

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VI (NEW) EXAMINATION – WINTER 2018

Subject Code: 2160609

Date: 07/12/2018

Subject Name: Computational Mechanics

Time: 02:30 PM TO 05:30 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Draw neat sketch wherever necessary.

- Q.1**
- | | | |
|-----|--|-----------|
| (a) | Explain symmetry and anti-symmetry with neat sketches. | 03 |
| (b) | Derive S_M matrix for beam member. | 04 |
| (c) | Determine joint displacements for the beam shown in fig.1. Take $EI =$ constant. | 07 |

- Q.2**
- | | | |
|-----|---|-----------|
| (a) | Formulate combined joint load vector for the grid shown in fig.2. | 03 |
| (b) | Explain various types of skeleton structures with their internal forces and deformations. | 04 |
| (c) | Formulate S_{MS} matrix for grid member. | 07 |

OR

- | | | |
|-----|---|-----------|
| (c) | Determine joint displacements for the loaded beam shown in fig.1, if the support B sinks by 10mm. Take $EI = 30000 \text{ kNm}^2$. | 07 |
|-----|---|-----------|

- Q.3**
- | | | |
|-----|--|-----------|
| (a) | Determine joint displacements and member forces of the truss shown in fig.2. All the members have same axial rigidity. Take $EA =$ constant. | 14 |
|-----|--|-----------|

OR

- Q.3**
- | | | |
|-----|--|-----------|
| (a) | Determine joint displacements and support reactions of the plane frame shown in fig.3. Take $EI = 30000 \text{ kNm}^2$, $EA = 2 \times 10^6 \text{ kN}$. | 14 |
|-----|--|-----------|

- Q.4**
- | | | |
|-----|---|-----------|
| (a) | Write steps of finite element analysis. | 03 |
| (b) | Explain plane stress and plane strain problems. | 04 |
| (c) | Find nodal displacements and element stresses of the bar shown in fig.4. Take $E = 200 \text{ GPa}$. | 07 |

OR

- Q.4**
- | | | |
|-----|---|-----------|
| (a) | Explain process of discretization. | 03 |
| (b) | Using potential energy approach, derive the equation $[k]\{q\}=\{f\}$. | 04 |
| (c) | Find nodal displacements and nodal reactions for the beam shown in fig.5. Take $EI =$ constant. | 07 |

- Q.5**
- | | | |
|-----|---|-----------|
| (a) | Derive strain displacement matrix of CST element. | 07 |
| (b) | Evaluate stiffness matrix of the CST element shown in fig.6. Assume plane stress condition and unit thickness of the element. Take $E = 2 \times 10^5 \text{ N/mm}^2$, $\mu = 0.3$. | 07 |

OR

- Q.5**
- | | | |
|-----|---|-----------|
| (a) | Explain various types of non-linearity with neat sketches. | 07 |
| (b) | For the plane stress element shown in fig.6, the nodal displacements are given as $u_1 = 0.05 \text{ mm}$, $v_1 = 0.02 \text{ mm}$, $u_2 = 0.0 \text{ mm}$, $v_2 = 0.0 \text{ mm}$, $u_3 = 0.04 \text{ mm}$, $v_3 = 0.01 \text{ mm}$. Determine the element stresses. Take $E = 200 \text{ GPa}$, $\nu = 0.3$, Use unit thickness for plane stress element. | 07 |

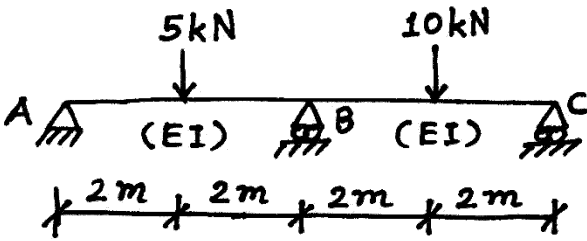


Fig. 1

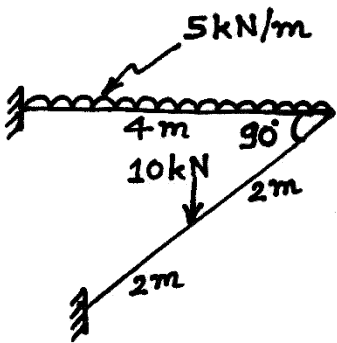


Fig. 2

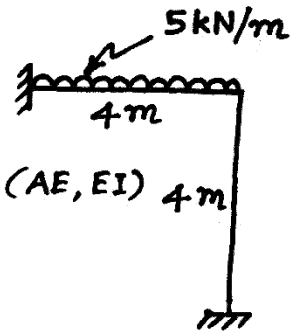


Fig. 3

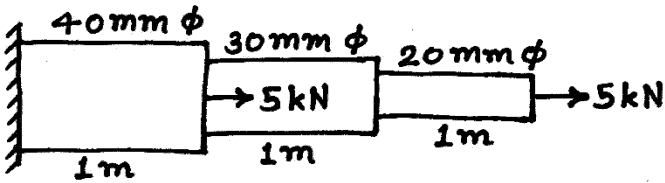


Fig. 4

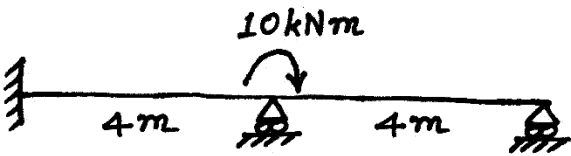


Fig. 5

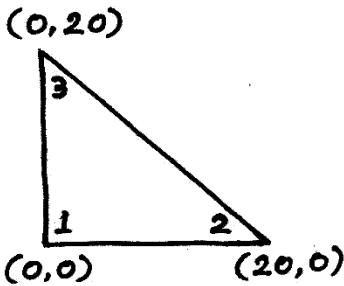


Fig. 6