U.S.N

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, M. Tech - Civil Engineering (MCAD)

Supplementary Semester End Examination; September - 2021

Continuum Mechanics - Classical and FE Approach

Computational Structural Mechanics and FEM

Time: 3 hrs *Max. Marks: 100*

Course Outcome

The Students will be able to:

CO1: Comprehend the matrix methods and method of direct stiffness method of analysis oftrusses with different support and loading conditions.

CO2: Apply the direct stiffness method to analyze the continuous beams and 2D frames withdifferent support and loading conditions.

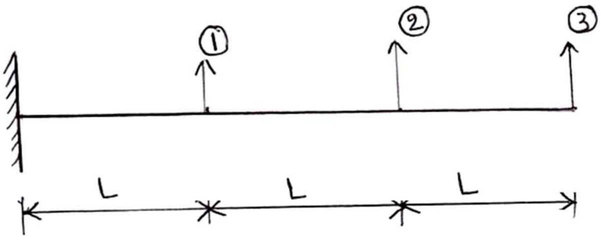
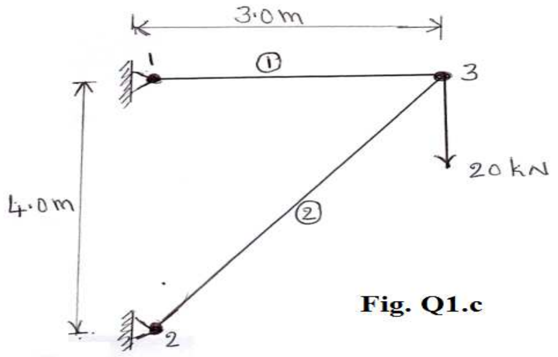
CO3: Understanding the concept of fem, formulate the displacement models for bar and beamelements and different weighted residual methods.

CO4: Learn the concept of shape functions/ interpolation functions for bar element and beam element and apply the FEM to analyze cantilever and simply supported beams.

***Note**: I) Answer any **FIVE** full questions, selecting **ONE** full question from each unit.*

***II)** Any **THREE** units will have internal choice and remaining **TWO** unit questions are compulsory.*

***III)** Missing data, if any, may suitably be assumed.*

Q. No.	Questions	Marks	BLs	COs	POs
	UNIT - I	**20**			
1 a.	Explain the properties of flexibility matrix.	5	L2	CO1	PO1
b.	Develop the flexibility matrix for the cantilever beam shown in Fig. Q1.b with respect to coordinates given. Take EI = constant.  **Fig Q1.b**	15	L3	CO1	PO2
	OR				
1 c.	Analyze the truss shown in Fig.Q1.c.Using direct stiffness method. Take $\frac{AE}{L} = constant$ for all members.  **Fig. Q1.c**	20	L4	CO2	PO3

UNIT - II 20

2. Analyze the continuous beam as shown in Fig. Q2, by using direct stiffness method. Draw BMD and SFD. Take EI = constant. 20 L4 CO2 PO3

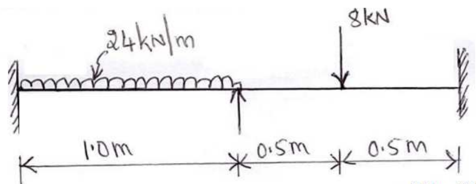


Fig. Q2

UNIT - III 20

3 a. Explain the following briefly:

i) External node and Internal node with example 3 L2 CO3 PO1

ii) Half bandwidth 3 L2 CO3 PO1

iii) Geometric invariance 4 L2 CO3 PO1

b. With neat sketches, describe various element shapes used in FEM for various structural problems. 10 L2 CO3 PO2

OR

3 c. Using the principle of virtual displacements derive the equilibrium equation of the form; 12 L2 CO3 PO2

$$\iiint_v [B]^T[C][B]dv\,\{d\}$$

$$\iiint_v [N]^T\{f\}dv + \iint_s [N^S]^T \{p\}ds$$

d. Derive the relationship between nodal degree of freedom and generalized coordinate. 8 L2 CO3 PO2

UNIT - IV 20

4 a. The one dimensional bar element is made up of two materials as shown in Fig Q4.a. Evaluate the nodal displacements, stress in each element and reaction forces. What will be the change in stress in the bar subjected to temperature variation of 20° to 50° C 12 L5 CO3 PO2

$A_1 = 2000\ mm^2$ $A_2 = 1000\ mm^2$

$L_1 = 1000$ mm $L_2 = 500$ mm

$E_1 = 70$ GPa $E_2 = 200$ GPa

$\alpha_1 = 23\times10^{-6}/°C$ $\alpha_2 = 11.7\times10^{-6}/°C$

P = 200kN

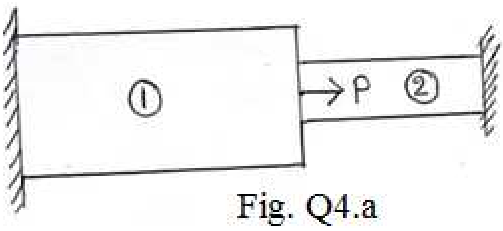
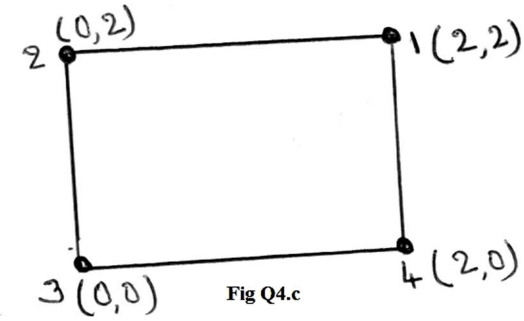


Fig. Q4.a

Contd…3

b.	Using Lagrangian polynomial, derive shape functions for one dimensional three noded bar element. Using natural coordinate and plot their shapes.	8	L2	CO4	PO2
	OR				
c.	In a four noded isoparametric quadrilateral element as shown in Fig. Q4.c. If node one collapse to node two. Show that the quadrilateral element reduce to constant strain triangle element.  Fig Q4.c	20	L3	CO4	PO3
	UNIT - V	**20**			
5 a.	Derive the shape function for two noded beam element using Hermitian interpolation function and plot their shapes.	12	L3	CO4	PO2
b.	Evaluate the following integral using two point Gauss quadrature formula and verify the exact value. I = $\int_{-1}^{+1}(4x+3x^2+2)dx$	8	L5	CO4	PO2

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