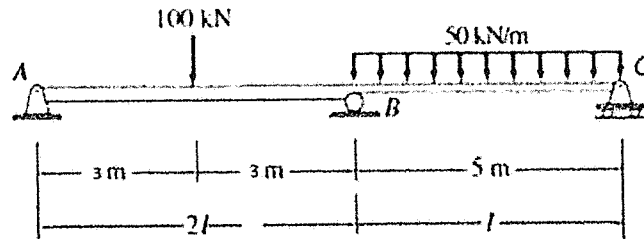


Fig. 1

18. A simply supported beam of steel ($E=200$ GPa) of length $L=2$ meters and square cross-section of each side, $a=5$ cm is subjected to a concentrated vertical transverse load, $P=5$ kN at the centre. Find:

- The maximum bending stress in the beam. (5 marks)
- The maximum deflection. (5 marks)

19. Discuss the various theories of failure.

20. Use Gauss Elimination Method to solve the given below set of simultaneous linear equations:

$$x-2y+z=0$$

$$2x+y-3z=5$$

$$4x-7y+z=-1$$

21. Using Force method, compute the support reactions at all three supports of the beam shown in Fig. 2.

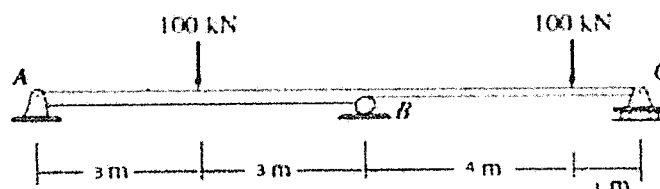


Fig. 2

22. Determine the principal stresses for the 3-D stress system given by the following:

$$\sigma_x = -160 \text{ N/mm}^2 \quad \sigma_y = +350 \text{ N/mm}^2 \quad \sigma_z = +100 \text{ N/mm}^2$$

$$\tau_{xy} = -200 \text{ N/mm}^2 \quad \tau_{xz} = 0 \text{ N/mm}^2 \quad \tau_{yz} = 0 \text{ N/mm}^2$$

